GROWTH AND YIELD OF WATERMELON (CITRULLUS LANATUS L.) AS INFLUENCED BY NPK FERTILIZER AND SPACING IN DUTSIN-MA, KATSINA STATE, NIGERIA

Musa Muhammad[1], Muhammad Sirajo[1], Sufiyanu Sani[2], Abdulkadir Aliyu[2], Mahmud Sani[3], Kabir Muhammad Ladan[1], Zara Musa[4] and Aliyu Suleiman[5]

[1]Department of Agronomy, Federal University Dutsin-ma Katsina State
[2]Department of Soil Science, Federal University Dutsin-ma Katsina State
[3]Department of Agronomy, Federal University Gashua, Yobe State
[4]Department of Forestry and Wildlife Management, Federal University Dutsin-ma Katsina State
[5]Department of Animal Science, Federal University Dutsin-ma Katsina State

ABSTRACT

The experiment was conducted at Dutsin-Ma Irrigation Farm behind Dutsin-Ma Dam, Dutsin-Ma Local Government Area, Katsina state, Nigeria during the 2023 dry season, to evaluate the effect of NPK fertilizer and spacing levels on the growth and yield of Watermelon (Citrillus lanatus L). Three different spacing (25 × 25, 50 × 50, and 100 × 100 cm) and three levels of NPK fertilizer (0, 100, and 150 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 fruits per plant at harvest was observed. The result of the experiment shows a significant difference (P=0.05) in plant height and number of leaves among the plant treated with NPK (20:10:10) at rates of 100 and 150kg/ha recorded (4.84cm) and (2.88cm) respectively throughout the sampling periods, while the spacing of 50 × 50 and 100 × 100cm produce (4.81cm) and (3.00). Similarly, the result shows a significant difference (P=0.05) in leaf area, number of fruits, and yield per hectare compared to the control. The interaction between the treatments indicates that 150 kg/ha of NPK and a spacing of 100 × 100 cm gave the highest number of fruit and yield per plant/hectare. Therefore, based on the result of this finding, it is recommended that the use of 150 kg NPK/ha at a spacing of 100 × 100cm should be adopted by the farmers for profitable watermelon production in the study area.

KEYWORDS

Watermelon, fertilizer, spacing, yield.

1. INTRODUCTION

Watermelon (Citrullus lanatus L.) is a significant vegetable crop extensively grown in tropical and subtropical regions of Asia and Africa (Feher, 1993) Watermelon Belongs to the family of cucurbitaceae, plantae kingdom, cucurbitales order, citrullus Genus and species: lanatus watermelon is both the fruit and plant of vine-like (climber or trailer) herb (Thulaja, 2005). The origin of watermelon fruits is believed to be in Africa's Kalahari and Sahara desert several thousand years ago. Over time they travelled from Africa to Asia then Europe before arriving in North America (Dube *et.al.* 2020)

Watermelons are warm season annuals that are less tolerant of cold than other cucurbits like cucumber and cantaloupe. They have long prostrate vine growth requiring ample garden space for good yield (George, 2004). Adequate soil drainage rich in organic matter with good water retention capacity is necessary for its thriving (Lawal, 2000; Noma and Sani, 2008). Watermelon seeds are rich sources of fat and protein consumed as snacks added to other dishes or used as an oil seed (Anon., 2005).

In Nigeria, the cultivation of watermelons has significantly increased over the past decade with major production areas located within the Sahel, Sudan and Guinea agro ecological zones. Their cultivation has stretched down to the forest belts found within southwestern Nigeria (NIHORT, 2000). Currently, grown throughout almost all regions within Nigeria, it's mostly cultivated for fresh consumption due to its juicy sweet flesh making it one of the popularly grown fruit vegetable. Furthermore, it's considered one of the most lucrative agribusinesses because it yields incredible returns on investment. Watermelon's nutritional value along with high yield contributes greatly towards its high demand among Nigerians. Recently, Nigeria was ranked fourth largest producer in Africa producing an estimated 1.5 million ton/ha annually with Algeria leading watermelon production chart in the continent (1.87 million units per year), closely followed by Egypt in second place (1.7 million units yearly) (Dube *et.al.,* 2020, Abdulkadir et. al, 2022).Thus, it becomes clear that watermelons hold great significance globally owing not only to their economic benefits but also their nutritional ones. Accordingly, the world healthiest food (2013) proclaims them as an unusual source containing lycopene, a carotenoid-rich substance, and phenolic antioxidants, Cucurbitacin E, triterpene anti-inflammatory phytonutrient, and unusually large amounts amino acid citrulline can also be found present inside this nutritious fruit crop-watermelon (Dube *et.al.,* 2020)

