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Effect of Spacing and NPK 20:10:10 Fertilizer on the Growth and Yield of Watermelon (Citrullus lanatus) in Enugu, South Eastern Nigeria.

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Abstract

A field experiment to investigate the effect of spacing and NPK 20:10:10 fertilizer on the growth and yield of watermelon was conducted at the teaching and Research Farm of Faculty of Agriculture and Natural Resources Management, Enugu State University of Science and Technology. The experiment was carried out in a 2 x 3 factorial in a Randomized Complete Block Design (RCBD) with six (6) treatments replicated three (3) times using "crimson sweet" as a test crop. Parameters measured were vine length, number of fruits per plant, days to 50% flowering, fruit yield (ton/ha), and number of marketable fruits. 400kg/ha fertilizer in spacing 30cm x 30cm plots recorded the highest vine length of 193.8 cm which significantly deferred from the other treatment means. This was followed by 200kg/ha fertilizer in spacing of 30 cm x 30 cm which recorded vine length of 151.50 cm that significantly deferred from the rest of the treatment means. There were no significant differences between 400kg/ha fertilizer in 15 cm x 15 cm plots and 200kg/ha fertilizer in 15 cm x 15cm plots, Okg/ha fertilizer in 30 cm x 30 cm pots and Okg/ha fertilizer in 15cm x 15 cm plots on vine length. 400kg/ha fertilizer in 30 cm x 30 cm plots recorded the highest mean number of 34.33 fruits per plant which deferred significantly from the rest of the treatment means. The following treatments produced the same effects on the number of fruits per plant – 200kg/ha fertilizer in 30 cm x 30 cm plots and 400kg/ha fertilizer in 15 cm x 15 cm plots, Okg/ha fertilizer in 30 cm x 30 cm plots and Okg/ha fertilizer in 1 5cm x 15cm plots. On fruit yield (ton/ha) 400kg/ha fertilizer in 30cm x 30cm plots, and 200kg/ha fertilizer in 30 cm x 30 cm plots produced the highest yield of 13.44 ton/ha and 13.22 ton/ha respectively which were not significantly different except the controls – Okg/ha fertilizer in 15cm x 15cm and Okg/ha fertilizer in 30 cm x 30 cm plots which yielded 3.89 ton/ha and 5.48 ton/ha respectively. 400kg/ha fertilizer in 30cm x 30cm, 400kg/ha fertilizer in 15cm x 15cm, 200kg/ha fertilizer in 30cm x 30cm and 200kg/ha fertilizer in 15cm x 15cm plots recorded mean number of 9.33, 9.00, 7.00 and 8.33 marketable fruits per plant respectively which were significantly the same except the controls. There was no treatment effect on the number of days to 50% flowering. There was no interaction (AB) effect on vine length (cm) between NPK 20:10:10 and spacing. Also, there was no interaction effect between NPK 20:10:10 and spacing on the number of fruits per plant. There was a significant interaction effect between NPK 20:10:10 and spacing on the fruit yield (ton/ha), so also on the number of marketable fruits. There was no interaction effect between NPK 20:10:10 and spacing on the number of days to 50% flowering.

Key words: Watermelon, spacing, NPK 20:10:10.

INTRODUCTION

Watermelon *(Citrullus Lanatus)* is a member of the cucurbit family (cucurbitaceae). It is one of the most common types of melons and a vine like flowering plant of South African origin. Its fruit which is also called watermelon, is a special kind referred to by botanists as a pepo, that is either round or cylindrical, up to 600 mm long. It has a smooth rind, usually green, yellow and sometimes white with thickness of 10 mm to 40 mm and a juicy sweet interior usually red but sometimes yellow, orange or pink and even green if unripe. Watermelon plays significant role in the preparation of different kinds of food materials such as salad, fruit juice etc.

