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PRODUCTIVITY OF WATERMELON (*CITRULLUS LANATUS* (THUNBERG) M.) AS INFLUENCED BY DIFFERENT FERTILIZATION, IRRIGATION METHODS, AND INTRA-ROW SPACINGS AT SAMARU, NORTHERN GUINEA SAVANNA

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ABSTRACT

An experiment comprised of three fertilizations (NPK 100-50-50, 5 tons (t) Poultry Manure (PM); NPK 50-25-25 + 2.5 t PM ha^{-1}, two irrigation methods (Furrow and Border) and three levels of intra-row spacing (1 m x 1 m, 1 m x 2 m and 1.5 m x 1.5 m) was carried out during 2021 and 2022 dry seasons. The experiment was carried out in the Teaching and Research Farm of the Institute for Agricultural Research, Ahmadu Bello University Zaria, latitude 11° 11' N and longitude 07° 38' E, 686 meters above sea level. The treatments were arranged in a Randomized Complete Block Design in a split-plot arrangement and replicated three times. Data measured were on vine length, number of branches plant^{-1}, days to 50% flowering, number of fruits plants^{-1}, fruits yield plot^{-1} (g), and yield ha^{-1} (kg ha^{-1}). All the required agronomic practices were duly observed. The data collected were subjected to statistical analysis of variance (ANOVA) using SAS version 9.0. Significant means were separated using Duncan Multiple Range Test at 5% probability. The results obtained from the study revealed that the application of 50-25-25 NPK + 2.5-ton PM ha^{-1}, using border irrigation and closer intra-row spacing of 1 m x 1 m appeared the best combination for good growth performance and optimum yield of watermelon in the northern Guinea ecological zone of Nigeria. Therefore, farmers are recommended to apply 50-25-25 NPK + 2.5 PM hectare^{-1} using border irrigation method and to plant watermelon at an intra-row spacing of 1 m x 1 m for good productivity of watermelon at Samaru, northern Guinea savanna.

Keywords: Productivity, Watermelon, fertilization, irrigation, intra-row spacings and savanna

INTRODUCTION

Due to its high nutritional value, watermelon (*Citrullus lanatus* (Thunb.) Mansfed) is the most farmed Cucurbitaceae species worldwide and one of the most frequently cultivated crops (Abd Allah *et al.*, 2022; Huh *et al.*, 2008). According to FAO (2011) statistics, China is the world's leading producer of watermelon. Adeoye *et al*. (2020) reported that the bulk production of watermelon in Nigeria still comes from the northern part of the country. Melons, gourds, squash, pumpkins, and cucumbers (Kacha *et al.*, 2017). Particularly in the Sudan Savannah region, watermelon is a popular eating and commercial fruit. It is widely cultivated as a vegetable around the world, notably India, and has a high nutritional value. It is grown commercially by farmers in Jigawa, Kano, Katsina Sokoto, Keffi, Kaduna and particularly in the irrigated areas for long-term revenue sustainability (Sabo *et al*., 2013). The crop is mostly grown for the fruit pulp, which may be eaten raw or mixed into salads. Because of its flavourful qualities and wonderful taste, it is also consumed as a juice. Furthermore, it has low sodium and high potassium content. The heart attack risk is lowered by the antioxidants in watermelons as reported by Kacha *et al.* (2017). It is also a significant crop that has a high-water content (Malolo *et al*., 2001), which promotes better food digestion and prevents dehydration during droughts (Sabo *et al*., 2013). Due to the high-water content in the fruits, watermelon is high in vitamins B6 and C and low in sugar and calories, making it a good option for people trying to lose weight. Since it is a short-season crop, farmers plant it after the wheat harvest, but before they sow rice. This would ensure that farmers can purchase agricultural inputs to produce rice and meet a portion of the family needs. The crop is edible when it's uncooked. Its seeds have a high oil content that can be extracted and used on a household basis. The fruits and tender leaves are used as a vegetable source. Although watermelon is becoming more and more popular in Nigeria, yields are often quite modest (Enujeke, 2013). A number of factors, including inadequate fertilizer application, low and poor distribution of rainfall, poor farming techniques, and restricted availability to improved varieties, can be responsible for the low watermelon yield (Dube *et al*., 2020; Nweke and Nsoanya, 2015; Kahan, 2013). To maintain the soil's fertility and meet the crop's needs, increasing the nutrient status of the soil is necessary to produce a high yield of water melon. A deficiency or insufficiency of soil nutrients for adequate plant nutrition results in poor growth and yield quality, which lowers farmers' revenue (Aluko *et al*., 2014). In regions with lower rainfall, the crop is planted around the end of the rainy season, while in arid areas, it is planted at the start of the rainy season. It has been discovered that supplemental watering benefits horticultural crops such as watermelon (Cabello *et al*., 2009) and capsicum (Antony and Singandhupe, 2004). A useful first step in advising farmers to produce watermelon on a commercial scale for profitable production is determining the crop's proper water needs as well as the best fertilization and intra-row spacing for excellent growth and yield. The research was aimed at identifying the most optimum fertilization, irrigation method and inter row spacing for profitable yield of watermelon in the northern guinea savanna.