Watermelons are a fruit that offer various health benefits. They contain vitamin B, which provides instant energy, and beta carotene, which boosts the immune system and fights age-related blindness (Jensen et al., 2011 Watermelons are also rich in water, making them helpful in preventing dehydration, and have low-calorie content, making them a good choice for diet-conscious people and are consumed in large amount especially during fasting period in the drier parts of Northern Nigeria (Ayodele and Shittu, 2013). Potassium helps lower high blood pressure and fights kidney stone formation and were found to be good for preventing diseases such as stroke and heart diseases (Naz et al., 2014). Watermelon also helps reduce symptoms of asthma, osteoarthritis, and rheumatoid arthritis. It is rich in antioxidants that fight free radicals in the body, reducing the risk of various types of cancers and heart diseases. Watermelon has been reported to have diuretic and cleansing properties that make it beneficial for patients with kidney and bladder diseases. It is also used for skin care as topical application of its juice reduces skin blemishes (Feher, 1993; Dube *et.al.,* 2020).

The low yield of watermelon in Sudan Savanna may be attributed to cultivation practices such as poor knowledge about spacing, lack of use of improved or recommended varieties, improper fertilizer application, seed rate, water requirement, and time of sowing etc. as farmers in the study often uses traditional methods of cropping systems which varies according to cultural needs of resource-poor farmers (Dube *et.al.,* 2020) This study aims to determine the influence of spacing and NPK fertilizer application on watermelon growth and yield by using different rates of NPK fertilizer and spacing between plants to figure out the correct rate and spacing to be recommended for watermelon farmers in Sudan Savanna.

2. MATERIALS AND METHODS

The experiment was conducted at Dutsin-Ma Irrigation Farm behind Dutsin-Ma Dam located at latitude 12^0 27^1 14.11" N, longitude 7^0 29^1 50.03" E with GPS coordinates of 12.45392 7.49723 (Abdulkadir *et. al*., 2024)The study was done in the year (2023) during dry season starting from the month of February to April. The study area has a temperature range of 26 -35°c, with tropical climate marked by two distinct (dry and wet) seasons. Two factors were considered i.e inorganic fertilizer and spacing on growth and yield of watermelon. The treatments applied during the study were two, which include application of NKP fertilizers and spacing at: (i) control (0kg/ha), (ii) NPK at 100kg/ha (iii) NPK at 150kg/ha, (iv) Spacing of 25 × 25cm (v) Spacing of 50 × 50cm (vi) Spacing of 100 × 100cm. The design experiment was laid out in Randomized Complete Block Design (RCBD) and replicated three times. Data was collected based on growth and yield parameters and were analysed statistically which was subjected to ANOVA procedure using GENSTAT version 17 edition. Treatment means were compared using Duncan's Multiple Range Test (DMRT) (Duncan, 1955) at 5% probability level. Harvesting was done manually using hand when the fruits shows sign of maturity, that is when the belly of the fruit turns from a greenish white to buttery yellow or cream.

3. RESULTS

Table one showed that at 4 WAS, greater increase in plant height of watermelon was recorded on plant treated with NPK 100 & 150kg/ha at spacing of both 50 × 50 and 100 × 100cm^2. While plants treated with control 0kg/ha at spacing of 25 × 25cm^2 produces the shortest plant (31.18cm). At 8WAS, significant increase in plant height of watermelon was obtained from plant treated with NPK 150kg/ha at a spacing of 100 × 100cm (144.14cm). While plants treated with NPK 0kg/ha at spacing of 25 × 25cm^2 produces the shortest plant (76.13cm).

Table 1: Interaction between NPK fertilizer and Spacing on plant height (cm) of watermelon

	SPACING (CM^2)					
NPK (20:10: 10) kg/h	25 × 25	50 × 50	100 × 100	25 × 25	50 × 50	100 × 100
	4WAS			**8WAS**		
0	31.18d	34.77cd	34.10cd	76.13d	83.62cd	87.64cd
100	42.59bc	50.02b	61.40a	96.71c	118.31b	127.59b
150	46.99b	60.55a	67.96a	96.64c	122.02b	144.14a
S E ±	2.778			4.938		

Means within a column of a set of treatment followed by unlike letter are significantly different using Duncan's Multiple Range Test (DMRT) at 5% level of probability.

