PRODUCTIVITY OF FINGER MILLET (*Eleusine coracana* (L.) Gaertn.) AS INFLUENCED BY WEED CONTROL, SOWING DATE AND METHOD IN SUDAN SAVANNA OF NIGERIA

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DECLARATION

I hereby declare that this work is the product of my research efforts undertaken under the supervision of Prof. M. A. Mahadi and Dr. A. Lado and has not been presented anywhere for the award of a degree or certificate. All sources of literature have been duly acknowledged.

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CERTIFICATION

This is to certify that the research work for this thesis and the subsequent preparation of the thesis by Tasiu Tukur Bello (SPS/13/PAG/00004) were carried out under our supervision.

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APPROVAL PAGE

This thesis titled "Productivity of Finger Millet as Influenced by Weed Control, Sowing Date and Method in Sudan Savanna of Nigeria" by Tasiu Tukur Bello (SPS/13/PAG/00004) has been examined and approved for the award of Doctor of Philosophy Degree in Agronomy.

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DEDICATION

This thesis is dedicated to my father late Malam Tukur, my mother late Hajiya Hauwa and my relatives.

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ABSTRACT

Field experiment was conducted during 2016, 2017 and 2018 rainy seasons at the Research Farm of National Institute for Horticultural Research (NIHORT) Bagauda (Latitude 11° 33' N and Longitude 8° 23' E, 481m asl) Kano, in the Sudan savanna of Nigeria. The aim of the study was to evaluate the productivity of finger millet (*Eleusine coracana* (L.) Gaertn.) as influenced by weed control treatment, sowing date and sowing method. The experiment consisted of three (3) sowing date (late June, early July and late July), three (3) sowing methods (broadcasting, drilling and dibbling) and six weed control treatment (atrazine at 0.8 or 1.2kg a.i.ha^{-1}, 2,4-D at 0.5 or 0.75kg a.i. ha^{-1}, two hoe weeding at 3 and 6 WAS and weedy check). These were factorially combined and laid out in a split-split-plot design and replicated three (3) times. Sowing dates were assigned to main plot, sowing methods to subplot while weed control treatments to sub-subplots. Data on growths, weed parameters, yield and yield characters were measured and analyzed using GenStat software. The results revealed that sowing between late June and early July produced significantly taller plant, larger leaf area, heavier crop growth rate (CGR) and relative growth rate (RGR), higher number of fingers $panicle^{-1}$, heavier panicle, heavier 1000grain, higher straw and grain yield ($kgha^{-1}$). Broadcasting method significantly produced higher number of tillers m^{-2}, heavier panicle ($kgha^{-1}$), higher straw and grain yield ($kgha^{-1}$). However, weed dry weight and weed density was higher with drilling method in 2017 rainy season and combined. Furthermore, weeding twice at 3 and 6 WAS significantly produced, larger leaf area, LAI, heavier CGR and RGR, higher weed control efficiency, weed control index, number of tillers m^{-2}, heavier panicle, 1000 grain weight, harvest index, straw and grain yield ($kgha^{-1}$). Nevertheless, two hoe weeding was at par with application of atrazine at 1.2 kg a.i. ha^{-1}, application of 2,4-D at 0.5 kg a.i. ha^{-1} and 2,4-D at 0.75 kg a.i. ha^{-1} in 2016, and between two hoe weeding and all other treated plots in 2017 and produced higher grain yield ($kgha^{-1}$). Weed cover score, weed dry weight and density were significantly higher with weedy check in all the experimental years and combined. The result further revealed positive and highly significant correlation between grain yield and growth and yield characters such as leaf area, LAI, CGR, number of tillers m^{-2}, number of fingers $panicle^{-1}$, panicle weight per hectare, 1000 grain weight and straw yield ($kgha^{-1}$). However, the weed parameters measured were negatively and highly significantly correlated with grain yield across the experimental years and combined. Based on the findings of this study, it can be recommended that finger millet should be sown between late June to early July by broadcasting method and application of either atrazine at 1.2 kg a.i. ha^{-1}, 2,4-D at 0.5 kg a.i. ha^{-1}, 2,4-D at 0.75 kg a.i. ha^{-1} or two hoe weeding at 3 and 6 WAS for effective weed suppression and higher grain yield ($kgha^{-1}$).

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND INFORMATION

Finger millet (*Eleusine coracana* (L.) Gaertn.) is a cereal crop grown mostly for its grain, it is a robust, tufted, tillering annual grass, up to 170cm height (FAO, 2012; de Wet, 2006; Quattrocchi, 2006). The inflorescence is a panicle with 4-19 finger-like spikes that resembles a fist when mature, hence the name finger millet (de Wet, 2006; Quattrocchi, 2006). The spikes bear up to 70 alternate spikelets, carrying 4 to 7 small seeds (Dida and Devos, 2006). The seed pericarp is independent from the kernel and can be easily removed from the seed coat (FAO, 2012). It is an annual herbaceous plant widely grown as a cereal crop in the arid and semiarid areas in Africa and Asia (NRC, 1996). It is a major food crop of the semi-arid tropics of Asia and Africa and has been an indispensable component of dryland farming systems (Kerr, 2014). It belongs to the family Poaceae, it is a native to Africa and was domesticated in the highlands of Ethiopia and Uganda 5000 years ago (NRC, 1996; Dida, Wanyera, Dunn, Bennetzen and Devos, 2008). The crop is ranked fourth globally in importance among the millets (Gupta*,*Gupta, Gaur and Kumar, 2012; Upadhyay, Gowda, Gopal andReddy, 2007), and it is cultivated in more than 25 countries, mainly in Africa and Asia (Chandrashekar, 2010; Dass, Sudhishri and Lenka*,* 2013). However, in Africa, finger millet is second and represents 19% of millet production, after pearl millet (76%) (Obilana, 2003).

The world annual production of finger millet is 4.5 million metric tonnes of grain out of which Africa produces 2.0 million metric tonnes from an estimated land area of 19 million hectares (Dida and Devos, 2006), and it accounts for 8% of the land area and 11% of all millets production worldwide (Glew, Chuang, Roberts and Glew, 2008). However, Asian production keeps growing (by 50% in India during the last fifty years and by 8% per year in Nepal) while African production remains unchanged (Styslinger, 2011). In Nigeria, Finger millet is produced mainly in the Northern part of the country (Around Plateau, Bauchi, Kano and Kaduna States, e.t.c.) mostly in combination with pearl millet with an average yield of 580-785kg/ha (Anonymous, 1996).

Finger millet is adapted to a wide range of environmental and climatic conditions. It is preferably grown on well drained sandy loam with pH range of 5.0 to 8.2. Finger millet can tolerate less fertile soils with poorer growing conditions such as intense heat and low rainfall (Baker, 2003). Also, it can grow in lateritic or black heavy vertisols and has some tolerance to alkaline and moderately saline soils (Dida and Devos, 2006). It grows best in an environment with medium rainfall of about 300 - 1000mm and temperature range of 11 to 27°C, but it can also tolerate cool climates (Anonymous, 1996). The striking feature of finger millet is its ability to adjust to different agro-climatic conditions (Hegde and Gowda, 1986). Once adequate moisture is available (minimum water requirement is 400mm) and the temperature is above 15°C, finger millet can be grown throughout the year (Hegde and Gowda, 1986). It is well adapted to higher elevations and is grown in the Himalayas up to an altitude of 2400m (NRC, 1996). Finger millet is drought tolerant (Dass *et al.,* 2013; Hegde and Gowda, 1986), disease resistant (Kerr, 2014) and able to grow on marginal lands with poor soil fertility.

1.2 IMPORTANCE AND UTILIZATIONS OF FINGER MILLET

Finger millet is primarily a subsistence staple cereal food for millions of people in dry lands of East and Central Africa and Southern India (Holt, 2000;

Mgonja, 2005). This plant, though not produced in large quantity in Nigeria compared to other cereals, is an important crop because of its high nutritive value. It is rich in minerals, such as calcium, iron, and phosphorus, (Glew *et al.,* 2008) and essential amino acids which include methionine and tryptophan (Fernandez, Vanderjagt, Millson, Haung, Chuang, Pastusyn and Glew, 2003). It contains 9.2% protein, 1.29% fat, 76.32% carbohydrate, 2.24% minerals and 3.9% ash besides vitamins A and B. The grains are rich in phosphorus, potassium and amino acid. It is also a rich source of calcium (410mg/ 100g grain) for growing children and aged people (Tomar, Taunk and Choudhary, 2011). Generally the production of finger millet is still at subsistence level by small scale holders and consumed as staple food and drink in most areas. The crop has high impact on the poor in Africa for food security and source of energy and protein for about 130million people in sub- Saharan Africa (Obilana*,* 2002). Finger millet plays an important role in both the dietary needs and income of many rural households where the crop is grown. Although the crop is not rich in total protein when compared to other cereals, the main protein fraction has high biological value with high amount of tryptophan, cystine, methionine and total aromatic amino acids (NRC, 1996).

Finger millet is primarily consumed as a porridge in Africa, but in South Asia as bread, soup, roti (flat bread), and to make beer (NRC, 1996). Interestingly, new food products made from finger millets are also becoming popular among younger people, including noodles, pasta, vermicelli, sweet products, snacks, and different bakery products (Shobana, Krishnaswamy, Sudha, Malleshi, Anjana, Palaniappan and Mohan, 2013; Verma and Patel*,* 2013). In some nutritional components, finger millet is a superior crop compared to some major cereal crops especially polished rice (Shobana *et al.,* 2013). Among the other millets, finger millet has a high amount of calcium (0.38%), fiber (18%), phenolic compounds (0.3%–3%), and sulphur containing amino acids (Shobana *et al.*, 2013; Singh and Raghuvanshi, 2012; Rurinda, Mapfumo, van Wijk, Mtambanengwe, Rufino, Chikowo and Giller, 2014; Devi, Vijayabharathi, Sathyabama, Malleshi and Priyadarisini, 2014). Regular consumption of finger millet is known to reduce the risk of diabetes mellitus and gastrointestinal tract disorders which helps in controlling blood sugar level in condition of diabetes (Tovey, 1994), this is due to presence of factors in finger millet's flour which lower digestibility and absorption of starch (Muninarayana, Balachandra, Hiremath, Iyengar and Anil, 2010).

Finger millet is therefore an important prevention against malnutrition, especially kwashiorkor. As a result, unlike many crops grown by subsistence farmers, finger millet remains highly valued in traditional production systems, especially for its nutrient benefits to pregnant women and children for whom it is used as a weaning food (NRC, 1996; Verma and Patel, 2013), and the straw is used as animal feed and for roof thatching. Finger millet seeds can be stored for more than five years due to low vulnerability to insect damage (NRC, 1996; Rurinda *et al.,* 2014). It has no major pest problem and so can be stored cheaply for a long time provided it is well dried to low moisture content. These attributes combine to make finger millet a suitable crop for ensuring food security in drought prone areas of the countries that grow it.

1.3 PROBLEM STATEMENTS

Finger millet production in Nigeria is constrained by several factors especially with regards to appropriate sowing date and methods as well as inappropriate weed control strategies. The low yields on farmers' field in Nigeria and elsewhere have been attributed to poor agronomic management practices such as poor weed management, soil fertility and inappropriate sowing date and methods among others.

Early planting of finger millet leads to early maturation of the crop which consequently leads to spoilage by rainfall, while finger millet sown late is normally affected by moisture stress which sometimes leads to crop failure. The most widely used method of sowing finger millet in Nigeria is broadcast, and this method is usually associated with wastage of seed and difficulty in carrying out other farm operations such as manual weeding, fertilizer application and earthen up of the soil around the crop to prevent lodging.

Also, Anonymous (1998) elucidated that weeds cause major constraints in the worldwide production of finger millet. Van Wyk and Gericke (2000) reported that finger millet is less susceptible to pests and diseases than other cereal crops, but it has a poor ability to compete with weeds. In many of the developing countries, half of the effort devoted to crop production is spent on weed control (Culpepper and York, 2000). The manner of initial slow growth of the finger millet favours weed growth, which leads to stiff competition for sunlight, nutrient and water in early stages of growth which consequently leads to lowering of productivity (Lall and Yadav, 1982). Also, Das and Yaduraju (1995) reported 72% yield loss in finger millet due to its initial slow growth rate, which picks up, tillers and increases in height 25-30 days after sowing and becomes more competitive against weeds, as its critical period of weed interference. In experiments conducted by Bulus (2002) in 1997, 1998 and 1999 he reported that the yield loss due to uncontrolled weeds in the first 6 weeks of finger millet growth to 78.2, 82.2 and 83.1%, respectively across the years. Such Yield losses due to weed competition are often minimized by giving the crop a competitive edge (Gibson, Hill, Foin, Caton and Fischer, 2001).

1.4 JUSTIFICATION

Despite the high medicinal, nutritional and industrial importance of finger millet, the crop has received little attention in terms of research and development especially with regards to appropriate sowing date and methods as well as weed control strategies particularly in Sub-Saharan Africa (Anonymous, 1996; Mgonja, 2005; Mitaru, Karugia and Munene, 1993). This problem led to low yield per hectare across producing countries in Africa for as low as 500-750kg/ha (Mitaru *et al*., 1993; Takan, Muthumeenakshi, Sreenivasaprasad, Akello, Bandy, Opdhyay, Coll, Brown and Talbot, 2002). Finger millet has been reported to escape peak period of weed infestation, competition and damage through manipulation of proper sowing date and sowing method (Shuaibu, 1998). Furthermore, Fryer and Makepeace (1997) reported that, to reduce the cost of finger millet production, intensive applications of weed control methods should be optimized. Therefore, determining appropriate weed management practices is important for production to ensure optimum grain yield.

In Africa, the area under finger millet production has decreased because most of the local farmers are engaged into production of other cereal crops (Oduori, 2005). Researches in finger millet production have been largely neglected by national and international research centres compared to the research lavished on other cereals particularly in the Sub-Saharan Africa (Anonymous, 1996; Mgonja, 2005; Mitaru *et al.*, 1993). Based on the foregoing, it becomes imperative to determine the productivity of finger millet as influenced by sowing dates, sowing methods and weed control treatments.

1.5 OBJECTIVES OF THE STUDY

This study was conducted with the following objectives;

1. To determine the appropriate sowing dates of finger millet production.

2. To determine the best sowing method of finger millet.
3. To determine the best weed control method in finger millet production

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 EFFECT OF SOWING DATE ON THE GROWTH AND YIELD OF MILLET

Sowing time recommendations for millet is commonly made based on calendar day or soil temperature (Andrews, Rajewski and Mason, 1998). Delay in sowing decreased values of all parameters (Iping, 1997). Sowing time is the most important non-monetary input influencing crop yield, and sowing at the right time improves the productivity by providing suitable environment at all the growth stages. Yield can be increased by identification of higher yielding varieties and proper planting time (Khan, Khalil, Nigar, Khalil, Haq, Ahmad, Ali and Khan, 2009 and Arif*,* Ihsanullah*,* Khan*,* Ghani and Yousafzai*,* 2001). Murthy (2002) reported that, higher growth and yield parameters in finger millet can be achieved when the crop is sown at optimum date of sowing with recommended cultivation practices. The variation in sowing time brings about varied plant environment interaction, which determines the efficiency of inherent physiological processes and ultimately the crop yield (Moorthy and Rao, 1986). Timely planting of crops generally ensures sufficient time for root development and vegetative growth for optimum utilization of available soil nutrients and radiant energy (Soler, Maman, Zhang and Mason, 2007), and also ensures a better harmony among soil, plant and atmospheric system. Optimum planting time is a chief factor influencing the seed production of millet (Jan, Khan, Amanullah and Sohail, 2015). Optimum sowing date of millet offers increased productivity (Khan *et al.* 2009), sufficient duration of vegetative growth, efficient consumption of soil nutrient and radiation energy and adequate reproductive growth (Soler, Maman, Zhang, Mason and Hoogenboom, 2008). For better productivity of millet, optimization of suitable planting time is prerequisite (Farrell, Fox, Williams, Fukai and Lewin, 2003). In the Northern Guinea savanna of Nigeria sowing date and planting method affect crop population, which must be optimal in order to compete with weeds and absorb nutrient and moisture for good growth and development.

Planting of finger millet on 25th June and 9th July at Samaru by dibbling method at the spacing of 10 and 15cm recorded heavier unthreshed panicles with consequent higher grain yield than sowing on 11th June (Shinggu and Gani, 2012). Similarly, Revathi, Sree Rekha and Pradeep Kumar (2017) indicated that finger millet sown on 2nd fortnight of July in India produced better yield attributes and grain yield than other time of sowing. Upadhyay, Rajeev, Santosh and Negi (2015) revealed that finger millet yield and its attributes were significantly affected by different sowing dates, and 23rd May was the suitable planting date of finger millet followed by 30th May in Bharsar, India. Pandiselvi *et al.* (2010) revealed that among the dates of planting finger millet, the crop planted on May 17th produced highest grain yield than the other sowing dates at Madurai, India. Whereas, Gavit, Rajemahadik, Bahure, Jadhav, Thorat and Kasture (2017) concluded that sowing of proso millet at 24th June produced maximum and significantly higher grain and straw yield over the rest of sowing times (10th June and 8th July). Gueye, Kanfany, Fofana, Gueye, Noba and Grove (2015) in their study conducted at southeastern Senegal using Fonio millet (*Digitaria exilis* Stapf) reported that, the plant growth and grain yield were significantly better for the early July sowing dates compared to other sowing dates. However, tillering capacity and grain size were not influenced by the sowing date, and highest grain yields were obtained on 15th July planting date. Juraimi, Begum, Sherif and Rajan (2009) in their study conducted at Ethiopia using tef millet (*Eragrostis tef*) concluded that delayed sowing of tef by 7 and 15 days had resulted in reduction of plant height by 22.80 and 32.06%, panicle length by 45.51 and 55.11%, crop biomass by 34.39 and 35.53% and grain yield by 60 and 68%, respectively.

Soler *et al.* (2008) in their studies conducted using two millet varieties established that, the optimum planting date to obtain the maximum yield was between 13th and 23rd May for Heini Kirei variety, while for the other varieties the planting dates were between 23rd May and 2nd June. Amanullah, Imran, Shahzad and Amanullah (2015) reported that sowing dates were significant for all parameters measured in pearl millet crop at Pakistan, but the crop sown on 20th June had the maximum leaves plant^{-1}, plant height, panicle length, panicle weight, grains panicle^{-1}, thousand grains weight and grain yield (kgha^{-1}) as compared with other sowing dates. Arslan, Zulfiqar, Ishfaq, Ahmad, Anwar, Ullah, Nazar, Iqbal and Anjum (2018) conducted a research at Faisalabad, Pakistan and elucidated that, higher value for plant height, leaf area, fresh weight of leaves per plant, number of grains per panicle and grain yield (kgha^{-1}) of millet were obtained from the 30th June sowing date under two hoe weeding at 15th and 30th days after sowing. Dapake, Chaudhari, Ghodke and M. R.Patil (2017) reported that sowing of pearl millet very early in the season may not be advantageous, and delayed sowing invariably reduces crop yield in India. Sowing the crop at optimum time increases yield due to suitable environment at all the growth stages of the crop. Maurya, Nath, Patra and Rout (2016) in their study conducted at Allahabad, India revealed that, sowing pearl millet on 23rd July recorded highest plant height, plant dry weight, grain and stover yield. Upadhyay, Dixit, Patel and Chavda (2001) have reported higher grain yield of summer pearl millet when sown on 15th march and found reduction in grain yield with delay in sowing in the mid Himalayan region of Uttarakhand, India.

2.2 EFFECT OF SOWING METHOD ON THE GROWTH AND YIELD OF CEREALS

Beside other agronomic factors, sowing method is the major factor which determines the crop vigor and ultimate yield (Korres and Froud-Williams, 2002). The choice of planting technique may depend on the availability of man power and technology, especially, in developed countries where labor is very limited (Birhane, 2013). Gani, Mahadi, Dadari, Babaji and Shinggu (2015) conducted a research at Bagauda, Kano and reported that, planting of finger millet using dibbling method produced significantly higher growth parameters such as plant height, leaf area index; number of tillers plant^{-1}, crop growth rate and relative growth rate which consequently out-yielded broadcasting method. Similarly, planting finger millet by dibbling recorded heavier unthreshed panicles with consequent higher grain yield than broadcasting (Shinggu and Gani, 2012). Patil, Shinde, Gadhave, Chavan and Mahadkar (2018) reported that planting of finger millet by transplanting method recorded higher plant height, tillers and grain yield than direct seeding using dibbling method. Thakur, Kumar, Salam, Patel and Netam (2016) reported that tallest plant, maximum number of tillers, highest number of seeds per finger and grain yield was obtained in finger millet crop sown by drilling method of planting. Planting method affects the germination population and establishment of finger millet, and the use of broadcasting method was found to be superior to other methods used for planting of finger millet (Adeyeye, Ahuchaogwu, Shinggu, Ibirinde and Musa, 2014).

Dachi, Mamza and Bakare (2017) in their research conducted at Badeggi, Niger State using fonio millet (*Digitaria exilis*) crop reported that, drilling method of sowing had superior influence on number of tillers, leaf area, spike length, straw weight (kgha^{-1}), and maximum grains yield (kgha^{-1}) was recorded under drilling method of sowing. Abraham, Nigussie and Kebebew (2018) in their trial conducted at

Ethiopia using tef millet concluded that the crop planted in rows manifested substantial number of tillers and taller plant height and grain yield as compared to broadcast sowing method. The most common way of planting tef millet is by broadcasting the small seed at the rate of 25 -50kg ha^{-1} (Bekalu and Tenaw, 2015a). This practice reduces the amount of grain production, promotes competition among plants for inputs and causes severe lodging; which is the main cause for low yield of tef millet due to high plant density (Fufa, Behute, Simons and Berhe, 2011). Also, in a separate experiment, Bekalu and Tenaw (2015b) confirmed that row sowing method hastened heading and maturity of tef millet by one day and increased growth rate by 23.46% than broadcasting; also row sowing had 24.8 and 23.8% more panicles, grain and biomass yields respectively, than broadcasting method of sowing. Furthermore, row sowing method could be recommended as an economically feasible choice for planting of tef millet than broadcasting method of sowing (Bekalu and Tenaw, 2015c). The combination of row sowing method with 10 kg/ha seed rate was the best treatment for high grain yield of tef (*Eragrostis tef*) compared to plants grown under broadcasting sowing method (Sahle and Altaye, 2016).

Umed, Mujeeb, Ejaz, Shereen and AbdulQadir (2009) concluded that drilling method of sowing at seed rate of 125 kg/ha is optimal for yield and quality of wheat grains. Kiliç (2010) revealed that planting methods in durum wheat (*Triticum turgidum* var. durum Desf.) had significant effect on yield and yield contributing characters, and concluded that bed planting method is suitable for wheat in irrigated area when appropriate genotypes are used. Planting method plays an important role in the placement of seed at proper depth, which ultimately affects crop growth. The selection of suitable planting method for wheat is dependent upon the time of planting, availability of soil water at planting time, amount of residue in the field and availability of planting machine (Sikander *et al.,* 2003). Abebaw and Hirpa (2018) conclude that row sowing provided high yield of wheat than the other methods of sowing. Geleta (2015) indicated that sowing wheat in row produced good quality seed than broadcasting method.

2.3 EFFECT OF WEED CONTROL PRACTICES ON GROWTH AND YIELD OF FINGER MILLET

Millet is very sensitive to weed competition during the early stage of growth (Lagoke *et al*., 1981), and the greatest loss in a crop yield due to weed competition occurs during the critical period of weed competition which is the period of the crop growth when it is most susceptible to weed competition (Lagoke, Adejonwo and Sinha*,* 1986). Weeds are unwanted plants which succeed in struggle for existence in competition with crops (Lavabre, 1991), and the critical period of crop-weed competition in finger millet has been observed to be from 25-45 days after sowing (DAS) and delay in weed removal beyond 45 DAS resulted in decreased grain yield. Also, weeding operations done earlier than 25 DAS affected the crop yield adversely and the weed free conditions extended beyond 45 DAS did not give any additional advantage. Instead, repeated weeding done to provide weed free conditions for the longer duration caused adverse effect on grain yield (Lall and Yadav, 1982). Styslinger (2003) and Das (1990) in their separate studies reported that, weeding in finger millet is problematic because the dominant weeds in Africa's finger millet fields are similar to the crop and are difficult to differentiate from the crop during weeding. Unchecked weed growth in millet throughout its life cycle has been reported to affect growth and causes 53% and 44% grain yield reduction in Savanna ecological zones of Nigeria (Lagoke, 1984; Lagoke, Adeleke, Ndahi and Choudhary, 1988). Two hoe-weeding at 3 and 6 or 7 weeks after sowing (WAS) were recommended to achieve good crop growth and grain yield in pearl millet (*Pennisetum americana*) in the absence of herbicide (Lagoke *et. al.*, 1988). One of the major constraints in finger millet production is poor weed management (Anonymous, 1998). A yield loss due to uncontrolled weeds in the first 6 weeks of finger millet growth was reported to be 78.2, 82.2 and 83.1% in 1997, 1998 and 1999 respectively (Bulus, 2002). Nanjappa and Hosmani (1982) observed that the neburon (1kg ha^{-1}) pre emergence or 2,4-D Na (1kg ha^{-1}) post-emergence, each in combination with two (2) hand weeding gave grain yield of 2.07 and 1.73 t ha^{-1}, respectively, compared with 2.56 t ha^{-1} on weed-free plots and 1.53 t ha^{-1} without weed control. Van Wyk and Gericke (2000) reported that finger millet is less susceptible to pests and diseases than other cereal crops, blast being the only major disease, but it has a poor ability to compete with weeds. Prasad *et al*. (1991) reported that the weeds reduced yield of finger millet by 55-61 % and hand weeding twice gave the highest grain yield. But Basavaraj and Reddy (2014) reported hand weeding twice at 20 and 30 DAP as being the best efficient method for the weed control which produces significantly the highest yield and weed control efficiency. Similarly, Amare and Etagegnehu (2016) reported the lowest weed density and weed biomass as well as the highest yield of finger millet from two hand weeding at 20 and 40 days after emergence as compared to other weed control practices. Singh and Arya (1999) also noted similar findings. Hand weeding in finger millet is tedious and time consuming, in many developing countries, half of the effort devoted to crop production is spent on weed control (Culpepper and York, 2000), but a well pulverized seedbed is highly essential for good germination and higher initial plant stand of finger millet which in turn reduces weed competition (Das, 2008). Also, Das and Yaduraju (1995) reported 72% yield loss in finger millet due to its initial slow growth rate, which picks up, tillers and increases in height after 25-30 DAS and becomes more competitive against weeds, as it is a critical period of weed interference. Dawson (1970) reported that the effect of weed on the growth and yield of crop varies with weed species, density and duration of the crop exposure to weeds.

Kumara, Basavaraj, Naik. and Palaiah (2007) observed that the grain yield differed significantly due to weed management practices, hand weeding twice at 20 and 40 DAT (days after transplanting) and butachlor at 0.75 kg ha^{-1} + 2,4 D Na salt 0.75 kg ha^{-1} recorded significantly higher grain yield as compared to unweeded control treatment. Weed competition as observed in unweeded control lowered the grain yield by 43.5 %, and had the highest weed index. The increases in grain yield in treated plots were due to increased yield components of the crop and reduced weed pressure, and the crop in weed-free plots also registered the highest uptake of major nutrients (Naik, Muniyappa and Kumar, 2000). Gosh (2000) observed a significant decrease in yield of finger millet due to delayed weeding from 15 - 65 days after sowing. Das (2008) reported that weeds having similar characteristics as those of crop plants are often more serious competitors than weeds with dissimilar habits, and poses the major constraints in the production of finger millet due to its initial slow growth rate, which favours weed growth and causes more competition for sunlight, nutrient and water in early stages of growth. Weeds usually absorb mineral nutrients faster than many of the crop plants and accumulate them in their tissues in relatively large amount and therefore, derive greater benefit (Gupta, 1998).

Channa, Muniyappa and Dinesh (2000) reported that the uptake of nutrients by finger millet was high and by weeds were low in application of isoproturon or 2,4-D treated plots giving highest grain and straw yield. Naik *et al*. (2000) revealed that the butachlor-treated plots (either with or without earthen-up) had significantly more dry matter of the finger millet. Also, Naik, Muniyappa and Kumar (2001) noted that weed free control and three manual weeding at 20, 40 and 60 DAS were similar in terms of effect on grain and straw yield of finger millet, and among the herbicides, butachlor application (0.5 or 0.75 kg ha^{-1}) along with hoeing recorded higher grain and straw yield. Guruprasanna, Setty and Nanjappa (2004) observed that chlorimuron ethyl at 5 and 10 g ha^{-1} recorded highest grain yield of finger millet which was at par with hand weeding twice and isoproturon.

Pradhan and Singh (2009) revealed that application of isoproturon (0.5 kg ha^{-1}) alone as pre emergence treatments recorded higher grain yield with harvest index of 60.57, 60.96 and 61.01 per cent during 2005, 2006 and 2007, respectively, and were significantly superior to lower doses of isoproturon (0.005 and 0.05 kg ha^{-1}). Pradhan, Rajput and Thakur (2010) found that two hand weeding at 20 and 45 DAS with higher dose of oxyflourfen (0.50 kg ha^{-1}) resulted in the highest grain yield, straw yield and harvest index of finger millet during 2004, 2005 and 2006. Weed management resulted in significant improvement in yield of finger millet as compared to weedy check. Prasad, Sanjay, Denesh, Kumar, Ananda, Lokesh and Upanal (2010) pooled the data of nine year of finger millet crop from 1999 to 2007 of which indicated that due to good control of weeds, application of butachlor (0.75 kg ha^{-1}) gave similar grain yield to hand weeding twice. Gowda, Naveen, Bhagyalakshmi and Gowda (2012) concluded that in finger millet cultivations, the highest grain and straw yield was obtained in butachlor applied plots.

Kumara, Naik and Ananadakumar (2014) reported that application of butachlor and 2,4-D Na salt in finger millet and butachlor 0.75 to 1.0 kg ai/ha and pendimethalin 1.0kg ai/ha in groundnut helped in retaining higher N, P_2O_5 and K_2O nutrient status in soil, as compared to hand weeding and unweeded control. Dhanapal, Sanjay, Hareesh and patil (2015) reported that application of butachlor at 0.75 kg ha^{-1} more or less recorded similar grain yield to hand weeding twice due to good control of weeds. Prithvi, Rao and Srinivasulm (2015) reported that pre-emergence application of oxadiargyl 100 g/ha followed by inter-cultivation at 20 DAT recoded higher plant height, crop dry weight, maximum number of productive tillers, grain per finger and highest grain yield that was at par with two hand weeding at 15 and 30 DAT. Tuti, Singh, Pandey, Bisht and Pattanayak (2016) observed that, manual weeding at 20 and 40 DAS significantly lowered the total weed dry weight. Studies of Nanjappa and Hosmani (1982) revealed that the application of neburon (1 kg ha^{-1}) as pre emergence, or 2,4-D Na (1 kg ha^{-1}) as post-emergence, each in combination with two hand weeding, recorded effective control of weeds in finger millet. Reddy, Raju, Prasad and Krishnamurthy (1990) found that the integration of chemical and cultural control methods further increased the weed control and enabled that herbicide rates to be reduced.

Prasad *et al*. (1991) recorded that the application of 2,4-D reduced the number of broad leaf weeds, with the exception of *Ageratum conyzoides* and grasses (*Digitaria marginata, Dactyloctenium aegyptium, Eragrostis pilosa and Echinochloa colona*) at all stages of growth. Naik *et al*. (2000) revealed that among the herbicides, butachlor application (0.75 kg ha^{-1} or 0.5 kg ha^{-1}) along with hoeing recorded lower weed density (10-13m^{-2}) and weed dry biomass (0.9-1.05 q ha^{-1}) at harvest that resulted in weed control efficiency of more than 85%. Guruprasanna *et al.* (2004) revealed that the chlorimuron ethyl recorded 69.4 and 67.4 percent of weed control efficiency at 5 and 10 g ha^{-1} respectively, which were close to that of isoproturon (74.1 %) and hand weeding twice (76.3 %). Kumara *et al*. (2007) concluded that the application of butachlor (0.75 kg ha^{-1}) was found to be more effective in controlling grasses and broad leaf weeds at most of the stages, while 2,4-D Na salt (0.75 kg ha^{-1}) was effective only against broad leaf weeds, and the total weed populations as well as total weed dry weight differed significantly at all crop growth period between these two herbicides and it was lower in butachlor applied plot.

Pradhan and Singh (2009) reported that the application of pre emergence spray of isoproturon (0.5 kg ha^{-1}) + two inter cultivation (20 and 40 DAS) resulted in significantly minimum weed population and dry matter accumulation and higher weed control efficiency (71.90, 70.19 and 68.29 % in 2005, 2006, 2007, respectively) over rest of treatments for broad leaf weeds. Narrow leaf weeds were suppressed effectively by isoproturon (0.05 kg ha^{-1}) as pre emergence + two inter cultivation + one hand weeding with weed control efficiency of 75.11, 77.39 and 79.77 per cent in 2005, 2006 and 2007, respectively. Pradhan *et al*. (2010) revealed that the lowest density and dry weight of weeds were recorded under hand weeding twice (20 and 45 DAS) followed by preemergence application of oxyflourfen (0.25 kg ha^{-1}) + one weeding at 20 DAS. Oxyflourfen 0.25 kg ha^{-1} + hand weeding at 20 DAS registered the highest weed control efficiency (60.18 %) followed by application of oxyflourfen (0.15 kg ha^{-1}) + two hand weeding. Ramamoorthy, Arthanari and Amanullah (2010) observed that pre-emergence application of isoproturon as spray at 0.5 kg ai ha^{-1} + post-emergence 2,4-D Na salt at 0.75 kg ha^{-1} on 15 DAS and one inter cultivation on 30 DAS gave lower weed population and dry matter of the major weed flora *Trianthema portulacastrum* and total weeds.

2.4 DESCRIPTION OF THE HERBICIDE USED

2.4.1 Atrazine Herbicide

Atrazine [6-chloro-N^2-ethyl-N^4-isopropyl-1,3,5-triazine-2,4-diamine] is a herbicide applied to soil for control of many broadleaf and certain grass weeds in maize, sorghum, millet and sugarcane (Wackett*,* Sadowsky, Martinez and Shapir*,* 2002). It is a white, crystalline solid, with a water solubility of 70ppm at 25℃ and acute oral LD_{50} for rats of 3,080mg/kg a.i. It is formulated either as wettable powder, flowable liquid suspension or granules (Annonymous, 2015). Historically, atrazine was considered to be slowly biodegradable in soil owing to the halogen and *N*-alkyl substituents, which impede microbial metabolism of the *s*-triazine ring (Wackett, *et al.,* 2002), and is widely used for selective control of broadleaf and grassy weeds in cereal crops. Depending upon the crop or intended use, Atrazine may be applied preplant, pre-emergence or post-emergence. Pre-emergence application is generally prepared method of application. Under dry condition, a shallow incorporation may increase the degree of weed control as it persists longer in the soil for maximum chemical and biological although appreciably reduced *Striga* compared to farmers practices of using two hoe weeding. Xu, Stucki, Wu, Kostka and Sims (2001) reported that atrazine herbicide was just like trifluralin and alachlor herbicides that were susceptible to rapid transformation in the presence of reduced iron-bearing soil clays, such as ferruginous smectites. In natural environments, some iron-bearing minerals are reduced by specific bacteria in the absence of oxygen, thus the abiotic transformation of herbicides by reduced minerals is viewed as "microbially induced". Also, Krutz, Shaner, Accinelli, Zablotowicz and Henry (2008) in a recent research elucidated that the microbial adaptation to atrazine has occurred in some fields where the herbicide is used repetitively, resulting in more rapid biodegradation. Felix (2016) reported that the photolytic degradation with 254nm ultraviolet was seen as an efficient process, which could be used in pilot plants to reduce or eliminate compounds of the atrazine class or similar emerging contaminants in effluents.

2.4.2 2,4-D Herbicide

The herbicide 2,4-D (2,4-Dichlorophenoxy acetiteacid) belongs to chlorinated phenoxy group of herbicides. Both inorganic salt amine and ester formulations are available either in solid or liquid form. Its acute oral LD_{50} for rat is 300 to 1000mg/kg body weight. It is a systemic herbicide which is widely used to controlled broadleaved weeds in cereal crops, turf pastures and non – crop land. Most dicotyledonous plants are susceptible at normal herbicide application rates. 2,4-D is normally applied as post-emergent treatment at the rate of 0.5 to 1.5kg a.i./ha (Akobundu, 1987). The usual carrier is water, oil or both, depending upon the formulation used. Low volumes are generally used for aerial application and higher volumes are used for ground application. Plant roots absorb polar (salt) forms of 2,4-D most readily, leaves absorb non polar (ester) form most readily. A rain free period of four (4) to six (6) month is adequate uptake and effective weed control. The ester of 2,4-D tend to resist washing from plants and are rapidly converted to acid by plants. Following foliar absorption, 2,4-D is translocated within the phloem probably in the photosynthates. Following root absorption, it may moves upward in the transpiration stream. The translocation is influenced by the growth status of the plant. Accumulation of the herbicide occurs principally at their meristematic regions of the shoots and the roots. 2,4-D causes abnormal growth response and affect respiration, food reserves and cell division in susceptible plants. It can also act as a plant growth regulator, and low rates can induce rooting blossom set. Also, it controls the ripening of banana and citrus fruits and delays pre-harvest dropping of some fruits. Salt of 2,4-D are leached in sandy soils. It also undergoes microbial breakdown in warm, moist soil, depending upon temperature, moisture, organic matter and other soil characteristics, which affect microbial activity. It may also undergo minor plant decomposition, and may persist generally for one (1) to four (4) weeks in warm moist soil and toxic to wildlife and fish (Vernon, 1983).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 EXPERIMENTAL SITE

The experiment was conducted during the 2016, 2017 and 2018 rainy seasons, at the research farm of National Institute for Horticultural Research (NIHORT) Bagauda (Latitude 11° 33' N and Longitude 8° 23' E, 481m asl) Kano, in the Sudan savanna ecological zone of Nigeria.

3.2 TREATMENTS AND EXPERIMENTAL DESIGN

The experiment consisted of three (3) sowing dates (late June, early July and late July), three (3) sowing methods (broadcasting, drilling and dibbling) and six weed control treatments (Atrazine at 0.8 or 1.2 kg a.i. ha^{-1}, 2,4-D at 0.5 or 0.75 kg a.i. ha^{-1}, two hoe weeding at 3 and 6 WAS, and weedy check). These were factorially combined and laid out in a split-split-plot design and replicated three (3) times. The sowing dates were assigned to the main plot and the sowing methods to the subplot while weed control treatments were assigned to the sub-subplot.

3.3 SOIL DATA

Before setting up of the experiment in each year, composite soil samples were collected in zigzag pattern from 0-20cm using auger from the experimental sites and analyzed for physical and chemical properties. The particle size was determined by Bouyocous hydrometer method (Bouyocous, 1951); soil pH by using pH meter as described by Black (1965); organic carbon content was determined by dichromate wet digestion method as described by Walkey and Black (1934); N content by Micro-Kjedhal method as described by Bremmer and Mulvaney (1982); available phosphorus (P) was extracted using the Bray 1 method (Bray and Kurtz, 1945);

exchangeable bases (Ca, Mg, K and Na) using 1M ammonium acetate solution (Anderson and Ingram, 1993) and CEC was estimated by ammonium acetate method.