METHODOLOGY

The trials were conducted in the Teaching and Research Farm of the Institute for Agricultural Research, Ahmadu Bello University Zaria latitude, 11° 11' N and longitude 07° 38' E 686 meters above sea level, during the dry seasons of 2021 and 2022. The experiment consisted of three fertilizations (NPK 100-50-50; 5 tons (t) Poultry Manure (PM) $ha^{-1}$and NPK 50-25-25 + 2.5 t PM ha^{-1}; two irrigation methods (Furrow and Border) and three levels of intra-row spacings (1 m x 1 m, 1 m x 2 m and 1.5 m x 1.5 m). The treatments were arranged in a Randomized Complete Block Design in a split-plot arrangement. and replicated three times. The plot size used was 5 m x 3 m giving 15 $m^{2.}$ beds. Data were collected on vine length (cm), number of branches $plant^{-1}$, days to 50 % flowering, number of fruits $plants^{-1}$, fruits yield $plot^{-1}$ (kg ha^{-1}) and yield ha^{-1}. All the required agronomic practices were duly observed. The data collected was subjected to statistical analysis of variance (ANOVA) using SAS Institute version 9 as described by Snedor and Cockren (1955). Significant means were separated using Duncan Multiple Range Test (DMRT) at 5 % probability.

RESULTS

The influence of fertilization, irrigation methods and plant density on vine length, number of branches per plant, days to 50% flowering, number of fruits per plant, marketable fruits, and fruit yield per hectare were presented in Tables 1 and 2. Results obtained indicated that fertilization at NPK 50-25-25 + 2.5 t ha^{-1} PM significantly ($p \leq 0.05$) growth and yield parameters measured except days to 50% flowering when application of NPK 100-50-50 rate significantly recorded the highest. The border irrigation method recorded higher vine length per^{-1}, number of branches per^{-1} as well as days to 50% flowering and yield parameters (number of fruits per^{-1} and marketable fruit yield) than the furrow method except for fruit yield per hectare when furrow irrigation method significantly performed better. Closer intra-row spacing of 1 m x 1 m significantly ($p \leq 0.05$) gave higher growth and yield parameters except the number of branches/plant and fruit number per plant that were higher with 1.5 m x 1.5 m intra-row spacing. There were no significant ($p \geq 0.05$) interactions among the treatments measured in both seasons. The influence of the treatments on vine length, number of branches per plant, days to 50% flowering, number of fruits per plant, marketable fruits, and fruit yield per hectare were presented in Table 2. Results obtained indicated that fertilization NPK 50-25-25 + 2.5 t/ha PM significantly gave higher growth and yield of the crop except for days to 50% flowering when the recommended rate of NPK recorded the highest. The border irrigation method recorded higher growth and yield components than the furrow method which produced the least except yield fruits per hectare which the furrow recorded the highest. Closer intra-row spacing of 1m x 1m significantly produced more growth and yield parameters like vine length, days to 50% flowering, and fruit yield per hectare while 1.5 m x 1.5 m intra-row spacing produced the highest number of branches $plant^{-1}$, number of fruits $plant^{-1}$ and marketable fruits yield. There were no significant interactions among the treatments measured at both seasons in all the parameters recorded.

