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Effect of Spacing and Cowdung Manure on the Growth of Radish (*Raphanus Sativus* L.) in the Sudan Savannah of Nigeria

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ABSTRACT: The experiment was carried out at the Teaching and Research Farm of Faculty of Agriculture, Bayero University Kano and Kano State Institute of Horticulture, Bagauda, during the rainy season of 2015 to investigate the effect of spacing and cow dung manure rates on the growth and yield of radish. The experiment comprised four levels of spacing (5, 10, 15, and 20 cm) and five rates of cow dung manure (0, 5, 10, 15, and 20 t ha^{1}). It was laid out in a Randomized Complete Block Design (RCBD) with three replications. The experiment showed that spacing had significant effects on plant height and leaf area index at BUK, while at Bagauda, it only enhanced the leaf area index. The spacing of 5 cm showed a higher effect over other levels of spacing. The higher values obtained per parameter from BUK were; plant height (14.23 cm) leaf area Index (80.58), all at 5 cm spacing. At Bagauda, the highest value obtained was leaf area index (48.33) at 5 cm. Cowdung manure influenced plant height. The highest value obtained due to the application of cow dung manure was plant height (14.31 cm) at 10 t ha^{-1} at BUK.

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INTRODUCTION

Radish is an edible root vegetable of the Brassicaceae family that was domesticated in Europe in pre-Roman times. It is an annual or biennial plant grown for its swollen tap roots that are rounded, tapering or cylindrical. The root skin colour ranges from white through pink, red, purple, yellow and green to black, but the flesh is usually white. Smaller types have a few leaves about 13 cm long with round roots up to 2.5 cm in diameter or more slender (slim) and long roots up to 7 cm long. These are typically eaten raw in salads (Brickell, 1992). A longer root form oriental radishes, daikon or mooli and winter radishes grow up to 60 cm long with foliage about 60 cm high with a spread of 45 cm (Brickell, 1992). The flesh of radishes harvested timely is crisp and sweet but becomes bitter and tough if the vegetable is left in the ground for too long (Steven et al., 2004). Leaves are arranged in a rosette manner. They have a lyrate shape, which is divided pinnately with an enlarged terminal lobe and smaller lateral lobes. The white flowers are borne on a racemose inflorescence (Gopalakrishnan, 2007). The fruits are small pods that can be eaten when young (Brickell 1992). The radish is a diploid species, and has 18 chromosomes (2n=18) (Dixon, 2007). Radish is a fast-growing, annual, or biennial crop. The seeds germinate in three to four days in moist conditions with soil temperatures between 18 and 29 °C. Best quality roots are obtained under moderate day lengths with air temperatures of 10 to 18 °C. Radishes have a short vegetable life (35-60 days), which provides a rapid return per capital (Juan et al., 2010). Radish grows best in full sunlight, sandy loams with a soil pH of 6.5 to 7.0, but a clayey-loam is ideal for late-season crops. Soils that bake dry and form a crust in dry weather are unsuitable and impair germination (Beattie, et al., 1882; Faust, 1996; and Peterson, 1999). Harvesting periods can be extended by making repeat plantings spaced a week or two apart. In warmer climates, radishes are usually planted in the autumn (Beattie et al., 1882). The depth at which seeds are planted affects the size of the root, from 1 cm deep recommended for small radishes to 4 cm for large radishes (Peterson, 1999). During the growing period, the crop needs to be thinned, weeds controlled, and irrigation may be required (Beattie et al., 1882). There is a lack of technical information for radish production in Nigeria, especially agronomic techniques and fertilization (Habu et al., 2012). Plant population affects plant growth, development and yield. The spacing between plants determines the level of competition between the plants. Development is badly affected if the spacing is too tight or crucial among crops.

Similarly, if the spacing is too broad, individual plants will yield more, but yield may be reduced per hectare due to the low plant population. Information on suitable plant population and fertilization is highly essential, in which the average yield per hectare will be maximum at a low cost of production. This research aims at finding out the effect of different levels of spacing and manure on the growth of radish grown in the Sudan Savannah of Nigeria.