3.4 METEOROLOGICAL DATA

Records of rainfall and temperature (maximum and minimum) were collected from the meteorological unit of the NIHORT Bagauda Kano for the 2016, 2017 and 2018 cropping seasons.

3.5 CULTURAL PRACTICES

3.5.1 Land Preparation

In each year of the trial, the field was harrowed twice to achieve a fine tilth and made into flat beds, it was then marked into the required number of plots each of gross area of 3m × 3m ($9m^2$) and net plot size of 2m x 3m ($6m^2$). The borders between main plots, subplots, sub-subplots and replicates were 1.5m, 1m, 0.5m and 2m, respectively.

3.5.1 Sowing

The seeds were sown manually on treatment basis using a seed rate of 5 kg ha^{-1}. The late June, early July and late July sowing was done on 25th June, 9th July and 23rd July, respectively. Broadcasting was done by spreading the seeds on the soil evenly, dibbling was done by planting the seeds at 20 x 10cm inter and intra row spacing, respectively, while drilling was done by sowing the seeds at a spacing of 20cm inter row.

3.5.2 Herbicide Application

The herbicides were applied on treatment basis using a CP3 knapsack sprayer fitted with green deflector nozzle at a pressure of 2.1 kg cm^{-2} using spray volume of 200 l ha^{-1}. The herbicide was applied in the morning when the weather was calm to avoid wind drift. Hoe weeding was carried out as per treatment at 3 and 6 weeks after sowing.

3.5.3 Fertilizer Application

Fertilizer was applied at the rate of 60 kg N, 30 kg P_2O_5 and 30 kg K_2O per hectare, compound fertilizer (NPK 15-15-15) was used to supply all the P, K and half N requirements at 2 WAS. The second half of N was applied as top dressing at 6 WAS using urea (46% N).

3.5.4 Harvesting

The crop was harvested at physiological maturity when the panicle turned brownish in colour, confirmed by free threshing of the grains when the heads fingers were squeezed by hand. The plants were cut about 5cm above the ground level using sickle and allowed to dry before threshing. Threshing was done by beating the panicle with sticks, and winnowed to remove the straws, foreign material and unfilled grains from the grains.

3.6 OBSERVATIONS AND DATA COLLECTION

3.6.1 Number of Days to 50% Emergence

These were determined by observing and recording the number of days from planting to when about 50% of the seedlings emerged.

3.6.2 Plant Height

The plant height of finger millet was recorded at 3, 6, 9 and 12 WAS by measuring the height of five randomly selected and tagged plants from the base of culm to the highest growing point using a metre rule in each plot. The mean was then computed and recorded.

3.6.3 Leaf Area Plant^{-1}

The leaf area per plant was measured from five randomly selected tagged plants at 3, 6, 9 and 12 WAS using leaf area meter, YMJ - A model, and the means were computed and recorded.

3.6.4 Leaf Area Index (LAI)

This is the ratio of the total area of the leaves of a crop to the ground area occupied by the crop (Watson, 1947). LAI was determined using the following equation.

$$\text{LAI} = \frac{\text{LA}}{\text{GA}}$$ Where LA = leaf area and GA = ground area

3.6.5 Dry Matter Plant^{-1}

Five plants were uprooted at 3, 6, 9 and 12 WAS from each plot and cleaned free of soil and then oven dried at 65^{o}C to a constant weight and the mean weight were computed and recorded.

3.6.6 Crop Growth Rate (CGR)

The crop growth rate was calculated at 3-6, 6-9 and 9-12 WAS, using the following formula as described by Watson (1958):

$$CGR = \frac{W_2 - W_1}{T_2 - T_1} \; g / wk$$

Where, W_1 is plant dry weight at time T_1, W_2 is plant dry weight at time T_2.

3.6.7 Relative Growth Rate (RGR)

This is the cumulative dry matter increment per unit dry matter per unit time, it was calculated at 3-6, 6-9 and 9-12WAS using the following formula as described by Radford (1967):

$$\text{RGR} = \frac{\text{loge W2 - loge W1}}{T_2 - T_1} \; g/g/wk$$

Where, W_1 is plant dry weight at time T_1, W_2 is plant dry weight at time T_2 respectively

3.6.8 Number of Days to 50% Heading

The number of days to 50% heading of finger millet was recorded by counting the number of days from sowing to when about 50% of the panicle extruded in each plots.

3.6.9 Number of Days to Maturity

The number of days to maturity was determined from the date of sowing to when about 75% of the panicles matured in each plot as indicated by change in colour to golden brown and free threshing of the grains when the heads fingers are squeezed by hand.

3.6.10 Weed Species Composition

Weeds were harvested from 0.5 x 0.5m quadrant placed randomly in each net plot at physiological maturity, the harvested weed samples were identified, classified by species and counted to obtain composition of individual weed species.

3.6.10 Weed Density

The counted weed samples above were summed to obtain the total number of weed species per unit area of the quadrat.

3.6.11 Weed Cover Score

The weed cover score was taken at physiological maturity by visual observation on a scale of 0 - 4 as described by Komboik *et al*. (2003); where 0 = no weed, 1 = moderately weedy, 2 = weedy, 3 = very weedy, 4 = highly weedy

3.6.12 Weed Dry Weight

At physiological maturity, the weeds within 1m^2 quadrat were harvested, cleaned, washed and oven dried at 65^{0}C to a constant weight. The dry weight was obtained using Metlar MT-2000 sensitive weighing scale, and then extrapolated to per hectare basis.

3.6.13 Weed Control Efficiency

Weed control efficiency was calculated on population/density per unit area as described by Mani *et al.* (1973) using the following formula;

$$WCE\ (\%) = \frac{WDc - WDt}{WDc} x\ 100$$

Where, WDc is the weed density (number/m^2) in control plot; WDt is the weed density (number/m^2) in treated plot.

3.6.14 Weed Control Index

Weed control index was calculated on dry weight basis as described by Misra and Tosh (1979) using the following relation;

$$WCI\ (\%) = \frac{WDMc - WDMt}{WDMc} x\ 100$$

Where, WDMc is the weed dry weight (unit/m^2) in control plot; WDMt is the weed dry weight (unit/m^2) in treated plot.

3.6.15 Number of Tillers

The number of established crops were counted at 3 WAS and at harvest using 0.5m x 0.5m quadrat placed in each plots, the number of tillers were then determined by computing the differences between the counting at harvest and establishment counts, and then extrapolated to per meter square (m^2).

3.6.16 Number of Fingers Panicle^{-1}

The number of fingers from five tagged plants in each net plot was counted and the average was computed and recorded.

3.6.17 Panicle Weight Plant^{-1}

Ten (10) panicles were harvested from each net plot and dried, weighed using Metlar MT-2000 sensitive weighing balance, and then averaged out and recorded as panicle weight per plant.

3.6.18 1000-Grain Weight

The 1000-grain was randomly counted manually from each plot, and weighed using Metlar MT-2000 sensitive weighing balance and recorded.

3.6.19 Panicle Weight

The harvested panicles from each net plot were weighed and expressed in to per hectare basis and recorded.

3.6.20 Straw Yield

The straw from each net plot was dried and weighed using weighing balance and recorded. The straw yield was then extrapolated to kilogram per hectare (kgha^{-1}).

3.6.21 Harvest index

This was determined by taking the ratio of economic yield to biological yield and the values for each plot was converted to percentage by using the following formula:

$$\text{Harvest Index (\%)} = \frac{\text{Economic yield}}{\text{Biological yield}} x\ 100$$

3.6.22 Grain Yield

The grain yield per net plot was weighed after threshing and winnowing using Metlar MT-2000 sensitive weighing scale, and then extrapolated to per hectare basis.

3.7 STATISTICAL ANALYSIS

The data collected were subjected to analysis of variance (ANOVA) as described by Snedecor and Cochran (1967) using GenStat (GenStat, 2013). The significant means were compared using Student-Newman Keuls, and the magnitude and type of relationship between the various parameters were determined by simple correlation analysis (Little and Hills, 1987). Path-coefficient analysis was used to estimate the direct and indirect effects of the parameters on yield and yield component.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 RESULTS

4.1.1 Physical and Chemical Properties of the Soil at the Experimental Sites

Table 1 shows the physical and chemical properties of the soil at the experimental sites for all the seasons. The results revealed that the textural class of all the soil in three (3) seasons were sandy loam (Table 1). The pH value for 2016 (6.00) and 2017 (6.00) were slightly acidic, while that of 2018 (5.27) was acidic. In all the seasons, the soil had low organic carbon, 7.42, 3.83 and 8.62gkg^{-1} for 2016, 2017 and 2018, respectively. The total nitrogen content of the soil in 2016 (1.05gkg^{-1}), 2017 (1.75gkg^{-1}) and 2018 (1.40gkg^{-1}) were high, while, the available phosphorus content in 2016, 2017 and 2018 (7.41, 5.92 and 5.02gkg^{-1}, respectively) were low. Among the exchangeable cations, calcium (Ca) content of the soil in 2016 (3.71$cmol_{+}kg^{-1}$), 2017 (2.41$cmol^{+}kg^{-1}$) and 2018 (3.97$cmol_{+}kg^{-1}$) were moderate, whereas the magnesium (Mg) content (1.55, 1.01 and 1.65$cmol_{+}kg^{-1}$) for 2016, 2017 and 2018, respectively, were high. The potassium (K) and sodium (Na) content of the soil were moderate across the seasons, and the CEC of the soil were low in 2016 (5.54$cmol_{+}kg^{-1}$) and 2017 (3.79$cmol_{+}kg^{-1}$), and it was moderate in 2018 (6.10$cmol_{+}kg^{-1}$).

4.1.2 Rainfall and Mean Monthly Temperature at the Experimental Sites

Table 2 shows the data of rainfall and temperature received at the experimental sites from May to October during 2016, 2017 and 2018 rainy seasons, respectively. The results indicated that total rainfall of 740.2, 1116.5 and 1033.3mm were received during 2016, 2017 and 2018, respectively. The average minimum and maximum temperature were 24.17 and 31.45^{0}C for 2016, 24.88 and 34.27^{0}C for 2017, and 23.80 and 33.27^{0}C for 2018, respectively.

Table 1: Physical and Chemical Properties of the Soil at the Experimental Sites in Bagauda During 2016, 2017 and 2018 rainy seasons.

Soil Composition	2016	2017	2018
Physical Properties (%)			
Clay	1	3	5
Silt	32	36	42
Sand	67	61	53
Textural Class	Sandy loam	Sandy loam	Sandy loam
Chemical Composition			
pH (H_2O)	6.00	6.00	5.27
Organic Carbon (g kg^{-1})	7.42	3.83	8.62
Total N (g kg^{-1})	1.05	1.75	1.40
Available P (mg kg^{-1})	7.41	5.92	5.02
Exchangeable Cations ($cmol_+ kg^{-1}$)			
Ca	3.71	2.41	3.97
Mg	1.55	1.01	1.65
K	0.18	0.26	0.36
Na	0.10	0.10	0.12
CEC	5.54	3.79	6.10

Source: As Analyzed in the Laboratory of Soil Science Department, Faculty of Agriculture, Bayero University, Kano

Table 2: Rainfall and Mean Monthly Temperature at Bagauda in 2016, 2017 and 2018

Month	Rainfall (mm)			Temperature (0^0C)					
	2016	2017	2018	2016		2017		2018	
				Min.	Max.	Min.	Max.	Min.	Max.
May	88.9	31.6.	93.8	26.8	36.7	27.1	37.6	26.1	37.2
June	183.2	125.0	170.0	24.2	28.5	25.0	36.2	24.7	34.8
July	159.6	223.9	65.5	22.0	26.4	23.5	33.1	23.1	30.0
August	201.3	505.8	441.0	20.5	29.8	24.2	33.3	22.7	30.5
September	56.6	236.8	209.0	23.4	32.8	22.9	31.5	22.6	31.8
October	50.6	25.0	54.0	28.1	34.5	26.6	33.9	23.6	35.3
Total	740.2	1116.5	1033.3						
Average				24.17	31.45	24.88	34.27	23.80	33.27

Source: Meteorological Unit, National Institute for Horticultural Research, Bagauda, Kano State.

4.1.3 Number Days to 50% Emergence

The effect of Weed control treatment, sowing date and sowing method on number of days to 50% emergence of finger millet at Bagauda is shown in Table 3. Weed control treatment had significant effect on number of days to 50% emergence of finger millet. In 2016 and 2017, application of atrazine at 0.8 and 1.2kg a.i.ha^{-1} significantly delayed the number of days to 50% emergence which were followed by plots treated with 2,4-D at 0.75kg a.i.ha^{-1} in 2016 and all other weed control treatments and the weedy check in 2017. Application of 2,4-D at 0.5kg a.i.ha^{-1} recorded the least number of days to 50% emergence in 2016. Whereas in 2018 and combined, the application of atrazine at 1.2kg a.i.ha^{-1} recorded the highest number of days to 50% emergence which was closely followed by application of atrazine at 0.8kg a.i.ha^{-1} and all other weed control treatments and the weedy check recorded the least.

The sowing date has no significant effect on number of days to 50% emergence in all the experimental years and combined. Also, there were no significant differences between the sowing methods on number of days to 50% emergence in all the experimental years and combined. Significant interactions between sowing date and sowing method was observed on number of days to 50% emergence in 2018 and combined (Table 4). In 2018, sowing on late June using drilling method recorded significantly higher number of days to 50% emergence (4.83) which was at par with sowing on late July (4.83) using broadcasting method, while sowing on late June using broadcasting method recorded the least (4.28). Similar trend was observed in the combined, but the crop planted on late June (4.48) using broadcasting method and late July (4.50) using drilling methods was at par and recorded the least number of days to 50% emergence.

Table 3: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Number of Days to 50% Emergence of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	4.30c	4.00b	4.22c	4.17c
Atrazine at 0.8kg a.i. ha^{-1} PE	5.47a	5.48a	5.12b	5.38b
Atrazine at 1.2kg a.i. ha^{-1} PE	5.56a	5.57a	5.67a	5.57a
2,4-D at 0.5kg a.i. ha^{-1} POE	4.26d	4.00b	4.19c	4.12c
2,4-D at 0.75kg a.i. ha^{-1} POE	4.63b	4.12b	4.22c	4.33c
Weedy check	4.30c	4.00b	4.04c	4.11c
Probability level	<.001	<.001	<.001	<.001
SE±	0.107	0.069	0.145	0.065
Sowing Date (D)				
Late June	4.78	4.55	4.56	4.63
Early July	4.76	4.54	4.53	4.60
Late July	4.72	4.50	4.65	4.62
Probability level	0.713	0.713	0.344	0.754
SE±	0.047	0.046	0.050	0.026
Sowing Method (M)				
Dibbling	4.79	4.57	4.52	4.62
Drilling	4.65	4.52	4.64	4.61
Broadcasting	4.83	4.50	4.57	4.63
Probability level	0.221	0397	0.240	0.840
SE±	0.073	0.039	0.051	0.031
Interaction				
D x M	0.430	0.445	0.006	<.001
D x W	0.685	0.404	0.116	0.201
M x W	0.551	0.755	0.175	0.128
D x M x W	0.346	0.470	0.406	0.203

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 4: Interaction of Sowing Date and Sowing Method on Number of Days to 50% Emergence of Finger Millet at Bagauda, 2018 Rainy Season and Combined.

	Sowing method		
	Dibbling	Drilling	Broadcasting
Sowing date			
	2018 rainy season		
Late June	4.56b	4.83a	4.28c
Early July	4.44bc	4.56b	4.61ab
Late July	4.56b	4.56b	4.83a
SE±		0.088	
	Combined		
Late June	4.67ab	4.74a	4.48c
Early July	4.57bc	4.58bc	4.66ab
Late July	4.61abc	4.50c	4.76a
SE±		0.091	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

4.1.4 Plant Height

The effect of weed control treatment, sowing date and sowing method on plant height at 3 WAS of finger millet at Bagauda is shown in Table 5. The results indicated significant differences with respect to plant height among weed control treatment at 2016 and combined. In 2016, application of 2,4-D at the rate of 0.75 kg a.i. ha^{-1} was statistically similar with application of 2,4-D at 0.5kg a.i. ha^{-1}, two hoe weeding, application of atrazine at 0.8 kg a.i. ha^{-1} and weedy check, and produced significantly taller plant while application of atrazine at the rate of 1.2 kg a.i. ha^{-1} produced the least. In combined, plots treated with 2,4-D at 0.5kg a.i. ha^{-1} produced the tallest plant which were statistically similar to plants in plots treated with 2,4-D at 0.75kg a.i. ha^{-1}, those weeded twice at 3 and 6 WAS and those in the weedy check plots. Whereas application of atrazine at 0.8 and 1.2kg a.i. ha^{-1} were at par and recorded significantly the shortest plant than the other treatments. Sowing date did not significantly affect the plant height of finger millet in all the seasons and combined. Also, there were no significant differences among the sowing method for plant height at 3 WAS at all the experimental years and combined. There were no significant interaction on plant height at 3 WAS in all the experimental years and combined.

Table 6 shows the effect of weed control treatment, sowing date and sowing method on plant height at 6 WAS of finger millet at Bagauda. Weed control treatment was found to be significant on plant height of finger millet at 6 WAS in the combined. In which the plots of all the weed control treatments produced significantly taller plants as compared to weedy check plots which produced the shortest plants (28.2cm). Also, there was a significant difference among the sowing dates in 2016, 2017, 2018 and combined. In 2016, 2017, 2018 and combined, sowing on late June recorded significantly tallest plant (31.0, 29.3 30.2 and 30.2cm, respectively) than the other

Table 5: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Plant Height (cm) at 3 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	14.9a	14.8	14.9	14.9ab
Atrazine at 0.8kg a.i. ha^{-1} PE	14.2a	14.7	14.4	14.3b
Atrazine at 1.2kg a.i. ha^{-1} PE	14.1b	14.9	14.6	14.4b
2,4-D at 0.5kg a.i. ha^{-1} POE	15.0a	15.2	15.1	15.1a
2,4-D at 0.75kg a.i. ha^{-1} POE	15.1a	14.8	14.9	15.0ab
Weedy check	14.8a	14.4	14.6	14.6ab
Probability level	0.083	0.705	0.292	0.028
SE±	0.31	0.33	0.24	0.17
Sowing Date (D)				
Late June	14.8	14.7	14.7	14.8
Early July	14.6	15.0	14.8	14.8
Late July	14.7	14.6	14.7	14.7
Probability level	0.936	0.805	0.933	0.933
SE±	0.53	0.46	0.26	0.25
Sowing Method (M)				
Dibbling	14.5	15.1	14.8	14.8
Drilling	14.9	14.3	14.6	14.6
Broadcasting	14.7	15.0	14.9	14.9
Probability level	0.648	0.218	0.741	0.495
SE±	0.29	0.35	0.27	0.18
Interaction				
D x M	0.758	0.378	0.793	0.456
D x W	0.200	0.990	0.748	0.197
M x W	0.442	0.414	0.497	0.071
D x M x W	0.197	0.557	0.153	0.061

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 6: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Plant Height (cm) at 6 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	30.5	28.8	29.6	29.6a
Atrazine at 0.8kg a.i. ha^{-1} PE	31.2	28.9	30.1	30.1a
Atrazine at 1.2kg a.i. ha^{-1} PE	30.7	28.7	29.9	29.7a
2,4-D at 0.5kg a.i. ha^{-1} POE	30.9	29.2	30.0	30.0a
2,4-D at 0.75kg a.i. ha^{-1} POE	30.6	28.9	29.7	29.7a
Weedy check	29.1	27.9	29.2	28.2b
Probability level	0.102	0.249	0.136	<.001
SE±	0.53	0.55	0.53	0.31
Sowing Date (D)				
Late June	31.0a	29.3a	30.2a	30.2a
Early July	30.2b	28.5b	29.2b	29.2b
Late July	30.2b	28.1b	29.3b	29.3b
Probability level	0.042	0.033	0.061	<.001
SE±	0.17	0.22	0.21	0.12
Sowing Method (M)				
Dibbling	30.6ab	28.7	29.6ab	29.6a
Drilling	31.2a	29.2	30.4a	30.3a
Broadcasting	29.7b	27.9	28.8b	28.8b
Probability level	0.083	0.213	0.104	0.002
SE±	0.43	0.49	0.46	0.27
Interaction				
D x M	0.752	0.807	0.790	0.319
D x W	0.291	0.556	0.360	<.001
M x W	0.461	0.715	0.585	0.008
D x M x W	0.280	0.461	0.351	0.063

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

sowing date. Sowing method had significant effect on plant height at 6 WAS of finger millet in 2016, 2018 and combined. Dibbling and drilling method was statistically at par in 2016, 2018 and combined, and produced significantly the tallest plant in the respective years and combined while broadcasting method recorded the shortest. The interaction between sowing date and weed control treatment, as well as between sowing method and weed control treatment were significant in combined (Tables 7 and 8, respectively).

Table 7 shows the interaction of sowing date and weed control treatment on plant height of finger millet at 6 WAS in combined analysis. Sowing on late June and weeding twice at 3 and 6 WAS recorded significantly taller plants (31.3cm), while sowing on early July and late July in a weedy situation were at par and recorded the shortest plants (27.5 and 27.6cm, respectively). Table 8 shows that, dibbling (31.0cm) and drilling (30.9cm) methods using atrazine at 0.8kg a.i. ha^{-1} recorded significantly the tallest plant at 6 WAS, whereas broadcasting method (27.8cm) under weedy situation recorded the shortest plant.

The effect of weed control treatment, sowing date and sowing method on plant height at 9 WAS of finger millet at Bagauda is presented in Table 9. Weed control treatments was found to be significant on plant height in all the experimental years and combined. All the treated plots were at par and recorded the tallest plant throughout the experimental years and combined, while the weedy check plots produced the shortest plants throughout the experimental years and combined. Sowing date significantly affected the plant height of finger millet at 9 WAS only in which sowing on late June (61.5cm) and early July (59.9) were similar and recorded the taller plants while sowing on late July recorded the least (56.4cm). Sowing method had significant effect on plant height of finger millet at 9 WAS in all the experimental

Table 7: Interaction of Sowing Date and Weed Control Treatment on Plant Height (cm) at 6 WAS of Finger Millet at Bagauda Combined.

	Sowing Date		
	Late June	Early July	Late July
Weed control Treatment			
Two hoe weeding at 3 and 6 WAS	31.3a	29.7bcd	27.9ef
Atrazine at 0.8kg a.i. ha^{-1} PE	29.5bcd	30.2abc	30.5abc
Atrazine at 1.2kg a.i. ha^{-1} PE	29.6bcd	29.7bcd	30.0a-d
2,4-D at 0.5kg a.i. ha^{-1} POE	30.4abc	29.3cde	30.4abc
2,4-D at 0.75kg a.i. ha^{-1} POE	30.7ab	28.7def	29.8bcd
Weedy check	29.6bcd	27.5f	27.6f
SE±		0.502	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 8: Interaction of Sowing Method and Weed Control Treatment on Plant Height (cm) at 6 WAS of Finger Millet at Bagauda Combined.

	Sowing Method		
	Dibbling	Drilling	Broadcasting
Weed control Treatment			
Two hoe weeding at 3 and 6 WAS	28.4def	30.8ab	29.7a-e
Atrazine at 0.8kg a.i. ha^{-1} PE	31.0a	30.9a	28.2ef
Atrazine at 1.2kg a.i. ha^{-1} PE	29.4b-f	30.8ab	29.1c-f
2,4-D at 0.5kg a.i. ha^{-1} POE	30.5abc	31.0a	28.5def
2,4-D at 0.75kg a.i. ha^{-1} POE	29.8a-e	29.8a-d	29.6a-e
Weedy check	28.6def	28.2ef	27.8f
SE±		0.557	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 9: Effects of Weed Control Treatment, Sowing date and Sowing Method on Plant Height (cm) at 9 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	64.4a	58.7a	61.2a	60.8a
Atrazine at 0.8kg a.i. ha^{-1} PE	63.1a	59.4a	61.5a	61.3a
Atrazine at 1.2kg a.i. ha^{-1} PE	62.2a	59.4a	61.0a	60.8a
2,4-D at 0.5kg a.i. ha^{-1} POE	63.1a	59.5a	61.9a	61.5a
2,4-D at 0.75kg a.i. ha^{-1} POE	63.0a	59.3a	61.8a	61.3a
Weedy check	56.8b	53.1b	55.6b	55.2b
Probability level	<.001	<.001	<.001	<.001
SE±	1.26	1.27	1.25	0.73
Sowing Date (D)				
Late June	61.5a	57.8	60.3	59.9
Early July	59.9a	56.6	58.5	58.3
Late July	56.4b	57.7	60.2	59.8
Probability level	0.632	0.747	0.541	0.260
SE±	1.30	1.22	1.23	0.72
Sowing Method (M)				
Dibbling	64.2a	60.2a	62.8a	62.4a
Drilling	61.5a	58.0a	60.3a	59.9b
Broadcasting	57.1b	53.9b	55.9b	55.6c
Probability level	<.001	0.002	<.001	<.001
SE±	0.97	1.00	0.95	0.56
Interaction				
D x M	0.783	0.908	0.841	0.452
D x W	0.565	0.299	0.497	0.002
M x W	0.865	0.786	0.766	0.070
D x M x W	0.179	0.325	0.194	0.061

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

years and combined where dibbling and drilling methods produced the tallest plants in all the seasons. Also, dibbling method produced the tallest plant in the combined, while broadcasting method recorded the shortest plant throughout the seasons and combined. Interaction between sowing date and weed control treatment on plant height at 9 WAS was significant in combined analysis (Table 10).

Table 10 shows the interaction of sowing date and weed control treatment on plant height at 9 WAS in the combined. Sowing on late July combined with application of 2,4-D at 0.75kg a.i. ha^{-1} recorded significantly taller plants which was statistically at par with planting on late June treated with atrazine at the rate of 0.8kg a.i. ha^{-1}, 2,4-D at 0.5kg a.i. ha^{-1} and two hoe weeding, as well as sowing at early June treated with atrazine at 1.2kg a.i. ha^{-1}, and sowing at late July using two hoe weeding and Atrazine at 1.2kg a.i. ha^{-1}. On the other hand, weedy check consistently produced the shortest crops irrespective of the sowing date.

The effect of weed control treatment, sowing date and sowing method on plant height of finger millet at 12 WAS is shown in Table 11. The weed control treatment had significant effect on plant height of finger millet at 12 WAS in all the experimental years and combined. Leaving the plots unweeded had resulted in significantly taller plant in all the experimental years and combined while all the weed control treatments recorded significantly shorter plants. On the other hand, sowing date and sowing method had no significant effect on plant height of finger millet in all the seasons and combined. Significant interactions on plant height were observed in the combined between sowing date and weed control treatment (Table 12) and between sowing date, sowing method and weed control treatment (Table 13). The interaction of sowing date and weed control treatment on plant height at 12 WAS in the combined is presented in Table 12. Weedy check consistently produced the tallest

Table 10: Interaction of Sowing Date and Weed Control Treatment on Plant Height (cm) at 9 WAS of Finger Millet at Bagauda Combined.

	Sowing Date		
	Late June	Early July	Late July
Weed control Treatment			
Two hoe weeding at 3 and 6 WAS	61.2a-d	59.5cde	61.6a-d
Atrazine at 0.8kg a.i. ha^{-1} PE	64.1ab	59.1de	60.8bcd
Atrazine at 1.2kg a.i. ha^{-1} PE	58.26	62.7abc	61.5a-d
2,4-D at 0.5kg a.i. ha^{-1} POE	64.0ab	59.6cde	60.8bcd
2,4-D at 0.75kg a.i. ha^{-1} POE	59.9cde	59.6cde	64.5a
Weedy check	56.9ef	54.3f	54.3f
SE±		2.38	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 11: Effects of Weed Control Treatment, Sowing date and Sowing Method on Plant Height (cm) at 12 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	85.5b	82.7b	84.9b	84.3b
Atrazine at 0.8kg a.i. ha^{-1} PE	86.1b	83.3b	85.1b	84.8b
Atrazine at 1.2kg a.i. ha^{-1} PE	85.1b	83.2b	84.7b	84.4b
2,4-D at 0.5kg a.i. ha^{-1} POE	86.6b	83.8b	86.0b	85.5b
2,4-D at 0.75kg a.i. ha^{-1} POE	86.0b	83.2b	85.4b	84.9b
Weedy check	95.0a	92.2a	94.4a	93.9a
Probability level	<.001	<.001	<.001	<.001
SE±	1.30	1.29	1.28	1.30
Sowing Date (D)				
Late June	88.0	85.1	87.4	86.9
Early July	86.5	84.0	85.7	85.4
Late July	87.7	85.0	87.1	86.6
Probability level	0.741	0.797	0.662	0.394
SE±	1.41	1.27	1.35	1.30
Sowing Method (M)				
Dibbling	88.1	85.0	87.3	86.8
Drilling	88.0	85.3	87.4	86.9
Broadcasting	86.1	83.9	85.6	85.2
Probability level	0.333	0.628	0.361	0.086
SE±	0.97	1.05	0.96	0.10
Interaction				
D x M	0.831	0.930	0.875	0.562
D x W	0.572	0.372	0.491	0.002
M x W	0.909	0.821	0.828	0.116
D x M x W	0.233	0.413	0.255	<.001

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application,WAS= weeks after sowing.

Table 12: Interaction of Sowing Date and Weed Control Treatment on Plant Height (cm) at 12 WAS of Finger Millet at Bagauda Combined.

	Sowing Date		
	Late June	Early July	Late July
Weed control Treatment			
Two hoe weeding at 3 and 6 WAS	84.8b-e	83.1de	85.1b-e
Atrazine at 0.8kg a.i. ha^{-1} PE	87.7bc	82.4e	84.3cde
Atrazine at 1.2kg a.i. ha^{-1} PE	81.8e	86.4bcd	85.0b-e
2,4-D at 0.5kg a.i. ha^{-1} POE	87.5bc	84.5b-e	84.4cde
2,4-D at 0.75kg a.i. ha^{-1} POE	83.4de	83.2de	88.0b
Weedy check	96.0a	92.8a	92.8a
SE±		1.42	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 13: Interaction of Sowing Date, Sowing Method and Weed Control Treatment on Plant Height at 12 WAS (cm) of Finger Millet at Bagauda Combined.

Treatment		Weed control treatment					
	Sowing Method	Two hoe weeding at 3 and 6 WAS	Atrazine at 0.8kg a.i. ha^{-1}	Atrazine at 1.2kg a.i. ha^{-1} PE	2,4-D at 0.5kg a.i. ha^{-1} POE	2,4-D at 0.75kg a.i. ha^{-1} POE	Weedy check
Sowing Date							
Late June	Dibbling	85.5e-r	82.9k-s	82.8l-s	90.7b-g	80.0n-s	105.0a
	Drilling	82.3l-s	90.9b-f	84.4g-s	86.5c-m	86.2d-q	90.6b-h
	Broadcasting	86.5c-o	89.2b-k	78.2s	85.4f-r	84.1i-s	92.5bcd
Early July	Dibbling	84.0i-s	82.6l-s	89.7b-i	88.1b-l	79.9qrs	94.1b
	Drilling	82.4l-s	85.2f-r	87.2c-m	82.2l-s	84.1h-s	92.9bc
	Broadcasting	83.0k-s	79.4rs	82.2l-s	83.1j-s	85.5e-r	91.5b-f
Late July	Dibbling	82.8k-s	83.1k-s	81.8l-s	83.0k-s	94.0b	92.0b-e
	Drilling	91.1b-f	86.4c-p	83.8i-s	86.5c-n	87.4c-m	93.8b
	Broadcasting	81.6m-s	83.5i-s	89.6b-j	83.6i-s	82.6l-s	92.7bc
SE±				2.34			

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

plant in sowing at the late June (96.0cm), early July (92.8cm) and late July (92.8cm) while sowing on early July using atrazine 1.2kg a.i. ha^{-1} (81.8cm) and late July using atrazine 0.8kg a.i. ha^{-1} (82.4cm) recorded the shortest plant. In Table 13, sowing on late June using dibbling method and weedy check resulted in significantly taller plant (105.0cm) while sowing on late June using broadcasting method and application of atrazine at 1.2kg a.i. ha^{-1} recorded the shortest (78.22cm).

4.1.5 Leaf Area

The effect of weed control treatment, sowing date and sowing method on leaf area of finger millet at 3 WAS is presented on Table 14. Weed control treatment significantly affected the leaf area of finger millet at 3 WAS in all the experimental years and combined. Application of 2,4-D at 0.75kg a.i ha^{-1} produced significantly larger leaves in all the seasons and the combined which were statistically comparable to two hoe weeding at 3 and 6 WAS in all the seasons with the exception of the combined while the others recorded the least. Sowing date did not significantly affect the leaf area of finger millet at 3 WAS in 2016, 2017 and 2018. On the other hand, sowing date had significantly affected the leaf area at 3 WAS in combined analysis where sowing on late June (7.09cm^2) and early July (7.08cm^2) produced significantly larger leaves than sowing on late July which recorded significantly smallest (6.24cm^2) leaves. Sowing method had significant effect on leaf area of finger millet at 3 WAS in 2017 and combined. In 2017, dibbling method recorded significantly larger leaf area (7.07cm^2) which was at par with drilling method of sowing, whereas the broadcasting method recorded the least (6.72cm^2). Similar trend was observed in the combined analysis. The interaction between sowing date and sowing method was significant in 2016, 2018 and combined (Table 15). In 2016, the sowing on late June using dibbling method recorded significantly larger leaves (7.58cm^2) which was statistically at par

Table 14: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Leaf Area (cm^2) $Plant^{-1}$ at 3 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	6.84ab	7.07ab	7.02ab	6.99b
Atrazine at 0.8kg a.i. ha^{-1} PE	6.45b	6.71b	6.67b	6.62c
Atrazine at 1.2kg a.i. ha^{-1} PE	6.48b	6.80b	6.73b	6.67c
2,4-D at 0.5kg a.i. ha^{-1} POE	6.49b	6.71b	6.66b	6.62c
2,4-D at 0.75kg a.i. ha^{-1} POE	7.11a	7.34a	7.30a	7.25a
Weedy check	6.59b	6.82b	6.78b	6.73c
Probability level	0.006	0.016	0.011	<.001
SE±	0.139	0.145	0.140	0.082
Sowing Date (D)				
Late June	6.95	7.18	7.14	7.09a
Early July	6.93	7.21	7.15	7.08a
Late July	6.12	6.34	6.29	6.24b
Probability level	0.251	0.319	0.259	0.021
SE±	0.340	0.398	0.353	0.211
Sowing Method (M)				
Dibbling	6.76	7.07a	6.99	6.94a
Drilling	6.69	6.94ab	6.87	6.83a
Broadcasting	6.54	6.72b	6.72	6.66b
Probability level	0.295	0.044	0.213	0.004
SE±	0.099	0.086	0.099	0.055
Interaction				
D x M	0.005	0.104	0.008	<.001
D x W	0.162	0.235	0.196	0.056
M x W	0.619	0.823	0.642	0.103
D x M x W	0.620	0.930	0.794	1.000

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

with sowing on early July using drilling and broadcasting method. While the other produced smallest leaves (Table 15). In 2018, sowing on late June using dibbling method recorded significantly larger leaf area (7.77cm^2) which was at par with sowing on early July using dibbling (6.92cm^2), drilling (7.38cm^2) and broadcasting (7.15cm^2) method, whereas the other recorded the least (Table 15). In combined, sowing on late June using dibbling method recorded significantly larger leaf area (7.72cm^2) which was statistically at par with sowing on early July using dibbling (7.35cm^2) and broadcasting (7.06cm^2) method. Sowing on late July using drilling method recorded the least (6.19cm^2) leaf area (Table 15).

Table 16 shows the effect of weed control treatment, sowing date and sowing method on leaf area at 6 WAS of finger millet at Bagauda. Weed control treatment significantly affected the leaf area of finger millet at 6 WAS in all the experimental years and combined. In 2016, weeding twice at 3 and 6 WAS produced significantly larger leaf area (12.70cm^2) which was statistically the same with application of atrazine at 0.8 kg a.i ha^{-1}(12.33cm^2), atrazine at 1.2 kg a.i ha^{-1} (13.41cm^2) and weedy check (13.73cm^2), while application of 2,4-D at 0.75 kg a.i ha^{-1} (11.48cm^2) was at par with 2,4-D at 0.5 kg a.i ha^{-1} (11.12cm^2) and recorded the least. In 2017, application of 2,4-D at 0.75kg a.i ha^{-1} produced significantly larger leaf area in 2017 (9.22cm^2) produced the largest leaves which was statistically similar with two hoe weeding at 3 and 6 WAS (8.95cm^2) while the others recorded the least. In 2018, weeding twice at 3 and 6 WAS produced significantly larger leaf area (9.97cm^2) which was statistically the same with application of atrazine at 0.8 kg a.i ha^{-1}(9.41cm^2), atrazine at 1.2 kg a.i ha^{-1} (10.19cm^2), 2,4-D at 0.75 kg a.i ha^{-1} (9.80cm^2) and weedy check (9.68cm^2), while application of 2,4-D at the rate of 0.5 kg a.i ha^{-1} (9.39cm^2) recorded the least leaf area. In combined analysis, application of atrazine at 1.2kg a.i ha^{-1} recorded significantly

Table 15: Interaction of Sowing Date and Sowing Method on Leaf Area (cm^2) Plant^{-1} at 3 WAS of Finger Millet at Bagauda in 2016, 2018 and Combined.

	Sowing method		
	Dibbling	Drilling	Broadcasting
Sowing date			
	2016 rainy season		
Late June	7.58a	6.81bc	6.46bc
Early July	6.63bc	7.20ab	6.96abc
Late July	6.08bc	6.06bc	6.19bc
SE±		0.368	
	2018 rainy season		
Late June	7.77a	6.99b	6.65b
Early July	6.92ab	7.38ab	7.15ab
Late July	6.26b	6.25b	6.37b
SE±		0.380	
	Combined		
Late June	7.72a	6.95bcd	6.60cef
Early July	6.88cde	7.35ab	7.06ab
Late July	6.22ef	6.19f	6.33def
SE±		0.224	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 16: Effects of Weed Control Treatment, Sowing date and Sowing Method on Leaf Area (cm^2) Plant^{-1} at 6 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	12.70	8.95ab	9.97	10.51ab
Atrazine at 0.8kg a.i. ha^{-1} PE	12.33	8.59b	9.41	10.03b
Atrazine at 1.2kg a.i. ha^{-1} PE	13.41	8.69b	10.19	10.83a
2,4-D at 0.5kg a.i. ha^{-1} POE	11.12	8.59b	9.39	10.03b
2,4-D at 0.75kg a.i. ha^{-1} POE	11.48	9.22a	9.80	10.44ab
Weedy check	13.73	8.70b	9.68	10.32ab
Probability level	0.323	0.016	0.282	0.042
SE±	0.531	0.145	0.166	0.201
Sowing Date (D)				
Late June	12.24	9.06	9.70	10.33
Early July	12.35	9.09	9.77	10.40
Late July	13.10	8.22	9.71	10.34
Probability level	0.648	0.319	0.989	0.984
SE±	0.673	0.398	0.379	0.289
Sowing Method (M)				
Dibbling	12.60	8.95a	9.82	10.45
Drilling	12.72	8.82ab	9.81	10.43
Broadcasting	12.37	8.60b	9.56	10.18
Probability level	0.890	0.044	0.682	0.509
SE±	0.514	0.085	0.232	0.190
Interaction				
D x M	0.880	0.004	0.483	0.272
D x W	0.497	0.234	0.474	0.078
M x W	0.334	0.825	0.270	0.018
D x M x W	0.197	0.931	0.232	0.056

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

larger leaf size (10.83cm^2) which was at par with two hoe weeding at 3 and 6 WAS (10.51cm^2), 2,4-D at 0.75kg a.i ha^{-1} (10.44cm^2) and weedy check (10.32cm^2). The application of 2,4-D at 0.5kg a.i ha^{-1} recorded the least (10.03cm^2). Sowing date did not significantly affect the leaf area of finger millet in all the experimental years and combined. On the other hand, sowing method had significantly affected the leaf area at 6 WAS in 2017 rainy season. Dibbling (8.95cm^2) method produced larger leaf which was at par with drilling (8.82cm^2) method while broadcasting method recorded the least (8.6cm^2). The interaction between sowing date and sowing method in 2017, as well as between sowing method and weed control treatment in combined were significant (Tables 17 and 18). Table 17 shows that, in 2017, sowing on late June using dibbling method recorded significantly larger leaf area (9.69cm^2) which was statistically at par with others except sowing on late July using broadcasting method which recorded the least (8.19cm^2).