Table 1: Effects of fertilization, irrigation method, and plant density on the growth of watermelon at Samaru, Nigeria during 2021 and 2022

Treatment	Vine length plant^{-1} plant^{-1} 2021	2022	No. of branches plant^{-1} 2021	2022	Day to 50% flowering 2021	2022
Fertilization (PM)						
NPK 100-50-50	99.0b	109.0b	6.0c	7.0c	45.0a	47.0a
5 t ha^{-1} Poultry Manure	117.0a	127.0a	8.0b	9.0b	39.0b	41.0b
NPK 50-25-25 + 2.5 t ha^{-1}	130.0a	130.0a	10.0a	11.0a	36.0c	38.0a
SE ±	2.65	2.65	0.36	0.45	0.43	0.45
Irrigation Method						
Furrow	110.0b	120.0b	11.0b	12.0b	39.0b	41.0b
Border	115.0a	125.0a	12.0a	13.0a	41.0a	43.0a
SE ±	2.00	2.05	0.21	0.22	0.40	0.42
Plant density (cm)						
1 m x 1 m	125.0a	135.0a	7.0c	8.0c	44.0a	46.0a
1 m x 2m	115.0b	125.0b	8.5b	9.5b	40.0b	42.0b
1.5 m x 1.5 m	100.0c	110.0c	9.0a	10.0a	36.0c	38.0c
SE ±	2.25	2.65	0.36	0.45	0.43	0.45
Interaction						
F x M	NS	NS	NS	NS	NS	NS
F x D	NS	NS	NS	NS	NS	NS
M x D	NS	NS	NS	NS	NS	NS
F x M x D	NS	NS	NS	NS	NS	NS

Means followed by different latter within the same column are significantly different using Duncan's Multiple Range Test at 5% probability level.

Table 2: Effects of fertilization, irrigation method, and plant density on yield attributes of watermelon at Samaru, Nigeria during 2021 and 2022

Treatment	No. of fruits plant $^{-1}$		Marketable fruit yield		Fruit yield (t ha^{-1})	
	2021	**2022**	**2021**	**2022**	**2021**	**2022**
Fertilization (PM)						
NPK 100-50-50	3.0c	4.0c	13.0c	15.0c	11.0b	13.9a
5 t ha^{-1} Poultry Manure	4,0b	5.0b	15.0b	17.0b	21.5b	23.5b
NPK 50-25-25 + 2.5 t ha^{-1}	5.0a	6.0a	17.0a	19.0a	25.6a	27.5a
SE (±)	0.04	0.05	0.50	0.60	0.21	0.26
Irrigation Method						
Furrow	5.0b	6.0b	23.0b	25.0b	28.3a	30.0a
Border	6.0a	7.0a	26.0a	28.0a	24.9b	26.9b
SE (±)	0.05	0.38	0.45	0.50	0.11	0.13
Plant density (cm)						
1 m x 1 m	4.0c	5.0c	13.0a	15.0c	20.0a	22.0a
1 m x 2 m	5.0b	6.0b	15.0b	17.0b	18.0b	30.0b
1.5 m x 1.5 m	6.0a	7.0a	17.0a	19.0a	16.0c	18.0c
SE (±)	0.04	0.05	0.50	0.60	0.21	0.26
Interactions						
F x M	NS	NS	NS	NS	NS	NS
F x D	NS	NS	NS	NS	NS	NS
M x D	NS	NS	NS	NS	NS	NS
F x M x D	NS	NS	NS	NS	NS	NS

