Scholarly Journal of Agricultural Science Vol. 3(8), pp. 325-330, August 2013
Available online at http:// www.scholarly-journals.com/SJAS
ISSN 2276-7118 © 2013 Scholarly-Journals

Full Length Research Paper

Effect of NPK fertilizer and spacing on growth and yield of watermelon (*Citrillus lanatus L.*) in Kaltungo Local Government area of Gombe State, Nigeria

Sabo M.U[1]. Wailare M.A[2]. Aliyu M[2]. Jari S[3]. And Shuaibu Y. M[1].

[1]Crop Production Department, Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University, Bauchi, Nigeria.
[2]Kano University of Science and Technology, Wudil, Kano, Nigeria..
[3]Federal University Dutsen-Ma, Katsina state, Nigeria

Accepted 31 August, 2013

An experiment was conducted at Kaltungo Local Government Area demonstration farm in Gombe state during the 2011 rainy season, to evaluate the effect of NPK fertilizer and spacing levels on growth and yield of Watermelon (*Citrillus lanatus L*). Three different spacings (1 × 1, 1 × 1.5, and 1 × 2 m) and four levels of NPK fertilizer (0, 100, 150 and 200 kg/ha) were used. All the treatments were set in a Randomized Complete Block Design (RCBD) with three replications. Plant height, number of leaves, number of male and female flowers at 50% flowering, number of fruits per plant and weight of fruits at harvest were observed. The result of the experiment shows a significant difference (P=0.05) in plant height and number of leaves. Similarly, the result shows significant difference (P=0.05) in number of flowers, number of fruits, weight of fruits (2.96 kg) and yield per hectare (63.6 t) as compared to the control. The interaction between the treatments indicate that 150 kg/ha of NPK and a spacing of 1 × 1.5 m gave the highest number of fruit and yield per hectare. Therefore, based on the result of this findings, it is hereby recommended that the use of 150 kg NPK/ha at a spacing of 1 × 1.5 m should be adopted by the farmers for profitable watermelon production in the study area.

Key words: Fertilizer, spacing, yield, watermelon.

INTRODUCTION

Watermelon (*Citrillus lanatus* L.) is a member of the family cucurbitaceae, kingdom; plantae, order: cucurbitales, Genus: citrullus and species: lanatus (Wikipedia, 2013). It refers to both fruit and plant of vine like (Climber or Trailer) herb (Thulaja, 2005).

Watermelon fruit are generally believed to have originated in Africa (Kalahari and Sahara desert) several thousand years ago and to have travelled over time from Africa to Asia to Europe to North America. Their arrival in Asia and the middle East is believed to have dated back to approximately 900 to 1, 000 A.D., and their arrival in Europe is estimated to have occurred in 1300 to 1400 A.D. (Worlds healthiest food organization, 2013).

Watermelon made its first appearance in an English dictionary in 1615. The top five watermelon producers in the world in 2011 are china 69, 576, 643, Iran 4, 501, 250, Turkey 3, 864, 490 Brazil 2, 864, 490 and United states 1, 769, 230 with the total world production of 104, 472, 354 in tones (Wikipedia, 2013).

According to Sonia (2011), watermelons are associated with various health benefits, some of which are:

- Watermelons contain vitamin B, which is helpful in producing instant energy in the body.
- Beta carotene contained in watermelons help to boost the immune systems and also act as fighting age-related blindness.
- Watermelons are rich in water and as such are helpful in preventing dehydration. The low-calories content of the fruits make it a best choice for diet-conscious people.
- Potassium helps in lowering high blood pressure and fights kidney stone formation. The minerals are said to be good for preventing conditions, like stroke and heart diseases.

*Corresponding authors E-mail: maharazu@yahoo.com.