Table 18 shows that, dibbling method in combination with application of atrazine at 1.2kg a.i. ha^{-1} recorded significantly larger leaf area (11.37cm^2) which was at par with weeding twice in combination with dibbling (10.71cm^2) and broadcasting (10.56cm^2), application of atrazine at 0.8kg a.i. ha^{-1} in combination with drilling (10.72cm^2) and weedy check in combination with drilling (10.95cm^2), while sowing using dibbling method in combination with application of atrazine at 0.8kg a.i. ha^{-1} recorded the least (9.48cm^2) leaf area.

Table 19 shows the effect of weed control treatment, sowing date and sowing method on leaf area at 9 WAS of finger millet at Bagauda. Weed control treatment had significant effect on leaf area of finger millet at 9 WAS in all the years and combined. Two hoe weeding at 3 and 6 WAS significantly produced larger leaves in 2016 (23.47cm^2), 2017 (23.90cm^2), 2018 (23.72cm^2) and combined (23.69cm^2).

Table 17: Interaction of Sowing Date and Weed Control Treatment on Leaf Area (cm^2) Plant^{-1} at 6 WAS of Finger Millet at Bagauda 2017.

	Sowing Date		
	Late June	Early July	Late July
Sowing method			
Dibbling	9.69a	8.96ab	8.30ab
Drilling	8.92ab	9.36ab	8.71ab
Broadcasting	8.57ab	8.94ab	8.19b
SE±		0.416	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 18: Interaction of Sowing Method and Weed Control Treatment on Leaf Area (cm^2) Plant^{-1} at 6 WAS of Finger Millet at Bagauda Combined.

	Sowing Method		
	Dibbling	Drilling	Broadcasting
Weed control Treatment			
Two hoe weeding at 3 and 6 WAS	10.71abc	10.25b-e	10.56a-d
Atrazine at 0.8kg a.i. ha^{-1} PE	9.48f	10.72abc	9.89cde
Atrazine at 1.2kg a.i. ha^{-1} PE	11.37a	10.80abc	10.33b-e
2,4-D at 0.5kg a.i. ha^{-1} POE	10.72abc	9.56e	9.80cde
2,4-D at 0.75kg a.i. ha^{-1} POE	10.26b-e	10.39a-e	10.66abc
Weedy check	10.18b-e	10.95ab	9.81cde
SE±		0.371	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 19: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Leaf Area (cm^2) $Plant^{-1}$ at 9 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	23.47a	23.90a	23.72a	23.69a
Atrazine at 0.8kg a.i. ha^{-1} PE	17.45c	18.28b	17.71b	17.89c
Atrazine at 1.2kg a.i. ha^{-1} PE	20.13b	20.87b	20.19b	20.40b
2,4-D at 0.5kg a.i. ha^{-1} POE	17.41bd	17.84b	17.66b	17.63c
2,4-D at 0.75kg a.i. ha^{-1} POE	17.15bd	17.58b	17.41b	17.38c
Weedy check	13.94e	14.37c	14.19c	14.16d
Probability level	<.001	<.001	<.001	<.001
SE±	0.904	0.963	0.897	0.532
Sowing Date (D)				
Late June	17.72	18.15	17.98	17.95
Early July	17.46	18.24	17.62	17.77
Late July	19.59	20.02	19.84	19.82
Probability level	0.488	0.497	0.477	0.117
SE±	1.250	1.149	1.261	0.705
Sowing Method (M)				
Dibbling	19.27	19.81	19.43	19.50a
Drilling	18.40	18.64	18.66	18.57ab
Broadcasting	17.10	17.96	17.36	17.47b
Probability level	0.322	0.397	0.358	0.048
SE±	0.976	0.940	0.990	0.559
Interaction				
D x M	1.000	0.969	0.909	0.992
D x W	0.305	0.359	0.298	<.001
M x W	0.110	0.474	0.126	<.001
D x M x W	0.086	0.379	0.085	0.057

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Whereas, weedy check consistently recorded the smallest leaf area (13.94, 14.37, 14.19 and 14.16cm^2) in the respective years and combined. Sowing date did not significantly affect the leaf area of finger millet in all the years and combined. There were no significant differences between the various sowing method in all the seasons. On the other hand, sowing method had significantly affected the leaf area at 9 WAS in combined where dibbling method recorded significantly larger leaf area (19.50cm^2) which was statistically similar with drilling method (18.57cm^2), while the broadcasting method recorded the smallest leaf area (8.6 cm^2). The interaction between sowing date and weed control treatment, as well as between sowing method and weed control treatment in combined were significant (Tables 20 and 21).

Table 20 shows the interaction of sowing date and weed control treatment on leaf area of finger millet in combined. Sowing on late July using two hoe weeding at 3 and 6 WAS recorded significantly the largest leaf area (24.81cm^2) which was at par with sowing on late June (24.09cm^2) and early July (22.19cm^2) using two hoe weeding at 3 and 6 WAS. Sowing on late July on a weedy check recorded the smallest leaf area (12.9cm^2) which was statistically at par with sowing on early July in a weedy check. Table 21 presents the interaction of sowing method and weed control treatment on leaf area of finger millet at 9 WAS in combined. The result indicated that, dibbling method in combination with weeding twice at 3 and 6 WAS recorded significantly larger leaf area (26.62cm^2) while sowing using broadcasting method in a weedy check recorded the smallest (12.81cm^2).

Table 22 shows the effect of weed control treatment, sowing date and sowing method on leaf area at 12 WAS of finger millet at Bagauda. Weed control treatment had significant effect on leaf area of finger millet at 12 WAS in all the experimental years and combined. Weeding twice at 3 and 6 WAS significantly produced larger

Table 20: Interaction of Sowing Date and Weed Control Treatment on Leaf Area (cm^2) $Plant^{-1}$ at 9 WAS of Finger Millet at Bagauda Combined.

	Sowing Date		
	Late June	Early July	Late July
Weed control Treatment			
Two hoe weeding at 3 and 6 WAS	24.09ab	22.19abc	24.81a
Atrazine at 0.8kg a.i. ha^{-1} PE	17.55f-j	17.28g-j	18.60fgn
Atrazine at 1.2kg a.i. ha^{-1} PE	19.09c-g	20.03c-f	22.07bcd
2,4-D at 0.5kg a.i. ha^{-1} POE	15.38ij	18.31e-i	19.21c-f
2,4-D at 0.75kg a.i. ha^{-1} POE	15.59h-i	15.31j	21.23b-e
Weedy check	16.01h-i	13.51k	12.97k
SE±		1.098	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 21: Interaction of Sowing Method and Weed Control Treatment on Leaf Area (cm^2) $Plant^{-1}$ at 9 WAS of Finger Millet at Bagauda Combined.

	Sowing Method		
	Dibbling	Drilling	Broadcasting
Weed control Treatment			
Two hoe weeding at 3 and 6 WAS	26.62a	21.92b	22.54b
Atrazine at 0.8kg a.i. ha^{-1} PE	16.11def	20.14bc	17.19de
Atrazine at 1.2kg a.i. ha^{-1} PE	22.77b	20.02bc	18.40cd
2,4-D at 0.5kg a.i. ha^{-1} POE	21.92bc	16.24def	16.33def
2,4-D at 0.75kg a.i. ha^{-1} POE	16.90de	17.69cde	17.56cde
Weedy check	14.29f	15.40ef	12.81g
SE±		1.011	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 22: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Leaf Area (cm^2) $Plant^{-1}$ at 12 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	24.55a	25.79a	25.23a	25.19a
Atrazine at 0.8kg a.i. ha^{-1} PE	18.68b	20.25b	19.34b	19.42c
Atrazine at 1.2kg a.i. ha^{-1} PE	21.05b	22.35b	21.46b	21.62b
2,4-D at 0.5kg a.i. ha^{-1} POE	18.48b	19.57b	19.15b	19.10c
2,4-D at 0.75kg a.i. ha^{-1} POE	18.37b	19.68b	19.03b	18.99c
Weedy check	15.20c	16.42c	15.88c	15.83d
Probability level	<.001	<.001	<.001	<.001
SE±	0.905	0.958	0.898	0.532
Sowing Date (D)				
Late June	19.62	20.16	19.96	19.91
Early July	19.24	20.11	19.49	19.62
Late July	19.30	21.75	20.59	20.55
Probability level	0.991	0.576	0.898	0.793
SE±	2.125	1.173	1.660	0.980
Sowing Method (M)				
Dibbling	21.05	21.71	21.30	21.35a
Drilling	20.19	20.54	20.53	20.42a
Broadcasting	16.92	19.77	18.21	18.30b
Probability level	0.125	0.369	0.148	0.008
SE±	1.381	0.937	1.071	0.661
Interaction				
D x M	0.600	0.969	0.842	0.410
D x W	0.334	0.377	0.337	<.001
M x W	0.080	0.436	0.085	<.001
D x M x W	0.099	0.328	0.097	0.100

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

leaf area in 2016 (24.55cm^2), 2017 (25.79cm^2), 2018 (25.23cm^2) and combined (25.19cm^2) followed by other weed control treatments. Whereas, weedy check consistently recorded the smallest leaf area (15.20, 16.42, 15.88 and 15.83cm^2) in the respective years and combined. However, sowing date did not significantly affect the leaf area of finger millet in all the years and combined. There were also no significant differences between the various sowing methods in all the season. However, sowing method significantly affected the leaf area at 12 WAS in combined where dibbling (21.35cm^2) and drilling (20.42cm^2) methods produced larger leaves than broadcasting method which recorded the smallest leaves (18.30cm^2). The interaction between sowing date and weed control treatment, as well as between sowing method and weed control treatment in combined analysis were significant (Tables 23 and 24).

The interaction of sowing date and weed control treatment on leaf area of finger millet in combined is shown in Table 23. Sowing on late July using two hoe weeding at 3 and 6 WAS recorded significantly larger leaf area (26.05cm^2) which was statistically at par with sowing on late June (25.48cm^2) and early July (24.04cm^2) using two hoe weeding at 3 and 6 WAS. Sowing on late July on a weedy check recorded the smallest leaf area (14.16cm^2). Table 24 shows the interaction of sowing method and weed control treatment on leaf area of finger millet at 12 WAS in combined. Dibbling method combined with two hoe weeding at 3 and 6 WAS recorded significantly larger leaf area (28.47cm^2) whereas broadcasting method in a weedy check recorded the smallest (14.11cm^2).

4.1.6 Leaf Area Index (LAI)

The effect of weed control treatment, sowing date and sowing method on LAI at 3 WAS of finger millet at Bagauda is presented in Table 25. Weed control treatment significantly affected the LAI of finger millet at 3 WAS in all the seasons

Table 23: Interaction of Sowing Date and Weed Control Treatment on Leaf Area (cm^2) $Plant^{-1}$ at 12 WAS of Finger Millet at Bagauda Combined.

	Sowing Date		
	Late June	Early July	Late July
<u>Weed control Treatment</u>			
Two hoe weeding at 3 and 6 WAS	26.05a	24.04abc	25.48ab
Atrazine at 0.8kg a.i. ha^{-1} PE	19.52d-i	19.13d-i	19.62e-i
Atrazine at 1.2kg a.i. ha^{-1} PE	21.05c-g	21.84b-f	21.97cde
2,4-D at 0.5kg a.i. ha^{-1} POE	17.32h-k	20.15d-h	19.83d-i
2,4-D at 0.75kg a.i. ha^{-1} POE	17.56h-k	17.17ijk	22.24cd
Weedy check	17.97hij	15.37jk	14.16k
SE±		1.292	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 24: Interaction of Sowing Method and Weed Control Treatment on Leaf Area (cm^2) $Plant^{-1}$ at 12 WAS of Finger Millet at Bagauda Combined.

	Sowing Method		
	Dibbling	Drilling	Broadcasting
<u>Weed control Treatment</u>			
Two hoe weeding at 3 and 6 WAS	28.47a	23.78b	23.32b
Atrazine at 0.8kg a.i. ha^{-1} PE	17.97de	21.99bc	18.32de
Atrazine at 1.2kg a.i. ha^{-1} PE	24.63b	21.87bc	18.35de
2,4-D at 0.5kg a.i. ha^{-1} POE	22.16bc	18.09de	17.05de
2,4-D at 0.75kg a.i. ha^{-1} POE	18.75d	19.54cd	18.67de
Weedy check	16.14ef	17.25de	14.11f
SE±		1.070	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 25: Effects of Weed Control Treatment Sowing Date and Sowing Method on Leaf Area Index (LAI) Plant^{-1} At 3 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	0.68ab	0.71ab	0.70ab	0.70b
Atrazine at 0.8kg a.i. ha^{-1} PE	0.65b	0.67b	0.67b	0.66c
Atrazine at 1.2kg a.i. ha^{-1} PE	0.64b	0.68b	0.67b	0.67c
2,4-D at 0.5kg a.i. ha^{-1} POE	0.65b	0.67b	0.68b	0.66c
2,4-D at 0.75kg a.i. ha^{-1} POE	0.71a	0.73a	0.74a	0.73a
Weedy check	0.66b	0.68b	0.67b	0.67c
Probability level	0.006	0.016	0.011	<.001
SE±	0.014	0.015	0.014	0.008
Sowing Date (D)				
Late June	0.71	0.72	0.71	0.71a
Early July	0.69	0.73	0.72	0.70a
Late July	0.61	0.63	0.64	0.63b
Probability level	0.251	0.319	0.259	0.012
SE±	0.034	0.040	0.035	0.021
Sowing Method (M)				
Dibbling	0.68	0.71a	0.69b	0.69a
Drilling	0.67	0.69ab	0.72a	0.68a
Broadcasting	0.65	0.67b	0.67b	0.66b
Probability level	0.295	0.044	0.213	0.004
SE±	0.001	0.009	0.010	0.006
Interaction				
D x M	0.058	0.004	0.008	<.001
D x W	0.168	0.235	0.196	0.102
M x W	0.619	0.823	0.642	0.300
D x M x W	0.620	0.930	0.794	0.141

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

and combined. Application of 2,4-D at the rate of 0.75kg a.i ha^{-1} consistently produced significantly higher LAI in all the seasons (0.71, 0.73, 0.74) and the combined (0.73) which were statistically similar to weeding twice at 3 and 6 WAS in all the seasons. Sowing date significantly affected the LAI in combined analysis only, where sowing on late June (0.71) and early July (0.70) had higher LAI than sowing on late July which recorded the least (0.63). Also, sowing method had significant effect on LAI of finger millet at 3 WAS in 2017, 2018 and combined. In 2017, dibbling method recorded significantly LAI (0.71) which was at par with drilling method of sowing (0.69), whereas the broadcasting method recorded the least (0.67). In 2018, drilling method recorded significantly higher LAI (0.72) while dibbling (0.69) and broadcasting (0.67) were at par and recorded the least. In combined, dibbling (0.69) and drilling (0.68) methods were statistically the same and produced significantly higher LAI while broadcasting method (0.66) recorded the least. The interaction between sowing date and sowing method was significant in 2016, 2018 and combined. Table 26 presents the interactions of sowing date and sowing method on LAI at 3 WAS in 2016, 2018 and combined at Bagauda. In 2017, sowing on late June using dibbling method recorded significantly larger LAI (0.78) which was statistically at par with sowing on early July using dibbling (0.75), drilling (0.71) and broadcasting (0.71) method, whereas the remaining were at par and recorded the least. In 2018, sowing on late June using dibbling method recorded significantly larger LAI (0.78) which was at par with sowing on early July using drilling (0.74) and broadcasting (0.72) method, whereas the remaining were at par and recorded the least. Also, in combined analysis, sowing on late June using dibbling method recorded significantly larger LAI (0.77), while sowing on late July using drilling method recorded the smallest.

Table 26: Interaction of Sowing Date and Sowing Method on Leaf Area Index (LAI) Plant^{-1} at 3 WAS of Finger Millet at Bagauda in 2017, 2018 and Combined

	Sowing method		
	Dibbling	Drilling	Broadcasting
Sowing date			
		2017 rainy season	
Late June	0.78a	0.70b	0.67b
Early July	0.75ab	0.71ab	0.71ab
Late July	0.63b	0.63b	0.64b
SE±		0.042	
		2018 rainy season	
Late June	0.78a	0.69b	0.67b
Early July	0.69b	0.74ab	0.72ab
Late July	0.63b	0.63b	0.64b
SE±		0.038	
		Combined	
Late June	0.77a	0.69bcd	0.66cef
Early July	0.69bcd	0.74ab	0.71ac
Late July	0.62ef	0.61f	0.63def
SE±		0.022	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 27 shows the effect of weed control treatment, sowing date and sowing method on LAI at 6 WAS of finger millet at Bagauda. Weed control treatment significantly affected the leaf area index of finger millet at 6 WAS in 2017 and in the combined. Application of 2,4-D at 0.75kg a.i ha^{-1} produced significantly larger leaf area index in 2017 (0.92) which was at par with two hoe weeding at 3 and 6 WAS (0.90) and atrazine at 1.2kg a.i ha^{-1} (0.87). The applications of other weed control treatments recorded lower LAI. However, in combined analysis, application of atrazine at 1.2kg a.i ha^{-1} recorded significantly larger LAI (1.08) which was statistically to all other weed control treatments with the exception of lower dose of atrazine at 0.8kg a.i ha^{-1} which produced the lower LAI (1.00). However, sowing date did not significantly affect LAI of finger millet in all the years and combined. On the other hand, sowing method had significant effect on LAI at 6 WAS in 2017 rainy season where dibbling method significantly produced the larger leaf area index (0.90) which was at par with drilling method(0.89) while broadcasting method recorded the least (0.86). The interaction between sowing date and sowing method in 2017, as well as between sowing method and weed control treatment in combined were significant (Tables 28 and 29).

Table 28 shows that, in 2017, sowing on late June using dibbling method recorded significantly larger leaf area index (0.97) which was statistically similar with sowing on late June using drilling (0.89) and early July using dibbling (0.90), drilling (0.94) and broadcasting (0.89) method, while the remaining were at par and recorded the smallest LAI. In combined analysis (Table 29), dibbling method combined with application of atrazine at 1.2kg a.i. ha^{-1} recorded significantly the larger leaf area index (1.14) which was at par with weeding twice and application of 2,4-D at 0.5 kg a.i. ha^{-1} in dibbled plots, application of atrazine at 0.8, 1.2 kg a.i. ha^{-1} and weedy

Table 27: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Leaf Area Index (LAI) Plant^{-1} at 6 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	1.27	0.90ab	0.99	1.05ab
Atrazine at 0.8kg a.i. ha^{-1} PE	1.21	0.86b	0.94	1.00b
Atrazine at 1.2kg a.i. ha^{-1} PE	1.36	0.87ab	1.02	1.08a
2,4-D at 0.5kg a.i. ha^{-1} POE	1.21	0.86b	0.94	1.00ab
2,4-D at 0.75kg a.i. ha^{-1} POE	1.23	0.92a	0.98	1.04ab
Weedy check	1.26	0.87b	0.97	1.03ab
Probability level	0.323	0.020	0.228	0.042
SE±	0.053	0.015	0.027	0.020
Sowing Date (D)				
Late June	1.22	0.92	0.97	1.03
Early July	1.24	0.91	0.98	1.04
Late July	1.31	0.82	0.97	1.03
Probability level	0.648	0.319	0.899	0.984
SE±	0.067	0.039	0.038	0.029
Sowing Method (M)				
Dibbling	1.26	0.90a	0.98	1.05
Drilling	1.27	0.89ab	0.98	1.05
Broadcasting	1.24	0.86b	0.96	1.02
Probability level	0.890	0.044	0.682	0.509
SE±	0.051	0.009	0.023	0.019
Interaction				
D x M	0.809	0.003	0.438	0.272
D x W	0.497	0.324	0.282	0.078
M x W	0.334	0.825	0.474	0.018
D x M x W	0.197	0.391	0.232	0.170

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 28: Interaction of Sowing Date and Weed Control Treatment on Leaf Area Index (LAI) Plant^{-1} at 6 WAS of Finger Millet at Bagauda 2017 Rainy Season.

	Sowing Date		
	Late June	Early July	Late July
Sowing Method			
Dibbling	0.97a	0.90ab	0.82b
Drilling	0.89ab	0.94ab	0.82b
Broadcasting	0.86b	0.89ab	0.83b
SE±		0.0416	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 29: Interaction of Sowing Method and Weed Control Treatment on Leaf Area Index (LAI) Plant^{-1} at 6 WAS of Finger Millet at Bagauda Combined.

	Sowing Method		
	Dibbling	Drilling	Broadcasting
Weed Control Treatment			
Two hoe weeding at 3 and 6 WAS	1.07abc	1.03b-e	1.06a-d
Atrazine at 0.8kg a.i. ha^{-1} PE	0.91f	1.07abc	0.989cde
Atrazine at 1.2kg a.i. ha^{-1} PE	1.14a	1.08abc	1.03b-e
2,4-D at 0.5kg a.i. ha^{-1} POE	1.07abc	0.96de	0.98cde
2,4-D at 0.75kg a.i. ha^{-1} POE	1.03b-e	1.04a-e	1.07abc
Weedy check	1.02b-e	1.10ab	0.98cde
SE±		0.037	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

check in drilled plots, and application of 2,4-D at 0.75 kg a.i. ha^{-1} and two hoe weeding in broadcasted plots. Whereas, the dibbling method applied with atrazine at 0.8kg a.i. ha^{-1} (0.91) recorded the least LAI.

Table 30 shows the effect of weed control treatment, sowing date and sowing method on LAI at 9 WAS of finger millet at Bagauda. Weed control treatment had significant effect on leaf area index at 9 WAS in all the experimental years and combined. Weeding twice at 3 and 6 WAS significantly and consistently produced larger leaf area index in 2016 (2.35), 2017 (2.39), 2018 (2.37) and combined (2.37). Whereas, weedy check consistently recorded the least values for LAI (1.39, 1.44, 1.42 and 1.42) in the respective years and combined. However, sowing date did not significantly affect the LAI of finger millet in all the years and combined. Sowing method had significantly affected the LAI at 9 WAS in the combined where dibbling method recorded significantly larger leaf area index (1.95) which was at par with drilling method (1.86), while the broadcasting method recorded the smallest LAI (1.75). The interaction between sowing date and weed control treatment, as well as between sowing method and weed control treatment in combined were significant (Tables 31 and 32).

Table 31 shows the interaction of sowing date and weed control treatment on LAI of finger millet at 9 WAS in combined. Sowing on late July using two hoe weeding at 3 and 6 WAS recorded significantly larger LAI (2.48) which was statistically similar with sowing on late June (2.41) and early July (2.22) using two hoe weeding at 3 and 6 WAS. On the other hand, sowing on late July (1.29) and early July (1.35) in a weedy check were at par and recorded the lowest LAI. Table 32 presents the interaction of sowing method and weed control treatment on LAI of finger millet at 9 WAS in combined.

Table 30: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Leaf Area Index (LAI) Plant^{-1} at 9 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	2.35a	2.39a	2.37a	2.37a
Atrazine at 0.8kg a.i. ha^{-1} PE	1.75c	1.83b	1.77b	1.78c
Atrazine at 1.2kg a.i. ha^{-1} PE	2.01b	2.09b	2.02b	2.04b
2,4-D at 0.5kg a.i. ha^{-1} POE	1.74bd	1.78b	1.77b	1.76c
2,4-D at 0.75kg a.i. ha^{-1} POE	1.72bd	1,76b	1.74b	1.74c
Weedy check	1.39e	1.44c	1.42c	1.42d
Probability level	<.001	<.001	<.001	<.001
SE±	0.090	0.096	0.089	0.053
Sowing Date (D)				
Late June	1.77	1.82	1.80	1.80
Early July	1.75	1.82	1.76	1.78
Late July	1.96	2.00	1.98	1.98
Probability level	0.488	0.497	0.747	0.117
SE±	0.125	0.115	0.126	0.071
Sowing Method (M)				
Dibbling	1.93	1.98	1.94	1.95a
Drilling	1.84	1.86	1.97	1.86ab
Broadcasting	1.71	1.80	1.74	1.75b
Probability level	0.322	0.379	0.358	0.048
SE±	0.010	0.094	0.099	0.056
Interaction				
D x M	0.929	0.699	0.990	0.992
D x W	0.305	0.359	0.298	<.001
M x W	0.110	0.474	0.126	<.001
D x M x W	0.086	0.379	0.085	0.056

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 31: Interaction of Sowing Date and Weed Control Treatment on Leaf Area Index (LAI) Plant^{-1} at 9 WAS of Finger Millet at Bagauda Combined.

	Sowing Date		
	Late June	Early July	Late July
Sowing method			
Two hoe weeding at 3 and 6 WAS	2.41ab	2.22abc	2.48a
Atrazine at 0.8kg a.i. ha^{-1} PE	1.76f-j	1.73g-j	1.86fgh
Atrazine at 1.2kg a.i. ha^{-1} PE	1.91c-g	2.00c-f	2.21bcd
2,4-D at 0.5kg a.i. ha^{-1} POE	1.54ij	1.83e-i	1.92c-g
2,4-D at 0.75kg a.i. ha^{-1} POE	1.56hij	1.53j	2.12b-e
Weedy check	1.60hij	1.35k	1.29k
SE±		0.109	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 32: Interaction of Sowing Method and Weed Control Treatment on Leaf Area Index (LAI) Plant^{-1} at 9 WAS of Finger Millet at Bagauda Combined.

	Sowing Method		
	Dibbling	Drilling	Broadcasting
Weed Control Treatment			
Two hoe weeding at 3 and 6 WAS	2.66a	2.19b	2.25b
Atrazine at 0.8kg a.i. ha^{-1} PE	1.61def	2.01bc	1.72de
Atrazine at 1.2kg a.i. ha^{-1} PE	2.28b	2.00bc	1.84cd
2,4-D at 0.5kg a.i. ha^{-1} POE	2.03bc	1.62def	1.63def
2,4-D at 0.75kg a.i. ha^{-1} POE	1.69de	1.77cde	1.76cde
Weedy check	1.43f	1.54ef	1.28g
SE±		0.101	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

The result indicated that, dibbling method combined with two hoe weeding at 3 and 6 WAS recorded significantly larger leaf area index (2.66) while sowing using broadcasting method in a weedy check recorded the smallest (1.28).

Effect of weed control treatment, sowing date and sowing method on LAI at 12 WAS of finger millet at Bagauda is presented in Table 33. Weed control treatment had significantly affected the LAI at 12 WAS in all the years and combined where weeding twice at 3 and 6 WAS significantly and consistently produced larger LAI in 2016 (2.46), 2017 (2.58), 2018 (2.52) and combined (2.52). Whereas, weedy check consistently recorded the smallest leaf area index in the respective years and combined (1.52, 1.64, 1.59 and 1.59). Sowing date did not significantly affect the LAI of finger millet in all the years and combined. Sowing method had significantly affected the LAI at 12 WAS in combined where dibbling (2.14) and drilling (2.04) methods produced significantly wider LAI, whereas broadcasting method recorded the smallest (1.83). The interaction between sowing date and weed control treatment, as well as between sowing method and weed control treatment in combined were significant (Tables 34 and 35).

Table 34 shows the interaction of sowing date and weed control treatment on leaf area index of finger millet at 12 WAS in the combined. Sowing on late June with two hoe weeding at 3 and 6 WAS recorded significantly larger LAI (2.61) which was statistically similar with sowing on early July (2.40) and late July (2.55) using two hoe weeding at 3 and 6 WAS. On the other hand, sowing on late July (1.42) and early July (1.54) in a weedy check were at par and recorded the smallest LAI. The interaction of sowing method and weed control treatment on LAI of finger millet at 12 WAS in combined is shown in Table 35. The result indicated that, dibbling method in combination with two hoe weeding at 3 and 6 WAS recorded significantly larger leaf

Table 33: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Leaf Area Index (LAI) Plant^{-1} at 12 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	2.46a	2.58a	2.52a	2.52a
Atrazine at 0.8kg a.i. ha^{-1} PE	1.87b	2.03b	1.93b	1.94c
Atrazine at 1.2kg a.i. ha^{-1} PE	2.11b	2.24b	2.15b	2.16b
2,4-D at 0.5kg a.i. ha^{-1} POE	1.85b	1.97b	1.92b	1.91c
2,4-D at 0.75kg a.i. ha^{-1} POE	1.84b	1.96b	1.90b	1.89c
Weedy check	1.52c	1.64c	1.59c	1.58d
Probability level	<.001	<.001	<.001	<.001
SE±	0.091	0.096	0.089	0.053
Sowing Date (D)				
Late June	1.96	2.02	1.99	1.99
Early July	1.92	2.01	1.95	1.96
Late July	1.93	2.18	2.06	2.06
Probability level	0.199	0.576	0.898	0.793
SE±	0.213	0.117	0.166	0.098
Sowing Method (M)				
Dibbling	2.11	2.17	2.13	2.14a
Drilling	2.02	2.05	2.05	2.04a
Broadcasting	1.69	1.98	1.82	1.83b
Probability level	0.125	0.369	0.148	0.008
SE±	0.138	0.094	0.107	0.066
Interaction				
D x M	0.600	0.969	0.842	0.410
D x W	0.334	0.377	0.337	<.001
M x W	0.080	0.436	0.085	<.001
D x M x W	0.099	0.328	0.097	0.065

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 34: Interaction of Sowing Date and Weed Control Treatment on Leaf Area Index (LAI) Plant^{-1} at 12 WAS of Finger Millet at Bagauda Combined.

	Sowing Date		
	Late June	Early July	Late July
Sowing method			
Two hoe weeding at 3 and 6 WAS	2.61a	2.40abc	2.55ab
Atrazine at 0.8kg a.i. ha^{-1} PE	1.95d-i	1.91d-i	1.96e-i
Atrazine at 1.2kg a.i. ha^{-1} PE	2.11c-g	2.18c-f	2.20cde
2,4-D at 0.5kg a.i. ha^{-1} POE	1.73h-j	2.02d-h	1.98d-i
2,4-D at 0.75kg a.i. ha^{-1} POE	1.76h-j	1.72ij	2.22cd
Weedy check	1.79hij	1.54jk	1.42k
SE±		0.129	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 35: Interaction of Sowing Method and Weed Control Treatment on Leaf Area Index (LAI) Plant^{-1} at 12 WAS of Finger Millet at Bagauda Combined.

	Sowing Method		
	Dibbling	Drilling	Broadcasting
Weed Control Treatment			
Two hoe weeding at 3 and 6 WAS	2.85a	2.38b	2.33b
Atrazine at 0.8kg a.i. ha^{-1} PE	1.80de	2.19bc	1.83de
Atrazine at 1.2kg a.i. ha^{-1} PE	2.46b	2.19bc	1.84de
2,4-D at 0.5kg a.i. ha^{-1} POE	2.22bc	1.81de	1.71de
2,4-D at 0.75kg a.i. ha^{-1} POE	1.88d	1.95cd	1.87de
Weedy check	1.61ef	1.73de	1.41f
SE±		0.107	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

area index (2.85) while sowing using broadcasting (1.41) and dibbling (1.61) method in a weedy check were statistically similar and recorded the smallest.

4.1.7 Dry Matter Plant^{-1}

Effect of weed control treatment, sowing date and sowing method on plant dry matter at 3 WAS of finger millet is presented in Table 36. There were no significant differences among the weed control treatment on plant dry matter in all experimental years and combined. However, sowing date significantly affected the plant dry matter in combined analysis where sowing on late July recorded significantly heavier plant (2.62g) while sowing on late June (2.49g) and early July (2.39g) produced the least dry matter. Sowing method did not significantly affect the plant dry matter at 3 WAS in all the experimental years and combined. There were no significant interaction among the treatments at all the experimental years and combined.

Table 37 presents the effect of weed control treatment, sowing date and sowing method on plant dry matter of finger millet at 6 WAS. Weed control treatments did not significantly affect the plant dry matter at 6 WAS in all the experimental years and combined. However, sowing date significantly influenced plant dry matter in 2016, 2018 and combined where sowing on early July recorded significantly heavier plant (6.07g), while sowing on late June (4.59g) and late July (4.95g) were statistically similar and recorded the lightest plant. Similar trends were observed in 2018 and combined. Sowing method had no significant effects on plant dry matter at 6 WAS in all the experimental years and combined. A significant interaction between sowing date and sowing method and also between sowing date and weed control treatment and among the sowing date, sowing method and weed control treatment were observed on plant dry matter at 6 WAS in combined.

Table 36: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Plant Dry Matter Plant^{-1} (g) at 3 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	2.34	2.70	2.49	2.51
Atrazine at 0.8kg a.i. ha^{-1} PE	2.35	2.74	2.48	2.52
Atrazine at 1.2kg a.i. ha^{-1} PE	2.27	2.67	2.42	2.45
2,4-D at 0.5kg a.i. ha^{-1} POE	2.34	2.71	2.49	2.51
2,4-D at 0.75kg a.i. ha^{-1} POE	2.33	2.69	2.48	2.50
Weedy check	2.32	2.68	2.47	2.49
Probability level	0.692	0.897	0.400	0.289
SE±	0.037	0.039	0.037	0.022
Sowing Date (D)				
Late June	2.31	2.68	2.46	2.49b
Early July	2.21	2.61	2.36	2.39b
Late July	2.44	2.81	2.59	2.62a
Probability level	0.159	0.194	0.143	0.004
SE±	0.067	0.065	0.066	0.038
Sowing Method (M)				
Dibbling	2.33	2.69	2.47	2.50
Drilling	2.31	2.71	2.46	2.50
Broadcasting	2.32	2.70	2.47	2.50
Probability level	0.969	0.915	0.365	0.190
SE±	0.031	0.028	0.031	0.017
Interaction				
D x M	0.182	0.135	0.172	0.056
D x W	0.101	0.193	0.151	0.210
M x W	0.420	0.831	0.515	0.091
D x M x W	0.205	0.366	0.326	0.060

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 37: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Plant Dry Matter Plant^{-1} (g) at 6 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	5.00	5.53	5.32	5.28
Atrazine at 0.8kg a.i. ha^{-1} PE	4.98	5.01	5.25	5.08
Atrazine at 1.2kg a.i. ha^{-1} PE	5.11	5.54	5.46	5.37
2,4-D at 0.5kg a.i. ha^{-1} POE	5.42	5.95	5.73	5.69
2,4-D at 0.75kg a.i. ha^{-1} POE	5.60	6.14	5.92	5.89
Weedy check	5.12	5.66	5.44	5.41
Probability level	0.737	0.324	0.710	0.059
SE±	0.337	0.357	0.334	0.198
Sowing Date (D)				
Late June	4.59b	5.12	4.90b	4.87b
Early July	6.07a	6.31	6.39a	6.26a
Late July	4.95b	5.49	5.27b	5.24b
Probability level	0.039	0.067	0.034	<.001
SE±	0.271	0.254	0.272	0.152
Sowing Method (M)				
Dibbling	4.85	5.38	5.12	5.13
Drilling	5.17	5.64	5.49	5.43
Broadcasting	5.59	5.89	5.91	5.80
Probability level	0.336	0.500	0333	0.056
SE±	0.340	0.299	0.341	0.189
Interaction				
D x M	0.265	0.279	0.264	0.006
D x W	0.103	0.438	0.132	<.001
M x W	0.648	0.779	0.611	0.066
D x M x W	0.111	0.352	0.072	<.001

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 38 shows that sowing on early July using broadcasting method recorded significantly heavier plant dry matter (7.20g), while sowing on late July using dibbling method recorded the lightest (4.46g). Sowing on early July in combined with the application of atrazine at 1.2kg a.i. ha^{-1} (6.82g) recorded significantly heavier plant dry matter (Table 39). This was statistically similar with the application of atrazine at 0.8kg a.i. ha^{-1} (6.76g), whereas the sowing on late June under weedy check recorded the lightest (4.43g). Table 40 indicated that, sowing on early July using broadcasting method in combination with application of atrazine at 0.8kg a.i. ha^{-1} recorded significantly heavier plant dry weight (8.70g), while sowing on late July using dibbling method in combination with application of atrazine at 1.2kg a.i. ha^{-1} recorded the lightest (3.23g).

The effect of weed control treatment, sowing date and sowing method on plant dry matter of finger millet at 9 WAS is presented on Table 41. Weed control treatment had significantly affected the plant dry matter at 9 WAS in all the experimental years and combined. The weedy check consistently recorded significantly lighter dry mater at 9 WAS in 2016 (10.48g), 2017 (12.24g), 2018 (11.59g) and combine (11.55g), whereas the remaining treatments recorded heavier plant dry matter and were at par throughout the experimental years and combined. However, sowing date did not significantly affect the plant dry matter at 9 WAS in all the years and combined. Sowing method significantly affected plant dry matter at 9 WAS in all the years and combined where dibbling method consistently recorded significantly heavier plant throughout the experimental years and combined, whereas broadcasting method recorded the lightest throughout the experimental years and combined.

Table 38: Interaction of Sowing Date and Sowing Method on Dry Matter Plant^{-1} (g) At 6 WAS of Finger Millet at Bagauda Combined.

	Sowing Date		
	Late June	Early July	Late July
Sowing Method			
Dibbling	4.93cd	6.00b	4.46d
Drilling	4.79cd	5.56bc	5.93b
Broadcasting	4.88cd	7.20a	5.31bcd
SE±		0.307	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 39: Interaction of Sowing Date and Weed Control Treatment on Dry Matter Plant^{-1} (g) at 6 WAS of Finger Millet at Bagauda Combined.

	Sowing Date		
	Late June	Early July	Late July
Weed Control Treatment			
Two hoe weeding at 3 and 6 WAS	4.72e-h	6.29abc	4.82e-h
Atrazine at 0.8kg a.i. ha^{-1} PE	3.88h	6.76a	4.59fgh
Atrazine at 1.2kg a.i. ha^{-1} PE	4.66fgh	6.82a	6.07a-d
2,4-D at 0.5kg a.i. ha^{-1} POE	5.46b-f	6.33ab	5.30d-g
2,4-D at 0.75kg a.i. ha^{-1} POE	6.04a-d	5.96a-d	5.65b-e
Weedy check	4.43gh	5.36c-g	4.96efg
SE±		0.348	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 40: Interaction of Sowing Date, Sowing Method and Weed Control Treatment on Dry Matter Plant^{-1} (g) at 6 WAS of Finger Millet at Bagauda Combined.