An increase in the production and consumption of watermelon has been observed in the last 15 years in Croatia, Southeastern Europe. Watermelon fruits contain 93% water, with small amount of protein, fat, minerals and vitamins. The major nutritional components of

the fruit are carbohydrates, vitamin A and lycopene, and anticarcinogenic compound found in red flesh watermelon. Lycopene may help reduce the risk of certain cancer of prostrate gland, pancreas and stomach. Watermelon is one of the world most important vegetable, as it is cultivated both for its fruits and the vegetative parts which are highly nutritious (Schippers 2000). The consumption and production of watermelon is greater than any other species in the cucurbitaceae family (Robinson and Decker-Water 1997).

Adequate plant spacing strategies and nutrient management has been reported to have a positive impact on watermelon yield (Duthie et al., 1999, Kaya et al., 2003., Goreta et al; 2005). Inappropriate plant density has accounted for poor yields of this crop among most small scale watermelon farmers. If plants are widely spaced, not all land area is covered by leaves and much of light available for photosynthesis is wasted, so also water and mineral resources in the soil. But if plants are closely spaced, competition for water and minerals in the soil, as well as light will occur among plants because their leaves will begin to shade one another (Forbes and Watson 1992). High plant density is recommended for watermelon seed production because more fruits per area is achieved at a denser spacing (Edelstein and Nerson 2002).

While some works indicate that watermelon do not have a large fertilizer requirement and that the crop can be grown with little or no fertilizer after a heavily fertilized crops or on fertile land. Other authors reported the crop to be a heavy feeder of Nitrogen and therefore requires a liberal application of 200kg/ha NPK fertilizer which needs to be applied two weeks before sowing and to be followed by an application of nitrogenous fertilizers at 5 weeks interval up to flowering (Schipper, 2000).

The objective of this research work was therefore to investigate the effect of spacing and NPK 20:10:10 fertilizer on the growth and yield of watermelon.

MATERIALS AND METHOD

The experiment was carried out during the 2012 cropping season at the Faculty of Agriculture and Natural Resources Management Research Farm, Enugu State University of Science and Technology, Nigeria (06^0 52'N, 07^0 15^1E; mean elevation of 450m above sea level). The area has an annual rainfall of 1700-2010 mm. The rainfall pattern is bimodal between November and March (Ezeaku and Anikwe 2006) and is classified as Typic Paleustult (Anikwe et al. 1999).

Experimental Design

The experiment was carried out in a 2 x 3 factorial in a randomized complete block design (RCBD) replicated three (3) times. The treatments were 2 different spacings viz; 15cm x 15cm, 30cm x 30cm and 3 rates of NPK 20:10:10 fertilizer viz; Okg/ha, 200kg/ha and 400kg/ha. The experimental units (plots) were separated by 1 m partway and each unit measured 1.5 m x 1.5 m $(2.25)^2$. The variety of watermelon (crimson sweet) used was obtained from Molon Agro-source Enugu.

Treatment Combinations

Treatment combinations involved all the possible combinations of the levels of the factors in the experiment such as factor 'A' (spacing) and factor 'B' (fertilizer rates) viz; A_1B_1, A_1B_2, A_1B_3, A_2B_1, A_2B_2 and A_2B_3.

Parameters measured were vine length, number of fruits per plant, number of days to 50% flowering, fruit yield and number of marketable fruits per plant, and leaf area index.

RESULTS

Effect of spacing and NPK 20:10:10 Fertilizer on vine length (cm) at 30 DAP.

400kg/ha NPK 20:10:10 in spacing of 30cm x 30cm plots recorded the highest vine length of 193.8cm which significantly deferred from the other treatment means. This was followed by 200kg/ha NPK 20:10:10 in spacing of 30cm x 30cm plots which produced vine length of 151.50 cm that significantly differed from the other treatment means. There were no significant treatment effects between 400kg/ha NPK 20:10:10 in spacing of 15cm x 15cm plots and 200kg/ha NPK 20:10:10 in spacing of 15cm x 15cm plots, 0kg/ha NPK 20:10:10 in spacing of 30cm x 30cm plots and 0kg/ha NPK 20:10:10 in spacing of 15cm x 15cm plots.

There was an interaction effect between NPK 20:10:10 fertilizer and spacing on vine length (cm). The main effect of A is 105.3 and the main effect of B is 158.6. The interaction AB = 74.8.