- It helps in reducing symptoms of asthma, osteoarthritis and rheumatoid arthritis.
- Being rich in antioxidant, watermelon is said to be good for fighting the action of free radicals in the body. This reduces the risk of various types of cancers and heart diseases.
- Watermelon has diuretic and cleansing properties that make it beneficial for those with certain kidney and bladder diseases.
- This fruit is also used for skin care, as topical application of its juice is found to reduce skin blemishes. Watermelons are also used in various cosmetic like, lipsticks and shower gels.
- It is also used as a remedy for constipation and is believed to be helpful for cleaning the toxic wastes in the body.
- Watermelon has low glycemic load, because of the high water content and low carbohydrates levels of this fruit, per serving, so now it is said that watermelons can be consumed in small amounts by diabetic patients. Above all, consult your doctor before introducing this fruit in your diet.

Watermelons are warm season annuals and are less tolerant too cold than other cucurbits like cucumber and cantaloupe. They have long prostrate vine growth and thus, require a lot of garden space for good yield (George, 2004). It requires well - drained soils that are rich in organic matter with good water retention capacity (Lawal, 2000).

The seeds are rich in fat and protein and are eaten as snacks added to other dishes or used as an oil seed (Anon, 2005). By world healthiest food (2013), watermelon is an unusual fruit source of the carotenoid, lycopene and rich source of phenolic antioxidants.

Watermelon contains cucurbitacin E, a triterpene anti-inflammatory, phytonutrient and unusual amounts of the amino acid citrulline. Watermelon contains about 127 to 129 KJ (30 Kcal) of energy, 7.55 g carbohydrate, 6.2 g sugar, 0.4 g dietary fiber, 0.15 g fat and 0.61 g protein per 100 g and also contains about 6.2 g sugars and 91.45% water by weight.

It is an excellent source of vitamin C (8.1 mg) and vitamin A (10%) nutritional value per 100 g. It also provides significant amount of vitamins B, as well as, minerals such as potassium (K), magnesium (Mg), iron (Fe), manganese (Mn), phosphorus (P), sodium (Na), and zinc (Zn) (Anon, 2005; Wikipedia, 2013).

The juice of the watermelon root is used to stop hemorrhage after abortion. Watermelon seeds are oasted and ground into tsamma meal, a nutritious food with a pleasant malty taste. Leaves and young fruits are utilized as green vegetables (Vanwyk and Grricke, 2000).

Watermelon is spaced widely in the farm, though, bush varieties that require less spacing are gradually introduced into cultivation. Watermelon is desired largely as a refreshing source of tasty water and utilizes large amount of moisture to produce juicy flesh (George, 2004). According to anon (2005), the critical period of watermelon field crop is at planting, vegetative growth, flowering and fruiting stage.

The production of watermelons is restricted to some areas in Nigeria. This restriction is mainly due to climatic conditions and geographical locations of these areas favoring the production. The low yield of watermelon in Nigeria may be attributed to number of reasons like cultivation practices, poor knowledge about spacing, lack of use of improved or recommended varieties, improper fertilizer application, seed rate, water requirement, and time of sowing etc. However, those areas of production face the problem of fertilization. For this reason, the growth of watermelon in Gombe State, Nigeria is not optimum in the areas of production, this make the use of inorganic fertilizer a necessity.

Most savannah soils are poorer in terms of fertility (Abdel et al., 2005). Ideas of the optimum fertility level needed for vegetative production can be gained from the quantities of nutrient removed by the crop. The removal may vary according to the soil nutrient content and their availability as affected by soil moisture and temperature (Donard and Escor, 1988, Ifitihar et al., 2004).

Watermelon responds positively to the fertilizer application, the dose depend on the soil type, climate and system of planting. In general, high nitrogen under high temperature condition promote maleness in flowering and lower the number of females or perfect flowers, resulting in low fruit set (Chadha et al., 2006). A significant increase in vine length, number of leaves, leaf area and number of branches was recorded with increase in fertilizer application (Lawal, 2000).

Similarly, a remarkable increase in vine length with increase in nitrogen application was observed (Abdel et al., 2005). Evidence suggested that, spacing affect the growth and yield of watermelon. Shorter internodes, thinner branches without epical dominance, fruit setting and tertiary branches were all affected by spacing. Growth and yield parameters are under the influence of spacing.

Measurable difference among plants is visible only when plants develop enough and compete for nutrients. Also, the vine length, diameter, number of leaves and number of branches linearly increased with increase in spacing (Dean et al., 2004, Mangata and Mausia, 2006).