Treatment		Weed control treatment					
	Sowing Method	Two hoe weeding at 3 and 6 WAS	Atrazine at 0.8kg a.i. ha^{-1}	Atrazine at 1.2kg a.i. ha^{-1} PE	2,4-D at 0.5kg a.i. ha^{-1} POE	2,4-D at 0.75kg a.i. ha^{-1} POE	Weedy check
Sowing Date							
Late June	Dibbling	4.45m-t	3.86r-u	5.19i-q	4.89j-r	6.35c-i	4.85k-r
	Drilling	4.85k-r	3.57stu	4.58m-s	4.87k-r	6.31c-i	4.56m-s
	Broadcasting	4.87k-r	4.21o-u	4.20o-u	6.62c-g	5.47g-o	3.90p-u
Early July	Dibbling	6.23d-i	4.40n-t	5.73g-m	7.32bcd	6.40c-h	5.89f-l
	Drilling	6.22d-i	7.19b-e	3.36tu	5.62g-n	4.92j-r	6.06e-j
	Broadcasting	6.41c-h	8.70a	7.00b-f	6.03e-k	6.55c-g	7.30bcd
Late July	Dibbling	4.72l-s	4.32n-u	3.23u	4.45m-t	4.69l-s	5.35h-p
	Drilling	4.80k-s	4.71l-s	7.18b-e	7.41bc	6.99b-f	4.47m-t
	Broadcasting	4.95j-r	4.73l-s	7.80b	4.03p-u	5.26h-p	5.07j-r
SE±					0.623		

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 41: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Dry Matter Plant^{-1} (g) at 9 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	19.26a	20.66a	20.01a	19.98a
Atrazine at 0.8kg a.i. ha^{-1} PE	18.96a	20.75a	19.42a	19.72a
Atrazine at 1.2kg a.i. ha^{-1} PE	18.25a	20.09a	19.20a	19.18a
2,4-D at 0.5kg a.i. ha^{-1} POE	18.64a	20.04a	19.39a	19.35a
2,4-D at 0.75kg a.i. ha^{-1} POE	18.65a	20.05a	19.40a	19.36a
Weedy check	10.84b	12.24b	11.59b	11.55b
Probability level	<.001	<.001	<.001	<.001
SE±	0.514	0.559	0.533	0.310
Sowing Date (D)				
Late June	17.04	18.44	17.79	17.76
Early July	17.18	19.00	17.89	18.02
Late July	18.08	19.48	18.83	18.79
Probability level	0.646	0.710	0.461	0.202
SE±	0.804	0.849	0.811	0.474
Sowing Method (M)				
Dibbling	19.24a	20.53a	19.94a	19.90a
Drilling	16.96b	18.64b	17.71b	17.77b
Broadcasting	16.11c	17.74b	16.86c	16.90c
Probability level	<.001	<.001	<.001	<.001
SE±	0.223	0.299	0.231	0.146
Interaction				
D x M	0.778	0.517	0.771	0.104
D x W	0.032	0.172	0.017	<.001
M x W	0.120	0.360	0.203	<.001
D x M x W	0.141	0.056	0.145	0.062

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

The interaction between sowing date and weed control treatment was significant at 2016, 2018 and combined. Also, the interaction between sowing method and weed control treatment was significant in combined.

Table 42 shows the interaction between sowing date and weed control treatment on plant dry matter at 9 WAS in 2016, 2018 and combined. In 2016, sowing on early July and weeding twice at 3 and 6 WAS recorded significantly heavier dry matter plant^{-1} (21.11g) which was statistically similar with sowing on late June applied with atrazine at 0.8kg a.i. ha^{-1} and sowing on late July applied with 2.4-D at 0.5 and 0.75kg a.i. ha^{-1}. Also, sowing on late July under weedy check recorded significantly lightest plant dry matter (10.20g) at 9 WAS which was at par with sowing on late June (11.36g) and early July (10.96g) under weedy check. In 2018, sowing on early July combined with weeding twice at 3 and 6 WAS recorded significantly heavier dry matter plant^{-1} (21.86g) which was statistically similar with sowing on late June combined with application of atrazine at 0.8kg a.i. ha^{-1} as well as sowing on late July combined with 2.4-D at 0.5 and 0.75kg a.i. ha^{-1}. Sowing on late July under weedy check recorded significantly lightest plant dry matter (10.95g) at 9 WAS which was at par with sowing on late June (12.11g) and early July (11.71g) under weedy check. Also, in the combined analysis, sowing on early July weeded twice at 3 and 6 WAS recorded significantly heavier plant dry matter (21.83g) which was statistically similar with sowing on late June applied with atrazine 0.8kg a.i. ha^{-1}, as well as sowing on late July combined with 2.4-D at 0.5 and 0.75kg a.i. ha^{-1}. Sowing on late July under weedy check recorded significantly lightest plant dry matter (10.92g) at 9 WAS which was at par with sowing on late June (12.08g) and early July (11.69g) under weedy check.

Table 42: Interaction of Sowing Date and Weed Control Treatment on Dry Matter Plant^{-1} (g) at 9 WAS of Finger Millet at Bagauda in 2016, 2018 and Combined.

	Sowing date		
	Late June	Early July	Late July
Weed Control Treatment			
	2016 rainy season		
Two hoe weeding at 3 and 6 WAS	17.60cd	21.11a	19.07bc
Atrazine at 0.8kg a.i. ha^{-1} PE	20.03ab	17.11d	19.77ab
Atrazine at 1.2kg a.i. ha^{-1} PE	17.84cd	17.71cd	19.20bc
2,4-D at 0.5kg a.i. ha^{-1} POE	17.99cd	17.81cd	20.11ab
2,4-D at 0.75kg a.i. ha^{-1} POE	17.43d	18.40cd	20.11ab
Weedy check	11.36e	10.96e	10.20e
SE±		1.143	
	2018 rainy season		
Two hoe weeding at 3 and 6 WAS	18.35de	21.86a	19.82b-e
Atrazine at 0.8kg a.i. ha^{-1} PE	20.78ab	16.97f	20.52abc
Atrazine at 1.2kg a.i. ha^{-1} PE	18.59de	19.06cde	19.95bcd
2,4-D at 0.5kg a.i. ha^{-1} POE	18.74de	18.56de	20.86ab
2,4-D at 0.75kg a.i. ha^{-1} POE	18.18e	19.15cde	20.86ab
Weedy check	12.11g	11.71g	10.95g
SE±		1.170	
	Combined		
Two hoe weeding at 3 and 6 WAS	18.31def	21.83a	19.79b-e
Atrazine at 0.8kg a.i. ha^{-1} PE	20.75ab	17.91f	20.48abc
Atrazine at 1.2kg a.i. ha^{-1} PE	18.55def	19.07c-f	19.91bcd
2,4-D at 0.5kg a.i. ha^{-1} POE	18.70def	18.53def	20.83ab
2,4-D at 0.75kg a.i. ha^{-1} POE	18.14ef	19.12c-f	20.82ab
Weedy check	12.08g	11.67g	10.92g
SE±		0.682	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 43 shows the interaction of sowing method and weed control treatment on dry matter plant^{-1} at 9 WAS in combined. Dibbling method in combination with application of 2,4-D at 0.5kg a.i. ha^{-1} recorded significantly heavier plant dry matter (22.44g) which was statistically similar with sowing using dibbling method applied with atrazine 0.8kg a.i ha^{-1} and atrazine 1.2kg a.i ha^{-1}. Whereas, sowing using broadcasting method under weedy environment recorded the lightest (11.42g) dry matter.

The effect of weed control treatment, sowing date and sowing method on plant dry matter plant^{-1} at 12 WAS is presented in Table 44. Weed control treatment had significantly affected the plant dry matter at 12 WAS in all the experimental years and combined. Weedy check consistently recorded significantly lightest dry matter plant^{-1} at 12 WAS in 2016 (12.64g), 2017 (14.10g), 2018 (13.45g) and combine (13.40g), whereas the remaining treatments were at par and recorded the heavier plant dry matter throughout the experimental years and combined. However, sowing date did not significantly affect the dry matter per plant at 12 WAS in all the experimental years and combined. On the other hand, sowing method significantly affects the plant dry matter in all the experimental years and combined where dibbling method of sowing consistently recorded significantly heavier plant throughout the experimental years and combined, while broadcasting method recorded the lightest dry matter throughout the experimental years and combined. The interaction between sowing date and weed control treatment was significant at 2016, 2018 and combined (Table 45). The interaction between sowing method and weed control treatment was also significant in combined (Table 46). Also, the interaction between sowing date, sowing method and weed control treatment was significant in combined (Table 47).

Table 43: Interaction of Sowing Method and Weed Control Treatment on Dry Matter Plant^{-1} (g) at 9 WAS of Finger Millet at Bagauda Combined.

	Sowing Method		
	Dibbling	Drilling	Broadcasting
Weed control Treatment			
Two hoe weeding at 3 and 6 WAS	20.80bc	20.36c	18.76d
Atrazine at 0.8kg a.i. ha^{-1} PE	21.91ab	18.63d	18.61d
Atrazine at 1.2kg a.i. ha^{-1} PE	21.17abc	18.24de	18.13de
2,4-D at 0.5kg a.i. ha^{-1} POE	22.44a	18.63d	16.99e
2,4-D at 0.75kg a.i. ha^{-1} POE	20.15c	20.45c	17.49de
Weedy check	12.95f	10.30h	11.42g
SE±		0.511	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 44: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Dry Matter Plant^{-1} (g) at 12 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	21.06a	22.53a	21.88a	21.82a
Atrazine at 0.8kg a.i. ha^{-1} PE	20.77a	22.64a	21.29a	21.57a
Atrazine at 1.2kg a.i. ha^{-1} PE	20.05a	22.09a	21.05a	21.06a
2,4-D at 0.5kg a.i. ha^{-1} POE	20.44a	21.90a	21.25a	21.20a
2,4-D at 0.75kg a.i. ha^{-1} POE	20.45a	21.91a	21.26a	21.21a
Weedy check	12.64b	14.10b	13.45b	13.40b
Probability level	<.001	<.001	<.001	<.001
SE±	0.514	0.571	0.533	0.312
Sowing Date (D)				
Late June	18.84	20.31	19.66	19.60
Early July	18.98	20.94	19.75	19.89
Late July	19.88	21.34	20.69	20.64
Probability level	0.102	0.332	0.114	0.232
SE±	0.804	0.842	0.812	0.473
Sowing Method (M)				
Dibbling	21.30a	22.71a	22.07a	22.03a
Drilling	18.72b	20.49b	19.54b	19.58b
Broadcasting	17.67	19.38c	18.49c	18.52c
Probability level	<.001	<.001	<.001	<.001
SE±	0.223	0.302	0.232	0.147
Interaction				
D x M	0.221	0.431	0.100	0.073
D x W	0.042	0.624	0.021	<.001
M x W	0.255	0.433	0.166	<.001
D x M x W	0.111	0.321	0.082	<.001

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 45 presents the interaction between sowing date and weed control treatment on dry matter plant^{-1} at 12 WAS in 2016, 2018 and combined. In 2016, sowing on early July combined with weeding twice at 3 and 6 WAS recorded significantly heavier dry matter (22.91g) which was statistically similar with sowing on late June treated with atrazine at 0.8kg a.i. ha^{-1} and sowing on late July treated with 2,4-D at 0.5 and 0.75kg a.i. ha^{-1}. Sowing on late July under weedy check (12.0g) was at par with sowing on late June (13.16g) and early July (12.76g) in unweeded environment, and recorded significantly lightest dry matter. In 2018, sowing on early July combined with weeding twice at 3 and 6 WAS recorded significantly heavier dry matter plant^{-1} (23.73g) which was statistically similar with sowing on late June combined with application of atrazine at 0.8kg a.i. ha^{-1} as well as sowing on late July combined with 2.4-D at 0.5 and 0.75kg a.i. ha^{-1}. Sowing on late July under weedy check recorded significantly lightest plant dry matter (12.76g) which was statistically at par with sowing on late June (13.98g) and early July (13.57g) under weedy check. Also, in the combined analysis, sowing on early July weeded twice at 3 and 6 WAS recorded significantly heavier plant dry matter (23.67g) which was statistically similar with sowing on late June treated with atrazine 0.8kg a.i. ha^{-1}, as well as sowing on late July combined with 2.4-D at 0.5 and 0.75kg a.i. ha^{-1}. Sowing on late July under weedy check recorded significantly lightest plant dry matter (12.76g) and was at par with sowing on late June (13.92g) and early July (13.52g) under unweeded environment.

Table 46 shows the interaction of sowing method and weed control treatment on dry matter plant^{-1} at 12 WAS in combined. Dibbling method treated with 2,4-D at 0.5kg a.i. ha^{-1} recorded significantly heavier plant dry matter (24.55g) which was statistically similar with sowing using dibbling method combined with atrazine 0.8kg

Table 45: Interaction of Sowing Date and Weed Control Treatment on Dry Matter Plant^{-1} (g) at 12 WAS of Finger Millet at Bagauda in 2016, 2018 Rainy Seasons and Combined.

	Sowing Date		
	Late June	Early July	Late July
Weed Control Treatment			
	2016 rainy season		
Two hoe weeding at 3 and 6 WAS	19.40cd	22.91a	20.87bc
Atrazine at 0.8kg a.i. ha^{-1} PE	21.83ab	18.91d	21.57b
Atrazine at 1.2kg a.i. ha^{-1} PE	19.64cd	19.51cd	21.00bc
2,4-D at 0.5kg a.i. ha^{-1} POE	19.79cd	19.61cd	21.91ab
2,4-D at 0.75kg a.i. ha^{-1} POE	19.23d	20.20cd	21.91ab
Weedy check	13.16e	12.76e	12.00e
SE±		1.143	
	2018 rainy season		
Two hoe weeding at 3 and 6 WAS	20.21de	23.73a	21.69b-e
Atrazine at 0.8kg a.i. ha^{-1} PE	22.65ab	18.83f	22.38bc
Atrazine at 1.2kg a.i. ha^{-1} PE	20.45de	20.90cde	21.81bcd
2,4-D at 0.5kg a.i. ha^{-1} POE	20.60de	20.43de	22.73ab
2,4-D at 0.75kg a.i. ha^{-1} POE	20.04e	21.02cde	22.72ab
Weedy check	13.98g	13.57g	12.82g
SE±		1.170	
	Combined		
Two hoe weeding at 3 and 6 WAS	20.16def	23.67a	21.63b-e
Atrazine at 0.8kg a.i. ha^{-1} PE	22.59ab	19.78f	22.33bc
Atrazine at 1.2kg a.i. ha^{-1} PE	20.40def	21.04c-f	21.76bcd
2,4-D at 0.5kg a.i. ha^{-1} POE	20.55def	20.37def	22.68ab
2,4-D at 0.75kg a.i. ha^{-1} POE	19.99ef	20.96c-f	22.67ab
Weedy check	13.92g	13.52g	12.76g
SE±		0.683	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 46: Interaction of Sowing Method and Weed Control Treatment on Dry Matter Plant^{-1} (g) at 12 WAS of Finger Millet at Bagauda Combined.

	Sowing Date		
	Dibbling	Drilling	Broadcasting
Weed control Treatment			
Two hoe weeding at 3 and 6 WAS	22.91bc	22.17c	20.38d
Atrazine at 0.8kg a.i. ha^{-1} PE	24.01ab	20.45d	20.24d
Atrazine at 1.2kg a.i. ha^{-1} PE	23.37abc	20.07d	19.76de
2,4-D at 0.5kg a.i. ha^{-1} POE	24.55a	20.44d	18.61e
2,4-D at 0.75kg a.i. ha^{-1} POE	22.26c	22.26c	19.10de
Weedy check	15.06f	12.11g	13.03g
SE±		0.515	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

and 1.2kg a.i ha^{-1}. Whereas, sowing using broadcasting and drilling method under weedy environment recorded the lightest dry matter. Table 47 shows that, sowing on late July using dibbling method combined with application of atrazine at 0.8kg a.i. ha^{-1} produced significantly heavier plant dry matter (27.14g) while sowing on late July using broadcasting method in unweeded environment recorded the lightest dry matter (11.33g).

4.1.8 Crop Growth Rate (CGR)

The effect of weed control treatment, sowing date and sowing method on CGR of finger millet at 6 WAS is presented in Table 48. Weed control treatment did not significantly affect the CGR at 6 WAS in all the experimental years and combined. However, sowing date significantly affected the CGR at 6 WAS in all the experimental years and combined where sowing on early July produced significantly higher CGR in 2016 (1.29gwk^{-1}), 2017 (1.23gwk^{-1}), 2018 (1.34gwk^{-1}) and combined (1.29gwk^{-1}), whereas sowing on late June and late July consistently produced the lowest which were at par throughout the experimental years and combined. Sowing method significantly affected the CGR of finger millet at 6 WAS in combined where broadcasting method produced significantly higher CGR (1.11gwk^{-1}) which was statistically at par with drilling method, while dibbling method recorded the lightest (0.88gwk^{-1}). The interactions between the treatments were not significant.

Table 49 presents the effect of weed control treatment, sowing date and sowing method on CGR of finger millet at 9 WAS. Weed control treatment significantly affect the CGR at 9 WAS in all the experimental years and combined. Weedy check consistently produced the least CGR in 2016 (1.91gwk^{-1}), 2017 (2.19gwk^{-1}), 2018 (2.05gwk^{-1}) and combine (2.05gwk^{-1}), whereas the remaining treatments were statistically similar and produced significantly higher CGR

Table 47: Interaction of Sowing Date, Sowing Method and Weed Control Treatment on Dry Matter Plant^{-1} (g) at 12 WAS of Finger Millet at Bagauda Combined

Treatment		Weed Control Treatment					
	Sowing Method	Two hoe weeding at 3 and 6 WAS	Atrazine at 0.8kg a.i. ha^{-1}	Atrazine at 1.2kg a.i. ha^{-1} PE	2,4-D at 0.5kg a.i. ha^{-1} POE	2,4-D at 0.75kg a.i. ha^{-1} POE	Weedy check
Sowing Date							
Late June	Dibbling	22.85def	25.05bc	23.29de	21.81e-j	21.31f-l	17.34p
	Drilling	20.86h-m	21.45e-l	20.11j-n	19.59lmn	21.07f-m	12.58rst
	Broadcasting	16.76q	21.28f-l	17.79op	20.24i-n	17.58op	13.09rst
Early July	Dibbling	25.15bc	19.85k-n	22.04e-i	26.01b	22.76d-g	13.95r
	Drilling	24.14cd	19.93j-n	19.14no	19.55lmn	21.65e-j	13.19rs
	Broadcasting	21.73e-j	19.55mn	21.93e-i	15.41r	18.48op	13.41rs
Late July	Dibbling	20.74i-n	27.14a	24.77bc	25.67b	22.73d-g	13.89r
	Drilling	21.52e-k	19.96j-n	20.95g-m	22.18e-h	24.05cd	11.81st
	Broadcasting	22.64d-i	19.88j-n	19.55lmn	20.17i-n	21.23f-l	11.33t
SE±					0.998		

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 48: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Crop Growth Rate (g week^{-1}) at 6 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	0.89	0.94	0.94	0.92
Atrazine at 0.8kg a.i. ha^{-1} PE	0.88	0.76	0.92	0.85
Atrazine at 1.2kg a.i. ha^{-1} PE	0.94	0.96	1.01	0.97
2,4-D at 0.5kg a.i. ha^{-1} POE	1.03	1.08	1.08	1.06
2,4-D at 0.75kg a.i. ha^{-1} POE	1.09	1.15	1.15	1.13
Weedy check	0.94	0.99	0.10	0.97
Probability level	0.748	0.312	0.724	0.061
SE±	0.113	0.121	0.112	0.067
Sowing Date (D)				
Late June	0.76b	0.81b	0.81b	0.80b
Early July	1.29a	1.23a	1.34a	1.29a
Late July	0.84b	0.89b	0.89b	0.87b
Probability level	0.019	0.031	0.020	<.001
SE±	0.081	0.073	0.081	0.045
Sowing Method (M)				
Dibbling	0.84	0.90	0.89	0.88b
Drilling	0.95	0.99	1.00	0.98ab
Broadcasting	1.09	1.06	1.16	1.11a
Probability level	0.308	0.489	0.313	0.047
SE±	0.109	0.095	0.110	0.061
Interaction				
D x M	0.277	0.267	0.280	0.066
D x W	0.114	0.436	0.131	0.057
M x W	0.578	0.979	0.553	0.084
D x M x W	0.096	0.378	0.066	0.055

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 49: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Crop Growth Rate (g week^{-1}) at 9 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	4.75a	5.04a	4.89a	4.89a
Atrazine at 0.8kg a.i. ha^{-1} PE	4.67a	5.25a	4.72a	4.88a
Atrazine at 1.2kg a.i. ha^{-1} PE	4.38a	4.85a	4.58a	4.60a
2,4-D at 0.5kg a.i. ha^{-1} POE	4.41a	4.61a	4.55a	4.55a
2,4-D at 0.75kg a.i. ha^{-1} POE	4.35a	4.64a	4.49a	4.49a
Weedy check	1.91b	2.19b	2.05b	2.05b
Probability level	<.001	<.001	<.001	<.001
SE±	0.209	0.236	0.212	0.127
Sowing Date (D)				
Late June	4.15	4.44	4.29	4.29ab
Early July	3.70	4.23	3.83	3.92b
Late July	4.37	4.66	4.52	4.52a
Probability level	0.215	0.543	0.207	0.028
SE±	0.225	0.257	0.226	0.137
Sowing Method (M)				
Dibbling	4.80a	5.05a	4.92a	4.92a
Drilling	3.93b	4.33b	4.07b	4.11b
Broadcasting	3.50b	3.95b	3.65b	3.70c
Probability level	<.001	0.001	<.001	<.001
SE±	0.144	0.159	0.148	0.087
Interaction				
D x M	0.471	0.426	0.495	0.056
D x W	0.017	0.251	0.006	<.001
M x W	0.310	0.835	0.420	0.060
D x M x W	0.614	0.529	0.745	0.055

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

throughout the experimental years and combined. Sowing date significantly affected the CGR at 9 WAS in combined where sowing on late July produced significantly higher CGR (4.52gwk^{-1}) which was statistically similar with sowing on late June (4.29gwk^{-1}), while sowing on early July produced the lowest (3.22gwk^{-1}). Sowing method significantly affects the CGR of finger millet in all the experimental years and combined. Dibbling method produced significantly higher CGR in 2016 (4.80gwk^{-1}), 2017 (5.05gwk^{-1}), 2018 (4.92gwk^{-}1) and combined (4.92gwk^{-1}). Drilling and broadcasting method were at par and produced the least crop growth rate in 2016, 2017 and 2018. In combined, the least crop growth rate was produced by broadcasting method (3.70gwk^{-1}). The interaction between sowing date and weed control treatment was significant at 2016, 2018 and combined.

Table 50 presents the interaction between sowing date and weed control treatment in 2016, 2018 and combined. In 2016, sowing on late June treated with atrazine at 0.8kg a.i. ha^{-1} produced significantly higher CGR (5.48gwk^{-1}) which was at par with sowing on late July treated with 2,4-D at 0.75kg a.i ha^{-1} while sowing on early July (1.47gwk^{-1}) and Late July (1.84gwk^{-1}) in unweeded environment were statistically similar and produced the lowest. In 2018, sowing on late June combined with application of atrazine at 0.8kg a.i. ha^{-1} recorded significantly higher crop growth rate (5.62gwk^{-1}), while sowing on early July (1.62gwk^{-1}) and late July (1.98gwk^{-1}) in unweeded environment was at par and recorded the lowest. Also, in the combined analysis, sowing on late June treated with atrazine at 0.8kg a.i. ha^{-1} produced significantly higher crop growth rate (5.62gwk^{-1}), whereas sowing on early July and late July under weedy check recorded the least.

Table 51 shows the effect of weed control treatment, sowing date and sowing method on CGR of finger millet at 12 WAS. There were no significant differences

Table 50: Interaction of Sowing Date and Weed Control Treatment on Crop Growth Rate (g wk^{-1}) at 9 WAS of Finger Millet at Bagauda in 2016, 2018 and Combined.

	Sowing Date		
	Late June	Early July	Late July
Weed Control Treatment			
	2016 rainy season		
Two hoe weeding at 3 and 6 WAS	4.39cde	5.03bc	4.84bcd
Atrazine at 0.8kg a.i. ha^{-1} PE	5.48a	3.37f	5.15b
Atrazine at 1.2kg a.i. ha^{-1} PE	4.49cde	4.19e	4.47cde
2,4-D at 0.5kg a.i. ha^{-1} POE	4.27de	3.92e	5.03bc
2,4-D at 0.75kg a.i. ha^{-1} POE	3.89e	4.24de	4.91abc
Weedy check	2.40g	1.47h	1.84h
SE±		0.400	
	2018 rainy season		
Two hoe weeding at 3 and 6 WAS	4.53def	5.18bc	4.99b-e
Atrazine at 0.8kg a.i. ha^{-1} PE	5.62a	3.25g	5.29b
Atrazine at 1.2kg a.i. ha^{-1} PE	4.63c-f	4.49def	4.61c-f
2,4-D at 0.5kg a.i. ha^{-1} POE	4.41ef	4.07f	5.18bc
2,4-D at 0.75kg a.i. ha^{-1} POE	4.03f	4.39ef	5.06a-d
Weedy check	2.55h	1.62i	1.98i
SE±		0.405	
	Combined		
Two hoe weeding at 3 and 6 WAS	4.53cde	5.18bc	4.9bcd
Atrazine at 0.8kg a.i. ha^{-1} PE	5.62a	3.72f	5.29b
Atrazine at 1.2kg a.i. ha^{-1} PE	4.63b-e	4.57cde	4.61cde
2,4-D at 0.5kg a.i. ha^{-1} POE	4.41de	4.07ef	5.18bc
2,4-D at 0.75kg a.i. ha^{-1} POE	4.03ef	4.39de	5.06bcd
Weedy check	2.55g	1.62h	1.82h
SE±		0.243	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 51: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Crop Growth Rate (g week^{-1}) at 12 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	0.60	0.62	0.62	0.62
Atrazine at 0.8kg a.i. ha^{-1} PE	0.60	0.67	0.62	0.62
Atrazine at 1.2kg a.i. ha^{-1} PE	0.60	0.63	0.62	0.63
2,4-D at 0.5kg a.i. ha^{-1} POE	0.60	0.62	0.62	0.62
2,4-D at 0.75kg a.i. ha^{-1} POE	0.60	0.62	0.62	0.62
Weedy check	0.60	0.62	0.62	0.62
Probability level	0.675	0.220	0.450	0.338
SE±	0.017	0.015	0.002	0.005
Sowing Date (D)				
Late June	0.60	0.62	0.62	0.62
Early July	0.60	0.65	0.62	0.62
Late July	0.60	0.62	0.62	0.62
Probability level	0.100	0.139	0.445	0.102
SE±	0.012	0.008	0.001	0.003
Sowing Method (M)				
Dibbling	0.69a	0.73a	0.71a	0.71a
Drilling	0.59b	0.62b	0.61b	0.61b
Broadcasting	0.52c	0.55c	0.54c	0.54c
Probability level	<.001	<.001	<.001	<.001
SE±	0.012	0.010	0.001	0.004
Interaction				
D x M	0.105	0.837	0.454	0.920
D x W	0.094	0.179	0.488	0.330
M x W	0.391	0.653	0.884	0.823
D x M x W	0.364	0.373	0.522	0.920

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing, NS = not significant.

among the weed control treatments on crop growth rate throughout the experimental years and combined. Also, sowing date did not significantly affect the crop growth rate at 12 WAS in all the experimental years and combined. However, sowing method significantly affects the CGR of finger millet in all the experimental years and combined where dibbling method consistently produced significantly higher CGR in 2016 (0.69g wk^{-1}), 2017 (0.73g wk^{-1}), 2018 (0.71gwk^{-1}) and combined (0.71gwk^{-1}), while the broadcasting method recorded the lowest throughout the experimental years and combined. The interactions between the treatments on crop growth rate were not significant.

4.1.9 Relative Growth Rate (RGR)

Effect of weed control treatment, sowing date and sowing method on RGR of finger millet at 6 WAS is presented in Table 52. Weed control treatment significantly affect the RGR in combined only, where application of 2,4-D at 0.5kg (0.11) and 0.75kg a.i. ha^{-1} (0.12) were at par and produced the highest RGR when compared to other weed control treatments. Also, sowing date significantly affect the RGR at 6 WAS in all the experimental years and combined where sowing on early July produced significantly higher RGR in 2016 (0.140), 2017 (0.12), 2018 (0.14) and combined (0.13), whereas sowing on late June and late July which consistently produced the lowest RGR were at par throughout the experimental years and combined. Sowing method had no significant effect on the RGR of finger millet at 6 WAS in all the experimental years and combined. The interactions between sowing date and weed control treatment was highly significant in combined.

Table 53 presents the interaction of sowing date and sowing method on relative growth rate at 6 WAS in combined analysis. The result indicated that, sowing on late June treated with atrazine at 0.8kg a.i. ha^{-1} produced the highest crop growth

Table 52: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Relative Growth Rate (g g^{-1} $week^{-1}$) at 6 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	0.10	0.10	0.11	0.10ab
Atrazine at 0.8kg a.i. ha^{-1} PE	0.09	0.08	0.10	0.09b
Atrazine at 1.2kg a.i. ha^{-1} PE	0.10	0.09	0.11	0.09b
2,4-D at 0.5kg a.i. ha^{-1} POE	0.11	0.11	0.12	0.11a
2,4-D at 0.75kg a.i. ha^{-1} POE	0.12	0.11	0.12	0.12a
Weedy check	0.11	0.10	0.11	0.10ab
Probability level	0.615	0.178	0.612	0.017
SE±	0.009	0.009	0.009	0.005
Sowing Date (D)				
Late June	0.09b	0.09b	0.09b	0.09b
Early July	0.14a	0.12a	0.14a	0.13a
Late July	0.09b	0.08b	0.09b	0.09b
Probability level	0.011	0.020	0.010	<.001
SE±	0.006	0.005	0.006	0.003
Sowing Method (M)				
Dibbling	0.10	0.09	0.09	0.10
Drilling	0.11	0.10	0.11	0.11
Broadcasting	0.12	0.11	0.11	0.11
Probability level	0.316	0.550	0.331	0.057
SE±	0.008	0.007	0.08	0.004
Interaction				
D x M	0.304	0.244	0.310	0.080
D x W	0.250	0.594	0.248	<.001
M x W	0.658	0.989	0.639	0.082
D x M x W	0.085	0.360	0.063	0.055

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 53: Interaction of Sowing Date and Weed Control Treatment on Relative Growth Rate (g g^{-1} wk^{-1}) $Plant^{-1}$ at 6 WAS of Finger Millet at Bagauda Combined.

	Sowing Date		
	Late June	Early July	Late July
Weed Control Treatment			
Two hoe weeding at 3 and 6 WAS	0.201bcd	0.184c-f	0.207bc
Atrazine at 0.8kg a.i. ha^{-1} PE	0.255a	0.147g	0.219b
Atrazine at 1.2kg a.i. ha^{-1} PE	0.202bcd	0.191cde	0.191cde
2,4-D at 0.5kg a.i. ha^{-1} POE	0.182c-f	0.158fg	0.205bc
2,4-D at 0.75kg a.i. ha^{-1} POE	0.164efg	0.175def	0.194bcd
Weedy check	0.142gh	0.084i	0.117h
SE±		0.0098	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

rate (0.245), while sowing on early July under weedy check produced the lowest (0.084).

Table 54 shows the effect of weed control treatment, sowing date and sowing method on RGR of finger millet at 9 WAS. Weed control treatment significantly affected the RGR at 9 WAS in all the experimental years and combined. Weedy check significantly produced the lowest RGR throughout the experimental years and combined, while the other treatments were statistically similar in 2016, 2017 and 2018 and recorded the highest RGR. Also, sowing date significantly affected RGR at 9 WAS in 2016, 2018 and combined, where the plants sown on late June (19.0) and those sown on early July (19.0) produced significantly higher RGR than those sown on late July in 2016, while sowing on late July recorded the least (0.16) RGR. In 2018, sowing on late June (19.0) and late July (0.18) were statistically similar and recorded the significantly higher RGR, while sowing on early July recorded the lowest (0.15). Also, in combined analysis, sowing on late June (1.19) and late July (1.19) were at par and produced significantly higher RGR at 9 WAS, whereas sowing on early July produced the lowest (1.16). Sowing method had significant effect on RGR at 9 WAS in all the experimental years and combined. Sowing using dibbling method produced significantly higher RGR in 2016 (0.20), 2017 (0.19), 2018 (0.19) and combined (0.20) which was closely followed by drilling method in 2016, 2017 and 2018. The broadcasting method consistently produced the lowest RGR in all the experimental years and combined. Interaction between sowing date and weed control treatment was significant in combined.

Table 55 shows the interaction of sowing date and weed control treatment on RGR at 9 WAS in 2018 and combined. Irrespective of the sowing date, weedy check

Table 54: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Relative Growth Rate (g g^{-1} $week^{-1}$) at 9 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	0.20a	0.19a	0.20a	0.19ab
Atrazine at 0.8kg a.i. ha^{-1} PE	0.20a	0.21a	0.19a	0.20a
Atrazine at 1.2kg a.i. ha^{-1} PE	0.19a	0.19a	0.19a	0.19ab
2,4-D at 0.5kg a.i. ha^{-1} POE	0.18a	0.18a	0.18a	0.18b
2,4-D at 0.75kg a.i. ha^{-1} POE	0.18a	0.18a	0.17a	0.18b
Weedy check	0.11b	0.12b	0.11b	0.11c
Probability level	<.001	<.001	<.001	<.001
SE±	0.010	0.010	0.009	0.006
Sowing Date (D)				
Late June	0.19a	0.18	0.19a	1.19a
Early July	0.19a	0.16	0.15b	1.16b
Late July	0.16b	0.19	0.18a	1.19a
Probability level	0.023	0.114	0.022	<.001
SE±	0.006	0.007	0.006	0.004
Sowing Method (M)				
Dibbling	0.20a	0.19a	0.19a	0.20a
Drilling	0.17ab	0.18ab	0.17a	0.17b
Broadcasting	0.16b	0.16b	0.15b	0.16b
Probability level	0.018	0.050	0.024	<.001
SE±	0.009	0.008	0.009	0.005
Interaction				
D x M	0.352	0.335	0.365	0.150
D x W	0.069	0.416	0.063	<.001
M x W	0.854	0.997	0.883	0.355
D x M x W	0.394	0.658	0.471	0.056

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 55: Interaction of Sowing Date and Weed Control Treatment on Relative Growth Rate (g g^{-1} wk^{-1}) at 9 WAS of Finger Millet at Bagauda Combined.

	Sowing Date		
	Late June	Early July	Late July
Weed Control Treatment			
Two hoe weeding at 3 and 6 WAS	0.014b-e	0.012h	0.013b-g
Atrazine at 0.8kg a.i. ha^{-1} PE	0.012fg	0.015b	0.013c-g
Atrazine at 1.2kg a.i. ha^{-1} PE	0.014bcd	0.014bcd	0.013b-g
2,4-D at 0.5kg a.i. ha^{-1} POE	0.014b-f	0.014bc	0.012f-g
2,4-D at 0.75kg a.i. ha^{-1} POE	0.015bc	0.014b-f	0.013d-g
Weedy check	0.023a	0.022a	0.024a
SE±		0.0007	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

consistently recorded significantly higher RGR while sowing on early July weeded twice at 3 and 6 WAS recorded the lowest.

Table 56 presents the effect of weed control treatment, sowing date and sowing method on crop growth rate at 12 WAS of finger millet. Weed control treatment significantly affected the RGR at 12 WAS in all the experimental years and combined. Weedy check significantly produced the highest RGR throughout the experimental years and combined, while the other treatments were statistically similar and produced the lowest RGR throughout the experimental years and combined. However, sowing date had no significant effect on the RGR at 12 WAS in all the experimental years and combined. Sowing method had significant effect on RGR at 12 WAS in all the experimental years and combined where dibbling method of sowing produced significantly higher RGR in 2016 (0.02), 2017 (0.02), 2018 (0.02) and combined (0.02) which was statistically similar with drilling method in all the experimental years and combined. The broadcasting method consistently produced the lowest RGR in all the experimental years and combined. Interaction between the treatments were not significant on RGR at 12 WAS throughout the experimental years and combined.

4.1.10 <u>Number of Days to 50% Heading</u>

Effect of weed control treatment, sowing date and sowing method on days to 50% heading of finger millet at Bagauda is shown in Table 57. Weed control treatment significantly affected the number of days to 50% heading in all the experimental years and combined. Weedy check significantly produced the highest number of days to 50% heading throughout the experimental years and combined, while the other treatments were statistically similar in 2016, 2017 and 2018 and produced the lowest number of days to 50% heading. In combined analysis, two hoe

Table 56: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Relative Growth Rate (g g^{-1} $week^{-1}$) at 12 WAS of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	0.01b	0.01b	0.01b	0.01b
Atrazine at 0.8kg a.i. ha^{-1} PE	0.01b	0.01b	0.01b	0.01b
Atrazine at 1.2kg a.i. ha^{-1} PE	0.01b	0.01b	0.01b	0.01b
2,4-D at 0.5kg a.i. ha^{-1} POE	0.01b	0.01b	0.01b	0.01b
2,4-D at 0.75kg a.i. ha^{-1} POE	0.01b	0.01b	0.01b	0.01b
Weedy check	0.02a	0.02a	0.02a	0.02a
Probability level	<.001	<.001	<.001	<.001
SE±	0.001	0.001	0.001	0.001
Sowing Date (D)				
Late June	0.02	0.02	0.02	0.02
Early July	0.02	0.02	0.02	0.02
Late July	0.02	0.01	0.02	0.02
Probability level	0.804	0.759	0.787	0.497
SE±	0.001	0.001	0.001	0.001
Sowing Method (M)				
Dibbling	0.02a	0.02a	0.02a	0.02a
Drilling	0.02a	0.02a	0.02a	0.02a
Broadcasting	0.01b	0.01b	0.01b	0.01b
Probability level	0.022	0.024	0.016	<.001
SE±	0.001	0.001	0.001	0.001
Interaction				
D x M	0.543	0.343	0.511	0.055
D x W	0.403	0.238	0.192	0.102
M x W	0.155	0.181	0.213	0.112
D x M x W	0.327	0.144	0.307	0.061

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 57: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Number of Days to 50% Heading of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	65.7b	65.0b	63.6b	64.8c
Atrazine at 0.8kg a.i. ha^{-1} PE	66.3b	65.7b	64.3b	65.4b
Atrazine at 1.2kg a.i. ha^{-1} PE	66.2b	65.6b	64.2b	65.3b
2,4-D at 0.5kg a.i. ha^{-1} POE	66.3b	65.6b	64.2b	65.4b
2,4-D at 0.75kg a.i. ha^{-1} POE	66.3b	65.6b	64.1b	65.3b
Weedy check	72.2a	71.5a	70.0a	71.2a
Probability level	<.001	<.001	<.001	<.001
SE±	0.23	0.23	0.25	0.14
Sowing Date (D)				
Late June	68.9a	67.9a	66.9a	67.8a
Early July	67.9b	66.8b	64.9b	66.5b
Late July	64.8c	64.9c	63.4c	64.3c
Probability level	<.001	<.001	<.001	<.001
SE±	0.19	0.19	0.13	0.10
Sowing Method (M)				
Dibbling	67.2	66.5	65.5	66.4
Drilling	66.9	66.2	64.9	65.9
Broadcasting	67.5	66.8	64.8	66.4
Probability level	0.420	0.240	0.102	0.221
SE±	0.31	0.30	0.32	0.18
Interaction				
D x M	0.726	0.726	0.071	0.066
D x W	0.055	0.056	0.064	0.094
M x W	0.089	0.088	0.100	0.067
D x M x W	0.082	0.067	0.201	0.111

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

weeding at 3 and 6 WAS recorded the shortest days to 50% heading. Sowing date significantly affect the number of days to 50% heading in all the experimental years and combined. Sowing on late June consistently recorded the highest number of days to50% heading throughout the experimental years and combined, which were followed by drilling methods. Sowing on late July recorded the shortest days to 50% heading throughout the experimental years and combined. Sowing method had no significant effect on number of days to 50% heading in all the experimental years and combined. Interactions between the treatments were not significant on number of days to 50% heading throughout the experimental years and combined.