Table 1. Effect of spacing and NPK Fertilizer on vine length (cm) at 30 DAP.

Treatment combinations	Mean
Okg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	87.40
200kg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	100.40
400kg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	117.67
Okg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	65.28
200kg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	151.50
400kg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	193.80
F-LSD (P = 0.05)	27.40

Effect of spacing and NPK 20:10:10 fertilizer on the number of days to 50% flowering.

Statistical analysis showed no significant treatment effect on the number of days to 50% flowering.

Table 2. Effect of spacing and NPK 20:10:10 fertilizer on the number of days to 50% flowering

Treatment combinations	Mean
Okg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	40.33
200kg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	37.66
400kg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	43.67
Okg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	43.67
200kg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	36.00
400kg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	41.00

Effect of spacing and NPK 20:10:10 on the number of fruits per plant

Statistical analysis showed a significant treatment effect on the number of fruits per plant with 400kg/ha NPK 20:10:10 fertilizer applied in spacing of 30 cm x 30 cm plots recording the highest mean number of 34.33 fruits per plant which deferred significantly from the other treatment means.

The following treatments produced the same effect on the number of fruits per plant – 400kg/ha NPK 20:10:10 applied in 15 cm x 15 cm plots, 200kg/ha NPK 20:10:10 applied in 15cm x 15 cm plots, 200kg/ha NPK 20:10:10 applied in 30 cm x 30 cm plots and 200kg/ha NPK 20:10:10 applied in 15 cm x 15 cm plots. Also the same effect was observed with treatments Okg/ha NPK 20:10:10 applied in 15 cm x 15 cm plots and Okg/ha NPK 20:10:10 applied in 30 cm x 30 cm plots (table 2). There was a negative interaction effect between spacing and NPK 20:10:10 on the number of

Table 3. Effect of spacing and NPK 20:10:10 fertilizer on the number of fruits per plant.

Treatment combinations	Mean
Okg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	1.67
200kg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	23.00
400kg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	23.00
Okg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	3.33
200kg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	24.00
400kg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	34.33
F-LSD (P = 0.05)	5.70

Effect of spacing and NPK 20:10:10 fertilizer on fruit yield (ton/ha)

The result of the experiment showed a significant treatment effect on fruit yield per hectare with 400kg/ha NPK 20:10:10 fertilizer applied in 30 cm x 30 cm plots recording the highest mean fruit yield of 13.44 ton/ha followed by 200kg/ha NPK 20:10:10 fertilizer applied in 30 cm x 30 cm plots producing mean fruit yield of 13.22 ton/ha which were not significantly different from the other treatment means except Okg/ha NPK 20:10:10 fertilizer applied in 15 cm x 15 cm plots and Okg/ha NPK 20:10:10 applied in 30 cm x 30 cm plots (table 4). There was a significant interaction effect on fruit yield. The main effect of A is 3.17, the main effect of B is 16.58 and the interaction (AB) effect is 0.0018.

Table 4. Effect of spacing and NPK 20:10:10 fertilizers on fruit yield (ton/ha)

Treatment combinations	Mean
Okg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	3.89
200kg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	12.45
400kg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	12.63
Okg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	5.48
200kg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	13.22
400kg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	13.44
F-LSD (P = 0.05)	3.05

Effect of spacing and NPK 20:10:10 on the number of marketable fruits per plant

The result of the experiment showed a significant treatment effect on the number of marketable fruits produced per plant with 400Kg/ha NPK 20:10:10 fertilizer applied in 30cm x 30cm plots producing the highest mean number of markeatable fruits of 9.33Kg/plant. Okg/ha NPK 20:10:10 applied in 15 cm x 15 cm plots and Okg/ha NPK 20:10:10 applied in 30 cm x 30 cm plots produced the same result but were significantly different from the other treatment means. Those fruits that weighed 1.7kg and above were regarded as marketable

fruits (Pincacco et al., 2006). There was a significant interaction effect between spacing and fertilizer on the number of marketable fruits per plant (table 5).