MATERIALS AND METHODS

This research was conducted during the rainy season of 2015 at two locations. The first location was the Teaching and Research Farm of Faculty of Agriculture Bayero University Kano (11° 58' N, 8° 28' E). The second location was Kano State Institute of Horticulture, Bagauda, Kano State (11^0 48' N, 8^0 34' E). The treatments consisted of five manure rates (0, 5, 10, 15 and 20 t ha^{-1}) and four spacing (5, 10, 15 and 20 cm). These rates were factorially combined to give 5 x 4 treatments. The treatments were laid out in a Randomized Complete Block Design (RCBD) with three replications. The land was cleared, harrowed to a fine tilth with no ridge. The Gross plot size was 1.8 m^2 (length 1.8 m and breadth 1 m) with a net plot size of 0.9 m^2 and an alley of 1 m between each plot. There were twenty plots for each replicate. The radish cultivar "French Breakfast" seeds were sown at four different intra-row spacing; 5 cm, 10 cm, 15 cm and 20 cm with three seeds per hole ((Musa et al., 2017; Musa et al., 2020). There were four rows distanced at 25 cm from each other in every plot. The two middle rows were the net plots, while the other two were the border rows. Planting at an intra-row spacing of 5 cm gave 200,000 plants ha^{-1}, while 10 cm gave 100,000 plants ha^{-1}, 15 cm gave 66,666 plants ha^{-1} and 20 cm gave 50,000 plants ha^{-1}. Five plants were systematically sampled and tagged from the net plot in every plot. The tagged plants were used as samples for data collection. The radish variety was obtained from the Agro-Tropic Seed Company at Sabon Gari, Kano state. Cowdung manure (dried) was incorporated into the soil two weeks before planting at five different rates 0, 5, 10, 15 and 20 t ha^{-1}. The manure was from the same source, and chemical analysis was carried out to determine the Nitrogen, Phosphorous, Potassium, Organic Carbon and organic matter content of it. Weeds were controlled manually using hoe and hand at 2, 4, and 6 WAS. Pest control was done organically using neem extract. Plant growth was monitored in-situ from five randomly sampled plants per plot using conventional growth indices such as plant height, number of leaves, leaf area per plant, and leaf area index (Bashir et al., 2014).

The data collected were subjected to analysis of variance (ANOVA) as described by Snedecor and Cochran (1967) using the SAS statistical software. Significant treatment means were separated at a 5 % probability level using the Duncan Multiple Range Test (Duncan, 1955).

RESULTS

Effect of Spacing and Cowdung Manure on Plant Height

Spacing and cow dung manure significantly affected plant height at BUK (Table 3). The tallest plants (14.23 cm and 14.31 cm) were observed at 5cm spacing and 10 t ha^{-1} cow dung manure. The shortest plants (11.44 cm and 11.57 cm) were observed at 10 cm spacing and control. Spacing at 10 cm (3.53 cm) and 20 cm (3.56 cm) led to statistically similar plant heights. Likewise, the application of cow dung manure at 5 t ha^{-1} (12.45 cm) and 15 t ha^{-1} (13.41 cm) also led to statistically similar plant heights.

At Bagauda, spacing significantly affected plant height only at four weeks after sowing. No significant effect was observed in other parameters across the weeks. The application of cow dung manure did not show any significant impact also. The tallest plants (13.29 cm and 12.85 cm) were observed at 5 cm spacing and 20 t ha^{-1} of cow dung manure. The shortest plants (11.27 cm and10.56 cm) were obtained at 15 cm spacing and control. The interaction of spacing and cow dung manure rates on plant height was insignificant.

Table 3. Effect of spacing and cow dung manure rates on plant height (cm) of radish at BUK and Bagauda, 2015 cropping season.

Treatment	Plant Height (cm)							
Location	BUK (WAS)				Bagauda (WAS)			
	4	5	6	7	4	5	6	7
Spacing (s)								
5	4.32a	7.68a	11.01a	14.23a	3.98a	7.01	10.02	13.29
10	3.62b	6.29b	8.97b	11.44b	3.53ab	6.09	8.67	11.38
15	4.05ab	7.07ab	10.14ab	13.02ab	3.34b	5.75	8.23	11.27
20	3.97ab	7.01ab	10.01ab	12.90ab	3.56ab	6.22	8.86	11.75
SE ±	0.188	0.378	0.563	0.762	0.203	0.404	0.602	0.799

Manure (m)								
0	3.66b	6.34b	9.04b	11.57b	3.32	5.66	8.07	10.56
5	3.88ab	6.80ab	9.68ab	12.45ab	3.74	6.54	9.35	12.50
10	4.33a	7.75a	11.10a	14.31a	3.46	6.02	8.56	11.24
15	4.12ab	7.24ab	10.40ab	13.41ab	3.73	6.51	9.32	12.46
20	3.96ab	6.95ab	9.94ab	12.75ab	3.76	6.61	9.43	12.85
SE ±	0.211	0.423	0.629	0.852	0.227	0.452	0.673	0.893
Interaction								
S x m	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns

Means followed by the same letter(s) are not significantly different at 5% level of probability using Duncan's multiple range test (DMRT), NS= Non-significant.