4.1.11 <u>Number of Days to Physiological Maturity</u>

The effect of weed control treatment, sowing date and sowing method on number of days to physiological maturity of finger millet is presented in Table 58. Weed control treatment had significant effect on number of days to physiological maturity in all the experimental years and combined. The weedy check significantly produced the highest number of days to physiological maturity throughout the experimental years and combined, while the other treatments were statistically similar and recorded the least throughout the experimental years and combined. Sowing date significantly affected the number of days to physiological maturity in all the experimental years and combined where sowing on late June recorded significantly higher number of days to maturity in 2016 (107.4), 2017 (109.0), 2018 (107.0) and combined (107.8), while sowing on late July consistently recorded the least number of days to physiological maturity throughout the experimental years and combined. Sowing method significantly affects the number of days to physiological maturity in 2017 and combined. In 2017, dibbling (106.5) and drilling (106.4) method of sowing recorded significantly higher number of days to physiological maturity, whereas

Table 58: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Number of Days to Physiological Maturity of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	102.1b	104.5b	103.2b	103.2b
Atrazine at 0.8kg a.i. ha^{-1} PE	102.7b	104.7b	103.8b	103.7b
Atrazine at 1.2kg a.i. ha^{-1} PE	102.6b	104.8b	103.6b	103.7b
2,4-D at 0.5kg a.i. ha^{-1} POE	102.6b	104.9b	103.5b	103.7b
2,4-D at 0.75kg a.i. ha^{-1} POE	102.7b	104.9b	103.6b	103.7b
Weedy check	113.0a	112.6a	109.6a	111.7a
Probability level	<.001	<.001	<.001	<.001
SE±	0.24	0.34	0.24	0.16
Sowing Date (D)				
Late June	107.4a	109.0a	107.0a	107.8a
Early July	105.6b	106.8b	105.9a	106.1b
Late July	99.8c	102.3c	100.8b	101.0c
Probability level	<.001	<.001	<.001	<.001
SE±	0.24	0.39	0.29	0.18
Sowing Method (M)				
Dibbling	104.6	106.5a	104.9	105.3a
Drilling	103.7	106.4a	104.0	104.3b
Broadcasting	104.5	105.2b	104.9	105.3a
Probability level	0.108	0.016	0.168	<.001
SE±	0.29	0.30	0.35	0.18
Interaction				
D x M	0.386	0.539	0.232	0.202
D x W	0.280	0.055	0.099	0.200
M x W	0.677	0.124	0.140	0.111
D x M x W	0.200	0.609	0.093	0.061

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

broadcasting method recorded the lowest (105.2). in combined, dibbling (105.3) and broadcasting (105.3) method were at par and recorded significantly higher number of days to physiological maturity, while drilling method recorded the least (104.3). Interactions between the treatments were not significant on number of days to physiological maturity throughout the experimental years and combined.

4.1.12 Weed Cover Score

Effect of weed control treatment, sowing date and sowing method on weed cover score is presented in Table 59. Weed control treatment was found to be significant on weed cover score in all the experimental years and combined where the weedy check produced significantly more weed cover in 2016 (3.78), 2017 (3.77), 2018 (3.70) and combined (3.75) compared to other weed control treatments in the respective years and combined, while two hoe weeding recorded the least weed cover throughout the experimental years and combined. Also, sowing date had significant effect on weed cover score in 2016 only, where sowing on late June significantly produced more weed cover (2.26) which was statistically similar with sowing on late July (2.20). Though, the difference between sowing on early July and late July was not significant. However, sowing method did not significantly affect the weed cover score in all the experimental years and combined.

The interaction between sowing method and weed control treatment was significant in 2016 (Table 60). Drilling method of sowing in unweeded environment produced significantly higher weed cover (4.00) than the other combinations, whereas sowing by dibbling method combined with two hoe weeding at 3 and 6 WAS produced the lowest (0.33).

Table 59: Effects of Sowing Date, Sowing Method and Weed Control Treatment on Weed Cover Score in Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	0.59d	0.70d	0.74d	0.68d
Atrazine at 0.8kg a.i. ha^{-1} PE	2.63b	2.63b	2.82b	2.69b
Atrazine at 1.2kg a.i. ha^{-1} PE	2.56b	2.52b	2.59b	2.56b
2,4-D at 0.5kg a.i. ha^{-1} POE	1.85c	1.70c	1.93c	1.83c
2,4-D at 0.75kg a.i. ha^{-1} POE	1.82c	1.56c	1.70c	1.69c
Weedy check	3.78a	3.77a	3.70a	3.75a
Probability level	<.001	<.001	<.001	<.001
SE±	0.079	0.090	0.118	0.056
Sowing Date (D)				
Late June	2.26a	2.15	2.28	2.23
Early July	2.15b	2.14	2.19	2.16
Late July	2.20ab	2.14	2.27	2.21
Probability level	0.033	1.000	0.600	0.205
SE±	0.019	0.029	0.070	0.026
Sowing Method (M)				
Dibbling	2.24	2.17	2.24	2.22
Drilling	2.22	2.19	2.20	2.20
Broadcasting	2.15	2.09	2.30	2.18
Probability level	0.629	0.728	0.790	0.861
SE±	0.071	0.086	0.095	0.049
Interaction				
D x M	0.613	0.196	0.970	0.381
D x W	0.133	0.968	0.834	0.717
M x W	0.043	0.932	0.713	0.104
D x M x W	0.055	0.136	0.312	0.091

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 60: Interaction of Sowing Method and Weed Control Treatment on Weed Cover Score in Finger Millet at Bagauda, 2016 Rainy Season.

	Sowing Method		
	Dibbling	Drilling	Broadcasting
Weed Control Treatment			
Two hoe weeding at 3 and 6 WAS	0.33i	0.67h	0.78h
Atrazine at 0.8kg a.i. ha^{-1} PE	2.56e	2.56e	2.78d
Atrazine at 1.2kg a.i. ha^{-1} PE	2.56e	2.56e	2.56e
2,4-D at 0.5kg a.i. ha^{-1} POE	2.00f	2.00f	1.56g
2,4-D at 0.75kg a.i. ha^{-1} POE	1.89f	1.89f	1.67g
Weedy check	3.78b	4.00a	3.56c
SE±		0.144	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

4.1.13 Weed Dry Weight

Table 61 shows the effect of weed control treatment, sowing date and sowing method on weed dry weight of finger millet at Bagauda. Weed control treatment was found to be significant on weed dry weight in all the experimental years and combined where weedy check plots consistently produced significantly heavier weed dry weight in 2016 (5030.0kg), 2017 (4899.0kg), 2018 (5391.0kg) and combined (5107.0kg) compared to other weed control treatments in the respective sampling periods, while weeding twice at 3 and 6 WAS recorded the lowest throughout the experimental years and combined. However, the difference between two hoe weeding, 2,4-D at 0.5kg and 2,4-D at 0.75kg a.i. ha^{-1} was not significant in 2017. Sowing date did not significantly affect the weed dry weight in all the experimental years and combined. However, sowing methods significantly affected weed dry weight in 2018 rainy season and combined only, where drilling method produced significantly heavier weed dry weight in 2018 (1851.0kg) and combined (1872.0kg) while sowing using dibbling and broadcasting were at par and produced the lowest weed dry weight. The interaction between sowing method and weed control treatment was significant in 2018 rainy season and combined (Table 62).

The interaction table revealed that, drilling method in unweeded environment produced significantly higher weed dry weight (5831.0kg) than the other combinations. Sowing by dibbling (270.0kg), drilling (90.0kg) and broadcasting (162.0kg) methods combined with two hoe weeding at 3 and 6 WAS were statistically similar and produced the lowest weed dry weight. In the combined however, drilling (5457.0kg) and broadcasting (5270.0g) method in unweeded environment was at par and produced significantly higher weed dry weight than the other combinations. Irrespective of the sowing method employed, two hoe weeding at 3 and 6 WAS

Table 61: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Weed Dry Weight (kg ha^{-1}) in Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	289.0e	279.0c	93.0f	220.0e
Atrazine at 0.8kg a.i. ha^{-1} PE	2409.0b	1993.0b	1860.0b	2087.0b
Atrazine at 1.2kg a.i. ha^{-1} PE	1478.0c	1840.0b	1195.0c	1504.0c
2,4-D at 0.5kg a.i. ha^{-1} POE	820.0d	728.0c	851.0d	776.0d
2,4-D at 0.75kg a.i. ha^{-1} POE	912.0d	657.0c	500.0e	713.0d
Weedy check	5030.0a	4899.0a	5391.0a	5107.0a
Probability level	<.001	<.001	<.001	<.001
SE±	158.20	151.70	113.2	82.90
Sowing Date (D)				
Late June	1857.0	1759.0	1726.0	1781.0
Early July	1749.0	1629.0	1570.0	1649.0
Late July	1863.0	1811.0	1649.0	1774.0
Probability level	0.746	0.415	0.411	0.197
SE±	113.90	89.30	73.60	58.60
Sowing Method (M)				
Dibbling	1823.0	1706.0	1505.0b	1678.0b
Drilling	1883.0	1881.0	1851.0a	1872.0a
Broadcasting	1763.0	1612.0	1589.0b	1655.0b
Probability level	0.800	0.363	0.002	0.038
SE±	126.00	130.00	53.90	58.60
Interaction				
D x M	0.238	0.188	0.057	0.100
D x W	0.980	0.966	0.866	0.554
M x W	0.681	0.055	0.016	<.001
D x M x W	0.220	0.106	0.174	0.070

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 62: Interaction of Sowing Method and Weed Control Treatment on Weed Dry Weight (kg ha^{-1}) in Finger Millet at Bagauda, 2018 Rainy Season and Combined.

	Sowing Method		
	Dibbling	Drilling	Broadcasting
Weed Control Treatment			
2018 rainy season			
Two hoe weeding at 3 and 6 WAS	270.0n	90.0mn	162.0mn
Atrazine at 0.8kg a.i. ha^{-1} PE	1391.0g	2220.0d	1968.0e
Atrazine at 1.2kg a.i. ha^{-1} PE	1073.0h	1669.0f	842.0hij
2,4-D at 0.5kg a.i. ha^{-1} POE	969.0hi	858.0hij	727.0ijk
2,4-D at 0.75kg a.i. ha^{-1} POE	647.0jl	502.0kl	350.0lm
Weedy check	4857.0c	5831.0a	5484.0b
SE±		186.90	
Combined			
Two hoe weeding at 3 and 6 WAS	192.0h	224.0h	244.0h
Atrazine at 0.8kg a.i. ha^{-1} PE	1990.0d	2389.0c	1882.0d
Atrazine at 1.2kg a.i. ha^{-1} PE	1489.0e	1845.0d	1180.0f
2,4-D at 0.5kg a.i. ha^{-1} POE	921.0fg	658.0g	561.0g
2,4-D at 0.75kg a.i. ha^{-1} POE	847.0fg	690.0g	791.0g
Weedy check	4594.0b	5457.0a	5270.0a
SE±		144.40	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

produced significantly the least weed dry weight.

4.1.14 Weed Density

Table 63 shows the effect of weed control treatment, sowing date and sowing method on weed density of finger millet at Bagauda. The effect of weed control treatment was significant on weed density in all the experimental years and combined where the weedy check plots consistently produced significantly higher weed density in 2016 (358.8), 2017 (314.4), 2018 (351.5) and combined (341.6) compared to other weed control treatments in the respective years, while weeding twice at 3 and 6 WAS recorded the least throughout the experimental years and combined. Sowing date significantly affected the weed density in 2018, 2017 and combined. Sowing on late June produced significantly higher weed density in 2016 (138.7), 2017 (136.0) and combined (133.6) while sowing on early and late July produced the least and were at par in the respective years. However, sowing methods significantly affected weed density in 2018 and combined only, where drilling method produced significantly higher weed density in 2018 (111.9) and combined (119.5) than the other sowing method, while broadcasting method produced the least.

The interaction between sowing date and weed control treatment on weed density was significant in the combined (Table 64). The result revealed that sowing on late June in unweeded environment recorded significantly higher weed density (408.2) compared to others, while sowing on late June (15.2), early July (18.1) and late July (12.3) that were weeded twice were at par and recorded the lowest. Table 65 shows the interaction between sowing method and weed control treatment on weed density in 2016, 2017, 2018 and combined. In 2016, drilling method in unweeded environment produced significantly higher weed density (421.0) than the other combinations, while dibbling method of sowing when weeded twice recorded the

Table 63: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Weed Density (m^{-2}) in Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	13.2e	23.9d	8.6d	15.2e
Atrazine at 0.8kg a.i. ha^{-1} PE	149.0b	152.3b	107.8b	134.6b
Atrazine at 1.2kg a.i. ha^{-1} PE	105.8c	125.5b	95.5b	108.9c
2,4-D at 0.5kg a.i. ha^{-1} POE	49.5d	62.1c	57.2c	49.1d
2,4-D at 0.75kg a.i. ha^{-1} POE	58.4d	56.0c	38.3c	52.9d
Weedy check	358.8a	314.4a	351.5a	341.6a
Probability level	<.001	<.001	<.001	<.001
SE±	10.74	10.45	8.82	5.80
Sowing Date (D)				
Late June	138.7a	136.0a	126.1	133.6a
Early July	109.7b	111.9b	103.5	107.1b
Late July	114.0b	116.5b	99.8	111.3b
Probability level	0.002	0.023	0.111	<.001
SE±	2.32	3.83	7.13	2.81
Sowing Method (M)				
Dibbling	123.3	123.5	111.9b	119.5b
Drilling	132.3	134.8	150.2a	139.1a
Broadcasting	106.8	106.2	67.3c	93.4c
Probability level	0.077	0.061	<.001	<.001
SE±	7.23	7.63	5.45	3.95
Interaction				
D x M	0.363	0.360	0.098	0.205
D x W	0.081	0.057	0.056	<.001
M x W	<.001	0.003	<.001	<.001
D x M x W	0.312	0.331	0.512	0.055

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 64: Interaction of Sowing Date and Weed Control Treatment on Weed Density (m^{-2}) in Finger Millet at Bagauda, Combined.

	Sowing Date		
	Late June	Early July	Late July
Weed Control Treatment			
Two hoe weeding at 3 and 6 WAS	15.2g	18.1g	12.3g
Atrazine at 0.8kg a.i.ha^{-1} PE	152.3d	125.5e	131.3e
Atrazine at 1.2kg a.i.ha^{-1} PE	109.9e	106.2e	110.7e
2,4-D at 0.5kg a.i.ha^{-1} POE	57.2f	42.8f	47.3f
2,4-D at 0.75kg a.i.ha^{-1} POE	58.8f	54.3f	45.7f
Weedy check	408.2a	295.9c	320.6b
SE±		9.58	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 65: Interaction of Sowing Method and Weed Control Treatment on Weed Density (m^{-2}) in Finger Millet at Bagauda in 2016, 2017, 2018 and Combined.

	Sowing Date		
	Dibbling	Drilling	Broadcasting
Weed Control Treatment			
2016 rainy season			
Two hoe weeding at 3 and 6 WAS	9.9j	12.3j	17.3j
Atrazine at 0.8kg a.i.ha^{-1} PE	149.de4	169.1d	128.4ef
Atrazine at 1.2kg a.i.ha^{-1} PE	106.2fg	114.8fg	96.3g
2,4-D at 0.5kg a.i.ha^{-1} POE	30.9ij	25.9ij	61.7h
2,4-D at 0.75kg a.i.ha^{-1} POE	50.6hi	50.6hi	74.1h
Weedy check	392.6b	421.0a	263.0c
SE±		18.46	
2017 rainy season			
Two hoe weeding at 3 and 6 WAS	21.0i	22.2i	28.4i
Atrazine at 0.8kg a.i.ha^{-1} PE	154.3e	188.9d	113.6f
Atrazine at 1.2kg a.i.ha^{-1} PE	124.7f	133.3f	118.5f
2,4-D at 0.5kg a.i.ha^{-1} POE	42.0hi	37.0hi	72.8g
2,4-D at 0.75kg a.i.ha^{-1} POE	61.7gh	61.7gh	63.0gh
Weedy check	365.4a	337.0b	240.7c
SE±		18.20	
2018 rainy season			
Two hoe weeding at 3 and 6 WAS	8.6i	3.7i	13.6i
Atrazine at 0.8kg a.i.ha^{-1} PE	64.2fg	191.c4	67.9f
Atrazine at 1.2kg a.i.ha^{-1} PE	103.7e	125.d9	56.8fgh
2,4-D at 0.5kg a.i.ha^{-1} POE	64.2fg	56.8fgh	50.6fgh
2,4-D at 0.75kg a.i.ha^{-1} POE	40.7gh	35.8h	38.3gh
Weedy check	390.1b	487.7a	176.7c
SE±		14.97	
Combined			
Two hoe weeding at 3 and 6 WAS	13.2h	12.8h	19.8h
Atrazine at 0.8kg a.i.ha^{-1} PE	122.6e	183.1d	103.3ef
Atrazine at 1.2kg a.i.ha^{-1} PE	111.5ef	124.7e	90.5f
2,4-D at 0.5kg a.i.ha^{-1} POE	45.7g	39.9g	61.7g
2,4-D at 0.75kg a.i.ha^{-1} POE	51.0g	49.4g	58.4g
Weedy check	373.3b	424.7a	226.8c
SE±		9.98	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

lowest (9.9). Though, the difference between dibbling, drilling and broadcasting method that were weeded twice was not significant. In 2017, dibbling method left unweeded produced significantly higher weed density (365.4) compared to others. Irrespective of the sowing method adopted, weeding twice at 3 and 6 WAS consistently recorded the lowest weed density. Also, in 2018 and combined, sowing using drilling method in unweeded environment recorded significantly highest weed density compared to the other combinations whereas, sowing using all the three methods weeded twice at 3 and 6 WAS recorded the least.

4.1.15 Weed Control Efficiency

Table 66 shows the effect of weed control treatment, sowing date and sowing method on weed control efficiency of finger millet at Bagauda. Weed control treatment was found to be significant on weed control efficiency in all the experimental years and combined. Weeding twice at 3 and 6 WAS consistently produced significantly higher percentage of weed control efficiency in 2016 (95.3%), 2017 (90.3%), 2018 (96.4%) and combined (94.0%) compared to other weed control treatments in the respective years, while weedy check recorded the lowest percentage throughout the experimental years and combined.

Sowing date had no significant effect on weed control efficiency in all the experimental years and combined. However, sowing method significantly affected weed control efficiency in 2016, 2018 and combined. In 2016, drilling method produced significantly higher percentage of weed control efficiency (68.3%), and was at par with dibbling method (64.8%). Sowing using broadcasting method produced the lowest percentage (56.6%) than the other sowing method. In 2018 and combined, dibbling and drilling methods recorded significantly higher percentage of weed control efficiency and were at par, while broadcasting method recorded the least.

Table 66: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Weed Control Efficiency (%) in Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	95.3a	90.3a	96.4a	94.0a
Atrazine at 0.8kg a.i. ha^{-1} PE	52.8d	43.7d	67.8d	54.7d
Atrazine at 1.2kg a.i. ha^{-1} PE	64.9c	52.7c	69.4d	62.4c
2,4-D at 0.5kg a.i. ha^{-1} POE	85.6b	78.9b	79.6c	81.4b
2,4-D at 0.75kg a.i. ha^{-1} POE	80.8b	77.0b	86.3b	81.3b
Weedy check	0.0e	0.0e	0.0e	0.0e
Probability level	<.001	<.001	<.001	<.001
SE±	2.37	2.97	2.01	1.43
Sowing Date (D)				
Late June	65.2	61.9	67.2	64.8
Early July	59.4	50.4	67.0	58.9
Late July	65.1	58.9	65.5	63.2
Probability level	0.432	0.355	0.866	0.188
SE±	3.29	5.11	2.35	2.17
Sowing Method (M)				
Dibbling	64.8ab	56.9	70.0a	63.9a
Drilling	68.3a	62.2	68.7a	66.4a
Broadcasting	56.6b	52.2	61.0b	56.6b
Probability level	0.046	0.206	0.012	<.001
SE±	2.99	3.73	1.92	1.72
Interaction				
D x M	0.447	0.385	0.918	0.103
D x W	0.909	0.566	0.924	0.397
M x W	0.192	0.161	0.003	<.001
D x M x W	0.391	0.598	0.539	0.059

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

The interaction between sowing method and weed control treatment on weed control efficiency was significant in 2018 and combined. From Table 67, the result indicated that in 2018, dibbling (97.59%) and drilling (99.22%) methods that were weeded twice produced significantly higher percentage of weed control compared to other combinations. Sowing using all the three methods left unweeded were at par and produced the lowest percent of weed control efficiency. In the combined, drilling method that weeded twice at 3 and 6 WAS (96.88%) was at par with dibbling method weeded twice, and recorded significantly higher percentage of weed control than the other combinations, while sowing using all the three method in unweeded plots produced the lowest percent of weed control efficiency.

4.1.16 Weed Control Index

Effect of weed control treatment, sowing date and sowing method on weed control index in finger millet at Bagauda is presented in Table 68. Weed control treatment was found to be significant on weed control index in all the experimental years and combined. Weeding twice at 3 and 6 WAS consistently produced significantly higher weed control index in 2016 (93.3%), 2017 (93.4%), 2018 (98.1%) and combined (94.9%) compared to other weed control treatments in the respective years, while weedy check recorded the least weed control index throughout the experimental years and combined.

Sowing date had no significant effect on weed control index in all the experimental years and combined. Sowing method significantly affected weed control efficiency in combined only, where broadcasting (67.5%) was at par with drilling method (63.5%) and produced significantly higher weed control index than dibbling method which recorded the lowest percentage (61.8%). The interactions between the treatments were not significant in all the experimental years and combined.

Table 67: Interaction of Sowing Method and Weed Control Treatment on Weed Control Efficiency (%) in Finger Millet at Bagauda in 2018 and Combined.

	Sowing Date		
	Dibbling	Drilling	Broadcasting
Weed Control Treatment			
	2018 rainy season		
Two hoe weeding at 3 and 6 WAS	97.59a	99.22a	92.34b
Atrazine at 0.8kg a.i.ha^{-1} PE	81.55c	60.25h	61.60ch
Atrazine at 1.2kg a.i.ha^{-1} PE	69.80ef	72.28e	65.55fh
2,4-D at 0.5kg a.i.ha^{-1} POE	81.29c	88.22b	69.96ef
2,4-D at 0.75kg a.i.ha^{-1} POE	90.04b	92.25b	76.49d
Weedy check	0.00i	0.00i	0.00i
SE±		3.709	
	Combined		
Two hoe weeding at 3 and 6 WAS	95.17ab	96.88a	89.97bc
Atrazine at 0.8kg a.i.ha^{-1} PE	57.84ef	54.55ef	51.84f
Atrazine at 1.2kg a.i.ha^{-1} PE	60.81e	68.33d	57.63ef
2,4-D at 0.5kg a.i.ha^{-1} POE	85.05c	90.62bc	68.62d
2,4-D at 0.75kg a.i.ha^{-1} POE	84.65c	87.95c	71.39d
Weedy check	0.00g	0.00g	0.00g
SE±		2.842	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 68: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Weed Control Index (%) in Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	93.3a	93.4a	98.1a	94.9a
Atrazine at 0.8kg a.i. ha^{-1} PE	47.0d	54.5c	64.4e	55.3d
Atrazine at 1.2kg a.i. ha^{-1} PE	66.7c	58.1c	76.3d	67.0c
2,4-D at 0.5kg a.i. ha^{-1} POE	81.9b	85.3b	83.1c	83.5b
2,4-D at 0.75kg a.i. ha^{-1} POE	80.1b	83.8b	90.7b	84.8b
Weedy check	0.0e	0.0d	0.0f	0.0e
Probability level	<.001	<.001	<.001	<.001
SE±	2.26	2.11	1.62	1.16
Sowing Date (D)				
Late June	61.2	63.3	68.6	64.1
Early July	59.5	61.1	67.8	62.8
Late July	63.9	64.0	69.9	65.9
Probability level	0.355	0.613	0.654	0.145
SE±	1.91	1.95	1.59	1.05
Sowing Method (M)				
Dibbling	57.8	59.0	68.5	61.8b
Drilling	61.8	61.2	67.6	63.5ab
Broadcasting	64.9	67.3	70.2	67.5a
Probability level	0.286	0.138	0.581	0.031
SE±	3.02	2.79	1.73	1.49
Interaction				
D x M	0.449	0.491	0.676	0.086
D x W	0.994	0.999	0.822	0.937
M x W	0.597	0.056	0.222	0.100
D x M x W	0.551	0.197	0.704	0.081

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

4.1.17 Weed Species Composition

The weed species composition comprising of grasses, broadleaved and sedges weed species in association with finger millet production in the experimental sites are presented in Table 69. A total of twenty eight (28) weeds species were identified, out of which eighteen (18) species appeared in all the experimental years. The most dominant species among the narrow leaved across the years are; *Eleucine indica*, *Cynodon dactylon, Digitaria horizontalis, Digitaria ciliaris* and *Rottboellia chochinchinensis,* while among the broadleaved is *Ageratum conyzoides.* The most dominant sedges across the experimental year are *Cyperus esculentus* and *Cyperus rotundus*. The species *Setaria pumila, Euphorbia prostra* and *Leucas aspera* appeared only in 2016, while *Setaria barbata* appeared only in 2017 rainy season. Also, the species *Eragrostic ciliaris*, *Amaranthus spinosus* and *Cleome viscosa* appeared in 2018 rainy season only.

4.1.18 Number of Tillers

Effect of weed control treatment, sowing date and sowing method on number of tillers per metre square is presented in Table 70. Weed control treatment significantly affected the number of tillers (m^{-2}) in all the experimental years and combined. Application of 2,4-D at both rate (0.5 and 0.75kg a.i. ha^{-1}) and plots weeded twice at 3 and 6 WAS were similar and produced significantly the highest number of tillers in all the experimental years and combined while the weedy check consistently produced the least number of tillers in the respective years (182.1, 217.0 and 211.7) and combined (203.6). Sowing date had no significant effect on the numbers of tillers in all the experimental years and combined. On the other hand, sowing method significantly affected the numbers of tillers in 2016, 2017 and combined. Broadcasting method produced significantly higher number of tillers in

Table 69: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Weed Species Composition in Finger Millet at Bagauda in 2016, 2017 and 2018 Rainy Seasons.

Weed Species	Level of Occurrence		
	2016	2017	2018
Narrow leaf species			
Cynodon dactylon	**	**	**
Digitaria horizontalis	**	**	***
Digitaria ciliaris	**	**	**
Echinochloa colona L.	*	*	*
Eleucine indica	***	***	***
Eragrostic ciliaris L.	-	-	**
Panicum maximum	*	*	*
Pennisetum pedicellatum	**	**	**
Rottboellia cochinchinensis	**	**	***
Setaria barbata Lam.	-	**	-
Setaria pumila	*	-	-
Broad leaf species			
Achanthospermum hispidum	*	*	-
Ageratum conyzoides	**	**	**
Amaranthus spinosus	-	-	*
Senna obtusifolia	*	*	*
Senna occidentalis L.	*	*	*
Cleome viscosa L.	-	-	*
Corchorus oltorius L.	-	*	*
Cummelina benghalensis	*	*	-
Desmodium tortuosum	**	*	*
Euphorbia hirta L.	*	*	*
Euphorbia prostra	*	-	-
Leucas aspera	*	-	-
Physalis minima L.	*	*	*
Portulaca oleracea	*	*	**
Tridex procumbens L.	**	-	*
Sedges species			
Cyperus esculentus	***	***	***
Cyperus rotundus	***	***	***

- = absent, * = low occurance (1 – 39%), ** = Moderate occurance (40 – 59%), *** = high occurance (60 – 100%)

Table 70: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Number of Tillers (m^{-2}) of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	372.3a	378.5a	384.3a	374.4a
Atrazine at 0.8kg a.i. ha^{-1} PE	274.4b	306.5b	300.2b	293.7b
Atrazine at 1.2kg a.i. ha^{-1} PE	280.4b	324.4b	317.7b	307.5b
2,4-D at 0.5kg a.i. ha^{-1} POE	391.4a	410.4a	397.6a	399.8a
2,4-D at 0.75kg a.i. ha^{-1} POE	397.5a	407.7a	416.0a	407.1a
Weedy check	182.1c	217.0c	211.7c	203.6c
Probability level	<.001	<.001	<.001	<.001
SE±	16.51	16.88	18.44	9.99
Sowing Date (D)				
Late June	331.3	343.2	350.6	341.6
Early July	300.8	348.8	342.9	331.2
Late July	317.1	329.3	320.4	322.2
Probability level	0.217	0.780	0.278	0.309
SE±	10.04	20.37	11.74	8.52
Sowing Method (M)				
Dibbling	283.0b	300.8b	300.0	294.6b
Drilling	307.2b	331.6b	348.0	328.9c
Broadcasting	358.9a	389.9a	365.8	371.5a
Probability level	<.001	<.001	0.058	<.001
SE±	10.73	11.91	17.84	8.00
Interaction				
D x M	0.576	0.550	0.012	<.001
D x W	0.043	0.027	0.063	<.001
M x W	0.449	0.776	0.827	0.096
D x M x W	0.957	0.963	0.956	0.303

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

2016 (358.9), 2017 (389.9) and combined (371.5) while dibbling method recorded the least (283.0, 300.8 and 294.6) in 2016, 2017 and combined, respectively. Though, the difference between dibbling and drilling methods in 2016 and 2017 were not significant. The interactions between sowing date and sowing method on number of tillers was significant in 2017 and combined. Also, interaction between sowing date and weed control treatments was significant in 2017, 2018 and combined.

Table 71 presents the interaction between sowing date and sowing method on number of tillers (m^{-2}) at Bagauda in 2018 rainy season and combined. In 2018, sowing on late June using broadcasting method produced significantly higher number of tillers (419.8) which was statistically the same with sowing on early July using drilling method (400.7) and sowing on late July using broadcasting method (388.7). On the other hand, sowing on late July using dibbling method produced significantly lowest number of tillers (232.4). In combined analysis, sowing on late June (404.7) and late July (380.4) using broadcasting method were at par and recorded significantly higher number of tillers, while sowing on late July using dibbling method recorded the least (265.7).

Table 72 shows that sowing on late June treated with 2,4-D at the rate of 0.75kg a.i. ha^{-1} produced significantly highest number of tillers (461.1) in 2016 rainy season, whereas sowing on late June, early July and late July in weedy check produced the lowest number of tillers. In 2017, sowing on late June treated with 2,4-D at the rate of 0.75kg a.i. ha^{-1} produced significantly higher number of tillers (469.1) which was statistically similar with sowing on late June (436.1) and early July (450.2) treated with 2,4-D at 0.5kg a.i. ha^{-1}. Irrespective of the sowing date, weedy check consistently produced the lowest number of tillers. In combined, sowing on late June treated with 2,4-D at the rate of 0.75kg a.i. ha^{-1} produced significantly higher number

Table 71: Interaction of Sowing Date and Sowing Method on Number of Tillers (m^{-2}) of Finger Millet at Bagauda in 2018 and Combined.

	Sowing Date		
	Late June	Early July	Late July
Sowing Method			
	2018 Rainy season		
Dibbling	328.6b	339.1b	232.4c
Drilling	303.2b	400.7a	339.9b
Broadcasting	419.8a	288.9b	388.7a
SE±	27.83		
	Combined		
Dibbling	307.4c	310.7c	265.7d
Drilling	312.8c	353.4bc	320.6c
Broadcasting	404.7a	329.5c	380.4ab
SE±		14.16	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 72: Interaction of Sowing Date and Weed Control Treatment on Number of Tillers (m^{-2}) of Finger Millet at Bagauda in 2016, 2017 and Combined.

	Sowing Date		
	Late June	Early July	Late July
Weed Control Treatment			
2016 rainy season			
Two hoe weeding at 3 and 6 WAS	380.0c	359.4cd	377.4c
Atrazine at 0.8kg a.i. ha^{-1} PE	260.3f	233.2f	329.8de
Atrazine at 1.2kg a.i. ha^{-1} PE	266.4f	261.3f	313.3e
2,4-D at 0.5kg a.i. ha^{-1} POE	428.1b	416.0b	330.2de
2,4-D at 0.75kg a.i. ha^{-1} POE	461.1a	370.3cd	361.1cd
Weedy check	191.1g	190.7g	164.6g
SE±		18.20	
2017 rainy season			
Two hoe weeding at 3 and 6 WAS	388.0b	379.4b	368.1b
Atrazine at 0.8kg a.i. ha^{-1} PE	268.3d	312.7c	338.6bc
Atrazine at 1.2kg a.i. ha^{-1} PE	274.4d	337.3bc	361.4b
2,4-D at 0.5kg a.i. ha^{-1} POE	436.1a	450.2a	345.0bc
2,4-D at 0.75kg a.i. ha^{-1} POE	469.1a	390.3b	363.6b
Weedy check	223.0e	228.9e	199.1e
SE±		26.43	
Combined			
Two hoe weeding at 3 and 6 WAS	384.2cd	379.5cde	371.4cde
Atrazine at 0.8kg a.i. ha^{-1} PE	269.2g	281.3g	330.7ef
Atrazine at 1.2kg a.i. ha^{-1} PE	275.2g	306.9fg	340.4c-f
2,4-D at 0.5kg a.i. ha^{-1} POE	433.9b	431.3b	334.3def
2,4-D at 0.75kg a.i. ha^{-1} POE	475.0a	388.4c	357.8cde
Weedy check	212.3h	199.7h	198.9h
SE±		14.16	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

of tillers (475.0), while sowing on late June (212.3), early July (199.7) and late July (198.9) in weedy check produced the lowest.

4.1.19 Number of Fingers Plant^{-1}

Table 73 presents the effect of weed control treatment, sowing date and sowing method on number of fingers plant^{-1}. Weed control treatment significantly affected the number of fingers plant^{-1} in all the experimental years and combined. Two hoe weeding at 3 and 6 WAS significantly produced the highest number of fingers plant^{-1} in 2016 (9.30), 2017 (14.86), 2018 (13.24) and combined (12.29) while weedy check consistently produced the lowest number of fingers plant^{-1} throughout the experimental years and combined. The difference between two hoe weeding at 3 and 6 WAS, application of atrazine at 0.8kg a.i. ha^{-1}, application of 2,4-D at 0.5kg a.i. ha^{-1} and application of 2,4-D at 0.75kg a.i. ha^{-1} in 2016 was not significant.

Sowing date significantly affected the number of fingers plant^{-1} in 2016 and combined where sowing on late June (10.30) and early July (9.00) produced significantly more number of fingers plant^{-1} than sowing on late July which recorded the least number of fingers plant^{-1} (4.87). Similar trend was observed in the combined. Also, sowing method had significant effect on the number of fingers plant^{-1} in all the experimental years and combined. In 2016, dibbling (8.59) and drilling (8.43) method produced significantly higher number of fingers plant^{-1}, while broadcasting method recorded the least (7.14). In 2017 (13.13), 2018 (12.21) and combined (11.32), dibbling method proved to have produced the highest number of fingers plant^{-1}, while broadcasting method recorded the least (7.34, 9.16 and 7.83) in 2017, 2018 and combined, respectively. The interactions between sowing date and sowing method on number of fingers plant^{-1} was significant in 2016 and 2018. Also, interaction between sowing date and weed control treatments was significant in 2017, 2018 and combined.

Table 73: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Number of Fingers Plant^{-1} of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	9.30a	14.86a	13.24a	12.29a
Atrazine at 0.8kg a.i. ha^{-1} PE	8.32ab	9.31b	9.83c	9.14b
Atrazine at 1.2kg a.i. ha^{-1} PE	7.78b	10.03b	10.75bc	9.58b
2,4-D at 0.5kg a.i. ha^{-1} POE	8.84ab	9.39b	11.42b	9.85b
2,4-D at 0.75kg a.i. ha^{-1} POE	8.15ab	9.62b	11.01bc	9.59b
Weedy check	5.93c	7.42c	7.88d	7.08c
Probability level	<.001	<.001	<.001	<.001
SE±	0.315	0.477	0.357	0.229
Sowing Date (D)				
Late June	10.30a	9.93	10.98	10.41a
Early July	9.00a	11.78	9.73	10.17a
Late July	4.87b	8.60	11.35	8.19b
Probability level	0.002	0.187	0.077	0.003
SE±	0.456	0.986	0.372	0.381
Sowing Method (M)				
Dibbling	8.59a	13.13a	12.21a	11.32a
Drilling	8.43a	9.84b	10.70b	9.62b
Broadcasting	7.14b	7.34c	9.16c	7.83c
Probability level	0.006	<.001	<.001	<.001
SE±	0.268	0.657	0.304	0.262
Interaction				
D x M	<.001	0.624	0.017	0.112
D x W	<.001	0.104	<.001	<.001
M x W	0.061	0.121	0.254	0.065
D x M x W	0.056	0.860	0.059	0.117

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

Table 74 shows the interaction between sowing date and sowing method on number of fingers plant^{-1} at Bagauda in 2016 and 2018 rainy season. In 2016, sowing on late June using dibbling method produced significantly higher number of fingers plant^{-1} (11.93) while sowing on late July using broadcasting method recorded the least (3.47). Also, in 2018 sowing on late June using dibbling method produced significantly higher number of fingers plant $^{-1}$ (13.28) while sowing on early July using broadcasting method recorded the least (7.56). From Table 75, the result indicated that sowing on early July weeded twice produced significantly highest number of fingers plant^{-1} (11.56) in 2016 rainy season, which was statistically similar with sowing on late June weeded twice (11.20) and sowing on late June treated with atrazine at the rate of 0.8kg a.i. ha^{-1}. Sowing on late July in a weedy check (3.96) was at par with sowing on late July treated with 2,4-D at the rate of 0.75kg a.i. ha^{-1} and produced the lowest number of fingers. In 2018, sowing on late June (13.28), early July (13.64) and late July (12.80) weeded twice were at par and produced significantly higher number of finger plant^{-1}, while sowing on early July in weedy check produced the lowest (5.19). In the combined analysis, sowing on early July weeded twice at 3 and 6 WAS recorded significantly higher number of fingers plant^{-1} (14.41) while sowing on late July under weedy check recorded the lowest (6.21).

