# PRODUCTIVITY OF WATERMELON (*Citrullus lanatus* Thunb Mansf.) AS AFFECTED BY SEED PRIMING WITH SALICYLIC ACID UNDER RAIN-FED CONDITION.

**BY**

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**A DISSERTATION SUBMITTED TO THE DEPARTMENT OF AGRONOMY, FACULTY OF AGRICULTURE, BAYERO UNIVERSITY, KANO. IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN AGRONOMY**

**APRIL, 2018**

## DECLARATION

I hereby declare that this project was written by me and it is a product of my own research effort under the supervision of Dr S. U. Yahaya. It has not been presented elsewhere by any application for the award of Masters of Science Degree or any Certificate. References to published literature have been duly acknowledged.

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Signature and Date

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## CERTIFICATION

This is to certify that the research work for this dissertation and the subsequent preparation for this dissertation titled "Productivity of Watermelon as affected by Seed Priming with Salicylic acid under Rain-fed conditions" were carried out by Mohammed Fatimah Sumaye (SPS/14/MAG/00002) under my supervision.

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## APPROVAL

This dissertation titled “Productivity of Watermelon (*Citrullus lanatus* Thunb Mansf.) as Affected by Seed Priming with Salicylic Acid Under Rain-Fed Condition” by Mohammed Fatimah Sumaye has been examined and approved for the award of the Degree of Master of Science in Agronomy.

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# DEDICATION

This research work is dedicated to my beloved parents, Col. M. S. Mohammed (rtd) and Hajiya Ramatu Mohammed; and my life partner Capt A. Lawal.

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## ABSTRACT

Field experiments were carried out during the 2017 Rainy Season at Bukavu Barracks, Fagge LGA, Kano (Latitude $12^0$ 58'N Longitude $08^0$ 30'E) and Tassa Village, Dawakin Kudu LGA, Kano (Latitude $11^0$ 50'N Longitude $08^0$ 32'E) to study the productivity of watermelon (C*itrullus lanatus*) as affected by seed priming with salicylic acid under rain-fed condition. The treatments consisted of four concentrations (0, 1, 2, $3gL^{-1}$) of salicylic acid and two watermelon varieties (Greybell and Kaolack). These were laid in a Randomized Complete Block Design with 3 replications. Significant ($p<0.05$) response of priming watermelon seeds with salicylic acid was observed on days to emergence, number of leaves, leaf area and leaf area index. Significant interaction of variety and salicylic acid were also obtained on days to emergence and number of leaves. Number of fruits per plant were also highly ($p<0.01$) correlated to fruit yield in this investigation. Based on the findings, priming watermelon seeds with salicylic acid at $1.0gL^{-1}$ reduces the days to emergence and enhances early growth characters. This however, did not translate to increased fruit yield; as such yield in watermelon under rain fed condition could not be enhanced with seed priming with salicylic acid.

# CHAPTER ONE

## 1.0 INTRODUCTION

### 1.1 BACKGROUND OF THE STUDY

Watermelon (*Citrullus lanatus* Thunb Mansf.) belongs to the Curcubitacea family. It originates in the dry regions of southern Africa. It is produced all over the world particularly in the semi-arid regions (Wehner *et al*., 2001). Watermelon is one of the most widely cultivated vegetable crops in the world and the global production in 2016 reached 117 million tons. Afghanistan was reported to be the leading country in production of watermelon, which was followed by Albania, Algeria, Argentina and Armenia (FAO, 2016). There are over 1,200 varieties of watermelon worldwide and quite a number of these varieties are also cultivated in Africa (Zohary and Hopf, 2000).

Watermelon is relished by many people across the world as a fresh fruit. This is because watermelon is known to be low in calories but highly nutritious and thirst quenching (Mangila *et al*., 2007). It also contains vitamins A and C in form of disease fighting beta-carotene (IITA, 2013). Watermelon is also a good source of carotenoid and lycopene, which is also expectedly high in citrulline; an amino acid the body make use of to produce another amino acid, arginine used in the urea cycle to remove ammonia from the body (Collins *et al.* 2004). It was reported to be delectable, thirst-quencher which helps quench the inflammation that contributes to conditions like asthma, atherosclerosis, diabetes, colon cancer and arthritis (Jian *et al.* 2005).

Seed priming is a promising technique that has been successfully employed to overcome the problem associated with poor germination and subsequent erratic crop stand under normal and stressful conditions (Farooq *et al.* 2009; Rehman *et al.* 2011; Jafar *et al.* 2012). It is nowadays being extensively used to improve seed germination and seedling emergence in a wide range of crop species (Hosseini and Koocheki, 2007). Seed priming is a pre-sowing treatment which involves a controlled hydration of seeds, sufficient to allow pre-terminative metabolic events to take place while insufficient to allow radicle protrusion through the seed coat (Armin *et al.* 2010). Priming generally induces faster and more uniform seed germination especially in adverse physical conditions of many crop species (Nascimento, 2003). Seed priming can improve germination rate, reduce time of germination and seedling emergence and improve plant establishment a requisite for improved yield in crops. There are evidences regarding the use of chemical stimuli in accelerating growth and germination (Imani *et al*., 2014). Growth hormones are normally used for seed priming, including auxin, abscisic acid, polyamines, ethylene, salicylic acid and ascorbic acid (Demiral and Turkan, 2005).

Salicylic acid (SA) is a common plant-produced signal molecule of phenolic nature which participates in the regulation of numerous physiological processes (Shakirova *et al*. 2003). It is shown to be a signal molecule in systemic acquired resistance (SAR) in several species (Raskin 1992b). Further, its role is evident in seed germination, fruit yield, glycolysis, flowering in thermo genic plants (Klessig and Malamy, 1994), ion uptake and transport (Harper and Balke, 1981), photosynthetic rate, stomatal conductance and transpiration (Khan *et al*., 2003). In addition to defense responses, salicylic acid is implicated in the regulation of a different biological processes, such as seed germination, seedling development, nodulation in legumes, plant vegetative growth, senescence-associated gene expression, flowering time, fruit yield, respiration, as well as response to ultraviolet (UV)-B radiation, ozone, metals, drought, temperature, and salinity stresses (Khan *et al*., 2015; Vlot *et al*., 2009).

## 1.2 PROBLEM STATEMENT

Plants are exposed to a number of potentially adverse environmental conditions such as water deficit, high salinity, extreme temperature, submergence, etc. These abiotic stresses adversely affect plant growth and productivity. Nowadays various strategies are employed to generate plants that can withstand these stresses. In recent years, seed priming has been developed as an indispensable method to produce tolerant plants against various stresses. Watermelon is produced mainly as a cash crop; which often yields low during the rains as compared to dry season and hence, attention needs to be given in terms of increasing productivity.

## 1.3 JUSTIFICATION OF THE STUDY

Watermelons are produced under irrigation or rainwater (Maynard, 2001). Under irrigation fruit yield can be as high as 72.0 tons $ha^{-1}$ in Florida (Simonne *et al*., 2004) whereas when grown on rainwater yields can be as low as 3.0 tons $ha^{-1}$ (Pala *et al*., 2000). Armin et al. (2010) reported that priming increased watermelon emergence, emergence rate, and plumule length. These promote good plant establishment, early maturity and hence, improved yields (Ndunguru & Rajabu, 2004).