Table 5: Effect of spacing and NPK Fertilizers 20:10:10 on the number of marketable fruits per plant.

Treatment combinations	Mean
Okg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	0.67
200kg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	8.33
400kg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	9.00
Okg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	1.00
200kg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	7.00
400kg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	9.33
F-LSD (0.05)	4.22

Effect of spacing and NPK 20:10:10 fertilizer on leaf area index

Analysis of variance showed a significant treatment effect on the leaf area index. Watermelon produced with 400kg/ha in 15 cm x 15 cm plots had the highest mean leaf area index of 28 followed by watermelon in 200kg/ha fertilizer in 15 cm x 15 cm plots with leaf area index of 21.2. There was no significant treatment effect on leaf area index of crops in 400kg/ha fertilizer in 30 cm x 30 cm plots. There was a positive interaction effect between spacing and fertilizer rates. Simple effect of A is – 87503.93, main effect of A is – 29167.98, main effect of B is 17672.39, interaction (AB) is 9673.03.

Treatment combinations	Mean
Okg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	9.2
200kg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	21.2
400kg/ha NPK 20:10:10 in spacing 15 cm x 15 cm	28.0
Okg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	2.3
200kg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	5.8
400kg/ha NPK 20:10:10 in spacing 30 cm x 30 cm	7.5
F-LSD (0.05)	3.39

DISCUSSION

The experiment showed that vine length of watermelon significantly increased with increased spacing and quantity of fertilizer applied at 30 DAP. This was evidence in AB interaction being significant and having a positive value of 74.8. At a particular spacing such as 15cm x 15cm, increased fertilizer rate from 200Kg/ha to 400kg/ha could not significantly increase vine length. So for a significant increase in vine length, it is of no help to increase fertilizer rate without increasing spacing. The experiment also showed that spacing and fertilizer could not interact to produce a significant effect on the number of fruits produced per plant. Therefore

space (land) should not be wasted in an attempt to increase the number of fruits produced per plant by increasing spacing.

The non significant treatment effect on the number of days to 50% flowering of watermelon showed that maturity was not influenced by spacing and fertilizer rates.

A significant treatment effect on the fruit yield ton/ha showed that a higher yield of watermelon in Enugu area could be achieved by increasing spacing and fertilizer rates. This finding agrees with the findings of (Brinen et al. 1979, Nesmith 1993, Dithie et al. 1999, Sanders et al. 1999, Motsenbocker and Aracilria 2000, Goreta et al. 2005, Andranda Junior et al. 2006) who noted that the Watermelon production increased with the application of Nitrogen fertilizer. This was also evidence in a significant interaction effect between spacing and fertilizer rates. This work however disagrees with the earlier findings of Edelstein and Nerson 2002 who recommended high plant density for more fruit production per unit area. The reason may be that dense spacing design increases competition for water, nutrient and light which result in inadequate vegetative growth and yield.

The significant combined effect (interaction) between spacing and fertilizer on the number of marketable fruits per plant indicated that the method of reducing plant density and increasing fertilizer rates could be practiced to increase marketable watermelon fruit size per plant by farmers in Enugu area.

RECOMMENDATION AND CONCLUSION

Farmers in Enugu area who are interested in production of watermelon as fodder crop should apply 400kg/ha of NPK 20:10:10 in spacing of 30cm x 30cm because this produced significantly higher vine length. Also they should not increase spacing and fertilizer in an attempt to increase the number of fruits per plant because it was found out that spacing and fertilizer could not interact to produce a significant effect on the number of fruits per plant. On the same note, watermelon farmers in this area should not waste land and fertilizer in an attempt to hasten maturity of this crop because spacing and fertilizer could not interact to produce a significant effect on the number of days to 50% flowering. Watermelon farmers in Enugu area are advised to increase spacing from 15cm x 15cm to 30cm x 30cm and fertilizer rate from 200kg/ha to 400kg/ha for a higher fruit yield per hectare because of the observed interaction effect between spacing and fertilizer rates on the fruit yield per hectare. This is also applicable to farmers who are interested in increasing the number of marketable fruits per plant.

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