4.1.20 Panicle Weight Plant^{-1}

Table 76 presents the effect of weed control treatment, sowing date and sowing method on panicle weight plant^{-1} of finger millet at Bagauda. Weed control treatment significantly affected panicle weight plant^{-1} in all the experimental years and combined. In 2016, application of atrazine at the rate of 0.8kg a.i. ha^{-1} (8.9g), 2,4-D at 0.5kg a.i. ha^{-1} (8.4g) and hoe weeding at 3 and 6 WAS (8.4g) produced significantly heavier panicles than all other weed control treatments. In 2017, 2018 and combined,

Table 74: Interaction of Sowing Date and Sowing Method on Number of Fingers Plant^{-1} of Finger Millet at Bagauda in 2016 and 2018 Rainy Seasons.

	Sowing Date		
	Late June	Early July	Late July
Sowing Method			
	2016 Rainy season		
Dibbling	11.93a	10.28b	3.47g
Drilling	10.53b	9.51c	5.99f
Broadcasting	8.44d	7.21e	6.01f
SE±		0.593	
	2018 Rainy season		
Dibbling	13.28a	11.77b	11.57b
Drilling	10.88b	9.86c	11.36b
Broadcasting	8.79d	7.56e	11.13b
SE±		0.569	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 75: Interaction of Sowing Date and Weed Control Treatment on Number of Fingers Plant^{-1} of Finger Millet at Bagauda in 2016, 2018 Rainy Seasons and Combined.

	Sowing Date		
	Late June	Early July	Late July
Weed Control Treatment			
	2016 rainy season		
Two hoe weeding at 3 and 6 WAS	11.20a	11.56a	6.24e
Atrazine at 0.8kg a.i. ha^{-1} PE	11.01a	7.71d	6.65e
Atrazine at 1.2kg a.i. ha^{-1} PE	10.10bc	9.36c	4.11f
2,4-D at 0.5kg a.i. ha^{-1} POE	10.72b	9.61c	6.43e
2,4-D at 0.75kg a.i. ha^{-1} POE	11.06a	9.84c	3.56f
Weedy check	7.71d	5.91e	3.96f
SE±		0.675	
	2018 rainy season		
Two hoe weeding at 3 and 6 WAS	13.28ab	13.64a	12.80ab
Atrazine at 0.8kg a.i. ha^{-1} PE	11.69c	8.67f	9.13f
Atrazine at 1.2kg a.i. ha^{-1} PE	10.78cde	10.06e	11.41cd
2,4-D at 0.5kg a.i. ha^{-1} POE	11.41cd	10.29e	12.56b
2,4-D at 0.75kg a.i. ha^{-1} POE	11.74c	10.53de	10.77cde
Weedy check	6.99g	5.19h	11.44cd
SE±		0.676	
	Combined		
Two hoe weeding at 3 and 6 WAS	12.68b	14.41a	10.03cde
Atrazine at 0.8kg a.i. ha^{-1} PE	10.72cd	8.14f	7.78fg
Atrazine at 1.2kg a.i. ha^{-1} PE	10.29cd	9.83de	9.03e
2,4-D at 0.5kg a.i. ha^{-1} POE	10.35cd	10.31cd	9.09e
2,4-D at 0.75kg a.i. ha^{-1} POE	11.13c	10.39cd	7.72fg
Weedy check	7.23fg	6.94g	6.21h
SE±		0.774	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 76: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Panicle Weight (g) Plant^{-1} of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	8.4a	11.8a	12.6a	11.0a
Atrazine at 0.8kg a.i. ha^{-1} PE	6.9b	9.3b	10.0b	8.8c
Atrazine at 1.2kg a.i. ha^{-1} PE	8.9a	9.4b	10.3b	9.6b
2,4-D at 0.5kg a.i. ha^{-1} POE	8.4a	10.0b	10.8b	9.7b
2,4-D at 0.75kg a.i. ha^{-1} POE	6.7b	9.3b	10.1b	8.7c
Weedy check	6.2b	7.7c	8.5c	7.5d
Probability level	<.001	<.001	<.001	<.001
SE±	0.41	0.42	0.42	0.24
Sowing Date (D)				
Late June	8.1	10.4a	10.8	9.8a
Early July	7.7	9.9a	10.4	9.3a
Late July	7.0	8.5b	10.0	8.6b
Probability level	0.210	0.015	0.129	<.001
SE±	0.35	0.25	0.22	0.23
Sowing Method (M)				
Dibbling	7.8ab	12.5a	13.3a	11.3a
Drilling	8.5a	8.4b	9.2b	8.7b
Broadcasting	6.5b	8.0b	8.6b	7.7c
Probability level	0.039	<.001	<.001	<.001
SE±	0.49	0.43	0.40	0.16
Interaction				
D x M	0.170	0.833	0.572	0.243
D x W	<.001	0.002	0.002	<.001
M x W	0.111	0.157	0.108	<.001
D x M x W	0.376	0.829	0.704	1.000

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

weeding twice at 3 and 6 WAS produced significantly heavier panicle (11.8, 12.6 and 11.0g, respectively) while weedy check consistently produced the lightest.

Sowing date significantly affected the panicle weight plant^{-1} in 2017 and combined. In 2017, sowing on late June (10.4) and early July (9.9g) recorded significantly heavier panicles, while sowing on late July recorded the lightest (8.5g). Similar trend was observed in combined. Sowing method had significant effect on panicle weight plant^{-1} in all the experimental years and combined. In 2016, drilling method produced significantly heavier panicle (8.5g) which was statistically similar with dibbling method (7.8g) while broadcasting method produced the lightest (6.5g). Also, dibbling method produced significantly heavier panicle in 2017 (12.5g), 2018 (13.3g) and combined (11.3g), whereas dibbling and drilling method were at par in 2017 and 2018 and recorded the lightest panicle. In combined, broadcasting method produced significantly lighter (7.7g) panicle. The interactions between sowing date and weed control treatment on panicle weight plant^{-1} was significant in 2016, 2017, 2018 and combined. Also, the interaction between sowing method and weed control treatment was significant in combined analysis.

Table 77 shows that sowing on late June combined with weeding twice at 3 and 6 WAS recorded significantly heavier panicle in 2016 (11.42g) rainy season, whereas sowing on late July in unweeded environment recorded the lightest (5.10g). In 2017, sowing on late June (13.58g) and early July (13.35g) combined with weeding twice at 3 and 6 WAS were statistically similar and recorded the significantly heavier panicle plant^{-1}, whereas sowing on early July (7.23g) and late July (7.19g) in unweeded environment recorded the lightest. In 2018, sowing on late June combined with weeding twice produced significantly heavier panicle (14.04) while sowing on late June (7.65g) and early July (7.69g) in unweeded environment was at par and

Table 77: Interaction of Sowing Date and Weed Control Treatment on Panicle Weight (g) Plant^{-1} of Finger Millet at Bagauda in 2016, 2017, 2018 and Combined.

	Sowing date		
	Late June	Early July	Late July
Weed Control Treatment			
	2016 rainy season		
Two hoe weeding at 3 and 6 WAS	11.42a	9.99b	6.22de
Atrazine at 0.8kg a.i. ha^{-1} PE	7.84c	7.52c	5.52e
Atrazine at 1.2kg a.i. ha^{-1} PE	7.67c	7.45c	10.22b
2,4-D at 0.5kg a.i. ha^{-1} POE	9.34b	7.50c	8.38c
2,4-D at 0.75kg a.i. ha^{-1} POE	7.22cd	7.22cd	5.74e
Weedy check	6.23de	6.27de	5.01f
SE±		0.736	
	2017 rainy season		
Two hoe weeding at 3 and 6 WAS	13.58a	13.35a	8.51ef
Atrazine at 0.8kg a.i. ha^{-1} PE	10.19c	9.87cd	7.92f
Atrazine at 1.2kg a.i. ha^{-1} PE	10.02cd	9.42cde	8.84def
2,4-D at 0.5kg a.i. ha^{-1} POE	11.69b	9.85cd	8.42ef
2,4-D at 0.75kg a.i. ha^{-1} POE	9.58cde	9.57cde	8.83def
Weedy check	8.70def	7.23g	7.19g
SE±		0.712	
	2018 rainy season		
Two hoe weeding at 3 and 6 WAS	14.04a	12.18b	9.97c
Atrazine at 0.8kg a.i. ha^{-1} PE	10.65c	10.04c	9.38c
Atrazine at 1.2kg a.i. ha^{-1} PE	10.48c	10.23c	10.30c
2,4-D at 0.5kg a.i. ha^{-1} POE	12.15b	10.31c	9.88c
2,4-D at 0.75kg a.i. ha^{-1} POE	10.04c	10.03c	10.29c
Weedy check	7.65d	7.69d	10.16c
SE±		0.696	
	Combined		
Two hoe weeding at 3 and 6 WAS	12.61a	12.38a	8.24cd
Atrazine at 0.8kg a.i. ha^{-1} PE	9.56c	9.08cd	7.75de
Atrazine at 1.2kg a.i. ha^{-1} PE	9.39c	8.90cd	10.72b
2,4-D at 0.5kg a.i. ha^{-1} POE	11.06b	9.22c	8.57cd
2,4-D at 0.75kg a.i. ha^{-1} POE	8.95cd	8.94cd	8.73cd
Weedy check	7.02e	7.06e	8.73cd
SE±		0.450	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

recorded the lightest. In combined analysis, sowing on late June (12.61g) and early July (12.38g) combined with weeding twice at 3 and 6 WAS were statistically similar and recorded significantly heavier panicle plant^{-1} whereas sowing on late June (7.02g) and early July (7.06g) in unweeded environment recorded the lightest. From Table 78, sowing using dibbling method that was weeded twice at 3 and 6 WAS produced significantly heavier panicle (14.01g) while broadcasting (6.30g) and drilling method under weedy check recorded the lightest.

4.1.21 <u>1000 Grain Weight</u>

Table 79 presents the effect of weed control treatment, sowing date and sowing method on 1000 grain weight of finger millet. Weed control treatment significantly affected 1000 grains weight in all the experimental years and combined. In 2016, two hoe weeding at 3 and 6 WAS (2.06g) and atrazine at 1.2kg a.i. ha^{-1} (2.08g) produced significantly heavier 1000 grains which was statistically similar with 2,4-D at 0.5kg a.i. ha^{-1} (1.96g). Weedy check (1.46g) was at par with application of atrazine at 0.8kg (1.58g) and produced significantly lighter panicle plant^{-1}. In 2017, 2018 and combined, weeding twice produced significantly heavier 1000 grains (2.57, 2.41 and 2.36g, respectively) while weedy check consistently produced the lightest 1000 grain in 2017 (1.92g), 2018 (1.88g) and combined (1.77g).

Sowing date significantly affected 1000 grain weight in 2017, 2018 and combined. In 2017, sowing on late June (2.39g) and late July (2.38g) produced significantly heavier 1000 grains while sowing on early July produced the lightest (2.05g). In 2018 and combined, sowing on late June (2.38 and 2.25g, respectively) produced significantly heavier 1000 grains while sowing on early July produced the lightest. The difference between sowing on early July and late July was not significant in 2018. Sowing method had significant effect on 1000 grains weight of finger millet

Table 78: Interaction of Sowing Date and Weed Control Treatment on Panicle Weight (g) Plant^{-1} of Finger Millet at Bagauda Combined.

	Sowing Method		
	Dibbling	Drilling	Broadcasting
Weed Control Treatment			
Two hoe weeding at 3 and 6 WAS	14.01a	9.51de	9.72cde
Atrazine at 0.8kg a.i. ha^{-1} PE	10.25cd	9.38de	7.76fg
Atrazine at 1.2kg a.i. ha^{-1} PE	11.85b	9.21de	7.96fg
2,4-D at 0.5kg a.i. ha^{-1} POE	10.78c	8.73ef	9.35de
2,4-D at 0.75kg a.i. ha^{-1} POE	10.85c	8.36ef	7.40g
Weedy check	9.71cde	6.80h	6.30h
SE±		0.450	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 79: Effects of Weed Control Treatment, Sowing Date and Sowing Method on 1000 Grain Weight (g) of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	2.06a	2.57a	2.41a	2.36a
Atrazine at 0.8kg a.i. ha^{-1} PE	1.58c	2.29b	2.05bc	2.00c
Atrazine at 1.2kg a.i. ha^{-1} PE	2.08a	2.29b	2.16b	2.18b
2,4-D at 0.5kg a.i. ha^{-1} POE	1.96ab	2.27b	2.19b	2.15b
2,4-D at 0.75kg a.i. ha^{-1} POE	1.84b	2.26b	2.20b	2.10bc
Weedy check	1.46c	1.92c	1.88c	1.77d
Probability level	<.001	<.001	<.001	<.001
SE±	0.046	0.067	0.069	0.037
Sowing Date (D)				
Late June	1.99	2.39a	2.39a	2.25a
Early July	1.72	2.05b	2.07b	1.95c
Late July	1.79	2.38a	1.99b	2.08b
Probability level	0.119	0.013	0.009	<.001
SE±	0.071	0.049	0.049	0.033
Sowing Method (M)				
Dibbling	1.89a	2.34	2.20	2.15a
Drilling	1.91a	2.27	2.09	2.11ab
Broadcasting	1.68b	2.21	2.16	2.03b
Probability level	0.027	0.174	0.417	0.029
SE±	0.057	0.046	0.056	0.030
Interaction				
D x M	0.008	0.043	0.970	0.125
D x W	<.001	0.443	<.001	<.001
M x W	0.351	0.551	0.245	0.112
D x M x W	0.056	0.188	0.680	0.056

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

in 2016 and combined. In 2016, dibbling (1.89g) and drilling (1.91g) method significantly produced heavier 1000 grain weight while broadcasting method produced the lightest (1.68g). Similar trend was observed in combined analysis.

The interactions between sowing date and sowing method on 1000 grain weight was significant in 2016 and 2017 rainy seasons (Table 80). The result indicated that in 2016, sowing on late June using dibbling method produced significantly heavier 1000 grains (2,17g) while sowing on late July using broadcasting method produced the least weight (1.37g). In 2017, sowing on late June and late July irrespective of the sowing method produced significantly heavier 1000 grains, while sowing on early July using broadcasting method produced the lightest (1.94g). Also, interaction between sowing date and weed control treatment was significant in 2016, 2018 and combined (Table 81). Sowing on late June combined with two hoe weeding at 3 and 6 WAS recorded significantly heavier 1000 grain (2.47g) while sowing on late July in unweeded environment recorded the lightest (1.10g). In 2018, Sowing on late June combined with two hoe weeding at 3 and 6 WAS recorded significantly heavier 1000 grain (2.87g), while sowing on early July (1.68g) and late June (1.77g) under weedy check recorded the lightest. In combined, sowing on late June combined with two hoe weeding at 3 and 6 WAS recorded significantly heavier 1000 grain (2.73g), while sowing on late June (1.63g) and early July (1.54g) under weedy check recorded the lightest.

4.1.22 Panicle Weight

Effect of weed control treatment, sowing date and sowing method on panicle weight hectare^{-1} is presented in Table 82. Weed control treatment significantly affected panicle weight hectare^{-1} in all the experimental years and combined. In 2016, two hoe weeding at 3 and 6 WAS produced significantly heavier panicle (1235.0kg)

Table 80: Interaction of Sowing Date and Sowing Method on 1000 Grain Weight (g) of Finger Millet at Bagauda in 2016 and 2017 Rainy Seasons.

	Sowing Date		
	Late June	Early July	Late July
Sowing Method			
	2016 Rainy season		
Dibbling	2.17a	1.85cd	1.79d
Drilling	1.91c	1.66e	2.04b
Broadcasting	2.01b	1.65e	1.37f
SE±		0.108	
	2017 Rainy season		
Dibbling	2.44a	2.11b	2.47a
Drilling	2.31a	2.10b	2.40a
Broadcasting	2.41a	1.94c	2.28a
SE±		0.082	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 81: Interaction of Sowing Date and Weed Control Treatment on 1000 Grain Weight (g) of Finger Millet at Bagauda in 2016, 2018 and Combined.

	Sowing Date		
	Late June	Early July	Late July
Weed Control Treatment			
	2016 rainy season		
Two hoe weeding at 3 and 6 WAS	2.47a	2.14b	1.56h
Atrazine at 0.8kg a.i. ha^{-1} PE	1.98cd	1.68g	1.73fg
Atrazine at 1.2kg a.i. ha^{-1} PE	2.18b	1.67g	2.38a
2,4-D at 0.5kg a.i. ha^{-1} POE	2.00cd	1.78fg	2.09ab
2,4-D at 0.75kg a.i. ha^{-1} POE	1.92de	1.78fg	1.83eg
Weedy check	1.37i	1.28i	1.10j
SE±		0.101	
	2018 rainy season		
Two hoe weeding at 3 and 6 WAS	2.87a	2.54b	1.81g
Atrazine at 0.8kg a.i. ha^{-1} PE	2.38c	1.85fg	1.92fg
Atrazine at 1.2kg a.i. ha^{-1} PE	2.58b	2.02ef	1.89fg
2,4-D at 0.5kg a.i. ha^{-1} POE	2.40c	2.18de	1.98fg
2,4-D at 0.75kg a.i. ha^{-1} POE	2.32cd	2.18de	2.11e
Weedy check	1.77gh	1.68h	2.20de
SE±		0.120	
	Combined		
Two hoe weeding at 3 and 6 WAS	2.73a	2.41b	1.94ghi
Atrazine at 0.8kg a.i. ha^{-1} PE	2.24cd	1.79i	1.97fgh
Atrazine at 1.2kg a.i. ha^{-1} PE	2.44b	1.85hi	2.24cd
2,4-D at 0.5kg a.i. ha^{-1} POE	2.27c	2.04efg	2.14c-f
2,4-D at 0.75kg a.i. ha^{-1} POE	2.19cde	2.04efg	2.07d-g
Weedy check	1.63j	1.54j	2.14c-f
SE±		0.066	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 82: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Panicle Weight (kg ha^{-1}) of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	1235.0a	1669.0a	1490.0a	3060.0a
Atrazine at 0.8kg a.i. ha^{-1} PE	1001.0c	1602.0ab	1486.0a	2483.0b
Atrazine at 1.2kg a.i. ha^{-1} PE	1152.0b	1588.0ab	1553.0a	2445.0b
2,4-D at 0.5kg a.i. ha^{-1} POE	1190.0ab	1575.0b	1169.0b	2412.0b
2,4-D at 0.75kg a.i. ha^{-1} POE	1082.0c	1565.0b	1186.0b	1397.0b
Weedy check	1001.0c	1402.0c	987.0c	1522.0c
Probability level	<.001	<.001	<.001	<.001
SE±	23.90	22.30	27.50	72.40
Sowing Date (D)				
Late June	1506.0a	1598.0	1334.0	3186.0a
Early July	1406.0a	1545.0	1285.0	1965.0b
Late July	420.0b	1557.0	1317.0	2008.0b
Probability level	<.001	0.320	0.359	<.001
SE±	41.80	25.20	21.90	171.90
Sowing Method (M)				
Dibbling	995.0b	1505.0b	1237.0b	2245.0b
Drilling	1094.0b	1512.0b	1268.0b	2232.0b
Broadcasting	1244.0a	1683.0a	1430.0a	2681.0a
Probability level	0.013	<.001	<.001	<.00
SE±	47.60	26.60	26.70	52.20
Interaction				
D x M	0.014	<.001	<.001	0.467
D x W	<.001	0.100	0.956	0.044
M x W	0.101	0.944	0.371	0.111
D x M x W	0.055	0.301	0.459	0.064

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

and was statistically similar with 2,4-D at 0.5kg a.i. ha^{-1} (1190.0kg). Weedy check produced the least which was statistically similar with application of atrazine at 0.8kg and 2,4-D at 0.75kg a.i. ha^{-1}. Also, two hoe weeding at 3 and 6 WAS produced significantly heavier panicle in 2017 (1669.0kg), 2018 (1490.0kg) and combined (3060.0kg) while weedy check recorded the lightest throughout these period. The difference between two hoe weeding at 3 and 6 WAS and application of atrazine at 0.8kg a.i. and atrazine at 1.2kg a.i. ha^{-1} in 2017 and 2018 was not significant.

Sowing date significantly affected the panicle weight $hectare^{-1}$ in 2017 and combined. In 2017, sowing on late June (1506.0kg) and early July (1406.0kg) recorded significantly heavier panicle, while sowing on late July recorded the lightest (420.0kg). Also, sowing on late June recorded significantly heavier panicle (3186.0kg) in the combined, while sowing on early and late July recorded the lightest. Sowing method had significant effect on panicle weight ($kgha^{-1}$) in all the experimental years and combined where broadcasting method produced significantly heavier panicle in 2016 (1244.0kg), 2017 (1683.0kg), 2018 (1430.0kg) and combined (2681.0kg) while dibbling and drilling method were at par and produced the lightest throughout the years and combined.

The interactions between sowing date and sowing method on panicle weight $hectare^{-1}$ was significant in 2016, 2017 and 2018 rainy seasons (Table 83). The result indicated that in 2016, sowing on late June using broadcasting method produced significantly heavier panicle (1778.1kg) while sowing on late July using drilling method produced the least weight (319.6kg). In 2017, sowing on late June (1717.0kg), early July (1659.0kg) and late July (1671.0kg) using broadcasting method were at par and produced significantly heavier panicles than the other combinations. Also, sowing on late June (1454.0kg), early July (1400.0kg) and late July (1436.0kg) using

Table 83: Interaction of Sowing Date and Sowing Method on Panicle Weight (kg ha^{-1}) of Finger Millet at Bagauda in 2016, 2017 and 2018 Rainy Seasons

	Sowing Date		
	Late June	Early July	Late July
Sowing Method			
	2016 Rainy season		
Dibbling	1256.4e	1222.1e	505.9f
Drilling	1484.7c	1361.5b	319.6h
Broadcasting	1778.1a	1634.3d	435.7g
SE±		79.24	
	2017 Rainy season		
Dibbling	1512.0c	1496.0c	1508.0c
Drilling	1564.0b	1480.0c	1493.0c
Broadcasting	1717.0a	1659.0a	1671.0a
SE±		43.80	
	2018 Rainy season		
Dibbling	1249.0b	1232.0b	1231.0b
Drilling	1301.0b	1221.0b	1283.0b
Broadcasting	1454.0a	1400.0a	1436.0a
SE±		43.60	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

broadcasting method in 2018 were at par and produced significantly heavier panicles, while the others were at par and recorded the lightest.

Also, the interaction between sowing date and weed control treatment was significant in 2016 and combined (Table 84). Sowing on late June combined with two hoe weeding at 3 and 6 WAS recorded significantly heavier panicle (1691.1kg) while sowing on late July in unweeded environment recorded the lightest (335.4kg). Also, sowing on late June combined with two hoe weeding at 3 and 6 WAS recorded significantly heavier panicle (1682.7kg) in combined, while sowing on late July in unweeded condition produced the lightest (1026.7kg).

4.1.23 Straw Yield

Table 85 shows the effect of weed control treatment, sowing date, sowing method on straw yield of finger millet. Weed control treatment significantly affected straw yield hectare^{-1} in all the experimental years and combined. Two hoe weeding at 3 and 6 WAS produced significantly heavier straw yield in 2016 (4497.0kg), 2017 (4682.0kg), 2018 (5501.0kg) and combined (3060.0kg), while the weedy check consistently produced the lightest straw throughout the experimental years and combined. Sowing date had significant effect on the straw yield per hectare in all the experimental years and combined. In all the seasons and combined, sowing on late June recorded significantly heavier straw, which were statistically similar with sowing on late July in 2016 and 2018 while sowing on early July recorded the lightest in all the seasons and combined, and was the same with the sowing on late July in 2017 and combined.

Sowing method had significant effect on straw yield (kgha^{-1}) in all the experimental years and combined. Broadcasting method produced significantly heavier straw in all the seasons (3992.0, 4052.0 and 5550.0kg, respectively) and the

Table 84: Interaction of Sowing Date and Weed Control Treatment on Panicle Weight ($kg\ ha^{-1}$) of Finger Millet at Bagauda in 2016 and Combined

	Sowing Date		
	Late June	Early July	Late July
Weed Control Treatment			
	2016 rainy season		
Two hoe weeding at 3 and 6 WAS	1691.1a	1574.7b	437.9j
Atrazine at 0.8kg a.i. ha^{-1} PE	1474.4cd	1405.2ef	122.9m
Atrazine at 1.2kg a.i. ha^{-1} PE	1479.6cd	1452.1de	524.7j
2,4-D at 0.5kg a.i. ha^{-1} POE	1570.6b	1371.5f	626.5i
2,4-D at 0.75kg a.i. ha^{-1} POE	1522.6bc	1386.9f	475.2k
Weedy check	1300.3g	1245.6h	335.4l
SE±		56.36	
	Combined		
Two hoe weeding at 3 and 6 WAS	1682.7a	1613.6b	1106.9g
Atrazine at 0.8kg a.i. ha^{-1} PE	1533.3c	1487.6cd	1130.6g
Atrazine at 1.2kg a.i. ha^{-1} PE	1542.1c	1527.2c	1236.8f
2,4-D at 0.5kg a.i. ha^{-1} POE	1526.3c	1338.5e	1091.5g
2,4-D at 0.75kg a.i. ha^{-1} POE	1452.5d	1353.9e	1116.7g
Weedy check	1140.7g	1150.6g	1026.7h
SE±		29.09	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

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Table 85: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Straw Yield (kg ha^{-1}) of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	4497.0a	4682.0a	5501.0a	3060.0a
Atrazine at 0.8kg a.i. ha^{-1} PE	3661.0b	3787.0b	4659.0b	2445.0b
Atrazine at 1.2kg a.i. ha^{-1} PE	3617.0b	3719.0b	4849.0b	2483.0b
2,4-D at 0.5kg a.i. ha^{-1} POE	3472.0b	3645.0b	4704.0b	2412.0b
2,4-D at 0.75kg a.i. ha^{-1} POE	3590.0b	3719.0b	4976.0b	2397.0b
Weedy check	2278.0c	2287.0c	3238.0c	1522.0c
Probability level	<.001	<.001	<.001	<.001
SE±	181.60	121.10	171.30	72.40
Sowing Date (D)				
Late June	4571.0a	4988.0a	5427.0a	3186.0a
Early July	2665.0b	3228.0b	3611.0b	1965.0b
Late July	3319.0ab	2704.0b	4927.0ab	2008.0b
Probability level	0.054	0.022	0.042	<.001
SE±	376.70	352.30	337.70	171.90
Sowing Method (M)				
Dibbling	3456.0b	3279.0b	3966.0c	2245.0b
Drilling	3109.0c	3588.0b	4447.0b	2232.0b
Broadcasting	3992.0a	4052.0a	5550.0a	2681.0a
Probability level	<.001	0.001	<.001	<.001
SE±	87.10	129.90	124.70	52.20
Interaction				
D x M	0.004	0.317	0.936	0.123
D x W	0.224	0.202	0.110	0.250
M x W	0.919	0.046	0.601	0.103
D x M x W	0.719	0.704	0.712	0.132

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

combined (2681.0kg) which was followed by drilling method in 2017 (3588.0kg), 2018 (4447.0kg) and combined (2232.0kg), though drilling and dibbling methods was statistically the same in 2017 and in combined. Whereas drilling method in 2016 (3109.0kg) and dibbling method in 2018 (3966.0kg) produced the lightest straw.

The interactions between sowing date and sowing method on straw yield hectare^{-1} was significant in 2016 (Table 86). The result indicated that, sowing on late June using broadcasting method produced significantly highest straw yield (4815.0kg) while sowing on late July using drilling method was at par with sowing on early July using dibbling and drilling method, and produced the lowest straw yield. Also, the interaction between sowing method and weed control treatment on straw yield hectare^{-1} was significant in 2017 (Table 87). Broadcasting method weeded twice at 3 and 6 WAS recorded significantly higher straw yield (5120.0kg) while dibbling method in unweeded environment produced the lowest (2157.0kg). Though, there was no significant difference between dibbling, drilling and broadcasting method under weedy check.

4.1.24 Grain Yield

Table 88 shows the effect of weed control treatments, sowing date and sowing method on grain yield (kg ha^{-1}) of finger millet at Bagauda. Weed control treatment was found to be significant on grain yield of finger millet in all the experimental years and combined. Two hoe weeding at 3 and 6 WAS produced significantly higher grain yield in 2016 (807.1kg), 2017 (1187.0kg), 2018 (1251.0kg) and combined (1085.3kgh) which were statistically similar with plots treated with atrazine at 1.2kg a.i. ha^{-1} and those treated with 2,4-D at bath doses in 2016, and those treated with atrazine at both doses and 2,4-D at both doses in 2017. While the weedy check consistently recorded the least in 2018 (956.0kg) and combined (903.0kg).

Table 86: Interaction of Sowing Date and Sowing Method on Straw Yield (kg ha^{-1}) of Finger Millet at Bagauda, 2016 Rainy Season

	Sowing Date		
	Late June	Early July	Late July
Sowing Method			
Dibbling	4500.0b	2299.0f	3569.0d
Drilling	4398.0b	2513.0f	2417.0f
Broadcasting	4815.0a	3188.0e	3972.0c
SE±		396.30	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 87: Interaction of Sowing Method and Weed Control Treatment on Straw Yield (kg ha^{-1}) of Finger Millet at Bagauda, 2017 Rainy Season

	Sowing Method		
	Dibbling	Drilling	Broadcasting
Weed Control Treatment			
Two hoe weeding at 3 and 6 WAS	4583.0b	4343.0bc	5120.0a
Atrazine at 0.8kg a.i. ha^{-1} PE	3657.0d	3843.0d	3861.0d
Atrazine at 1.2kg a.i. ha^{-1} PE	3259.0e	3704.0d	4194.0c
2,4-D at 0.5kg a.i. ha^{-1} POE	2917.0f	3602.0d	4417.0bc
2,4-D at 0.75kg a.i. ha^{-1} POE	3102.0ef	3731.0d	4324.0bc
Weedy check	2157.0g	2306.0g	2398.0g
SE±		231.40	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 88: Effects of Weed Control Treatment, Sowing Date and Sowing Method and on Grain Yield ($kgha^{-1}$) of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	807.1a	1187.0a	1251.0a	1085.3a
Atrazine at 0.8kg a.i. ha^{-1} PE	645.6c	1119.0ab	1058.0b	954.7c
Atrazine at 1.2kg a.i. ha^{-1} PE	777.7ab	1149.0ab	1123.0b	1021.6b
2,4-D at 0.5kg a.i. ha^{-1} POE	763.5ab	1145.0ab	1095.0b	1006.7b
2,4-D at 0.75kg a.i. ha^{-1} POE	743.3ab	1123.0ab	1100.0b	989.7bc
Weedy check	688.1bc	1059.0b	956.0c	903.0d
Probability level	<.001	0.014	<.001	<.001
SE±	25.00	24.37	25.90	14.50
Sowing Date (D)				
Late June	1062.0a	1217.0a	1125.0	1135.1a
Early July	989.0a	1134.0a	1047.0	1056.6b
Late July	161.3b	1040.0b	1120.0	788.6c
Probability level	<.001	0.011	0.075	<.001
SE±	25.40	21.69	18.90	12.96
Sowing Method (M)				
Dibbling	634.8b	1069.0b	960.0c	890.1c
Drilling	690.6b	1092.0b	1077.0b	960.9b
Broadcasting	887.3a	1230.0a	1255.0a	1129.2a
Probability level	<.001	0.008	<.001	<.001
SE±	32.30	31.90	34.20	18.98
Interaction				
D x M	0.006	0.942	0.949	0.069
D x W	<.001	0.005	0.001	<.001
M x W	0.295	0.307	0.520	0.019
D x M x W	0.447	0.294	0.289	<.001

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

There was significant difference between the sowing dates in 2016, 2017 and combined. In 2016 and 2017, crops sown on late June and early July recorded significantly higher grain yield, while those sown on late July recorded the lowest. In combined, sowing on late June (1135.1kg) produced significantly higher grain yield than the other sowing date while sowing on late July produced the lowest (788.6kg). Sowing method had significant effect on grain yield of finger millet at all the experimental years and combined. Broadcasting method consistently produced the highest grain yield in 2016, 2017, 2018 and combined (887.3, 1230.0, 1255.0 and 1129.2kgha^{-1}, respectively) while dibbling and drilling methods were at par in 2016 and 2017 and recorded the lowest grain yield (kg ha^{-1}). Also, in 2018 and combined, the dibbling method recorded significantly lowest grain yield (kg ha^{-1}) than the other method of sowing.

The interaction between sowing date and sowing method on grain yield was significant in 2016 (Table 89). The result indicated that sowing finger millet by broadcasting method on late June (1285.8kg) and early July (1227.2kg) produced significantly higher grain yield. Whereas, delay in planting up to late July using all the three sowing methods had resulted in lower grain yield. Also, significant interaction between sowing date and weed control treatment was observed in 2016, 2017, 2018 rainy seasons and combined on grain yield (Table 90). The result revealed that in 2016, sowing on late June weeded twice at 3 and 6 WAS (1137.0kg) was statistically similar with sowing on early July (1119.0kg) weeded twice and sowing on late June treated with 2,4-D at 0.5kg a.i.ha^{-1} (1134.0kg), and produced significantly higher grain yield. These was followed closely by sowing on late June treated with atrazine at 1.2kg and 2,4-D at 0.75kg a.i.ha^{-1}. Sowing on late July in unweeded environment produced the lowest grain yield (64.0kg). In 2017, the result indicated that sowing on

Table 89: Interaction of Sowing Date and Sowing Method on Grain Yield (kg ha^{-1}) of Finger Millet at Bagauda, 2016 Rainy Season

	Sowing Method		
	Dibbling	Drilling	Broadcasting
Sowing Date			
Late June	854.6c	1046.8b	1285.8a
Early July	820.0c	919.8bc	1227.2a
Late July	229.8d	105.1d	149.0d
SE±		52.20	

Means followed by the same letter are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 90: Interaction of Sowing Date and Weed Control Treatment on Grain Yield (kg ha^{-1}) of Finger Millet at Bagauda in 2016, 2017, 2018 and Combined

	Sowing Date		
	Late June	Early July	Late July
Weed Control Treatment			
	2016 rainy season		
Two hoe weeding at 3 and 6 WAS	1137.0a	1119.0a	165.0g
Atrazine at 0.8kg a.i.ha^{-1} PE	1037.0bc	964.0d	279.0f
Atrazine at 1.2kg a.i.ha^{-1} PE	1083.0ab	1028.0bc	222.0g
2,4-D at 0.5kg a.i.ha^{-1} POE	1134.0a	985.0cd	172.0g
2,4-D at 0.75kg a.i.ha^{-1} POE	1086.0ab	950.0d	195.0g
Weedy check	897.0e	889.0e	64.0h
SE±		47.00	
	2017 rainy season		
Two hoe weeding at 3 and 6 WAS	1292.5a	1289.0a	1081.0cde
Atrazine at 0.8kg a.i.ha^{-1} PE	1192.6b	1101.3cd	1062.3def
Atrazine at 1.2kg a.i.ha^{-1} PE	1238.2ab	1139.4c	1070.4cde
2,4-D at 0.5kg a.i.ha^{-1} POE	1274.1a	1140.0c	1006.8ef
2,4-D at 0.75kg a.i.ha^{-1} POE	1240.8ab	1104.7cd	1024.7ef
Weedy check	1051.9def	1043.9def	994.2f
SE±		44.22	
	2018 rainy season		
Two hoe weeding at 3 and 6 WAS	1290.0a	1272.0a	1190.0b
Atrazine at 0.8kg a.i.ha^{-1} PE	1100.0cd	1009.0e	1137.0bc
Atrazine at 1.2kg a.i.ha^{-1} PE	1146.0bc	1079.0cde	1146.0bc
2,4-D at 0.5kg a.i.ha^{-1} POE	1197.0b	1048.0de	1041.0de
2,4-D at 0.75kg a.i.ha^{-1} POE	1149.0bc	1012.0e	1139.0bc
Weedy check	870.0f	862.0f	1065.0de
SE±		45.20	
	Combined		
Two hoe weeding at 3 and 6 WAS	1240.1a	1221.7a	794.1gh
Atrazine at 0.8kg a.i.ha^{-1} PE	1110.1cd	1024.8e	838.0g
Atrazine at 1.2kg a.i.ha^{-1} PE	1155.8bc	1082.1de	826.8g
2,4-D at 0.5kg a.i.ha^{-1} POE	1206.6ab	1057.5de	756.1h
2,4-D at 0.75kg a.i.ha^{-1} POE	1158.3bc	1022.2e	787.1gh
Weedy check	939.5f	931.4f	729.3h
SE±		26.34	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

late June (1292.5kg) and early July (1289.0kg) weeded twice at 3 and 6 WAS produced the highest grain yield hectare^{-1}, though it wasn't differed significantly with sowing on late June treated with atrazine at 1.2kg, 2,4-D at 0.5kg and 2,4-D at 0.75kg a.i.ha^{-1}. In 2018, sowing on late June (1290.0kg) and early July (1272.0kg) weeded twice at 3 and 6 WAS produced significantly higher grain yield hectare^{-1} compared to others. Also, sowing on late June (1240.0kg) and early July (1221.7kg) weeded twice at 3 and 6 WAS produced significantly higher grain yield hectare^{-1} compared to others in the combined. Also, significant interactions between sowing method and weed control treatment as well as between sowing date, sowing method and weed control treatment were observed on grain yield (kg ha^{-1}) of finger millet in the combined.

Table 91 shows that, broadcasting method weeded twice produced significantly higher grain yield (1206.8kg) which was statistically similar with broadcasting method treated with atrazine at 1.2kg (1152.0kg), 2,4-D at 0.5kg (1166.1kg), and 2,4-D at 0.75kg a.i. ha^{-1}.(1185.6kg). Whereas sowing using dibbling method treated with 2,4-D at the rate of 75kg a.i. ha^{-1} (821.0kg) was statistically similar with sowing by drilling method in unweeded environment (828.0kg) and produced the lowest grain yield.

Table 92 indicated that, significantly higher grain yield (1466.5kg) was obtained when sown on late June using broadcasting method and weeded twice at 3 and 6 WAS compared to the other combinations, while sowing on early July using dibbling method and weeded twice at 3 and 6 WAS (1116.3) recorded the lest grain yield.