Seed priming is a simple, low cost and effective approach for early seedling growth and yield under stressed and non-stressed conditions. Primed seeds have been reported to give rise to crops which matured earlier and gave higher yields (Ndunguru & Rajabu, 2004). Several studies have reported the benefits of priming watermelon seeds. However, little or no work has been done to determine the efficacy of priming watermelon seeds with salicylic acid under field conditions.

## 1.4 OBJECTIVES OF THE STUDY

The objective of this research is to determine the effect of seed priming with salicylic acid on the productivity of watermelon under rain-fed condition. The specific objectives are:

1. To study the response of watermelon to salicylic acid.
2. To study varietal response of seed priming with salicylic acid in watermelon.

# CHAPTER TWO

## 2.0 LITERATURE REVIEW

### 2.1 VARIETAL PERFORMANCE IN WATERMELON

There are more than 100 currently cultivated varieties of watermelon in the world ranging in weight from less than 1.4 kg to more than 32 kg and these may be round or oblong in shape. Watermelon has a smooth skin and may vary in color from light green to dark green. Some varieties have stripes. The flesh may be red, orange, yellow or white. The flesh is juicy and crunchy. The seeds are usually black and embedded in the fruit (Schippers, 2000). Its cultivation is confined to the drier savanna region of Nigeria (Jarret *et al*., 1996; Ufoegbune *et al*., 2014). Anikwe *et al*., (2016) also reported a significant difference in leaf area index from five watermelon varieties which was attributed to differences in genetic make-up. Lack of genetic variations and slow improvement in fruit yield is common in watermelon breeding (Gusmini and Wehner, 2005). Anikwe *et al*., (2016) reported that yield difference among watermelon varieties seem to be environment specific.

Varietal differences affect or determine the growth and yield of crops. Majanbu *et al.,* (1996) and Sajjan *et al.,* (2002) reported that growth characters in crops such as plant height, vine length, leaf area, number of leaves or branches, and fruit production were influenced by genetic factors of the different varieties. Ibrahim *et al.,* (2000) also reported that the difference in growth indices of crops is normally attributed to their genetic constitution.

Akinfosoye *et al*., (1997) and Ray and Sinclair (1997) attributed the growth characters of crop species not only to genetic constitution of the crop but also to the suitable agro-ecological zone where they can express their full genetic resources for growth and yield enhancement. However, Clark *et al*., (1997) attributed the differences in yield and its components between crop genotypes to variations in genetic structure, mineral concentration and potentials to transport photosynthetic materials within plants. In a study with three watermelon varieties, Armin *et al*., (2010) reported that priming with 0.1N Hydrochloric acid, 1.5N NaCl, 3% polyethylene glycol (PEG) 6000, and 3% $KNO_3$ increased watermelon emergence, emergence rate, and plumule length germination among different varieties. Oraegbunam *et al*., (2016) also reported differences in days to emergence of different watermelon varieties. There were also significant differences in the number of leaves of the watermelon varieties tested (Enujeke, 2013). In another investigation, Damaso (2013) reported a non-significant response of three watermelon varieties (Sugar baby, Sugar baby Max F1 and Sugar baby Jumbo) to mean fruit diameter, number of fruits, marketable yield and mean fruit weight. This was however contrary to the work of Anikwe *et al*., (2016) who reported differences in fruit weight and number of fruits. However, he reported a significant difference in vine length at 60 days after sowing which agreed with the findings of Oraegbunam *et al*., (2016) and Anikwe *et al*., (2016).

## 2.2 RESPONSE OF CROPS TO SEED PRIMING

Abiotic stresses are becoming more prevalent as the intensity of agriculture and the demand for farmable land are ever increasing. Besides chilling and freezing temperatures, drought is one of the most important limiting factors of crop production all around the world. It slows growth, induces stomatal closure and therefore reduces photosynthesis (Nemeth *et al*. 2002).

According to Taylor and Herman (1990), seed priming is a strategy for influencing seedling development by modulating pre-germination metabolic activities prior to emergence of the radicle and generally enhances germination rate and plant performance. Fast germination and uniform emergence assist the farmer to “catch-up” on the time lost to drought (Harris *et al*., 2001). Seed priming has been successfully employed to overcome the problem associated with poor germination and subsequent erratic crop stand under normal and stressful conditions (Jafar *et al*., 2012). It has been successfully demonstrated to improve germination and emergence in seeds of many crops particularly vegetables and small seeded grasses (Bradford, 1986).

Research results indicated that the use of treatments to increase seed germination and early vigor, uniform emergence and the strong plants are achieved (Afzal *et al*., 2002; Farooq *et al*., 2006). Sivritepe *et al.,* (2003) reported that watermelon seeds priming with 1% NaCl for 3 day at 20 °C reduced salinity effects on germination and increased tolerance to salinity in the early stages of growth. Jian *et al.* (2007) investigated effects of different osmotics which can be used in seed priming on watermelon germination and reported that priming with solutions of copper sulfate1% for 4 h and zinc sulfate 0.2% for 24 h enhances germination by 17.1% and 73.3% respectively compared with untreated seeds. Demir and Mavi (2004) evaluated the effects of osmo-priming (using solution of potassium nitrate for 6 days at 24°C) and hydropriming (using distilled water with temperature of 30°C for 18 days) on watermelon germination under 3 different temperatures of 15, 25, and 38°C, and reported that no significant impact of osmo-priming and hydro-priming were found between 25°C and 38°C on seed germination. It was however, significantly increased in seed germination at 15°C for both osmopriming and hydropriming. The beneficial effects of osmo- and hydro- priming are associated with increase in radicle and plumule lengths.

Priming also enhances the crop establishment in field. Manigopa *et al.* (2007) reported that priming in chickpea (*Cicer arietinum* L.) led to better crop establishment and growth and greater yield. Seed priming increased the number of plants at harvest, yield, germination, number of pods per plant, number of lateral branches per plant, and number of seeds per plant by 12.8%, 9.6%, 9.4%, 6.4%, and 6.5%, respectively over the non-primed treatment. In another study, Sung and Chiu (1995) found that primed watermelon seeds had higher seedling emergence force. Hosseini and Koocheki (2007) stated that different varieties responded differently to priming in sugar beet seeds. In cucurbits, priming has been proven successful to increase either germination rate or percentages in muskmelon (Bradford *et al.,* 1988; Nelson & Govers, 1986), diploid watermelon (Demir & Van de Venter, 1999; Sachs, 1977); and bitter gourd (Lin &Sung, 2000). The response of seeds to priming has been found to be dependent on the osmotica, duration of priming, seed maturity, cultivar, and environmental conditions (Nascimento, 2003).

## 2.3 INFLUENCE OF SEED PRIMING WITH SALICYLIC ACID ON PRODUCTIVITY OF CROPS

Salicylic acid (SA) is a common plant-produced signal molecule of phenolic nature which participates in the regulation of numerous physiological processes (Shakirova *et al*., 2003). Salicylic acid has been found to play a key role in the regulation of plant growth, development, interaction with other organisms and in the responses to environmental stresses (Raskin, 1992a; Yalpani *et al.,* 1991; Senaratna *et al.,* 2000). Further, its role is evident in seed germination, fruit yield, glycolysis, lowering in thermogenic plants (Klessig and Malamy,1994), ion uptake and transport (Harper and Balke,1981), photosynthetic rate, stomatal conductance and transpiration (Khan *et al.,* 2003).