One of the most important factors in flourishing crop plant is correct spacing because it allows plant to develop to their full potential on top and underneath ground. Adequate space ensures less competition for sunlight, water, and fertilizers. Spacing also prevents the spread of pest and diseases from one plant to another (Celac, 2011).

Determination of different aspects of fertilizer rates for watermelon cultivation system like appropriate spacing and improved varieties are essential for development of sustainable increase in yield. The main aim of the

Table 1. Effect of NPK fertilizer and spacing on plant height of watermelon at 2, 4, 6, 8, and 10 WAS.

Treatments	Weeks after sowing (WAS)				
	2	4	6	8	10
NPK (kg/ha)					
0	3.17	6.21	56.50	139.11	208.9
100	2.95	12.03	111.24	178.67	242.22
150	3.25	9.84	100.36	180.11	260.00
200	3.13	13.33	101.10	174.33	271.11
LS	NS	*	*	NS	NS
LSD		4.51	27.90		
Spacing (m)					
1 × 1	3.13	8.83	89.96	178.08	256.67
1 × 1.5	2.97	8.52	96.76	169.33	231.67
1 × 2	3.22	13.72	90.20	156.75	258.35
LS	NS	NS	NS	NS	NS

NS = Not significant; LSD = least significant different; * = significant at P=0.05.

experiment was to determine the effect of NPK fertilizer and spacing levels on the growth and yield of watermelon.

MATERIALS AND METHODS

The experiment was conducted at Kaltungo Local Government Area, Gombe State, during 2011 rainy season. The site is located at approximately latitude 10° to 17 N and longitudes 9 to 49 East. On the altitude of 830 M above the sea level in the Northern Guinea Savannah ecological zone of Nigeria. The climate of the area is characterized by dry and wet season.

The soils are mostly clay- loam with low cation exchange capacity (CEC) (Kowal and Knabe, 1972). The variety used was sugar baby early mature within 70 to 75 days to harvest. Four levels of compound fertilizer (NPK 20: 10: 10) at 0, 100, 150 and 200 kg/ha, with three different spacing (1 × 1, 1 × 1.5 and 1 × 2 m) were combined into a total of twelve treatments combination.

The treatment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The different levels of fertilizer were applied at 2 to 3 weeks after planting. The parameters tested are plant height, number of leaves, number of males and females flowers, number of days to 50% flowering, number of fruits and weight of fruits at harvest. All recorded data were analyzed following the ANOVA technique and mean differences were adjudged by Duncan s New multiple range test (DMRT) (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Plant height

The result shown in Table 1 revealed that, there is no significant difference at 2, 8 and 10 weeks after sowing in effect of both fertilizer and spacing. However, there is significant difference in the effect of spacing and fertilizer application on plant heights at 4 and 6 weeks after sowing. The result further revealed that the application of 200 kg/ha NPK gave the highest effect on plant height than the other rates and all the rates were better than the control.

The spacing of 1 × 2 m was found to be better than all the level of spacing used in promoting plant height at 4 WAS. Similarly, the application of 100 kg/ha NPK was found to be highest in plant height at 6 WAS and all the rates were better than the control. So the spacing of 1×1.5 m was found to be better in plant height at 6 WAS. The result also revealed that, there is no significant interaction between spacing and fertilizer application on plant height of watermelon at 2, 4, 6, 8 and 10 WAS.

Number of leaves

The result in Table 2 revealed that NPK fertilizer has significant effect on the number of leaves at 4 and 6 WAS. However, there is no significant difference in the effect of N P K fertilizer at 2 and 8 WAS. The result showed that application of 100 kg NPK/ha was found to be higher in terms of number of leaves at 4 WAS and all the rates were better than the control.

Similarly, the rate of 200 kg NPK/ha was found to be better than all the rates in terms of leaf number per plant at 6 WAS but all the rates were better than the control. However, there is no significant difference in all the level of spacings used in promoting number of leaves, but the spacing of 1 × 1.5 m gave the highest number of leaves at 6 WAS.

Fifty percent (50%) flowering

There is a significant difference in the effect of NPK

Table 2. Effects of NPK fertilizer and spacing on number of leaves of watermelon at 2, 4, 6 and 8 weeks after sowing.