Effect of Spacing and Cowdung Manure on Number of Leaves

The data for the number of leaves is presented in Table 4. The effect of different levels of spacing and cowdung manure on the number of leaves at both BUK and Bagauda was not significant. At BUK, the highest number of leaves was 8.62 at 15 cm spacing and 9.11 at 5 t ha^{-1} of cow dung manure. The least number of leaves was 7.76 at 10 cm spacing and 7.49 at 20 t ha^{-1} of cow dung manure.

At Bagauda, the highest number of leaves was 6.64 at 10 cm spacing and 6.9 at 20 t ha^{-1} of cow dung manure. The least was 6.06 at 15 cm spacing and 5.84 at control. Results for interaction between spacing and cow dung manure rates were not significant.

Table 4. Effect of spacing and cow dung manure rates on the number of leaves of radish at BUK and Bagauda, 2015 cropping season.

Treatment	Number of Leaves							
Location	BUK (WAS)				Bagauda (WAS)			
	4	5	6	7	4	5	6	7
Spacing (s)								
5	5.70	7.47	7.47	8.56	5.38	6.00	6.00	6.20
10	5.25	6.96	6.96	7.76	5.58	6.21	6.21	6.64
15	5.55	6.99	6.92	8.62	5.65	6.22	6.22	6.06
20	5.35	8.00	8.00	8.56	5.30	6.25	6.25	6.56
SE ±	0.209	0.418	0.413	0.820	0.139	0.299	0.299	0.458
Manure (m)								
0	5.74	7.07	7.07	8.22	5.48	6.01	6.01	5.84
5	5.65	7.85	7.85	9.11	5.24	5.94	5.94	6.38
10	5.40	7.77	7.77	8.18	5.59	6.38	6.38	6.24
15	5.18	7.11	7.11	8.78	5.66	6.38	6.38	6.45
20	5.34	6.93	6.85	7.49	5.43	6.13	6.13	6.90
SE ±	0.234	0.468	0.462	0.916	0.024	0.112	0.335	0.512
Interaction								
S x m	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns

Means followed by the same letter(s) are not significantly different at 5% level of probability using Duncan's multiple range test (DMRT), NS= Non-significant.

Effect of Spacing and Cowdung Manure on Leaf Area

Data for leaf area per plant is presented in Table 5. The results revealed no significant effect for the different spacing and cowdung manure rates applied at BUK and Bagauda. At BUK, the largest area was 502 cm^2 at 10 cm spacing and 613.5 cm^2 at control. The smallest was 354.40 cm^2 at 20 cm spacing and 269.30 cm^2 at 5 t ha^{-1} of cow dung manure.

At Bagauda, the largest area was 241.70 cm^2 at 5 cm spacing and 258.01 cm^2 at 10 t ha^{-1} of cow dung manure. The smallest was 176.45 cm^2 at 15 cm spacing and 145.30 cm^2 at control. There was no significant interaction between spacing and cow dung manure on leaf area per plant.

Effect of Spacing and Cowdung Manure on Leaf Area Index

The data for the leaf area index were analyzed statistically and the results obtained are presented in Table 5. Spacing significantly affected the leaf area index at both BUK and Bagauda. The application of cow dung manure revealed no significant effect on leaf area index at both BUK and Bagauda. At BUK, the most extensive leaf area index was 80.58 obtained at 5 cm spacing and 61.67 obtained at control. The smallest leaf area index was 17.72 at 20 cm spacing and 26.46 at 5 t ha^{-1} of cow dung manure.

At Bagauda, the largest leaf area index observed was 48.33 at 5 cm and 29.14 at 10 t ha^{-1} of cow dung manure. The smallest was 11.34 at 20 cm spacing and 14.39 at control. The interaction of spacing and cow dung manure rates on the leaf area index was insignificant.

Table 5. Effect of spacing and cow dung manure rates on leaf area (cm^2) and leaf area index of radish at BUK and Bagauda, 2015 cropping season.