Salicylic acid is shown to be a signal molecule in systemic acquired resistance in several species (Raskin, 1992b). In addition, its role in plant's tolerance to abiotic stresses is also emerging. The exogenous application of SA was reported to have an effect on a wide range of physiological processes including increased cold germination tolerance in pepper (Korkmaz 2005), chilling tolerance in cucumber (Kang and Saltveit, 2002) and maize (Janda *et al.,* 2000), salinity tolerance in barley (El-Tayeb, 2005), improved heat shock tolerance in mustard (Dat *et al*., 1998), decreased inhibitory effect of drought stress in tomato and beans (Senaratna *et al*., 2000) and wheat (Sakhabutdinova *et al.*, 2003).

In a study reported by Cakmad and Horst (1991), the use of salicylic acid in soybean had significant effect on seedling growth and root dry weight. Best result was obtained by soaking seeds with salicylic acid with a minimum amount (0.1 / MM). It was also reported by Zhou *et al*. (2009) that seed priming with salicylic acid increases antioxidant enzymes such as glutathione in the seeds. These enzymes reduce lipid peroxidation activity in germination stage, so also increases the percentage of germination; increasing stress levels reduce the percentage of germination. This decrement salinity stress (toward drought stress) is disturbed due to osmotic pressure, water absorption process and then alpha amylase enzyme activity is intercepted.

In another experiment, it was found that germination rate of the seeds primed (mulberry fox plant) with salicylic acid under drought and salinity stress was greater than control treatment, but decreased by increasing the level of drought and salinity stress (Zares & Tavili, 2000). Application of salicylic acid in mulberry fox also reduces germination time and the greatest impact on reducing the duration of germination was at low levels of stress (Zares & Tavili, 2000). Salicylic acid reduces the duration of watermelon seeds germination. It causes the germination of primed seeds to begin earlier than the control, therefore in stress conditions, these seeds come out of the soil earlier and the establishment is faster and be exposed less time to pests and diseases to be splashing and hence improved yield (Hus & Sung, 1997). In a research with wheat and barley, seed priming with salicylic acid was reported to enhance the antioxidant activity and increased seedling stress tolerance (Hanan, 2007).

# CHAPTER THREE

## 3.0 MATERIALS AND METHODS

### 3.1 EXPERIMENTAL SITES

The experiment was conducted during the 2017 wet season in two locations. The first location was at Bukavu Barracks, Kano (Latitude $12^0$ 3'N Longitude $08^0$ 31'E 476m). The second location was at Tassa village, Dawakin Kudu LGA, Kano (Latitude $11^0$ 50'N Longitude $08^0$ 35'E 450m). Both locations fall within the Sudan savannah ecological zone of Nigeria characterized by a mean annual rainfall of 300-600mm per annum (Jonas *et al.*, 2007). The region is characterized by high annual average temperature (28-32°C), short wet season and long dry season (6-9 months), abundant short grasses (<2 m) and a few scattered trees (Sowunmi and Akintola, 2010).

### 3.2 SOIL ANALYSIS

Soil samples were collected randomly at 0 – 15 cm and 15-30cm depths from the trial sites before the start of the experiment. Composite sample was air-dried, bulked and analyzed for physico-chemical properties using standard procedure as described by Black (1965).

### 3.3 TREATMENTS AND EXPERIMENTAL DESIGN

The experiment comprised of four levels of salicylic acid (0, 1.0, 2.0, and 3.0$gL^{-1}$) and two varieties (Kaolack and Grey Bell) of watermelon. These were factorially combined and laid in a Randomized Complete Block Design with four replications.

## 3.4 CULTURAL PRACTICES

### 3.4.1 Land Preparation

The land was cleared, harrowed and levelled prior to layout and sowing. The experimental field was 25.5m x 29m; gross plot size of $18m^2$ (6m x3m) with 0.5m between treatments and 1m between blocks. The net plot size was $9m^2$. A total of eight plots were in each replicate.

### 3.4.2 Variety

Grey Bell and Kaolack varieties, which are the commonly grown varieties in the research area, were used for this experiment. Seeds were sourced from Greenspore Agric., Hadeja road, Kano.

#### 3.4.2.1 Grey Bell

This variety has circular fruits of about 7-8kg, with a light green rind colour characterized with veins. The flesh is red with light brown seeds. It is high yielding and matures in 80 days. It has high resistance to sun burn and has a strong plant vigor.

#### 3.4.2.2 Kaolack

This variety is characterized by round fruit 5-6kg, with a light green skin colour and finely medium green stripes. The red flesh colour is crunchy and sweet, well-appreciated by consumers. It has a high yield and tolerance to Anthracnose. Kaolack is famous in sub-saharan countries and matures in 80-85days.

### 3.4.3 Salicylic Acid Treatment

The prescribed concentrations were formulated by dissolving 1.0, 2.0 and 3.0g of salicylic acid each in 1litre of distilled water. The watermelon seeds were placed in covered petri-dishes on double layers of filter paper wetted with 15 ml of 1.0, 2.0 and 3.0 $gL^{-1}$ salicylic acid solutions and control. This was kept at room temperature in darkness for 24 hours after which the seeds were rinsed with an aim to wash off the solutions from the surface of the seeds and planted immediately as described by Korkmaz (2007).

#### 3.4.4 Sowing

The seeds were sown manually at the rate of two seeds per hole at 3cm depth using a spacing of 1.5m between rows and 1m between stands. After germination, seedlings were thinned to one plant per stand.

#### 3.4.5 Weed Control

Manual hoe weeding was done at 3 and 6 weeks after sowing.

#### 3.4.6 Fertilizer Application

This was applied using ring method at 3weeks after sowing at the rate of 150kg/ha NPK 15:15:15 as recommended by Sabo *et al.* (2013).

#### 3.4.7 Pests and Disease Control

Lambda-cyhalothrin (Karate 2.5EC) was applied using a knapsack sprayer weekly at the rate of 15g ai $ha^{-1}$ beginning from 3 weeks after sowing (WAS) to control pest infestation during the growing period of the crop. Disease control was also carried out using Ridomil MZ (Mefenoxam and mancozeb) at the rate of 2kg/ha.

#### 3.4.8 Harvesting

Harvesting was carried out manually with a knife when it was observed that fruit tendrils turned brown, the fruits turned pale yellow at the spot close to the ground and when the sound of the fruit when thumbed with a knock gave a soft hollow sound instead of metallic ringing sound.

## 3.5 DATA COLLECTION

Four plants in each net plot were randomly tagged. Data was collected from these tagged plants on the following parameters.

### 3.5.1 Days to Emergence

The days to when the first plant emerges was observed and recorded for each plot.

### 3.5.2 Number of Leaves per Plant

Number of leaves per plant was counted and recorded at 4, 6 and 8 weeks after sowing.

### 3.5.3 Days to First Flowering

The days to when the first flower appeared was observed and recorded for each plot.

### 3.5.4 Canopy Temperature

Canopy temperature was measured at 4, 6 and 8 weeks after sowing using an infrared thermometer.