Treatments	Weeks after sowing (WAS)			
	2	4	6	8
NPK (kg/ha)				
0	3	5	18	75
100	3	7	35	75
150	3	7	35	80
200	4	7	37	66
LS	NS	*	*	NS
LSD		1.18	12.0	
Spacing (m)				
1 × 1	3	7	29	75
1 × 1.5	4	7	33	80
1 × 2	4	7	32	65
LS	NS	NS	NS	NS

LS = Level of significance; LSD = least significant difference; NS = not significant; * = significant at P=0.05.

Table 3. Effect of NPK fertilizer and spacing on 50% flowering of watermelon.

Treatments	Number of flowers
NPK (kg/ha)	
0	2
100	4
150	4
200	3
LS	*
LSD	0.69
Spacing (m)	
1 ×1	2
1 ×1.5	3
1 × 2	3
LS	NS

LS = Level of significance; LSD = least significant difference; NS = not significant; * = significant at P=0.05.

fertilizer on 50% flowering of watermelon. The rate of 100 kg/ha NPK gave the highest number of flowers. However, all the rates were better than the control. No significant difference was noticed with respect to spacing (Table 3).

Weight of fruit at harvest

Table 4 summarizes the effect of NPK fertilizer and spacing on final fruit weight of watermelon. The result revealed that there is no significant difference among the rates of fertilizer used. However, all the rates were better than the control. Moreover, no significant difference was recorded with respect to spacing. The interaction of NPK fertilizer and spacing on the yield of watermelon was statistically significant. The highest yield (63.6 t/ha) was obtained from the combination of 150 kg/ha with 1 × 1.5 m spacing and the lowest yield (18.3 t/ha) from the combination of control with 1 × 1 m spacing (Table 5).

The result of the study revealed that growth and yield of watermelon can be enhanced by the application of fertilizer. Plant height was found to increase significantly with increasing levels of NPK fertilizer (up to 200 kg/ha) at 6 WAS, this is in conformity with the result of Lawal (2000) and Agba et al. (2005) who reported increase in growth and yield component of watermelon in respond to increased level of fertilizer application.

Similarly, Lawal (2000) reported that improved supply of nutrient to cucumber will lead to better utilization of carbon and subsequent synthesis of assimilate. The number of leaves increased significantly with fertilizer application at 4 and 6 WAS, though, statistically the same among the various levels used but significantly better than the control. This confirms the result of Abdel et al. (2005) and Ahmed et al. (2007) who reported increase in vine length and leaf number of watermelon with increase in nitrogen application.

The study further revealed that the number of flowers

Table 4. Effect of NPK fertilizer and spacing on fruit weight of watermelon at harvest.

Treatments	Weight of fruits at harvest (g)
NPK (kg/ha)	
0	1.52
100	2.46
150	2.96
200	2.60
LS	*
LSD	0.632
Spacing (m)	
1 × 1	2.30
1 × 1.5	2.25
1 × 2	2.64
LS	NS

LS = Level of significance; LSD = least significant difference; NS = not significant; * = significant at P=0.05.

Table 5. An interaction between NPK fertilizer and spacing on the yield of watermelon.

Spacing (m)	Fertilizer levels of NPK (kg/ha)			
	0	100	150	200
1 ×1	18.3	37.5	39.0	62.4
1 × 1.5	12.8	59.4	63.6	43.2
1 × 2	24.0	63.0	28.8	55.8
LS	*			
LSD	19.6			

LS = Level of significance LSD = least significant difference; * =significant at P=0.05.

was also affected by the fertilizer application. This may be attributed to increase in vegetative growth as affected by fertilizer application. This is in accordance with the findings of Efediyi (2009) who reported a response of watermelon flowering to fertilizer application. The result shows that spacing has a significant effect on plant height. This is in conformity with the findings of Dean (2004), who reported that, vegetative growth and yield parameters are under the influence of plant spacing.