Table two (2) revealed that at 4WAS, increase in number of leaves of watermelon was recorded on plant treated with NPK 100 & 150kg/ha at a spacing of 100 × 100cm (32.76/plant). While plants treated with control 0kg/ha at spacing of 25 × 25cm and 100 × 100cm^2 produces the plant with lowest number of leaves (16.73/plant).

At 8WAS, significant increase in number of leaves of watermelon was also recorded from plant treated with NPK 150kg/ha at spacing of 100 × 100cm (54.00/plant). While plants treated with 0kg/ha at spacing of 25 × 25cm^2 produces the lowest number of leaves (22.29/plant).

Table 2: Interaction between NPK fertilizer and Spacing on Number of leaves of watermelon

NPK (20:10: 10) kg/h	SPACING (CM^2)					
	25 × 25	50 × 50	100 × 100	25 × 25	50 × 50	100 × 100
	4WAS			**8WAS**		
0	16.76f	20.66cd	16.73f	22.29d	31.33c	27.20cd
100	24.13de	26.16cd	31.00ab	31.83c	41.37b	44.43b
150	24.66cde	28.41bc	32.76a	32.43c	45.70b	54.00a
S E ±	1.277			1.792		

Means within a column of a set of treatment followed by unlike letter are significantly different using Duncan's Multiple Range Test (DMRT) at 5% level of probability.

Table three (3) shows significant increase in leaf area of watermelon at 8WAS was obtained from plant treated with NPK 150kg/ha at spacing of 100 × 100cm^2 (105.46cm^2). Although plants treated with 0kg/ha at spacing of 25 × 25cm^2 produces the lowest leaf area (32.20cm^2).

Table 3: Interaction between NPK fertilizer and Spacing on Leaf Area (cm^2) of watermelon

NPK (20:10: 10) kg/h	SPACING (CM^2)		
	25 × 25	50 × 50	100 × 100
	8WAS		
0	32.20e	37.18de	37.58de
100	46.12d	69.02c	65.92c
150	47.01d	92.00b	105.46a
S E ±	3.622		

Means within a column of a set of treatment followed by unlike letter are significantly different using Duncan's Multiple Range Test (DMRT) at 5% level of probability.

Table four shows that as per plot, increase in number of fruits of watermelon was recorded on plant treated with NPK 150kg/ha at spacing of 100 × 100cm (30.00). While plant treated with 0kg/ha as spacing of 25 × 25cm produces the lowest number of fruits (10.66). Also per ha, greater increase in number of fruits of watermelon was recorded from plant treated with NPK 150kg/ha at spacing of 100 × 100cm (7500.00). While plants treated with 0kg/ha at spacing of 25 × 25cm produces the lowest number of fruits/ha (2666.66).

Table 4: Interaction between NPK fertilizer and Spacing on Number of Fruits per plant/plot/ha of watermelon

NPK (20:10: 10) kg/h	SPACING (CM^2)					
	25 × 25	50 × 50	100 × 100	25 × 25	50 × 50	100 × 100
	No. of Fruit/Plot			**No. of Fruit/ha**		
0	10.66c	13.33c	13.00c	2666.66c	3333.33c	3250.00c
100	20.33b	24.33b	21.00b	5083.33b	6083.33b	5250.00b
150	20.66b	24.33b	30.00a	5166.16b	6083.33b	7500.00a
S E ±	1.248			312.113		

Means within a column of a set of treatment followed by unlike letter are significantly different using Duncan's Multiple Range Test (DMRT) at 5% level of probability.

The analysis revealed a correlation between the type of fertilizer used and the level of spacing employed. The highest yield per hectare was achieved with 100 × 100 cm spacing and an application rate of 150 kg/ha NPK. In general, it can be deduced from the study that increasing the application rates and spacing for NPK (20:10:10) kg/h enhances watermelon production and yield. This is consistent with Dean's (2004) findings that plant spacing and NPK fertilizer have an impact on vegetative growth as well as yield parameters. Furthermore, we observed a significant disparity in terms of the number of fruits produced per plant based on the degree of spacing utilized. This finding contradicts Webber et al.'s (2006) report which indicates that fruit output per hectare decreases when there is an increase in plant spacing. By expanding watermelon yields, farmers who specialize in its cultivation could potentially improve their standard of living significantly.

4. CONCLUSION

It could be concluded that there was a significant increase in plant height, number of leaves, leaf area per plant and fruit number 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 100 × 100cm spacing, which gave the highest yield. Spacing and fertilizer level of 100 × 100cm with 150 kg NPK/ha showed better performance than other spacing and fertilizer rates. It is hereby recommended to farmers in the study area for a more profitable production of watermelon.