### 3.5.5 Leaf Area

This was measured using a portable leaf area meter (YMJ-A/B model) at 4, 6 and 8 weeks after sowing.

### 3.5.6 Leaf Area Index

Leaf area index was measured using the formula:

$$\text{Leaf Area Index} = \frac{leaf\,area\ per\ plant}{ground\ area\ per\ plant}$$

### 3.5.7 Leaf chlorophyll content

This was measured using a leaf chlorophyll meter (Minolta SPAD 502) at 4, 6 and 8 weeks after sowing.

3.5.8 Vine length (cm)

This was measured from the ground base point to the end of the apex leaf using a meter rule at harvest.

3.5.9 Number of Fruits per plant

The number of fruits per plant was counted from tagged plants at each harvest, and the total was pooled and the average was recorded.

3.5.10 Average Fruit weight (kg)

The weight of fruits on tagged plants was measured using a weighing scale and the average was recorded.

3.5.11 Fruit Yield (tons per ha)

The fruits from net plots were weighed at each harvest; the total weight was converted to tons and recorded. The yield was calculated using the relation

$$\text{Yield} = \frac{total\ fruit\ weight}{net\ plot\ area} \times 10{,}000$$

3.5.12 Marketable Fruit Yield

The marketable yield was determined by weighing the marketable fruits from each harvest and calculating using the formula

$$\text{Marketable Yield} = \frac{total\ weightof\ marketable\ fruits}{net\ plot\ area} \times 10{,}000$$

3.6 DATA ANALYSIS

Data collected for all the measured characters were subjected to analysis of variance using GENSTAT 17$^{th}$ edition. Significant treatment means were compared using DMRT (Duncan, 1955). Correlation analysis was carried out to establish the extent of the relationships between the measured characters to total fruit yield.

# CHAPTER FOUR

## 4.0 RESULTS AND DISCUSSION

### 4.1 RESULTS

#### 4.1.1 Physical and Chemical Properties of Soils of the Experimental Sites

The results of the physico-chemical properties of soils of the experimental sites are shown in Table 1. This indicated that both soils were sandy loam. It also showed that the soils were relatively low in terms of organic carbon (0.68 and 0.47) and total nitrogen (1.05 and 0.81) at Bukavu and Tassa respectively, hence optimal for vegetable production. The soil pH was neutral at both locations and hence within normal limits. The soils of both sites were thus, moderately fertile with the soils of Bukavu being relatively more fertile than that of Tassa.

#### 4.1.2 Days to Emergence

Table 2 shows the influence of variety and salicylic acid on days to emergence of watermelon. Significant ($p<0.05$) varietal effect of watermelon on days to emergence was recorded at both locations. The result indicated that Kaolack emerged much earlier than Grey bell. The result also shows that priming watermelon seeds with salicylic acid significantly affected days to emergence of watermelon.  Primed seeds emerged earlier irrespective of the rate applied with the control treatment emerging much later at both locations.

Interactions of variety with salicylic acid were also significant on days to emergence at both locations. This showed that primed seeds emerged much earlier irrespective of variety from all locations (Tables 3&4). The control treatment emerged later with Kaolack emerging earlier than Grey bell.

Table 1: Physical and chemical properties of soil at experimental sites at Bukavu and Tassa during 2017 rainy season.

| Properties | Bukavu | Tassa |
|---|---|---|
| **Physical (%)** | | |
| Sand | 58 | 69.2 |
| Clay | 12 | 18.8 |
| Silt | 30 | 12 |
| Textural Class | Sandy loam | Sandy loam |
| **Chemical Composition** | | |
| pH in water | 7.23 | 6.8 |
| Organic Carbon (%) | 0.68 | 0.47 |
| Total Nitrogen (%) | 1.05 | 0.81 |
| Available phosphorus (mg/kg) | 11.55 | 8.95 |
| Exchangeable bases (cmol/kg) | | |
| Ca++ | 1.75 | 1.25 |
| Mg++ | 1.333 | 0.87 |
| K+ | 0.573 | 0.506 |
| Na+ | 0.115 | 0.108 |
| CEC | 4.92 | 4.31 |

Analyzed at Soil Science Laboratory, Faculty of Agriculture, Bayero University, Kano.

Table 2: Days to emergence in watermelon (*Citrullus lanatus*) as influenced by Variety and Salicylic acid at Bukavu and Tassa during 2017 rainy season.

| **Treatment** | **Bukavu** | **Tassa** |
|---|---|---|
| **Variety(V)** | | |
| Greybell | 4.38a | 2.38a |
| Kaolack | 4.13b | 2.13b |
| SE± | 0.072 | 0.072 |
| | | |
| **Salicylic Acid gL$^{-1}$(SA)** | | |
| 0 | 5.00a | 3.00a |
| 1.0 | 4.00b | 2.00b |
| 2.0 | 4.00b | 2.00b |
| 3.0 | 4.00b | 2.00b |
| **SE±** | 0.102 | 0.102 |
| | | |
| **Interaction** | | |
| VxSA | * | * |

Means followed by the same letter within treatment groups are not significantly different using DMRT at 5% probability level.

Table 3: Interaction of variety and salicylic acid on days to emergence in watermelon (*C. lanatus*) at Bukavu during 2017 rainy season.

| | Salicylic acid($gL^{-1}$) | | | |
|---|---|---|---|---|
| **Variety** | 0 | 1.0 | 2.0 | 3.0 |
| Greybell | 5.50a | 4.00c | 4.00c | 4.00c |
| Kaolack | 4.50b | 4.00c | 4.00c | 4.00c |
| SE± | | | 0.144 | |

Means followed by the same letter within treatment groups are not significantly different using DMRT at 5% probability level.

Table 4: Interaction of variety and salicylic acid on days to emergence in watermelon (*C. lanatus)* at Tassa during 2017 rainy season.

| | Salicylic acid(gL-1) | | | |
|---|---|---|---|---|
| **Variety** | 0 | 1.0 | 2.0 | 3.0 |
| Greybell | 3.50a | 2.00c | 2.00c | 2.00c |
| Kaolack | 2.50b | 2.00c | 2.00c | 2.00c |
| SE± | | | 0.144 | |

Means followed by the same letter within treatment groups are not significantly different using DMRT at 5% probability level.

4.1.3 Days to Flowering

Days to flowering was not significantly ($p>0.05$) influenced by variety and salicylic acid in this study (Table 5). This indicated that all varieties flowered at the same time. Similarly, the salicylic acid treatments were all at par thus produces flower at the same time irrespective of the rate applied. There was also a non-significant interaction of variety and salicylic acid in days to flowering during the study.

4.1.4 Number of Leaves per Plant

Table 6 presents the number of leaves per plant in watermelon at 4, 6 and 8 WAS as influenced by variety and salicylic acid. Variety had no significant ($p>0.05$) effect on number of leaves with both varieties bearing similar number of leaves throughout the period of study in both locations. Priming watermelon seeds with salicylic acid significantly affected the number of leaves at 4 and 6 WAS at Bukavu only. Primed seeds gave higher number of leaves at 4 and 6WAS irrespective of the rate of salicylic acid applied. The control treatment produced the least number of leaves at 4 and 6 WAS at Bukavu.