It was observed that no significant difference on the number of fruits per plant with respect to spacing at 6 and 8 WAS. This is in line with the result of Webber et al. (2006) who reported that with increase in spacing, number of fruit per hectare decreases. The result also revealed that there is a significant interaction between the fertilizer and various level of spacing used. It was found that 1 × 1.5 m spacing and 150 kg/ha of NPK gave the highest yield per hectare.

Conclusion

From the aforementioned discussion, it could be concluded that there was a significant increase in plant height, number of leaves, number of flowers per plant and final fruit weight of watermelon as a result of NPK fertilizer application at the rate of 150 kg NPK/ha. A significant interaction was also noticed at 150 kg NPK/ha and 1 × 1.5 m spacing, which gave the highest yield. Spacing and fertilizer level of 1 m × 1.5 m with 150 kg NPK/ha showed better performance than other spacings and fertilizer rates. It is hereby recommended to farmers in the study area for a more profitable production of watermelon.

REFERENCES

Abdel, A.M., Eldesuki, R.M., Salman, S.R. and Hussein, S.D. (2005). Performance of some snap bean varieties as affected by different levels of mineral fertilizers, *J. Agro.* 4: 242-247.

Agba, O.A. and Enga, V.E. (2005). Response of Cucumber (*Cucumissativun* L.) to Nitrogen in cross river state of Nigeria, *Global J. Agric. Sci.* 4: 145.

Ahmed, N., Baloch, M.H., Halem, A. and Ejaz, M. (2007). Effect of different levels of Nitrogen on growth and production of Cucumber, *Life Sci. Int. J.* **1**: 99-102.

Anon (2005). An African nature world popularity http://agrichorticulture.tamuedupplanntanswers/publication(vegetabletraveler/watermelon.html), Texas A & M University.

Cached (2013).urbanrxt.illinois.edu/veggies/watermelon.

Celac (2011).proper crop spacing for higher crop yields. Word press .com /category/ farmer- to- farmer- advise p. 3.

Chedha, K.L. (2006). Hand book of Horticulture, pp. 226-229.

Dean, B., Miljana, G. and Borsic, J. (2004). Plant spacing and cultivar effect on melon growth and yield component. Proceedings of American Society of Horticultural Sciences. 109: 238-243.

Donard, N.M. and Escor, A.L. (1988). Hand book of vegetable growers, pp. 151-153.

Efediyi, E.K. and Samson, U.R. (2009). Effect of inorganic fertilizer on the yield of two varieties of cucumber (*Cucumissativum* L.), *Report and opinion*. **5**: 74-79.

George, A. (2004). Horticulture, principles and practice, second edition.

Gomez, L.A, and Gomez, A.A. (1984).Statistical procedures for Agricultural Research. Second edition. johnAwilley inter science publication New York. pp. 97-411.

Ifitihar, H.M.,Shamsad, H.S.,Sajjah, H., and Khalid,I. (2004).Growth,yield and quality response of three wheat (Triticum aestivum L) varieties of different levels of N P and K. Int. J. Agric. Biol. :3:362-364.

Kowal, J.M. and Knabe, D.T. (1972). An agro-climatological Atlas of the Northern state of Nigeria .Ahmadu Bello University press. Zaria.

Lawal, A.B. (2000). Response of cucumber to intercropping with maize and varying rates of farmyard manure and inorganic fertilizer, *Agriculture and Environment.* **2**(1): 78-83.

Mangala, R. and Mausia, S. (2006). Hand book of Agriculture, pp 169.

Sonia Nair (2013).www.Buzzle.com/…/Nutritional facts about watermelon.

Thulaja N. R. (2005). Watermelon, National library board, Singapore North Carolina University (2006). Water melon, a paper presented at charpel hill (http://www.google.com).

Vonwyk, V.E. and Gericke, N. (2000). Peoples plant, Briza Pretoria, pp. 24-28.

Webber. I.I., Charles, L., Davis, A.R., Shrefler, P.M. and Russo, J.V. (2006). Organic weed control in two water melon varieties trial.Vegetable weed control studies, Oklahoma state University division of Agricultural Sciences and Natural resources. (62):31-33.

Wikipedia (2013). Free encyclopedia .htto;//en.wikipedia.org/w/index.

Worlds healthiest foods (2013). www.wh food.com.