Means followed by different latter within the same column are significantly different using Duncan's Multiple Range Test at 5% probability level

DISCUSSION

In terms of growth and yields parameters like vine length, number of branches/plants, days to 50% flowering, number of fruits per plant, marketable yield, and fruits yield per hectare. Watermelon is significantly more productive when combined with NPK 50-25-25 + 2.5 t/ha PM than when grown alone with NPK 100-50-50 and 5 t/ha poultry manure. This is because combination of these two N fertilizers sufficiently supply nitrogen needed for normal growth and yield of the crop better than either of NPK alone or manure alone manifested with high photosynthetic activity and vigorous vegetative grow. This assertion agreed with the opinion of William *et al*. (2018) that growth, development, and yield of watermelon can be enhanced by using NPK (20:10:10) fertilizer. Due to low and poor inherent soil fertility, fertilizer application is a critical requirement for good yield, particularly in Southern Nigeria (Okwoche *et al*., 2018). Application of fertilizer enhanced the crop's fruit output characteristics, which may be associated to the compost's and NPK fertilizer's capacity to encourage rapid growth and enhanced the plant's meristematic and physiological activities as a result of the availability of nutrients and better soil conditions. thereby encouraging the synthesis of more photo-assimilates, which are then utilized in fruit production (Dauda *et al*., 2008). Additionally, the application of poultry manure may be caused by the important nutrients it contains, which are linked to high photosynthetic activities and hence encourage the growth of roots and vegetation (John *et al*., 2004). In the same vein, application of poultry manure improves soil physical and chemical properties as improved soil texture and structure. This will facilitate water and nutrients retention and usage by plants The results of Adeyeye *et al*. (2002), whom reported 50% NPK plus 50% compost is sufficient for watermelon production in the northeastern region of Nigeria, were in disagreement with the outcome in this study. Furrow irrigation is the usual method used to irrigate watermelon; nevertheless, drip irrigation has been effectively used in light-textured soils (FAO, 2010). The experimental site has clay loam soil. With the exception of fruit production per hectare, the data showed that the border irrigation approach recorded higher growth and yield characteristics than the furrow method. The standard of living for farmers who grow watermelon can rise in tandem with increased yield and production. To that reason, organic and inorganic farming is becoming more and more popular worldwide. The agronomic attributes of inter- and intra-row spacing are significant because they are thought to impact light interception, which in turn impacts the photosynthetic process. Since plant spacing is thought to have an impact on light interception, which in turn impacts the photosynthetic process, it is a crucial agronomic feature as observed by Adlan *et al*. (2018). The quantity of fruits per plant in watermelon reduces with increasing planting density, but the size of individual fruits is mostly unaltered (Duthie *et al*., 1999). Numerous factors impact the ideal plant population for a given crop, including the availability of sunlight, water, and nutrients; the duration of the growing season; the maximum size of the plant; and the plant's ability to adapt to changing environmental conditions (Ramírez *et al.*, 2009). The study's findings showed that, aside from the number of branches/plant and fruits derived per plant, which were produced at the largest plant density 1.5 m x 1.5 m, 1 m x 1 m plant density considerably increased growth and yield indicators. This result is consistent with the findings of Akimtoye *et al*. (2009), who found that as planting density increased, the average fruit weight of commercial watermelon dropped. However, according to (Adlan *et al*., 2017), the optimal planting technique to produce the highest-quality watermelon with the highest yield in the Gezira area of Sudan is to plant one plant per hole at an intra-row spacing of 70 cm.

CONCLUSION

Based on the result obtained in this study, farmers can be advised to apply 50-25-25 NPK + 2.5-ton poultry manure ha^{-1}, using border irrigation and at a closer intra-row spacing of 1 m x 1 m. for optimum watermelon performance in Samaru as well as areas with similar ecology.

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