The interaction between variety with salicylic acid on number of leaves was significant at 4 and 6 WAS at Bukavu (Table 7). This showed that primed seeds had higher number of leaves with $2.0gl^{-1}$ having the highest number of leaves than all other treatments. There was also significant ($p<0.05$) interaction of variety and salicylic acid during 4 WAS at Tassa (Table 8). Results showed that primed seeds had higher number of leaves irrespective of rate of salicylic acid applied, with the control having the least number of leaves.

4.1.5 Canopy Temperature

The result of canopy temperature in watermelon as influenced by variety and salicylic acid at 4, 6 and 8WAS are presented in Table 8. Varietal difference had no significant response on canopy temperature; thus indicating that all varieties had similar canopy temperature throughout the period of study and in all the locations. Similarly, the salicylic acid treatments were statistically at par recording similar canopy temperature irrespective of rate applied. The interaction of variety and salicylic acid on canopy temperature was also not significant during the study.

#### 4.1.6 Leaf Area ($cm^2$)

Table 9 shows the leaf area of watermelon as influenced by variety and salicylic acid during 4, 6 and 8WAS at Bukavu and Tassa. Varietal difference was not significant on leaf area at Bukavu with all varieties having similar leaf areas throughout the study period. However, there was significant ($p<0.05$) response of leaf area to variety at 4WAS only in Tassa. It indicated that Kaolack had the highest leaf area. The salicylic acid treatment was also not significant on leaf area in all the sampling periods from both locations. This indicated that all treatments had similar leaf area irrespective of salicylic acid rate applied. The interaction of variety and salicylic acid on leaf area of watermelon was also not significant in this study.

Table 5: Days to flowering in watermelon (*Citrullus lanatus*) as influenced by Variety and Salicylic acid at Bukavu and Tassa during 2017 rainy season.

| Treatment | Bukavu | Tassa |
|---|---|---|
| **Variety(V)** | | |
| Greybell | 40.50 | 36.00 |
| Kaolack | 39.06 | 35.69 |
| SE± | 0.546 | 0.295 |
| | | |
| **Salicylic Acid gL$^{-1}$(SA)** | | |
| 0 | 41.50 | 36.00 |
| 1.0 | 39.25 | 36.75 |
| 2.0 | 39.75 | 35.50 |
| 3.0 | 38.62 | 35.75 |
| **SE±** | 0.772 | 0.417 |
| | | |
| **Interaction** | | |
| V x SA | ns | Ns |

Means followed by the same letter within treatment groups are not significantly different using DMRT at 5% probability level.

ns – not significant

Table 6: Number of leaves in watermelon (*Citrullus lanatus*) as influenced by Variety and Salicylic acid at Bukavu and Tassa during 2017 rainy season.

| | Weeks after Sowing (WAS) | | | | | |
|---|---|---|---|---|---|---|
| **Treatment** | **Bukavu** | | | **Tassa** | | |
| | **4** | **6** | **8** | **4** | **6** | **8** |
| **Variety(V)** | | | | | | |
| Greybell | 6.69 | 11.94 | 20.24 | 8.11 | 13.25 | 22.18 |
| Kaolack | 6.5 | 11.71 | 19.98 | 8.52 | 13.68 | 22.73 |
| SE± | 0.327 | 0.38 | 0.385 | 0.246 | 0.259 | 0.287 |
| **Salicylic Acid gL$^{-1}$(SA)** | | | | | | |
| 0 | 5.10b | 10.35b | 19.18 | 8.53 | 13.56 | 22.96 |
| 1.0 | 6.55a | 11.53ab | 19.68 | 7.71 | 12.86 | 22.19 |
| 2.0 | 7.21a | 12.50a | 20.73 | 8.25 | 13.66 | 22.18 |
| 3.0 | 7.52a | 12.93a | 20.80 | 8.78 | 13.76 | 22.50 |
| SE± | 0.462 | 0.537 | 0.544 | 0.348 | 0.366 | 0.405 |
| **Interaction** | | | | | | |
| V x SA | * | * | ns | * | ns | Ns |

Means followed by the same letter(s) within treatment groups are not significantly different using DMRT at 5% probability level.

ns – not significant

* - significant

Table 7: Interaction of variety and salicylic acid on number of leaves of watermelon (*C. lanatus*) at Bukavu during 2017 rainy season.

| | | **SA 4WAS** | | | | **SA 6WAS** | | |
|---|---|---|---|---|---|---|---|---|
| **Variety** | 0 | 1.0 | 2.0 | 3.0 | 0 | 1.0 | 2.0 | 3.0 |
| **Grey bell** | 4.45c | 6.90ab | 8.72a | 6.70ab | 9.65d | 12.33abc | 14.15a | 11.70bcd |
| **Kaolack** | 5.75bc | 6.20bc | 7.72ab | 6.32bc | 10.73cd | 11.05bcd | 13.35ab | 11.70bcd |
| **SE±** | | 0.654 | | | | 0.760 | | |

Means followed by the same letter(s) within treatment groups are not significantly different using DMRT at 5% probability level.

Table 8: Canopy temperature in watermelon (*Citrullus lanatus*) as influenced by Variety and Salicylic acid at Bukavu and Tassa during 2017 rainy season.

| Treatment | Weeks after Sowing (WAS) | | | | | |
|---|---|---|---|---|---|---|
| | Bukavu | | | Tassa | | |
| | **4** | **6** | **8** | **4** | **6** | **8** |
| **Variety(V)** | | | | | | |
| Greybell | 27.46 | 32.73 | 32.35 | 27.43 | 29.80 | 31.59 |
| Kaolack | 27.73 | 32.38 | 32.73 | 27.47 | 29.80 | 31.29 |
| SE± | 0.312 | 0.483 | 0.616 | 0.327 | 0.238 | 0.234 |
| **Salicylic Acid gL$^{-1}$ (SA)** | | | | | | |
| 0 | 27.51 | 32.29 | 32.56 | 27.01 | 29.50 | 31.31 |
| 1.0 | 27.70 | 31.69 | 32.02 | 28.11 | 30.41 | 31.20 |
| 2.0 | 27.86 | 32.59 | 32.82 | 27.41 | 29.74 | 31.87 |
| 3.0 | 27.29 | 33.66 | 32.75 | 27.26 | 29.55 | 31.37 |
| SE± | 0.441 | 0.683 | 0.872 | 0.462 | 0.337 | 0.331 |
| **Interaction** | | | | | | |
| V x SA | ns | Ns | ns | ns | ns | Ns |

Means followed by the same letter(s) within treatment groups are not significantly different using DMRT at 5% probability level.

ns – Not Significant

Table 9: Leaf area in watermelon (*Citrullus lanatus*) as influenced by Variety and Salicylic acid at Bukavu and Tassa during 2017 rainy season.