4.1.25 Harvest Index

Effect of weed control treatment, sowing date and sowing method on harvest index of finger millet at Bagauda is presented on Table 93. Weed control treatment

Table 91: Interaction of Sowing Method and Weed Control Treatment on Grain Yield (kg ha^{-1}) of Finger Millet at Bagauda, Combined

	Sowing Method		
	Dibbling	Drilling	Broadcasting
Weed Control Treatment			
Two hoe weeding at 3 and 6 WAS	993.1bcd	1056.0b	1206.8a
Atrazine at 0.8kg a.i. ha^{-1} PE	885.7fg	944.4def	1034.0bc
Atrazine at 1.2kg a.i. ha^{-1} PE	915.4efg	997.3bcd	1152.0a
2,4-D at 0.5kg a.i. ha^{-1} POE	877.0fg	977.1cde	1166.1a
2,4-D at 0.75kg a.i. ha^{-1} POE	821.1h	940.9def	1185.6a
Weedy check	849.8g	828.1h	1031.0bc
SE±		29.77	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 92: Interaction of Sowing Date, Sowing Method and Weed Control Treatment on Grain Yield (kg ha^{-1}) of Finger Millet at Bagauda Combined

Treatment		Weed Control Treatment					
	Sowing Method	Two hoe weeding at 3 and 6 WAS	Atrazine at 0.8kg a.i. ha^{-1}	Atrazine at 1.2kg a.i. ha^{-1} PE	2,4-D at 0.5kg a.i. ha^{-1} POE	2,4-D at 0.75kg a.i. ha^{-1} POE	Weedy check
Sowing Date							
Late June	Dibbling	1123.1f	1032.9gh	955.1i-l	1061.2g	942.4j-m	818.8opq
	Drilling	1284.1cde	1147.4f	1174.4f	1141.8f	1066.0g	939.9j-m
	Broadcasting	1312.9cd	1150.1f	1337.9c	1416.8b	1466.5a	1059.7g
Early July	Dibbling	1116.3u	978.4h-k	1024.8ghi	898.6k-n	867.8mno	781.6pqr
	Drilling	1143.7f	934.5klm	977.2h-k	1010.7g-j	1040.4gh	880.6l-o
	Broadcasting	1405.1b	1161.5f	1244.4e	1263.3de	1158.4f	1132.1f
Late July	Dibbling	739.8rs	645.9t	766.4pqr	671.2st	712.9rs	884.0l-o
	Drilling	740.2rs	751.4qr	840.3nop	778.9pqr	716.3rs	728.9rs
	Broadcasting	902.3k-n	790.5pqr	873.6l-o	818.1opq	932.0klm	901.1k-n
SE±				49.66			

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

Table 93: Effects of Weed Control Treatment, Sowing Date and Sowing Method on Harvest Index (%) of Finger Millet at Bagauda in 2016, 2017, 2018 Rainy Seasons and Combined.

Treatments	2016	2017	2018	Combined
Weed Control Treatment (W)				
Two hoe weeding at 3 and 6 WAS	18.9a	30.9a	25.3a	25.1a
Atrazine at 0.8kg a.i. ha^{-1} PE	13.9b	21.7b	17.8b	17.7b
Atrazine at 1.2kg a.i. ha^{-1} PE	15.7b	23.1b	18.2b	19.1b
2,4-D at 0.5kg a.i. ha^{-1} POE	14.3b	23.4b	19.8b	19.2b
2,4-D at 0.75kg a.i. ha^{-1} POE	14.4b	22.3b	18.5b	18.4b
Weedy check	13.1b	19.1c	18.9b	16.9c
Probability level	<.001	<.001	<.001	<.001
SE±	0.87	0.88	0.90	0.51
Sowing Date (D)				
Late June	16.8a	19.1	17.4	17.8b
Early July	24.5a	25.2	23.2	24.3a
Late July	3.8b	25.9	18.6	16.1b
Probability level	0.006	0.081	0.069	<.001
SE±	2.18	1.68	1.30	1.02
Sowing Method (M)				
Dibbling	14.3	24.8	20.0	19.7
Drilling	14.3	22.7	20.3	19.2
Broadcasting	16.6	22.6	18.9	19.3
Probability level	0.082	0.189	0.568	0.707
SE±	0.73	0.89	0.94	0.50
Interaction				
D x M	0.221	0.153	0.732	0.058
D x W	0.009	0.122	0.036	<.001
M x W	0.818	0.777	0.987	0.667
D x M x W	0.725	0.846	0.964	0.279

Means followed by the same letter within a column are not significantly different at 5% level of probability using Student-Newman Keuls Test. PE= preemergence application, POE= post emergence application, WAS= weeks after sowing.

significantly affected harvest index in all the experimental years and combined where two hoe weeding at 3 and 6 WAS produced significantly the highest harvest index in 2016 (18.9), 2017 (30.9), 2018 (25.3) and combined (25.1), while the weedy check consistently produced the lowest harvest index in 2017 rainy season and combined only, but statistically similar with the plots treated with atrazine and 2,4-D at all rates in 2016 and 2018 rainy seasons. Also, sowing date had significant effect on harvest index in 2016 and combined. In 2016, sowing on late June (16.8) and early July (24.4) was statistically similar and recorded significantly higher harvest index compared to sowing on late July (3.8). However in the combined, sowing on early July (24.3) recorded significantly higher harvest index compared to other sowing dates. Sowing method had no significant effect on harvest index in all the experimental years and combined.

The interactions between sowing date and weed control treatment on harvest index was significant in 2016, 2018 and combined (Table 94). In 2016, the result indicated that sowing on early July weeded twice at 3 and 6 WAS produced significantly higher harvest index (31.25) compared to other combinations, while sowing on late July treated with 2,4-D at the rate of 0.5 kg a.i. ha^{-1} (2.26) and atrazine at the rate of 1.2 kg a.i. ha^{-1} (3.32) recorded the lowest harvest index. In 2018, sowing on early July weeded twice at 3 and 6 WAS produced significantly higher percent of harvest index (33.07) compared to others, while sowing on late June treated with atrazine at the rate of 1.2 kg a.i. ha^{-1} (14.51) recorded the least. Also, in combined analysis, sowing on early July weeded twice at 3 and 6 WAS produced significantly higher harvest index (32.57) as compared to other combinations, while sowing on late June treated with atrazine at the rate of 1.2 kg a.i. ha^{-1} (15.59) produced the lowest percent of harvest index.

Table 94: Interaction of Sowing Date and Weed Control Treatment on Harvest Index (%) of Finger Millet at Bagauda in 2016, 2018 and Combined

	Sowing date		
	Late June	Early July	Late July
Weed Control Treatment			
	2016 rainy season		
Two hoe weeding at 3 and 6 WAS	20.16d	31.25a	5.44f
Atrazine at 0.8kg a.i.ha^{-1} PE	16.36e	23.49c	1.74
Atrazine at 1.2kg a.i.ha^{-1} PE	16.09e	27.57b	3.32fg
2,4-D at 0.5kg a.i.ha^{-1} POE	16.60e	24.09c	2.26g
2,4-D at 0.75kg a.i.ha^{-1} POE	16.06e	22.24c	4.90f
Weedy check	15.76e	18.27e	5.18f
SE±		2.573	
	2018 rainy season		
Two hoe weeding at 3 and 6 WAS	22.80b	33.07a	20.00cde
Atrazine at 0.8kg a.i.ha^{-1} PE	15.86g	19.67cde	17.88d-g
Atrazine at 1.2kg a.i.ha^{-1} PE	14.51h	21.57bc	17.37efg
2,4-D at 0.5kg a.i.ha^{-1} POE	16.95fg	22.94b	19.46c-f
2,4-D at 0.75kg a.i.ha^{-1} POE	16.50g	21.90bc	17.11fg
Weedy check	16.68g	20.18cd	19.77cde
SE±		1.927	
	combined		
Two hoe weeding at 3 and 6 WAS	22.10c	32.57a	20.75cd
Atrazine at 0.8kg a.i.ha^{-1} PE	16.89ef	21.99c	14.25f
Atrazine at 1.2kg a.i.ha^{-1} PE	15.58ef	24.52b	16.06ef
2,4-D at 0.5kg a.i.ha^{-1} POE	17.38e	24.35b	15.95ef
2,4-D at 0.75kg a.i.ha^{-1} POE	16.95ef	22.89bc	15.34ef
Weedy check	16.70ef	19.55d	14.40f
SE±		1.297	

Means followed by the same letter(s) are not significantly different at 5% level of probability using Student-Newman Keuls Test.

4.1.26 Correlation Coefficient

The matrix of the correlation coefficient between some selected growth characters, yield components and grain yield of finger millet during 2016 rainy season at Bagauda are presented in Tables 95. The results revealed a positive and highly significant ($P \leq 0.01$) correlation between grain yield, crop growth rate, number of tillers, number of fingers panicle^{-1}, panicle weight hectare^{-1}, 1000 grain weight and straw yield hectare^{-1}. The correlation coefficients between grain yield and plant height, leaf area, leaf area index, relative growth rate, weed control efficiency and weed control index were low, positive but not significant. The association between weed dry weight, weed cover score, weed density and grain yield were negative and non significant. The relative growth rate and straw yield were highly significant ($P \leq 0.01$) and positively correlated with plant height. Also, weed dry weight and weed density were highly significant ($P \leq 0.01$) and positively correlated with plant height. Whereas 1000 grain weight, weed control efficiency and weed control index were negative and highly significantly ($P \leq 0.01$) correlated with plant height.

The correlation coefficients between leaf area index, crop growth rate, number of tillers, number of fingers panicle^{-1}, 1000 grain weight, weed control efficiency and weed control index were highly significant ($P \leq 0.01$) and positively correlated with leaf area. However, the correlation coefficient between weed dry weight, weed cover score and weed density were highly significant ($P \leq 0.01$) and negatively correlated with leaf area. Also, number of fingers panicle^{-1}, panicle weight, 1000 grain weight, straw yield, weed control efficiency and weed control index were positive and highly significantly ($P \leq 0.01$) correlated with number of tillers (m^{-2}), while weed dry weight, weed cover score and weed density were negative and highly significantly ($P \leq 0.01$) correlated with number of tillers (m^{-2}).

Table 95: Simple Correlation Matrix Between Grain Yield and Growth and Yield Components of Finger Millet at Bagauda in 2016 Rainy Season

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.00															
2	0.04	1.00														
3	0.08	-0.14	1.00													
4	0.08	-0.13	0.43**	1.00												
5	0.50**	0.08	0.34**	0.34**	1.00											
6	0.03	0.29**	0.21	0.25**	0.09	1.00										
7	0.29**	0.20*	0.31**	0.31**	0.23**	-0.37**	1.00									
8	0.34**	0.15	0.40**	0.40**	0.31**	0.23**	0.20*	1.00								
9	0.94**	-0.14	0.16	0.17	-0.45**	-0.07	0.29**	0.39**	1.00							
10	0.41**	-0.32**	0.38**	0.37**	0.11	-0.42**	0.35**	0.37**	0.12	1.00						
11	0.94**	0.25**	0.12	0.11	-0.11	0.39**	0.35**	0.29**	0.28**	0.56**	1.00					
12	-0.05	0.37**	-0.26**	-0.27**	0.01	0.64**	-0.52**	-0.30**	-0.10	-0.51**	-0.39**	1.00				
13	-0.07	0.34**	-0.28**	-0.28**	0.04	0.54**	-0.48**	-0.30**	-0.13	-0.44**	-0.34**	0.75**	1.00			
14	-0.07	0.41**	-0.21**	-0.27**	0.04	0.66**	-0.52**	-0.21*	-0.11	-0.49**	-0.32**	0.82**	0.72**	1.00		
15	0.04	-0.36**	0.21**	0.22**	0.07	-0.61**	0.52**	0.39**	0.35**	0.58**	0.36**	-0.83**	-0.75**	-0.85**	1.00	
16	0.04	-0.35**	0.25**	0.32**	-0.07	-0.63**	0.58**	0.28**	0.11	0.52**	0.41**	-0.88**	-0.77**	-0.82**	-0.85**	1.00

*Significant at $P \leq 0.05$ **significant at $P \leq 0.01$

1=Grain yield (kg/ha)
2= Plant height at 12 WAS (cm)
3=Leaf area (cm^2)
4=Leaf area index (LAI)
5=Crop growth rate at 12 WAS ($g\ wk^{-1}$)
6=Relative growth rate at 12 WAS ($g\ g^{-1}\ wk^{-1}$)
7= Number of tillers (m^{-2})
8= Number of fingers $panicle^{-1}$
9= Panicle weight ($kg\ ha^{-1}$)
10= 1000 grain weight (g)
11= Straw yield ($kg\ ha^{-1}$)
12= Weed dry weight ($g\ m^{-2}$)
13= Weed cover score
14= Weed density (m^{-2})
15= Weed control efficiency (%)
16= Weed control index (%)

Table 96 shows the matrix of the correlation coefficient between some selected growth characters, yield components and grain yield of finger millet during 2017 rainy season at Bagauda. The results revealed positive and highly significant ($P \leq 0.01$) correlation between grain yield, leaf area, leaf area index, number of tillers, panicle weight hectare^{-1}, 1000 grain weight and straw yield hectare^{-1}. However, the weed cover score was negative and highly significantly ($P \leq 0.01$) correlated with grain yield. The correlation coefficient between number of fingers panicle^{-1} and weed control index were positive and significantly ($P \leq 0.05$) correlated with grain yield, while weed density was negative and significantly ($P \leq 0.05$) correlated with grain yield. There were positive and non significant correlation between grain yield and weed control efficiency. Also, the correlation coefficient between grain yield, plant height, crop growth rate and relative growth rate were negative and non significant.

The relative growth rate, straw yield, weed dry weight, weed cover score and weed density were highly significant ($P \leq 0.01$) and positively correlated with plant height, 1000 grain weight, weed control efficiency and weed control index were negative and highly significantly ($P \leq 0.01$) correlated with plant height. The correlation coefficients between leaf area index, crop growth rate, number of fingers panicle^{-1}, weed control efficiency and weed control index were highly significant ($P \leq 0.01$) and positively correlated with leaf area. However, the correlation coefficient between weed dry weight, weed cover score and weed density were highly significant ($P \leq 0.01$) and negatively correlated with leaf area. The correlation between panicle weight hectare^{-1} and number of tillers panicle^{-1} was positive and highly significant ($P \leq 0.01$), while crop growth rate and relative growth rate were highly significant ($P \leq 0.01$) and negatively correlated with panicle yield.

Table 96: Simple Correlation Matrix Between Grain Yield and Growth and Yield Components of Finger Millet at Bagauda in 2017 Rainy Season

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.00															
2	-0.06	1.00														
3	0.31**	-0.17*	1.00													
4	0.31**	-0.17*	0.98**	1.00												
5	-0.14	0.05	0.26**	0.26**	1.00											
6	-0.03	0.27**	-0.24**	-0.24**	0.28**	1.00										
7	0.40**	0.17*	0.18*	0.18*	0.30**	-0.38**	1.00									
8	0.16*	-0.16*	0.26**	0.25**	0.35**	-0.09	0.10	1.00								
9	0.74**	0.14	0.01	0.01	-0.24**	-0.25**	0.30**	-0.12	1.00							
10	0.37**	-0.20**	0.16*	0.16*	0.20**	-0.28**	0.16*	0.14	0.42**	1.00						
11	0.44**	0.21**	0.16*	0.16*	-0.14	-0.36**	0.29**	0.07	0.34**	0.26**	1.00					
12	-0.14	0.35**	-0.30**	-0.29**	0.02	0.60**	-0.45**	-0.29**	-0.30**	-0.30**	-0.39**	1.00				
13	-0.20**	0.31**	-0.34**	-0.33**	0.07	0.51**	-0.45**	-0.33**	-0.34**	-0.26**	-0.40**	0.73**	1.00			
14	-0.17*	0.36**	-0.28**	-0.27**	0.59**	0.60**	-0.49**	-0.26**	-0.35**	-0.26**	-0.32**	0.79**	0.71**	1.00		
15	0.07	-0.29**	0.24**	0.23**	0.04	-0.51**	0.43**	0.34**	0.21**	0.31**	0.38**	-0.73**	-0.73**	-0.78**	1.00	
16	0.17*	-0.33**	0.30**	0.29**	-0.13	-0.66**	0.49**	0.23**	0.36**	0.36**	0.39**	-0.88**	-0.78**	-0.80**	0.79**	1.00

*Significant at $P \leq 0.05$ **significant at $P \leq 0.01$

1=Grain yield (kg/ha)
2= Plant height at 12 WAS (cm)
3=Leaf area (cm^2)
4=Leaf area index (LAI)
5=Crop growth rate at 12 WAS ($g\ wk^{-1}$)
6=Relative growth rate at 12 WAS ($g\ g^{-1}\ wk^{-1}$)
7= Number of tillers (m^{-2})
8= Number of fingers $panicle^{-1}$
9= Panicle weight ($kg\ ha^{-1}$)
10= 1000 grain weight (g)
11= Straw yield ($kg\ ha^{-1}$)
12= Weed dry weight ($g\ m^{-2}$)
13= Weed cover score
14= Weed density (m^{-2})
15= Weed control efficiency (%)
16= Weed control index (%)

The weed dry weight significantly ($P \leq 0.01$) and positively correlated with relative growth rate, whereas negative and highly significant correlation was observed between weed dry weight, leaf area index, number of tillers (m^{-2}), number of fingers panicle^{-1}, panicle weight hectare^{-1} , 1000 grain weight and straw yield.

Table 97 presents the matrix of the correlation coefficient between some selected growth characters, yield components and grain yield of finger millet during 2018 rainy season at Bagauda. The results indicated positive and highly significant ($P \leq 0.01$) correlation between grain yield, crop growth rate, relative growth rate, number of tillers, panicle weight hectare^{-1}, 1000 grain weight, straw yield hectare^{-1}, weed control efficiency and weed control index. On the other hand, the weed cover score, weed dry weight and weed density were negative and highly significantly ($P \leq 0.01$) correlated with grain yield. The correlation coefficient between leaf area, leaf area index and number of fingers panicle^{-1} were positive but not significantly correlated with grain yield. Also, the correlation between plant height and grain yield was negative and not significant.

The relative growth rate, weed dry weight, weed cover score and weed density were highly significant ($P \leq 0.01$) and positively correlated with plant height, while straw yield, weed control efficiency and weed control index were negative and highly significantly ($P \leq 0.01$) correlated with plant height. The correlation coefficient between number of tillers and plant height was significant ($P \leq 0.05$). The correlation coefficients between leaf area index, weed control efficiency and weed control index were highly significant ($P \leq 0.01$) and positively correlated with leaf area. Also, 1000 grain weight, straw yield, weed control efficiency and weed control index were positive and highly significantly ($P \leq 0.01$) correlated with number of tillers (m^{-2}),

Table 97: Simple Correlation Matrix Between Grain Yield and Growth and Yield Components of Finger Millet at Bagauda in 2018 Rainy Season

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.00															
2	-0.10	1.00														
3	0.08	-0.15	1.00													
4	0.08	-0.15	0.96**	1.00												
5	0.55**	0.07	0.19*	0.19*	1.00											
6	0.28**	0.28**	-0.25**	-0.25**	0.11	1.00										
7	0.29**	0.19*	0.19*	0.18*	0.23**	0.33**	1.00									
8	0.07	-0.14	0.12	0.28**	0.38**	-0.28**	0.17*	1.00								
9	0.68**	-0.24**	0.17*	0.17	-0.27**	-0.40**	0.18*	0.21**	1.00							
10	0.25**	-0.15	0.12	0.12	0.06	-0.24**	0.21**	0.40**	0.40**	1.00						
11	0.57**	-0.21**	0.05	0.05	-0.49**	-0.36**	0.29**	0.19*	0.54**	0.49**	1.00					
12	-0.30**	0.43**	-0.30**	-0.30**	-0.02	0.65**	-0.45**	-0.41**	-0.40**	-0.27**	-0.37**	1.00				
13	-0.29**	0.25**	-0.26**	-0.26**	-0.01	0.45**	-0.40**	-0.39**	-0.25**	-0.32**	-0.33**	0.70**	1.00			
14	-0.37**	0.42**	-0.21**	-0.21**	0.11	0.67**	-0.44**	-0.35**	-0.43**	-0.23**	-0.36**	0.87**	0.62**	1.00		
15	0.25**	-0.41**	0.34**	0.34**	0.10	-0.65**	0.45**	0.49**	0.36**	0.26**	0.34**	-0.90**	-0.72**	-0.83**	1.00	
16	0.31**	-0.44**	0.31**	0.31**	-0.02	-0.68**	0.47**	0.46**	0.41**	0.28**	0.43**	-0.96**	-0.73**	-0.83**	0.93**	1.00

*Significant at $P \leq 0.05$ **significant at $P \leq 0.01$

1=Grain yield (kg/ha)
2= Plant height at 12 WAS (cm)
3=Leaf area (cm^2)
4=Leaf area index (LAI)
5=Crop growth rate at 12 WAS ($g\ wk^{-1}$)
6=Relative growth rate at 12 WAS ($g\ g^{-1}\ wk^{-1}$)
7= Number of tillers (m^{-2})
8= Number of fingers panicle^{-1}
9= Panicle weight ($kg\ ha^{-1}$)
10= 1000 grain weight (g)
11= Straw yield ($kg\ ha^{-1}$)
12= Weed dry weight ($g\ m^{-2}$)
13= Weed cover score
14= Weed density (m^{-2})
15= Weed control efficiency (%)
16= Weed control index (%)

while weed dry weight, weed cover score and weed density were negative and highly significantly ($P \leq 0.01$) correlated with number of tillers (m^{-2}). The correlation coefficient between number of tillers, number of fingers panicle^{-1} panicle weight hectare^{-1} was significant ($P \leq 0.05$). Panicle weight hectare^{-1} and 1000 grain weight were positive and highly significantly ($P \leq 0.01$) correlated with straw yield hectare^{-1}.

Table 98 presents the matrix of the correlation coefficient between some selected growth characters, yield components and grain yield of finger millet in combined. The results indicated positive and highly significant ($P \leq 0.01$) correlation between grain yield, leaf area, leaf area index, number of tillers, panicle weight hectare^{-1}, 1000 grain weight, straw yield hectare^{-1}, weed control efficiency and weed control index. On the other hand, the crop growth rate, relative growth rate, weed cover score, weed dry weight and weed density were negative and highly significantly ($P \leq 0.01$) correlated with grain yield. The correlation between plant height and grain yield was negative and not significant. The relative growth rate, weed dry weight, weed cover score and weed density were highly significant ($P \leq 0.01$) and positively correlated with plant height, whereas leaf area, leaf area index, straw yield, weed control index were negative and highly significantly ($P \leq 0.01$) correlated with plant height. The correlation coefficients between number of tillers, leaf area and leaf area index were highly significant ($P \leq 0.01$).

The correlation coefficients between leaf area index, crop growth rate, number of tillers, number of fingers panicle^{-1}, 1000 grain weight, weed control efficiency and weed control index were highly significant ($P \leq 0.01$) and positively correlated with leaf area. Also, 1000 grain weight, straw yield, weed control efficiency and weed

Table 98: Simple Correlation Matrix Between Grain Yield and Growth and Yield Components of Finger Millet at Bagauda Combined

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
1	1.00															
2	-0.09	1.00														
3	0.37**	-0.16**	1.00													
4	0.37**	-0.16**	0.92**	1.00												
5	-0.31**	0.05	0.16**	0.16**	1.00											
6	-0.14**	0.30**	-0.24**	-0.23**	0.16**	1.00										
7	0.36**	-0.20**	0.36**	0.18**	-0.19**	-0.36**	1.00									
8	0.05	-0.13**	0.29**	0.29**	0.33**	-0.18**	0.25**	1.00								
9	0.79**	-0.21**	0.13**	0.14**	-0.22**	-0.22**	0.23**	0.06	1.00							
10	0.18**	0.04	0.38**	0.08	-0.02	-0.04	0.20**	0.32**	-0.20**	1.00						
11	0.39**	-0.20**	0.10*	0.10*	-0.17**	-0.34**	0.30**	0.14**	0.23**	-0.11*	1.00					
12	-0.14**	0.38**	-0.28**	-0.29**	0.01	0.63**	-0.48**	-0.32**	-0.22**	-0.05	-0.37**	1.00				
13	-0.17**	0.30**	-0.29**	-0.28**	0.04	0.50**	-0.44**	-0.31**	-0.23**	0.01	-0.33**	0.72**	1.00			
14	-0.20**	0.39**	-0.22**	-0.22**	0.05	0.64**	-0.48**	-0.23**	-0.26**	0.07	-0.33**	0.82**	0.68**	1.00		
15	0.15**	-0.09	0.16**	0.16**	0.01	-0.24**	0.18**	0.42**	0.14**	0.94**	0.03	-0.34**	-0.25**	-0.23**	1.00	
16	0.15**	-0.36**	0.28**	0.28**	-0.08	-0.65**	0.51**	0.32**	0.22 **	0.06	0.41**	-0.90**	-0.75**	-0.81**	0.36**	1.00

*Significant at P ≤ 0.05 **significant at P ≤ 0.01

1=Grain yield (kg/ha)
2= Plant height at 12 WAS (cm)
3=Leaf area (cm^2)
4=Leaf area index (LAI)
5=Crop growth rate at 12 WAS ($g\ wk^{-1}$)
6=Relative growth rate at 12 WAS ($g\ g^{-1}\ wk^{-1}$)
7= Number of tillers (m^{-2})
8= Number of fingers $panicle^{-1}$
9= Panicle weight ($kg\ ha^{-1}$)
10= 1000 grain weight (g)
11= Straw yield ($kg\ ha^{-1}$)
12= Weed dry weight ($g\ m^{-2}$)
13= Weed cover score
14= Weed density (m^{-2})
15= Weed control efficiency (%)
16= Weed control index (%)

control index were positive and highly significantly (P≤0.01) correlated with number of fingers panicle^{-1}, while weed dry weight, weed cover score and weed density were negative and highly significantly (P≤0.01) correlated with number of fingers panicle^{-1}. The correlation coefficient between number of tillers and panicle weight hectare^{-1} was positive and highly significant (P≤0.01).

4.1.27 Path Coefficient Analysis

The partitioning of the total correlation in to direct and indirect effect of some growth and yield characters on grain yield of finger millet at Bagauda during 2016, 2017, 2018 rainy seasons and combined is shown in Table 99 and 100, and figure1, 2, 3 and 4. From Table 99, the result indicated that in 2016 all the direct effect was positive except leaf area which indicated a negative direct effect on grain yield. Among the direct effect, crop growth rate had the greatest effect on grain yield which was followed by 1000 grain weight. In 2017 however, all the direct effect was positive except crop growth rate which indicated a negative direct effect on grain yield, among the direct effect number of tillers had the greatest effect followed by 1000 grain weight. In 2018, the positive direct effect on grain yield was observed from crop growth rate, number of tillers and 1000 grain weight, whereas leaf area and number of fingers panicle^{-1} indicated a negative direct effect on grain yield. Crop growth rate recorded the highest direct effect on grain yield followed by 1000 grain weight.

In combined, the positive direct effect on grain yield was observed from leaf area and Number of fingers panicle^{-1}, while crop growth rate, number of tillers and 1000 grain weight indicated a negative direct effect on grain yield.

Table 99: Direct and Indirect Contribution of Some Growth and Yield Components to Grain Yield (kg ha^{-1}) of Finger Millet at Bagauda, 2016 2017, 2018 Rainy Seasons and Combined

	Leaf area (cm^2) plant^{-1}	Crop growth rate	Number of tillers (m^2)	Number of fingers Panicle^{-1}	1000 grain weight (g)	Total
			Effect through at Bagauda, 2016			
Leaf area (cm^2) plant^{-1}	**-0.3349**	0.1694	0.0340	0.0600	0.1514	0.08
Crop growth rate	-0.1139	**0.4983**	0.0252	0.0465	0.0438	0.5
Number of tillers (m^2)	-0.1038	0.1146	**0.1097**	0.0300	0.1395	0.29
Number of fingers Panicle^{-1}	-0.1340	0.1545	0.0219	**0.1501**	0.1474	0.34
1000 grain weight (g)	-0.1273	0.0548	0.0384	0.0555	**0.3985**	0.42
			Effect through at Bagauda, 2017			
Leaf area (cm^2) plant^{-1}	**0.2574**	-0.1188	0.0759	0.0428	0.0528	0.31
Crop growth rate	0.0669	**-0.4570**	0.1265	0.0576	0.0659	-0.14
Number of tillers (m^2)	0.0463	-0.1371	**0.4215**	0.0165	0.0528	0.4
Number of fingers Panicle^{-1}	0.0669	-0.1599	0.0422	**0.1647**	0.0462	0.16
1000 grain weight (g)	0.0412	-0.0914	0.0674	0.0231	**0.3297**	0.37
			Effect through at Bagauda, 2018			
Leaf area (cm^2) plant^{-1}	**-0.0674**	0.1195	0.0276	-0.0374	0.0377	0.08
Crop growth rate	-0.0128	**0.6289**	0.0334	-0.1183	0.0189	0.55
Number of tillers (m^2)	-0.0128	0.1446	**0.1451**	-0.0529	0.0660	0.29
Number of fingers Panicle^{-1}	-0.0081	0.2390	0.0247	**-0.3113**	0.1258	0.07
1000 grain weight (g)	-0.0081	0.0377	0.0305	-0.1245	**0.3144**	0.25
			Effect through at Bagauda, combined			
Leaf area (cm^2) plant^{-1}	**0.3927**	-0.0883	-0.0303	0.1414	-0.0454	0.37
Crop growth rate	0.0628	**-0.5521**	0.0160	0.1609	0.0024	-0.31
Number of tillers (m^2)	0.1414	0.1049	**-0.0843**	0.1219	-0.0239	0.26
Number of fingers Panicle^{-1}	0.1139	-0.1822	-0.0211	**0.4876**	-0.0382	0.36
1000 grain weight (g)	0.1492	0.0110	-0.0169	0.1560	**-0.1194**	0.18

Bold = Direct effect

Table 100 indicated that the crop growth rate had the highest percentage contribution to grain yield in 2016 which was followed by 1000 grain weight and leaf area. However, the greatest and positive combined contributions were made from crop growth rate via 1000 grain weight followed by crop growth rate via number of fingers, number of fingers via 1000 grain weight and number of fingers via 1000 grain weight. The percent unaccounted contributions from other factors to finger millet yield (residual) was 41.69% while the total contributions from both individual and combined contributions that can be explained by this model was 58.31%. In 2017, also the crop growth rate made the highest percentage contribution to grain yield which was followed by number of tillers, 1000 grain weight and leaf area. However, the highest and positive combined contributions were made from crop growth rate via 1000 grain weight followed by number of tillers via 1000 grain weight, leaf area via number of tillers and number of tillers via number of fingers panicle^{-1}. The percent unaccounted contributions from other factors to finger millet yield was 42.72% while the total contributions from both individual and combined contributions that can be explained by this model was 57.28%.

The highest percentage contribution to grain yield was observed by crop growth rate in 2018 which was followed by number of fingers panicle^{-1}, 1000 grain weight and number of tillers. On the other hand, the highest and positive combined contributions were made from crop growth rate via 1000 grain weight followed by crop growth rate via number of tillers. The percent unaccounted contributions from other factors to finger millet yield was 38.72% while the total contributions from both individual and combined contributions that can be explained by this model was 61.28%. In combined, crop growth rate recorded the highest percentage contribution

Table 100: Percentage Contributions of Some Growth and Yield Attributes of Finger Millet to Grain Yield (kg ha^{-1}) at Bagauda 2016, 2017, 2018 Rainy Seasons and Combined

Growth parameters	Percentage contribution (%)			
	2016	2017	2018	combined
Direct contribution				
Leaf area (cm^2) plant^{-1}	11.22	6.62	0.45	15.42
Crop growth rate	24.83	20.88	39.55	30.49
Number of tillers (m^2)	1.20	17.77	2.10	0.71
Number of fingers Panicle^{-1}	2.25	2.71	9.69	23.78
1000 grain weight (g)	15.88	10.87	9.89	1.43
Combined contribution				
Leaf area (cm^2) via Crop growth rate at 12 WAS	-5.67	-3.86	-0.81	-3.47
Leaf area (cm^2) via Number of tillers (m^2)	-1.14	1.95	-0.19	-1.19
Leaf area (cm^2) via Number of fingers panicle^{-1}	-2.01	1.10	0.25	5.55
Leaf area (cm^2) via 1000 grain weight (g)	-5.07	1.36	-0.25	-1.78
Crop growth rate via Number of tillers (m^2)	1.69	-5.47	1.73	1.68
Crop growth rate via Number of fingers Panicle^{-1}	2.99	-3.96	-2.35	-7.81
Crop growth rate via 1000 grain weight (g)	7.55	2.41	2.37	2.51
Number of tillers (m^2) via Number of fingers Panicle^{-1}	0.66	1.81	-0.54	-1.19
Number of tillers (m^2) via 1000 grain weight (g)	1.66	2.22	0.56	0.36
Number of fingers Panicle^{-1} via 1000 grain weight (g)	2.27	0.87	-1.17	-2.21
Residual	41.69	42.72	38.72	35.72
Total	100.0	100.0	100.0	100.0

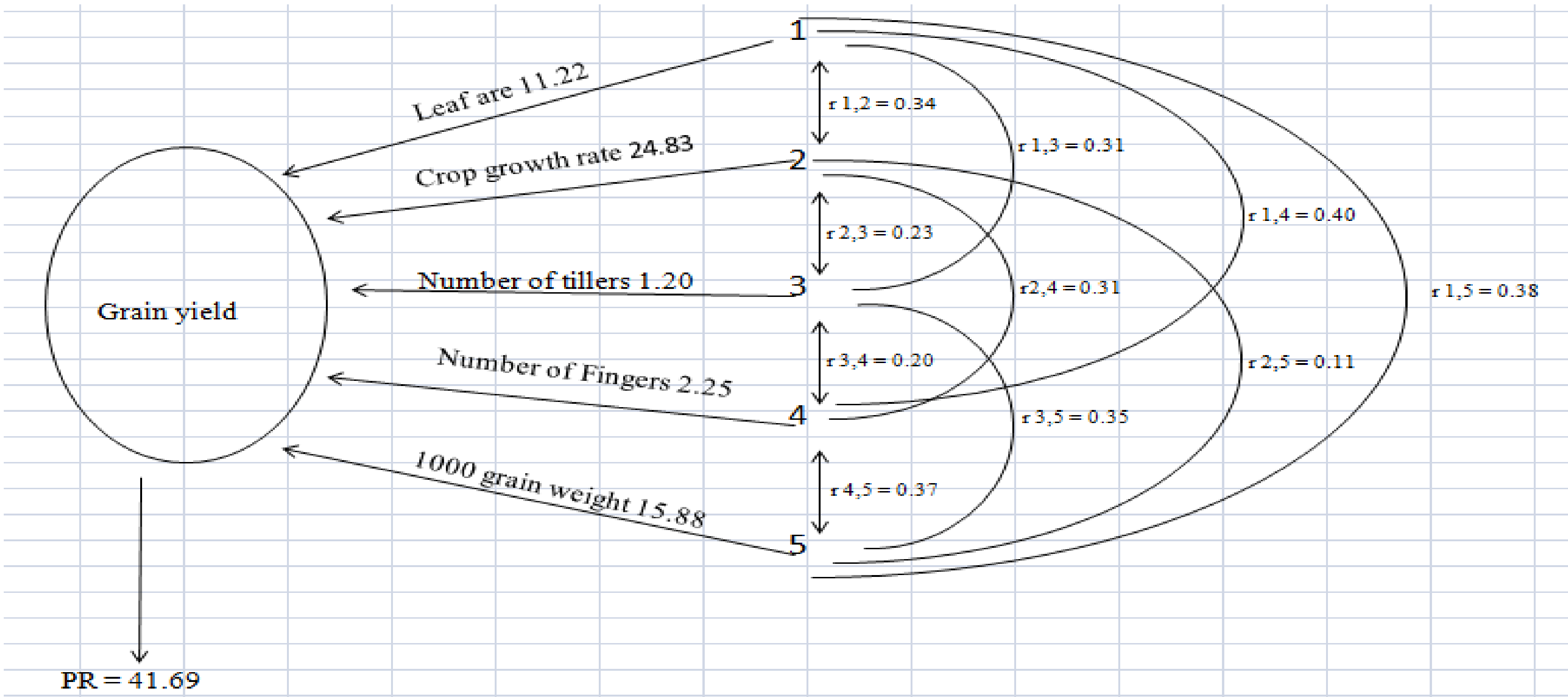

Figure 1: Path Diagram Showing Individual Contributions (%) and Interrelations to Grain Yield (kg ha^{-1}) of Finger Millet at Bagauda, 2016 Rainy Season.

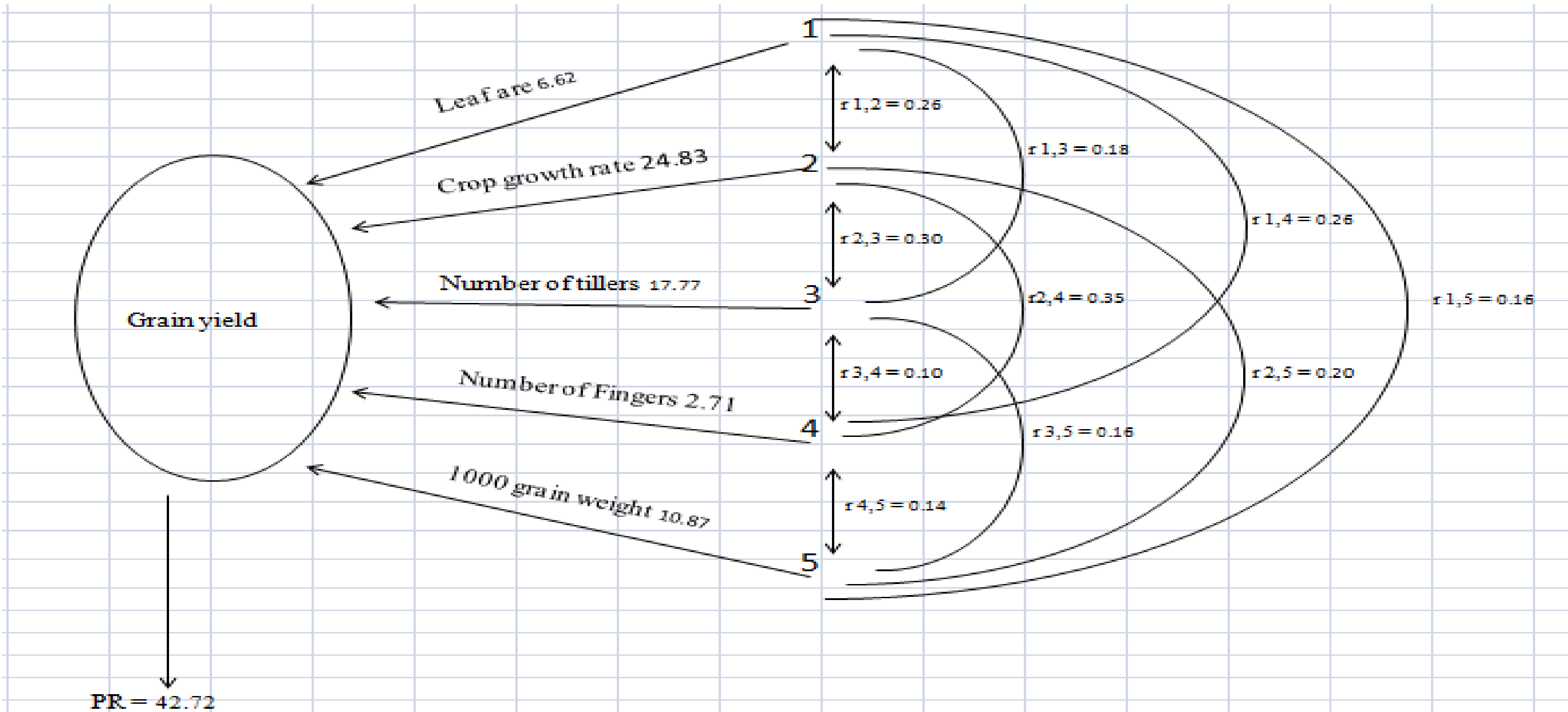

Figure 2: Path Diagram Showing Individual Contributions (%) and Interrelations to Grain Yield (kg ha^{-1}) of Finger Millet at Bagauda, 2017 Rainy Season.