REFERENCES

[1] Abdel, A.M., Desuki, 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.*

[2] Abdulkadir, A, Halilu, Y., & Sani, S. (2022). Evaluation of Physical and Chemical Properties of Soils at Bichi Local Government Area, Kano State, Nigeria. *IRE Journal, 5(9), 556–562.*

[3] Ayodele, O.J., and O.S. Shittu. (2013). Cost-benefit analysis of melon (egusi) seed and seed- oil yield responses to phosphorus fertilizer application. Int. Res. J. Agric. Sci. Soil Sci. 3:152–155.

[4] Abdulkadir Aliyu, Sufiyanu Sani, Muhammad Nasir, Hamza Yahaya, Musa Muhammad, Zara Musa, Muazu Salisu and Maryam Umar Adamu (2024). Influence of Biochar and NPK Fertilizer on the growth and yield of Amaranths (Amaranthus Viridis) *Agricultural science: An international journal (AGRIJ) 2(1). 1-15*

[5] Dean B, Smilijana GB, Milan O, Josipa H, Bruno N, Katja Z, (2011). Growth and yield response of Water melon to in-row plant spacing and mycorrhizae. *Chilean J Agric. Res; 71(4):497-502.*

[6] 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.*

[7] Dube J., Ddamulira, G and Maphosa, M. (2020). Watermelon production in Africa: challenges and opportunities, *International Journal of vegetable science, DOI:10.1080/19315260.2020.1716128*

[8] Goreta, S., S. Perica, G. Dumičić, L. Bućan, and K. Žanić. (2005). Growth and yield of watermelon on polyethylene mulch with different spacings and nitrogen rates. *HortScience* 40:366-369.

[9] 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.*

[10] Jensen, B.D., F.M. Touré, and M. Ag. 2011. Watermelons in the sand of Sahara: Cultivation and use of indigenous landraces in the Tombouctou Region of Mali. *Ethnobotany Res. Appl. 9:151–162*. doi: 10.17348/era.9.0.151-162.

[11] Leskovar, D.I., H. Bang, K.M. Crosby, N. Maness, J.A. Franco, and P. Perkins-Veazie. (2004). Lycopene, carbohydrates, ascorbic acid and yield components of diploid and triploid watermelon cultivars are affected by deficit irrigation. *J. Hortic. Sci. Biotechnol. 79 (1):75–81*. doi: 10.1080/14620316.2004.11511739

[12] Mahmud Sani, Babayo AH. and Sufiyanu Sani (2022). Effects of Manure Types on the Emergence and Seedlings growth of Amaranths in a Sahelian Savannah Region of Nigeria. *IRE Journals 5(9) 563-570*

[13] Maoto, M., D. Beswa, and A.I.O. Jideani. (2019). Watermelon as a potential fruit snack. *Int.J. Food Prop. 22:355–370*. doi: 10.1080/10942912.2019.1584212.

[14] Mohammed BT. 2011. Socio-economic Analysis of Melon Production in Ifelodun Local Government Area, Kwara State, Nigeria. *Journal of Development and Agricultural Economics 3(8):362-367.*

[15] Naz, A., M.S. Butt, M.T. Sultan, M.M.N. Qayyum, and R.S. Naiz. (2014). Watermelon lycopene and allied health claims. *Excli J. 13:650–666.*

[16] NIHORT (2000) National Horticultural Research Institute. 25 years of research into Horticultural Crops Development in Nigeria (1975 – 2000). A Commemorative Publication 120-122.

[17] Sufiyanu, S., Mahmud, S., Pantami, S. A., Harisu, G. N., Abdulkadir, A., Abdullahi,Y.M.(2022). Spatial Variability of Soil Hydraulic Properties in Jibia Irrigation Project, Katsina State, Nigeria. *NRSDJ, 12(2), 245–254*

[18] S.S. Noma and S. Sani (2008). Estimating soil organic matter content in soils of Sokoto area: comparing the Walkley –black and a proposed unconventional method. *Techno science Africana journal 2(1) 71-76*

[19] Thulaja N. R. (2005). Watermelon, National library board, Singapore North Carolina University (2006). Water melon, a paper presented at charpel hill

AUTHOR

Sufiyanu Sani is a Ph.D. student in the Department of Soil Science, Bayero University Kano, Nigeria and currently lectures at Federal university Dutsin-ma, Katsina State, Nigeria since 2018. His research focuses on soil physics, climate change and soil water management