| | Weeks after Sowing (WAS) | | | | | |
|---|---|---|---|---|---|---|
| **Treatment** | | **Bukavu** | | | **Tassa** | |
| | **4** | **6** | **8** | **4** | **6** | **8** |
| **Variety(V)** | | | | | | |
| Greybell | 250.0 | 307.0 | 371.3 | 116.8b | 219.8 | 321.9 |
| Kaolack | 243.8 | 305.5 | 384.4 | 140.9a | 220.6 | 318.0 |
| SE± | 12.36 | 11.67 | 11.19 | 7.55 | 7.84 | 11.69 |
| **Salicylic Acid gL$^{-1}$ (SA)** | | | | | | |
| 0 | 241.4 | 299.4 | 371.3 | 133.4 | 213.7 | 295.5 |
| 1.0 | 241.3 | 292.2 | 362.5 | 116.7 | 214.3 | 326.8 |
| 2.0 | 238.6 | 304.0 | 366.7 | 130.5 | 225.6 | 322.1 |
| 3.0 | 266.3 | 329.3 | 410.8 | 134.8 | 227.1 | 335.3 |
| SE± | 17.49 | 16.5 | 15.83 | 10.68 | 11.08 | 16.54 |
| **Interaction** | | | | | | |
| V x SA | ns | ns | ns | ns | ns | ns |

Means followed by the same letter within treatment groups are not significantly different using DMRT at 5% probability level.

ns – Not Significant

4.1.7 Leaf Area Index

` The results of leaf area index in watermelon as influenced by variety and salicylic acid during 4, 6 and 8WAS at Bukavu and Tassa are presented in Table 10. The result indicated non-significant varietal response on leaf area index at Bukavu with all the varieties recording statistically similar leaf area index. At Tassa however, there was significant ($p < 0.05$) effect of variety on leaf area index at 4WAS with Kaolack having higher leaf area index than Grey bell. The salicylic acid treatment had no significant effect on leaf area index in watermelon during this study. This indicated that leaf area index was similar irrespective of rate of salicylic acid applied during this study. The interaction between variety and salicylic acid was also not significant.

4.1.8 Leaf Chlorophyll Content

Table 11 shows the result of leaf chlorophyll content in watermelon as influenced by variety and salicylic acid during 4, 6 and 8WAS at Bukavu and Tassa. Results of the study showed that leaf chlorophyll content did not significantly differ among the varieties in both locations except at Bukavu at 8WAS, where Kaolack had highest leaf chlorophyll content. Similarly, salicylic acid treatment had non-significant effect on leaf chlorophyll content irrespective of rate applied at all growth stages from both locations. Interaction of variety with salicylic acid was also not significant during this study.

4.1.9 Vine length (m)

Vine length of watermelon was not significantly ($p>0.05$) influenced by variety and salicylic acid in this study (Table 12). This indicated that all varieties had statistically similar vine length. Similarly, the salicylic acid treatments were all at par, thus having statistically similar vine length irrespective of salicylic acid rate applied from both locations. There was also a non-significant interaction of variety and salicylic acid on vine length of watermelon during this study.

4.1.10 Number of Fruits per plant

The result of number of fruits per plant of watermelon as influenced by variety and salicylic acid is presented in Table 13. Varietal effect showed a non-significant difference in number of fruits with all varieties producing statistically similar number of fruits. Similarly, the salicylic acid treatment had no significant effect on number of fruits, thus, all treatments produced similar number of fruits irrespective of salicylic acid rate applied. The interaction of variety and salicylic acid was also not significant in this study.

4.1.11 Average Fruit Weight (kg)

The influence of variety and salicylic acid on average fruit weight of watermelon at Bukavu and Tassa are presented in table 14. Results of the study showed that varietal difference had no significant effect on average fruit weight, thus average fruit weight of watermelon was statistically similar for both varieties from both locations. There was also no significant effect salicylic acid treatment on average fruit weight of watermelon in this study. This indicated that average fruit weight was similar irrespective of the rate applied. The interaction between variety and salicylic acid was also not significant in this study.

4.1.12 Yield (tons per hectare)

Table 15 shows the result of the influence of variety and salicylic acid on yield of watermelon. Varietal difference did not significantly influence the yield of watermelon with all varieties producing statistically similar yields. The yield was also not significantly ($p>0.05$) affected by salicylic acid treatments thus, all treatments gave similar yields irrespective of SA rate applied. The interaction between variety and salicylic acid was not significant in this study.

Table 10: Leaf area index in watermelon (*Citrullus lanatus*) as influenced by Variety and Salicylic acid at Bukavu and Tassa during 2017 rainy season.

| Treatment | Weeks after Sowing (WAS) Bukavu 4 | 6 | 8 | Tassa 4 | 6 | 8 |
|---|---|---|---|---|---|---|
| **Variety(V)** | | | | | | |
| Greybell | 166.7 | 204.7 | 247.5 | 77.9b | 146.5 | 214.6 |
| Kaolack | 162.5 | 203.7 | 256.3 | 93.9a | 147.0 | 212.0 |
| SE± | 8.24 | 7.78 | 7.46 | 5.04 | 5.22 | 7.8 |
| **Salicylic Acid{gL$^{-1}$}(SA)** | | | | | | |
| 0 | 160.9 | 199.6 | 247.5 | 88.9 | 142.5 | 197.0 |
| 1.0 | 160.9 | 194.8 | 241.7 | 77.8 | 142.9 | 217.9 |
| 2.0 | 159.1 | 202.7 | 244.5 | 87.0 | 150.4 | 214.7 |
| 3.0 | 177.6 | 219.5 | 273.9 | 89.9 | 151.4 | 223.5 |
| SE± | 11.66 | 11.00 | 10.55 | 7.12 | 7.39 | 11.03 |
| **Interaction** | | | | | | |
| V x SA | ns | Ns | ns | ns | ns | ns |

Means followed by the same letter within treatment groups are not significantly different using DMRT at 5% probability level.

ns – Not Significant

Table 11: Leaf chlorophyll content in watermelon (*Citrullus lanatus*) as influenced by Variety and Salicylic acid at Bukavu and Tassa during 2017 rainy season.

| | Weeks after Sowing (WAS) | | | | | |
|---|---|---|---|---|---|---|
| **Treatment** | **Bukavu** | | | **Tassa** | | |
| | **4** | **6** | **8** | **4** | **6** | **8** |
| **Variety(V)** | | | | | | |
| Greybell | 31.4 | 59.8 | 33.8b | 45.8 | 68.2 | 32.0 |
| Kaolack | 32.8 | 59.1 | 38.1a | 43.7 | 70.4 | 29.9 |
| SE± | 1.76 | 1.99 | 1.46 | 1.35 | 2.61 | 1.58 |
| **Salicylic Acid $gL^{-1}$(SA)** | | | | | | |
| 0 | 30.7 | 56.8 | 35.4 | 44.6 | 74.0 | 32.4 |
| 1.0 | 29.0 | 56.9 | 39.3 | 44.7 | 67.0 | 32.4 |
| 2.0 | 34.1 | 63.4 | 36.7 | 48.5 | 70.1 | 29.8 |
| 3.0 | 34.7 | 60.8 | 32.4 | 41.2 | 66.2 | 29.3 |
| SE± | 2.49 | 2.82 | 2.06 | 1.9 | 3.69 | 2.23 |
| **Interaction** | | | | | | |
| V x SA | ns | Ns | ns | ns | ns | ns |

Means followed by the same letter within treatment groups are not significantly different using DMRT at 5% probability level.
ns – Not Significant

Table 12: Vine length of watermelon (*Citrullus lanatus*) as influenced by Variety and Salicylic acid at Bukavu and Tassa during 2017 rainy season.