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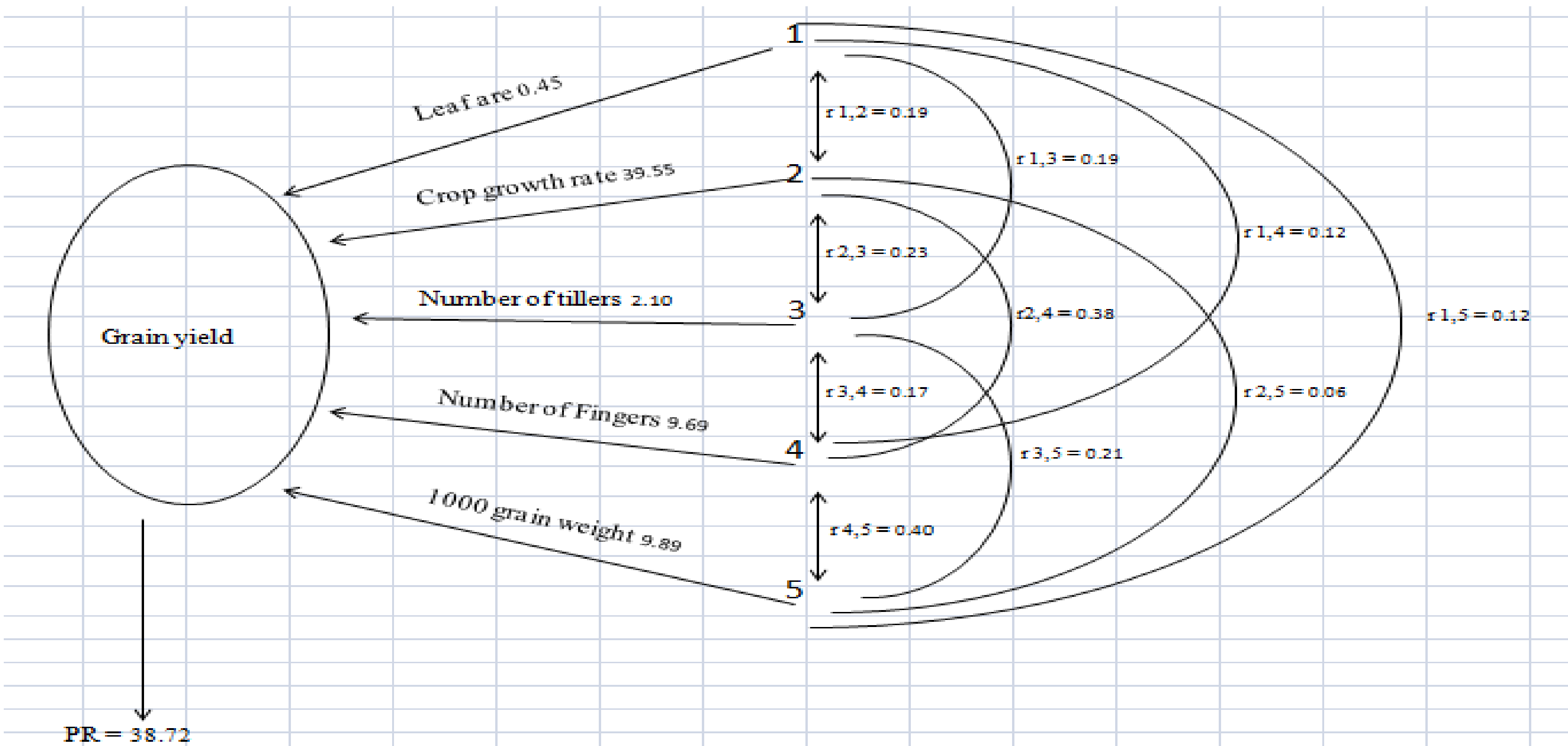

Figure 3: Path Diagram Showing Individual Contributions (%) and Interrelations to Grain Yield (kg ha^{-1}) of Finger Millet at Bagauda, 2018 Rainy Season.

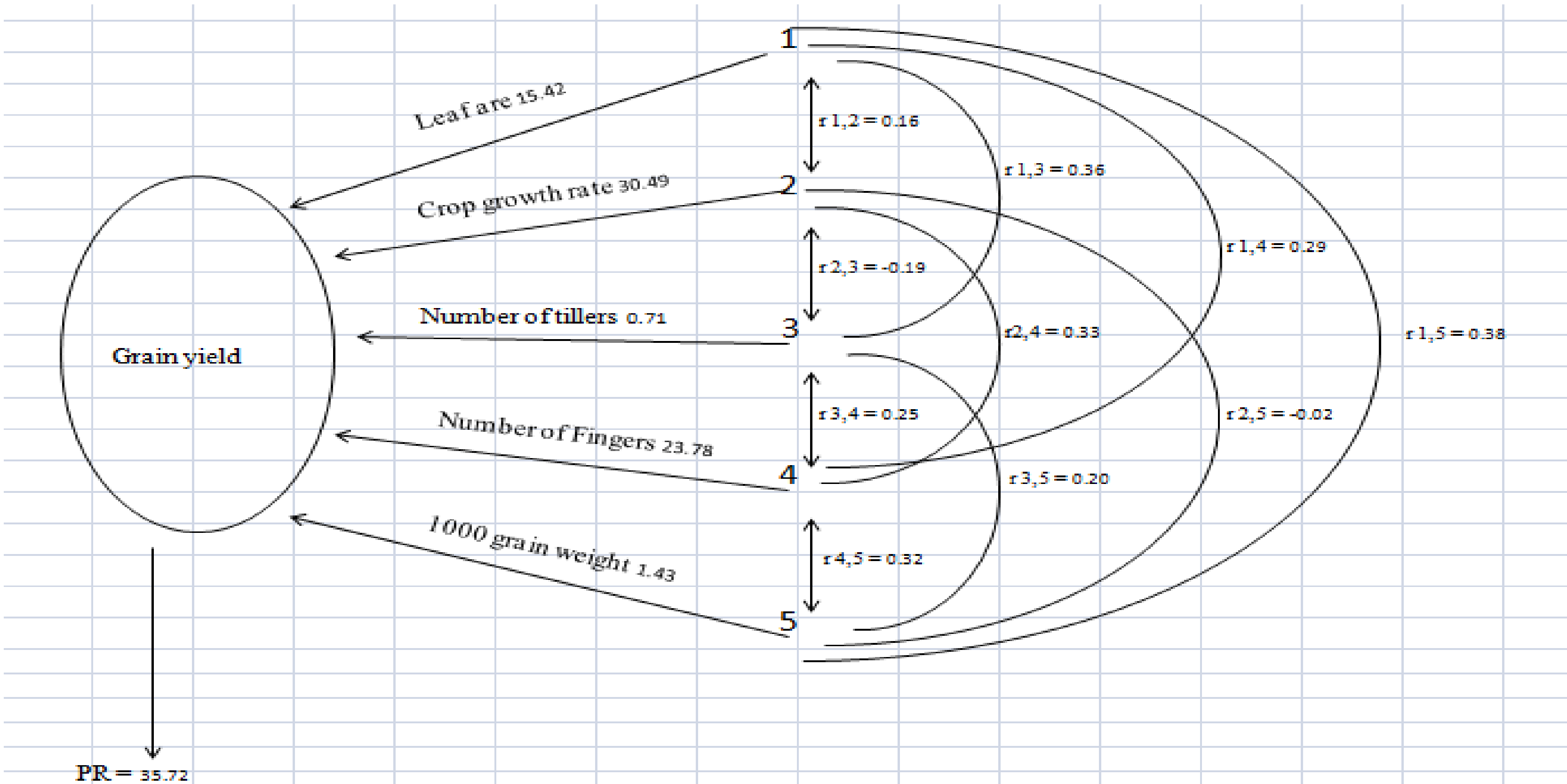

Figure 4: Path Diagram Showing Individual Contributions (%) and Interrelations to Grain Yield (kg ha^{-1}) of Finger Millet at Bagauda, Combined.

to grain yield which was followed by number of fingers $panicle^{-1}$, leaf area and 1000 grain weight.

Also, the highest and positive combined contributions were observed from leaf area via number of fingers $panicle^{-1}$ followed by crop growth rate via 1000 grain weight and crop growth rate via number of tillers. The percent unaccounted contributions from other factors to finger millet yield was 35.72% while the total contributions from both individual and combined contributions that can be explained by this model was 64.28%.

4.2 DISCUSSION

4.2.1 Soil and Meteorological Data of the Experimental Sites

Soil physical and chemical properties of the three seasons had shown some similarities especially in the soil textural class, soil pH, organic carbon, total nitrogen, available phosphorus and exchangeable cations. This could be due to maintaining almost the same field for the trials throughout the three seasons. The recorded data on rainfall at the experimental site indicated that the total rainfall received in 2016 was low (740.2mm) compared to the other season under study. This might probably be the reason for the lower crop performance and grain yield obtained as compared to the other seasons of trials. Araya, Stroosnijder, Girmay and Keesstra (2011) in their study elucidated that crops are likely to give significantly higher grain yield when optimal or higher water supply is provided. Also, Zinolabedin, Hemmatollah, Seyed, Modarres and Hamidreza (2008) reported that water shortage or stress may contribute to decrease in crop growth and final yield.

4.2.2 Effect of Sowing Date on Growth and Yield Characters of Finger Millet

Various sowing dates showed significant differences for some of the phenology, growth and yield parameters (plant height, leaf area, plant dry matter, CGR, RGR, days to 50% heading, days to maturity, number of fingers plant^{-1} panicle weight plant^{-1}, 1000 grain weight, panicle weight per hectare, straw yield, grain yield and harvest index, etc.) with sowing on late June performing the best. This could probably be due to the fact that early sowing of a crop may allow it to make full use of soil moisture during the cropping season and also to utilize solar radiation more efficiently and proper assimilate partitioning which translated to maximum aerial biomass and highest grain yield. Similar findings was reported by Upadhyay *et al.* (2015) who revealed that finger millet yield and its attributes were significantly affected by different sowing dates, and the early sowing period was the suitable planting time for the crop. Also, Gueye *et al.* (2015) observed that early sowing of crop resulted in better plant growth and grain yield compared to other sowing dates, while delay in sowing decreased values of all parameters (Iping, 1997). In the same vein, Amanullah *et al.* (2015) reported that sowing of pearl millet early in the season (20^{th} June) was significant for all the parameters measured such as; maximum leaves plant^{-1}, plant height, panicle length, panicle weight, grains panicle^{-1}, thousand grains weight and grain yield (kgha^{-1}) as compared with other sowing dates. Furthermore, Soler *et al*. (2007) indicated that timely planting of crops generally ensures sufficient time for root development and vegetative growth for optimum harvesting of available soil nutrients and radiant energy. In another development, Khan *et al.* (2009) and Solar *et al.* (2008) indicated that timely sowing of crop offers increased productivity, sufficient duration of vegetative growth, efficient consumption of soil nutrient and radiation energy and adequate reproductive growth.

Sowing on late June significantly produced longest days to 50% heading and days to physiological maturity throughout the experimental years and combine. This could be due to the fact that earlier planting of crop tended to extend the time from planting to vegetative growth phase as well as the time from vegetative growth phase to flowering. This was in agreement with the finding of Balaji (2015) who observed that the early sown crop took more number of days to attain the panicle initiation, days to 50% flowering and days to physiological maturity.

Sowing on late June was observed to recorded the significantly highest number of fingers panicle^{-1}, panicle weight plant^{-1}, panicle weight hectare^{-1}, 1000grain weight and grain yield hectare^{-1}. This could be due to the pact that early sown crop utilized favourable climatic condition such as temperature, solar radiation, rainfall and relative humidity during various crop growth stages, which reflected into better growth and higher yield and yield attribute. This was in conformity with the findings of Revathi *et al.* (2017) who indicated that finger millet sown early produced better yield attributes and grain yield than the other times of sowing. Also, Shinggu and Gani (2012) observed that planting of finger millet on the 25^{th} June and 9^{th} July recorded heavier unthreshed panicles with consequent higher grain yield. Similarly, Gavit *et al.* (2017) concluded that sowing of proso millet on 24^{th} June produced maximum and significantly higher grain and straw yield over the rest of sowing times. Pandiselvi, Narayanan and Karthikeyan (2010) also revealed that among the dates of planting finger millet, the crop planted early produced highest grain yield than the other sowing dates.

Differences due to straw yield hectare^{-1} in 2016 and combined as observed on late June over the other sowing date could be due to the fact that, in early sown crop there were higher crop establishment count, higher growth parameters, more number of tillers and more plant height which are attributes for straw yield. This was in line with the findings of Donaldson, Schillinger and Dofing (2001) who reported that early sowing resulted in higher straw yield due to more number of tillers.

4.2.3 <u>Effect of Sowing Method on the Growth Components of Finger Millet</u>

From the results obtained, it was observed that growth parameters of finger millet such as plant height, leaf area, leaf area index, plant dry matter, crop growth rate (CGR), relative growth rate (RGR) and days to physiological maturity were affected by sowing method in which in most cases dibbling and drilling were at par and recorded the highest. This might be due to sufficient utilization of growth factors such as light, space, nutrition, and soil moisture from less plant population as a result of reduced intra specific competition. Similar finding was reported by Gani *et al.*

(2015) who elucidated that dibbling method produced significantly higher growth parameters such as plant height, leaf area index; number of tillers $plant^{-1}$, crop growth rate and relative growth rate which consequently out-yielded the other method of sowing. This is also in agreement with the findings of Tollenaar and Auguilera (1992) who reported that narrow row spacing produced higher leaf area index (LAI), which result in more interception of solar radiation which translates to dry matter accumulation. Similarly, Thakur *et al.* (2016) reported that tallest plant, maximum number of tillers, highest number of seeds per finger and grain yield was obtained in finger millet crop sown by drilling method of planting. Similarly, Abraham *et al.* (2018) in the trial conducted at Ethiopia using tef millet concluded that the crop planted in rows manifested higher plant height compared to other method of sowing. Furthermore, Dachi *et al.* (2017) in their research conducted using Fonio (*Digitaria exilis*) confirmed that, drilling method of sowing had superior influenced on number of tillers, leaf area, spike length and straw weight ($kgha^{-1}$). The differences in days to physiological maturity among the sowing method could probably be due to the ability of the crop to exploit resources especially water, nutrients and solar radiation more efficiently due to the spaces provided between the stand. Bekalu and Tenaw (2015b) reported that row sowing method hastened heading and maturity of tef millet by one day and increased growth rate by 23.46% than the other method of sowing.

Sowing method significantly affected weed density and weeds dry weight, with drilling method recording the highest in 2017 and combined. This can be related to the fact that crops planted in a wider spacing allow weed growth more than when planted with less or no spacing due to the smothering effect encountered from the crop. Alternatively, this could be due to the fact that the weed under drilling method acquired more space for sunlight, water and nutrients absorption which enhanced their good and vigorous establishment when compared with other methods used in this study. This finding corroborated with the report of Nyende, Tenywa, Oryokot and Kidoido (2001) who observed that planting methods indirectly influence weed species population density.

4.2.4 Effect of Sowing Method on the Yield and Yield Component of Finger Millet

Sowing method significantly increased yield and yield character of finger millet such as number of tillers per meter square, number of fingers plant^{-1}, panicle weight plant^{-1}, 1000 grain weight, panicle weight hectare^{-1}, straw yield hectare^{-1}, and grain yield hectare^{-1}. Broadcasting method proved to have recorded significantly higher number of tillers (m^2) in all the experimental years and combined. This could be explained on the basis that the plant competition for growth factors was not stiff enough to reduce tiller production. It could also be explained on the basis of high plant density of the broadcasting method in which the tillers produced by individual plant can cumulatively resulted in higher number than the other method of sowing employed. This finding was corroborated with the finding of Maobe, Nyang'au, Basweti, Getabu, Mwangi and Ondicho (2014) who observed that the number of tillers produced increased as plant density of finger millet was raised. However, the results was in contrast with the work of Gani *et al.* (2015) and Qazi, Akhlaq, Mubarik, Muhammad and Muhammad (2013) which in their separate studies concluded that dibbling or line planting produced highest number of tillers per meter square (m^2) than broadcasting method.

On the other hand, dibbling method recorded significantly higher number of fingers plant^{-1}, panicle weight plant^{-1} and 1000 grain weight throughout the experimental years and combined. This could be related to the better finger millet growth characters (such as; plant height, leaf area, LAI, CGR and RGR) under dibbling method which positively translated in to better yield characters. This finding was in conformity with the report by Das *et al.* (2015) who concluded that dibbling method of sowing produced total number of spikelets panicle^{-1}, panicle length, 1000-grain weight and grain yield hectare^{-1} in rice crop.

Panicle weight hectare^{-1}, straw yield hectare^{-1} and grain yield hectare^{-1} were significantly affected by sowing method in which broadcasting method recorded the highest. This could be related to the highest number of harvested plant in the broadcasted plot that gave more number of straw and panicles which translated to more grain and straw weight. Also, the increase in number could result in an increased in weight. A similar finding was reported by Adeyeye *et al.* (2014) which indicated that the use of broadcasting method of sowing was found to be superior to other methods used for sowing of finger millet. Similarly, Njoka, Wanjugu, Kinyua, Ndirangu and Kimani (2003) reported that the yields of rice sown using broadcasting method were significantly higher than the other method employed during the two seasons trials. Also, El-Sherief, El-heaty, Galel, Abdelhameed (2004) reported that broadcasting was more efficient than other direct sowing methods and even better than transplanting, it gives highest average grain yield and yield components in rice. Yesuf and Worku (2018) also reported that broadcast sowing method were found to be more economical and recommended for NERICA 4 rice productions than drilling and dibbling methods of planting. However, this result was in contrast with the findings of Shinggu and Gani (2012) which concluded that planting finger millet by dibbling recorded the heavier panicles with consequent higher grain yield. It also negated the finding of Thakur *et al.* (2016) who observed that highest number of seeds per finger and grain yield in finger millet crop sown by using drilling method of planting.

4.2.5 Effect of Weed Control Treatments on Growth Parameters of Finger Millet

This study observed that finger millet and weeds respond similarly to environmental factors involved in plant growth and development, such as water, solar radiation and nutrients which resulted in competition for those resources, thereby causing deficiencies and reduction in growth and yield characters such as plant height, leaf area, leaf area index and grain yield due to competition for growth especially when weed competed stiffly for growth resources thereby leading to reduction in growth characters. This was in line with the finding of Lall and Yadav (1982) which indicated that weeds causes stiff competition for sunlight, nutrient and water in early stages of growth of finger millet and lead in lowering productivity. In another development, Andrade *et al*. (2002) reported a decrease in dry matter accumulation as a result of lower plant growth rates caused by weed competition which in turn influenced final kernel set. Similarly, Emeghara, Onwuegbunam, Sharifai and Ezeukwu (2013) reported that weed competitions in crops depends on four factors which included; crop growth stage, amount of weed present, the degree of water and nutrient stress, and the weed species that are found in the field.

The delay in achieving the 50% emergence of finger millet seedlings observed in plots treated with atrazine 0.8 and 1.2kg a.i. ha^{-1} as pre emergence treatment across all the experimental years could be due to the slow hypocotyl and radicle elongation normally caused by pre emergence herbicide especially on small seeded crop. Kamble (2006) reported a gradual inhibition of hypocotyl and radicle elongation of seedling due to actions of preemergence herbicide, which beside exhibited malformed seedlings with swollen hypocotyls and radicles. The differences in plant height as affected by weed control method indicated that at 9 WAS the weedy check plots recorded the shortest plant throughout the experimental years and combined. This could be expected because the weed competition for growth resources in plant usually retards growth and development, and also may be attributed to faster weed emergence as compared to finger millet crops. This result is in conformity with the findings of Ishaya, Tunku and Kuchinda (2008) who observed that weeds in greater densities are serious challenges to the growth and development of the crop. Also, Everaarts (1993) reported that weed competition reduced growth rates of crop, leading to lower yields. In another development, Ronald, Bryan, George and Joseph (2001) reported that weed competition reduced soybean height by 10% and grain yield by 68%. On the other hand however, weedy checks recorded the tallest plant at 12 WAS across the experimental years and combined. This could also be related to the competition with weeds for sunlight which leads to continuous growth and delay in maturity of the crop. Similar observation was made by Ilhan, Mehmet and Ahmet (2005) who reported that the highest plant height of soybean was obtained from weedy check plots while the lowest was obtained from weed-free control treatments. On the contrary, Shaalan, Abou-zied and El-nass (2014) reported that plant height increased with prolonged weed free conditions and decreased with increasing weedy duration.

It was also observed that, leaf area, leaf area index, plant dry matter, CGR and RGR were significantly affected by weed control treatments. This could probably be due to the effect of weed suppression by weed control treatments as they performed differently in their ability to eliminate or retard weed growth and competitions for resources. Weeding twice at 3 and 6 WAS produced significantly larger leaf area and leaf area index at 9 and 12 WAS throughout the experimental years and combined. Similar observations was made by Basavaraj and Reddy (2014) which reported that hand weeding twice produced significantly higher growth parameters viz., taller plants, higher LAI, more number of tillers $hill^{-1}$ and higher dry matter accumulation than the other treatments. Also, Lagoke *et al.* (1988) reported that two hoe-weeding at 3 and 6 or 7 weeks after sowing (WAS) was recommended to achieve good crop growth and grain yield in pearl millet. In all the experimental years and combined, weedy check resulted in shorter plant, smallest leaf area index and lower dry matter accumulations than all other weed control treatments evaluated. This could be related to the facts that weed competitions for the growth resources in plants usually retards growth and development. Similar observations were made by Ishaya *et al.* (2008) which reported that, weeds infestation are serious challenges to the growth and development of crop plants. The highest RGR observed in weedy check at 9 - 12 WAS throughout the experimental years and combined could be due to the high weed infestation that resulted in competitions for solar radiation which caused increase in growth rate and subsequent delay in maturity of the plant. A similar observation was made by Ilhan *et al.* (2005), however, the result was in contrast with the findings of Khaliq, Hussain, Matloob, Tanveer, Zamir, Afzal and Aslam (2014) who reported that the maximum crop growth rate was obtained from weed free treatments.

4.2.6 Effect of Weed Control Treatments on Yield and Yield Parameters of Finger Millet

The highest number of tillers obtained in all the experimental years and combined by weeding twice at 3 and 6 WAS and applications of 2,4-D at the rate of 0.5 and 0.75kg a.i. ha^{-1} was an indications that these treatments were able to control weed more effectively. This was in conformity with the findings of Prithvi *et al.* (2015) who reported that application of oxadiargyl 100 g/ha followed by inter-cultivation at 20 days after transplanting (DAT) recoded higher plant height, crop dry weight, maximum number of productive tillers, grain per finger and highest grain yield that was at par with two hand weeding. In another development, Yawale *et al.*

(2015) confirmed that applications of herbicide produced higher number of tillers plant^{-1}, grain bearing panicles and grain yield hectare^{-1} of the rice plant.

Weed control treatments produced significantly highest number of fingers plant^{-1}, panicle weight plant^{-1}, panicle weight hectare^{-1}, 1000grain weight, grain yield hectare^{-1}, straw yield and harvest index throughout the experimental years and combined with weeding twice at 3 and 6 WAS been the best. This could be attributed to better crop growth due to turning of the soil and incorporation of the nutrient as well as absence of weed-crop competition for any of the growth factors. Naik *et al*. (2000) observed the increases in grain yield in treated plots of finger millet due to increased yield components of the crop and reduced weed pressure as a result of highest uptake of major nutrients. It could also be due to the fact that the reduced competition and increased availability of resources paved way for higher leaf area and consequently increased the biomass of the crop which consequently translated to better yield characters. This was in conformity with the findings of Pradhan *et al*. (2010) who found that weeding twice resulted in the highest grain yield, straw yield and harvest index of finger millet. In the same vein, Tuti *et al.* (2016) reported that the grain yield of finger millet was significantly higher in hand weeding twice than the other method of weed control employed. Also, Kumara *et al*. (2007) observed that weeding twice at 20 and 40 DAT (days after transplanting) and butachlor at 0.75 kg ha^{-1} + 2,4 D Na salt 0.75 kg ha^{-1} recorded significantly higher grain yield of finger millet as compared to unweeded control treatment. Similarly, Prasad *et al*. (2010) conducted research for nine years consecutively and concluded that two hand weeding and application of butachlor at the rate of 0.75kg ha^{-1} were similar and gave the highest grain yield of finger millet. The weed free environment thus created helped the crop to put forth better growth without competition for sunlight, space, water and nutrient which in turn resulted in higher grain yield. Rambakudzibga, Makanganise and Mangosho (2002) indicated that better grain yield can be maintained if weeds growing within the crop are removed before exerting competition effect, and therefore suggested that weeds should be removed within four to six weeks after sowing (4 – 6 WAS) of the crop to avoid growth and grain yield reduction.

In all the experimental years and combined, weedy check resulted in lower number of tillers, lower number of fingers plant^{-1}, lower panicle weight plant^{-1}, lower panicle weight hectare^{-1}, lower 1000 grain weight, lower grain yield hectare^{-1}, lower straw yield and lower harvest index than all other weed control treatments evaluated. This is expected because weed competition usually suppressed plant growth and development, increased tiller mortality and decreased grain production. This was in conformity with the findings of Siddiqui, Bajwa, Javaid (2010) who observed that weeds were competitive and caused substantial reduction in the vegetative growth and grain yield of the crop. Similarly, Hossain, Amzad, Kenji, Akamine, Ishimine (2008) indicated that, season-long weed infestation significantly reduced shoot biomass and rhizome yield of turmeric. Also, Singh, Sharma, Singh and Pandey (2002) observed that maintaining weed free environment till maturity recorded significantly higher grain yield of crop. In another development, Pandey, Lakra, Nargis, Alam and Puran (2018) observed that the weed management practices employed significantly improved the growth and yield attributes of finger millet over weedy check.

Weed parameters such as; weed cover, weed density and weed dry weight were significantly reduced by application of weed control treatments throughout the experimental years and combined, with weeding twice at 3 and 6 WAS been the best. This could be due to effective weeds removal during the early stage of crop growth as evident by the good appearance of the crop which shows that there was little or no competition from the weed due to effective weed control. The result was in conformity with the findings of Basavaraj and Reddy (2014) which stated that hand weeding twice was the best efficient method for the weed control which produces significantly highest yield and weed control efficiency. Similarly, Amare and Etagegnehu (2016) observed that, the lowest weed density and weed biomass was recorded from weeding twice at 20 and 40 days after emergence which resulted in the highest yield as compared to other control practices. Also, Devender, Tyagi, Agarwal and Singh (1998) reported that weeding and other weed control methods significantly reduced the dry weight of all weeds. In the same vein, Rao, Johnson, Sivaprasad, Ladha and Mortimer (2007) reported the highest reduction in total weed density and weed dry weight in hand pulling over the weedy check in rice crop. Furthermore, Tuti *et al*. (2016) reported that, all the weed control measures significantly reduced total weed dry weight and weed index as compared to that of weedy check, but weeding at 3 and 6 WAS significantly lowered the total weed dry weight.

The highest percentages of weed control efficiency and weed control index observed in weeding twice at all the experimental years and combined was an evident of achieving effective weed control. The result was in conformity with the findings of Pradhan, Rajput and Thakur (2012) who indicated that the highest percentage of weed control efficiency in finger millet was obtained under weed-free condition throughout crop growth period followed by weed-free up to 40 and 50 DAS, and hand weeding at 20 and 40 DAS.

4.2.7 Interaction Between Sowing Date and Sowing Method on Growth and Yield of Finger Millet

Higher number of days to 50% emergence were recorded under sowing on late June and drilling method of sowing in 2018 and combined. This can be explained by the nature of the small seeded crop that used to take longer period of time before emergence especially when buried in a deeper groove. The interaction of sowing date and sowing method on leaf area and leaf area index was significant at 3 WAS in 2016, 2018 and combined, and at 2017 in 6 WAS. These characters were higher when sown on late June by using dibbling method. This could probably be due to the fact that the crop sown earlier with adequate spacing can utilized the environmental resources more efficiently with little or no competition. Gueye *et al.* (2015) observed better plant growth in early sown fonio crop. The interaction between sowing date and sowing method on number of fingers plant^{-1} and 1000 grain weight revealed that sowing on late June by using dibbling method was the best across the experimental years and combined. Revathi *et al.* (2017) indicated that finger millet sown early produced better yield attributes, and the total number of spikelets panicle^{-1}, panicle length, 1000-grain weight were produced when the crop was sown using line sowing (Das, Samanta, Biswas, Saha and Bhattacharya, 2015).

Higher panicle weight, straw yield and grain yield hectare^{-1} was produced under sowing on late June and broadcasting method of sowing. This could be related to the highest number of harvested plant in the broadcasted plot as well as better crop growth obtained due to early sowing which collectively resulted in more number of straw and panicles which translated to more grain yield. This was in conformity with the findings of Adeyeye *et al.* (2014) which indicated that the use of broadcasting method of sowing was found to be superior to other methods used for sowing of finger millet.

4.2.8 Interaction Between Sowing Date and Weed Control Treatments on Growth and Yield of Finger Millet

The interactions between sowing date and weed control method on growth characters such as plant height, leaf area, leaf area index, plant dry matter, CGR and RGR were observed. The highest leaf area and leaf area index at 9 and 12 WAS were produced across the sowing date employed in conjunction with two hoe weeding at 3 and 6 WAS. This could be due to the effective removal of weed which resulted in reducing the competition between plant and the weeds for environmental resources. Ishaya *et al.* (2008) observed that weeds in greater densities are serious challenges to the growth and development of the crop.

The highest number of fingers, panicle weight, 1000 grain weight, straw yield, harvest index and grain yield was produced under sowing on late June and two hoe weeding at 3 and 6 WAS. This was an indication that this treatment was able to control weed more effectively and also attributed to better crop growth due to turning of the soil and incorporation of the nutrient for plant absorption. This was in conformity with the findings of Pradhan *et al*. (2010) who found that weeding twice resulted in the highest grain yield, straw yield and harvest index of finger millet than the other method of weed control employed.

4.2.9 Interaction Between Sowing Method and Weed Control Treatments on Growth and Yield of Finger Millet

The highest plant height and leaf area at 6 WAS in combined analysis was recorded under dibbling method of sowing in conjunction with the application of atrazine at 0.8 and 1.2kg a.i. ha^{-1}. Also, the significant interactions between sowing method and weed control on leaf area index at 3, 6, 9 and 12 WAS in combined were observed with dibbling method weeded twice at 3 and 6 WAS been the best. This could be due to the reduced competition due to weed removal and wider spacing which increased the availability of resources that helped the crop to put forth better growth and development. Rambakudzibga *et al.* (2002) indicated that weeds should be removed within four to six weeks after sowing (4 – 6 WAS) of the crop to avoid growth and grain yield reduction.

The highest straw yield in 2017 and grain yield in combined were recorded under broadcasting method of sowing in conjunction with two hoe weeding at 3 and 6 WAS. This could be related to the highest number of plant in the broadcasted plot that gave more number of straw and panicles which translated to more grain and straw weight. It could also be due to the reduced in competition between the weed and the crop. Pradhan *et al*. (2010) observed that weeding twice resulted in the highest grain yield and straw yield of finger millet. Also, Adeyeye *et al.* (2014) indicated that the use of broadcasting method of sowing was found to be superior to other methods used for sowing of finger millet.

4.2.10 Interaction Between Sowing Date, Sowing Method and Weed Control Treatments on Growth and Yield of Finger Millet

From the result, it was observed that sowing on late June using dibbling method under weedy check resulted in significantly taller plant in the combined. This was due to the competition with weeds for sunlight which leads to continue growing and delay in maturity of the crop. Also, the higher grain yield was obtained when sown on late June using broadcasting method and weeded twice at 3 and 6 WAS in combined. This could possibly be due to the better crop growth as a result of planting on time and absence of weed-crop competition that coincided with the highest number of harvested panicles. Naik *et al*. (2000) observed the increases in grain yield of finger millet due to increased yield components of the crop and reduced weed pressure.

Also, Pradhan *et al*. (2010) found that weeding twice resulted in the highest grain yield of finger millet.

4.2.11 Correlation and Path Coefficient of Growth and Yield Parameters

The results from correlation analysis conducted had indicated positive and significantly correlation between characters such as leaf area, leaf area index, crop growth rate, number of tillers, panicle weight, number of fingers and 1000 grain weight, straw yield and grain yield. This highlighted the importance of such characters in determining the finger millet grain yield, and as such can be used during crop improvement process since they have direct effect on yield. Also, it indicates the importance of these characters in net assimilate production and partitioning to grain yield in finger millet. This result is in conformity with findings of Sarmezey (1987) who reported that yield was correlated positively and significantly with the selected growth parameters of finger millet. Zulqrnain, Abdussalam and Samta (2012) reported that the growth characters of a crop were very important determinant for enhancing yield. In another development, Sneha, Sapkal, Bhavsar, Barhate and Sarika (2019) indicated that the grain yield exhibited highly significant positive correlation with all other growth and yield characters of finger millet. Similarly, Gani and Shinggu (2016) noted the positive and highly significant correlations of grain yield with growth and yield characters of finger millet. Also, Gubta, Bhushan, Ladha, Singh, Tirol-Padre (2007) recorded positive and significant correlation of panicle weight and other yield attributes with grain yield.

The negative correlation between grain yield and weed attributes such as weed cover score, weed density and weed dry weight during the experimental periods and combined was due to severe weed-crop competition for the important environmental resources which led to yield reduction. Similar findings was reported by Gani and

Shinggu (2016) which indicated that, the grain yield of finger millet was negatively and highly significantly correlated with cumulative weed dry weight and weed density. Similarly, Bulus (2002) and Gani (2012) obtained negative correlation of weed dry weight and grain yield in finger millet.

The partitioning of the total correlation to direct and indirect contribution indicated that, crop growth rate made greatest contribution to grain yield through 1000 grain weight in 2016, 2017, 2018 and combined, which was followed by through number of fingers panicle^{-1} in 2016 and number of tillers in 2018 and combined, all of which have direct bearing in the total grain yield. Manamava, Goggi and Pollak (2006) indicated that higher crop growth facilitate greater uptake of nutrients for higher dry matter accumulation and better grain yield production. The high residual values obtained from the analysis indicated that there are other factors affecting the finger millet productivity that were not considered particularly soil fertility status, non uniform rainfall distribution and prevalence of stubborn and herbicide resistant weeds at the experimental sites. Also, apart from the selected parameters, there are others to be considered for grain yield improvement of finger millet.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

Field experiment was conducted during the 2016, 2017 and 2018 rainy seasons at the research farm of National Institute for Horticultural Research (NIHORT) Bagauda (Latitude 11° 33' N and Longitude 8° 23' E, 481m asl) Kano, in the Sudan savanna ecological zone of Nigeria. The aim of the study was to evaluate the productivity of finger millet (*Eleusine coracana* (L.) *Gaertn.*) as influenced by sowing date, sowing method and weed control treatments in Sudan savanna zone of Nigeria. The experiment consisted of three (3) sowing dates (late June, early July and late July), three (3) sowing methods (broadcasting, drilling and dibbling) and six weed control treatments (Atrazine at 0.8 or 1.2kg a.i. ha^{-1}, 2,4-D at 0.5 or 0.75kg a.i. ha^{-1}, two hoe weeding at 3 and 6 WAS and weedy check). These were factorially combined and laid out in a split-split-plot design and replicated three (3) times. The sowing dates were assigned to the main plot and the sowing methods to the subplot while weed control treatments were assigned to the sub-subplot. Data on growths characters, weed parameters and yield characters were measured and analyzed using GenStat software.

The findings of the study revealed that sowing on late June produced significantly higher plant height, leaf area, crop growth rate (CGR), relative growth rate (RGR), days to 50% heading, days to maturity, number of fingers $panicle^{-1}$, panicle weight, 1000 grain weight, straw yield, harvest index, grain yield, weed cover score and weed density. Also, broadcasting method of sowing significantly produced higher number of tillers m^{-2}, panicle weight $hectare^{-1}$, straw yield ($kgha^{-1}$) and grain yield ($kgha^{-1}$). Though, the dibbling method of sowing recorded significantly higher plant height, leaf area, leaf area index (LAI), CGR, RGR, number of finger panicle^{-1} and 1000 grain weight per individual plant basis. However, weed dry weight and weed density was higher with drilling method in 2017 rainy season and combined. Furthermore, weeding twice at 3 and 6 WAS significantly produced higher plant height, leaf area, LAI, CGR, RGR, weed control efficiency, weed control index, number of tillers m^{-2}, panicle weight per hectare, 1000 grain weight, straw yield, harvest index and grain yield per hectare. Though, the differences in grain yield per hectare among two hoe weeding, application of atrazine at 1.2 kg a.i. ha^{-1}, application of 2,4-D at 0.5 kg a.i. ha^{-1} and 2,4-D at 0.75 kg a.i. ha^{-1} in 2016, and between two hoe weeding and all the treated plots in 2017 were not significant. Weed parameters such as; weed cover score, weed dry weight and weed density were significantly higher with weedy check in all the experimental years and combined. The result further revealed a positive and highly significant correlation between the grain yield and growth and yield characters such as leaf area, leaf area index, crop growth rate, number of tillers m^{-2}, number of fingers panicle^{-1}, panicle weight hectare^{-1}, 1000 grain weight and straw yield hectare^{-1}. Moreover, the weed parameters such as weed cover score, weed dry weight and weed density were negative and highly significantly correlated with grain yield across the experimental years and combined.

5.2 CONCLUSION

The result of the experiments had shown that sowing of finger millet on late June resulted in higher growth and yield characters. Also, sowing of finger millet using broadcasting method resulted in higher number of tillers m^{-2}, panicle weight (kgha^{-1}), straw and grain yield (kgha^{-1}), though, the higher growth and yield characters per individual plant was obtained using dibbling method. All the weed control treatments significantly reduced weed parameters and sustained fewer yield reduction as compared to weedy check.

Furthermore, weeding twice at 3 and 6 WAS resulted in the effective weed control and produced higher plant height, leaf area, LAI, CGR, RGR, weed control efficiency, weed control index, number of tillers m^{-2}, panicle weight $hectare^{-1}$, 1000 grain weight, straw yield, harvest index and grain yield ($kgha^{-1}$), though, the grain yield was at par with application of atrazine at 1.2 kg a.i. ha^{-1}, application of 2,4-D at 0.5 kg a.i. ha^{-1} and 2,4-D at 0.75 kg a.i. ha^{-1} in 2016, and between two hoe weeding and all other treated plots in 2017.

5.3 RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made;

1. Sowing of finger millet between late June to early July is recommended as it gave better results with regards to growth and yield components than sowing on late July.
2. Sowing of finger millet by broadcasting method is also recommended in order to achieve higher grain and straw yield per hectare.
3. Weeding twice at 3 and 6 WAS, application of atrazine at 1.2 kg a.i. ha^{-1}, application of 2,4-D at 0.5 kg a.i. ha^{-1} and application of 2,4-D at 0.75 kg a.i. ha^{-1} are recommended as they produced higher grain yield per hectare.
4. Farmers in the study area should adopt sowing of finger millet between late June to early July by using broadcasting method of sowing and application of either atrazine at 1.2 kg a.i. ha^{-1}, 2,4-D at 0.5 kg a.i. ha^{-1} or 2,4-D at 0.75 kg a.i. ha^{-1} for effective weed suppression and higher grain yield. Nevertheless, two hoe weeding at 3 and 6 WAS is also recommended especially in areas where manual labour is very cheap and available.

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