| **Treatment** | **Bukavu** | **Tassa** |
|---|---|---|
| **Variety(V)** | | |
| Greybell | 2.03 | 2.33 |
| Kaolack | 2.19 | 2.49 |
| SE± | 0.137 | 0.137 |
| **Salicylic Acid gL$^{-1}$ (SA)** | | |
| 0 | 2.28 | 2.58 |
| 1.0 | 2.20 | 2.50 |
| 2.0 | 2.26 | 2.56 |
| 3.0 | 1.70 | 2.00 |
| SE± | 0.194 | 0.194 |
| **Interaction** | | |
| V x SA | ns | ns |

Means followed by the same letter within treatment groups are not significantly different using DMRT at 5% probability level.

ns – Not Significant

Table 13: Number of fruits in watermelon (*Citrullus lanatus*) as influenced by Variety and Salicylic acid at Bukavu and Tassa during 2017 rainy season.

| Treatment | Bukavu | Tassa |
|---|---|---|
| **Variety(V)** | | |
| Greybell | 3.25 | 2.84 |
| Kaolack | 2.78 | 2.66 |
| SE± | 0.186 | 0.268 |
| **Salicylic Acid gL$^{-1}$ (SA)** | | |
| 0 | 3.00 | 2.81 |
| 1.0 | 2.75 | 2.88 |
| 2.0 | 3.12 | 2.88 |
| 3.0 | 3.19 | 2.94 |
| SE± | 0.263 | 0.379 |
| **Interaction** | | |
| V x SA | ns | ns |

Means followed by the same letter within treatment groups are not significantly different using DMRT at 5% probability level.

ns – Not Significant

Table 14: Average fruit weight in watermelon (*Citrullus lanatus*) as influenced by Variety and Salicylic acid at Bukavu and Tassa during 2017 rainy season.

| **Treatment** | **Bukavu** | **Tassa** |
|---|---|---|
| **Variety(V)** | | |
| Greybell | 3.20 | 3.70 |
| Kaolack | 3.24 | 3.88 |
| SE± | 0.097 | 0.233 |
| **Salicylic Acid gL$^{-1}$ (SA)** | | |
| 0 | 3.34 | 3.28 |
| 1.0 | 3.04 | 4.19 |
| 2.0 | 3.40 | 3.89 |
| 3.0 | 3.03 | 3.81 |
| SE± | 0.137 | 0.330 |
| **Interaction** | | |
| V x SA | ns | ns |

Means followed by the same letter within treatment groups are not significantly different using DMRT at 5% probability level.

ns – Not Significant

Table 15: Yield per hectare in watermelon (*Citrullus lanatus*) as influenced by Variety and Salicylic acid at Bukavu and Tassa during 2017 rainy season.

| Treatment | Bukavu | Tassa |
|---|---|---|
| **Variety(V)** | | |
| Greybell | 13.34 | 12.68 |
| Kaolack | 12.16 | 11.00 |
| SE± | 1.230 | 1.395 |
| **Salicylic Acid $gL^{-1}$ (SA)** | | |
| 0 | 11.72 | 10.78 |
| 1.0 | 13.17 | 12.31 |
| 2.0 | 14.66 | 13.16 |
| 3.0 | 10.91 | 11.11 |
| SE± | 1.740 | 1.937 |
| **Interaction** | | |
| V x SA | ns | ns |

Means followed by the same letter within treatment groups are not significantly different using DMRT at 5% probability level.

ns – Not Significant

4.1.13 Marketable Yield (tons per hectare)

Marketable yield of watermelon was not significantly ($p>0.05$) influenced by variety and salicylic acid (Table 16). This indicated that all varieties were statistically similar in terms of marketable yield. Similarly, results of the salicylic acid treatments were all at par, thus producing similar marketable yield irrespective of rate applied at both locations. There was also a non-significant interaction between variety and salicylic acid in this study.

4.1.14 Correlation Analysis

The relationship between growth, yield components and fruit yield of watermelon grown during 2017 rainy season in Bukavu is shown in table 17. The results showed highly significant and positive correlation between yield and number of fruits. There was also significant ($p< 0.05$) and positive correlation between yield and average fruit weight. Number of leaves was also positively related with number of fruits. However days to flowering had a negative correlation with number of leaves.

Table 18 shows the relationship between growth, yield components and fruit yield of watermelon grown during 2017 rainy season at Tassa. The relationship between yield and number of fruits was positive and highly significant. Also, number of fruits and vine length had a highly significant and positive relationship. Yield also had a positive correlation with average fruit weight.

Table 16: Marketable yield in watermelon (*Citrullus lanatus*) as influenced by Variety and Salicylic acid at Bukavu and Tassa during 2017 rainy season.

| Treatment | Bukavu | Tassa |
|---|---|---|
| **Variety(V)** | | |
| Greybell | 12.42 | 11.70 |
| Kaolack | 11.08 | 10.19 |
| SE± | 1.213 | 1.969 |
| | | |
| **Salicylic Acid gL$^{-1}$ (SA)** | | |
| 0 | 10.64 | 9.78 |
| 1.0 | 12.61 | 11.35 |
| 2.0 | 13.61 | 12.26 |
| 3.0 | 10.15 | 10.40 |
| SE± | 1.716 | 2.784 |
| | | |
| **Interaction** | | |
| V x SA | Ns | ns |

Means followed by the same letter within treatment groups are not significantly different using DMRT at 5% probability level.

ns – Not Significant

Table 17: Correlation Coefficient (r) for Growth, Yield Components and Fruit yield of watermelon (*Citrullus lanatus*) during 2017 rainy season at Bukavu

| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
|---|---|---|---|---|---|---|---|---|---|
| **1** | 1.000 | | | | | | | | |
| **2** | -0.079 | - | | | | | | | |
| 3 | -0.048 | -0.189 | - | | | | | | |
| **4** | 0.157 | 0.064 | 0.183 | - | | | | | |
| **5** | 0.175 | -0.446* | 0.152 | 0.066 | - | | | | |
| **6** | 0.600** | -0.064 | 0.069 | 0.047 | 0.386* | - | | | |
| **7** | -0.060 | -0.155 | -0.134 | 0.137 | -0.210 | -0.009 | - | | |
| **8** | -0.184 | 0.160 | 0.212 | -0.010 | 0.267 | 0.169 | 0.083 | - | |
| **9** | 0.367* | 0.268 | -0.151 | 0.058 | -0.182 | -0.241 | 0.005 | 0.118 | 1.000 |

1= Yield

2= Days to flowering

3= Leaf Area Index

4= Vine Length

5= Number of Leaves

6= Number of Fruits

7= Leaf Chlorophyll Content

8= Canopy Temperature

9= Average fruit weight

*= Significant at 5% level

**= Highly Significant

Table 18: Correlation Coefficient (r) for Growth, Yield Components and Fruit yield of watermelon (*Citrullus lanatus*) during 2017 rainy season at Tassa.

| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
|---|---|---|---|---|---|---|---|---|---|
| **1** | 1.00 | | | | | | | | |
| **2** | 0.068 | - | | | | | | | |
| 3 | 0.079 | 0.113 | - | | | | | | |
| **4** | 0.340 | 0.074 | -0.165 | - | | | | | |
| **5** | -0.014 | -0.158 | -0.043 | 0.071 | - | | | | |
| **6** | 0.790** | 0.139 | 0.040 | 0.574** | 0.082 | - | | | |
| **7** | 0.071 | 0.015 | -0.026 | -0.217 | -0.290 | -0.148 | - | | |
| **8** | -0.105 | -0.211 | 0.149 | -0.136 | -0.031 | 0.077 | -0.165 | - | - |
| **9** | 0.547* | 0.072 | 0.002 | -0.110 | -0.158 | 0.036 | 0.244 | -0.305 | 1.00 |

1= Yield

2= Days to flowering

3= Leaf Area Index

4= Vine Length

5= Number of Leaves

6= Number of Fruits

7= Leaf Chlorophyll Content

8= Canopy Temperature

9= Average fruit weight

*= Significant at 5% level

**= Highly Significant

## 4.2 DISCUSSION

### 4.2.1 Varietal Response in Watermelon

Varietal differences affect or determine the growth and yield of crops. Performance of any crop in respect to growth, yield and quality are influenced by factors such as genetic constitution, climate and management practices of the crop. The results from this study indicate a significant difference between Greybell and Kaolack in growth characters such as days to emergence, leaf area and leaf area index.

The ability of Kaolack to emerge earlier than greybell may be attributed to genetic differences and or environmental factors. This is in conformity with the findings of Gajri *et al*., (2002) which attributed that seed germination and emergence are affected by soil water, soil temperature, soil air, mechanical impedance and other edaphic factors. Leaf area and leaf area index are indicators of plant growth. There was a significant difference in leaf area and leaf area index at 4 weeks after sowing in Tassa, with Kaolack having higher leaf area and leaf area index. However, no significant difference was recorded among varieties grown at Bukavu. This is in conformity with the findings of Anikwe *et al*. (2016) who reported difference in leaf area index between watermelon varieties at one location of the study.

The non-significant differences in number of fruits, average fruit weight and marketable yield observed in this study may be due to similarities in the genetic constitution of the varieties. This agrees with the works of Majanbu *et al.* (1996) and Sajjan *et al.* (2002) reported that growth characters of crops such as plant height, vine length, leaf area, number of leaves or branches, and fruit production were influenced by genetic factors of the different varieties.

Based on the results of this research, there was no significant difference in yield of the two varieties. This can be attributed to non-significant differences in growth characters. It could be that the varieties of the present study lacked the diversity to cause differences in fruit yield (Gusmini and Wehner, 2005).

### 4.2.2 Response of watermelon to Seed Priming with Salicylic Acid

Priming generally induces faster and more uniform germination especially in adverse physical conditions of many crop species. Results presented in this research showed that priming watermelon seeds in salicylic acid reduced the days to emergence irrespective of concentration. This may be due to improved germination. This agrees with the findings of Argerish *et al* (1989) whom reported that seedling emergence of primed seeds is earlier and the emergence is more synchronous, especially when sown under suboptimal temperatures. Armin *et al*. (2010) also reported a lower mean emergence time from primed watermelon seeds.

The results showed significant effect of salicylic acid on number of leaves observed in this study may be related to increase $CO_2$ assimilation and photosynthetic rate under salicylic acid application (Szepesi *et al*., 2005). The significant response of leaf area and leaf area index to applied SA also agrees with findings of Ahmad *et al*. (2014) who reported increase in number of branches, leaf area and number of leaves with application of salicylic acid. The non-response of leaf chlorophyll content to priming with salicylic acid however, contradicts the findings of El-Tayeb (2005) who reported increase in leaf chlorophyll content with applied salicylic acid.

According to this study, seed priming with salicylic acid had no effect on the yield of watermelon varieties. This could be attributed to their genetic make-up as reported by Nascimento (2003) who stated that the response of seeds to priming has been found to be dependent on the osmotica, duration of priming, seed maturity, cultivar, and environmental conditions. However, this is contrary to findings of Ndunguru and Rajabu (2004) who reported that primed seeds give rise to crops which matured earlier and gave higher yields.

### 4.2.3 Interaction

The combined effect of variety and salicylic acid was not significant on most of the agronomic parameters investigated. Results of this research revealed that priming watermelon seeds with salicylic acid irrespective of rate applied led to a decrease in number of days to emergence, with Kaolack emerging earlier than grey bell at both locations. Also, priming watermelon seeds with salicylic acid increased the number of leaves at 4 and 6 weeks after sowing at Bukavu and 4 weeks after sowing at Tassa. This agrees with the findings of Hosseini and Koocheki (2007) who reported that different varieties can respond differently to priming.

### 4.2.4 Correlation Analysis

The correlation coefficient is a measure of degree of symmetrical associations between two variables which displays the nature and magnitude of association between growth and yield component. The results of this study showed a highly significant and positive correlation between vine length and number of fruits at Tassa observed in the present investigation signifies that vine length is an important factor that determines fruit number and yield. This is in conformity with the works of Gichimu *et al.* (2010) who reported strong and highly significant positive relationship between main vine length and fruit number in watermelon.

There was a highly significant positive association between yield and number of fruits at both locations; average fruit weight and yield also had a significant positive relationship at the two locations. This can be attributed to the direct effect of these characters to yield. Warren *et a*l. (1998) indicated that more watermelon foliage translates into high photosynthetic assimilation rates and ultimately more fruits. This was confirmed by the significant positive relationship that was observed between number of leaves and number of fruits at Tassa in this study.

# CHAPTER FIVE

## 5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

### 5.1 SUMMARY AND CONCLUSION

Field experiment was carried out during the 2017 rainy season at Bukavu Barracks, (Latitude $12^0$ 3'N Longitude $08^0$ 31'E 476m) and Tassa village, Dawakin Kudu LGA, (Latitude $11^0$ 50'N Longitude $08^0$ 35'E 450m) both in Kano State. The research was carried out to study productivity of watermelon (*Citrullus lanatus*) under the influence of seed priming with salicylic acid under rain-fed condition. Four concentrations (0, 1, 2, $3gL^{-1}$) of salicylic acid were used on two watermelon varieties (Greybell and Kaolack). These were laid out in a Randomised Complete Block design with 3 replications. Data were collected on days to emergence, number of leaves, days to flowering, leaf area, leaf area index, leaf chlorophyll content, canopy temperature, yield and marketable yield.

Significantly different means were compared using Duncan Multiple Range Test (DMRT). Simple correlation analysis was done to determine the association between the observed parameters. The results of the study indicated significant response of priming watermelon with salicylic acid on days to emergence, number of leaves, leaf area and leaf area index. Interaction of variety and salicylic acid were obtained on days to emergence and number of leaves per plant. The result of the simple correlation analysis also revealed a significant association between some of the characters to fruit yield.

From the research, it could be concluded that priming watermelon seeds with salicylic acid reduced the days to emergence and had a positive effect during the early growth stage of the crop. However, this had no effect on the yield of the crop.

## 5.2 RECOMMENDATION

Based on the findings of this study, priming watermelon seeds with $1.0gl^{-1}$ salicylic acid is recommended to improve seedling emergence and good stand establishment of the crop in the study area. Increased rate of SA is however, recommended for further study with a view to harness the potentials of seed priming for increased yield of watermelon under rain fed condition.

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