Treatment	leaf area (cm^2)		leaf area index	
Location	BUK	Bagauda	BUK	Bagauda
Spacing (S)				
5	402.90	241.70	80.58a	48.33a
10	502.00	237.27	50.20ab	23.72b
15	293.90	176.45	19.59b	11.76b
20	354.40	226.81	17.72b	11.34b
SE ±	135.007	42.612	14.167	4.421
Manure (M)				
0	613.50	145.30	61.67	14.39
5	269.30	220.56	26.46	23.87
10	395.30	258.01	47.04	29.14
15	366.20	231.01	43.76	27.36
20	297.40	247.92	32.22	24.18
SE ±	150.942	47.642	15.839	4.942
Interaction				
S x M	NS	NS	NS	NS

Means followed by the same letter(s) are not significantly different at 5% level of probability using Duncan's multiple range test (DMRT), NS= Non-significant.

DISCUSSION

Spacing and cow dung manure improved plant height in radish at BUK. Narrow spacing (5 cm) gave the tallest plants. This result can be attributed to greater competition that exits for space and light, forcing the plants to grow taller. Similar results were obtained by Parvez et al. (2004), Pandey et al. (1996) and Malik et al. (1999). Pandey et al. (1996) observed the highest plant height in narrow spacing. They also attributed the higher plant heights recorded in narrow spacing to greater competition for space and light. Malik et al. (1999) revealed that the closest spacing gave the highest plant height in radish.

The effect of Cowdung manure can be attributed to the presence of a substantial nitrogen level (11.4 g/kg) and other nutrients that were gradually released to the plant in the manure. Soil nutrients are essential for the height of plants. The presence of manure could have increased the amount of Nitrogen made available to the plants through mineralization (Anyaegbu et al., 2010). So, the higher dose of Nitrogen could have increased plant height. These results conform with the findings of Sharma and Rastogi (1992). Spacing and cow dung manure did not improve plant height at Bagauda.

The leaves are the plant factories for the manufacturing of carbohydrates. Photosynthesis occurs in leaf cells, and carbohydrates are formed. The number of leaves and leaf areas did not increase with cow dung manure or plant spacing in BUK and Bagauda. This result can be attributed to changes in carbon partitioning to various organs during the transition from one growth phase to another. This result is similar to Egbuchua and Enujeke's (2013) findings. They found that leaf areas of plants treated with organic manures were not statistically different in ginger (*Zingiber officinale*) at the fourth and sixth week after planting.

LAI revealed a significant difference between control and other treatments, where 5cm spacing was found to be superior. The increase in LAI is caused by an increase in the size and number of leaves per plant as affected by the treatments applied. This result

is similar to that of Oke (2012) and Muhammad et al., (2020) who revealed that pumpkin and okra plants' LAI was statistically altered by liquid organic manure application and plant spacing.

CONCLUSION

This research showed that radish could thrive in the Sudan Savannah of Nigeria. The crop's ability to grow to maturity within six to seven weeks and its demand and value in the market makes it a new opportunity for farmers, as it can be raised three times in a season. The crop can be a good opportunity for farmers who are into cash cropping and support the federal government to attain its vision of diversification in the agricultural sector of providing adequate food for its increasing population. It could open up new opportunities to improve farmers' income, strengthen the nation's food security, and increase federal governments revenue through export. The research can also help future researchers who need information regarding the crop's requirement in terms of spacing and cow dung manure rate. Further research involving different varieties should be conducted for more knowledge on the crop's requirement in the Sudan Savannah.

REFERENCES

1. Anyaegbu, P.O., IwuanyanwuU.P. and Ekwughe,E.U.(2010). Nutrient uptake and root yield of cassava as influenced by liming and poultry manure under different cropping system.*Int. Sci. Res. J.*, 2: 82-89.
2. Bashir, K. A., Bawa, J. A., & Mohammed, I. (2014). Efficacy of leaf extract of drumstick tree (Moringa oleifera Lam.) on the growth of local tomato (Lycopersicon esculentum). *Journal of Pharmacy and Biological Sciences*, *9*(4), 74-79.
3. Beattie, J. H. (1882), Beattie, W. R. (1870); United States Department of Agriculture. *Production of radishes* (Leaflet) (57). Washington, D.C.: United States Department of Agriculture; UNT Digital Library. Retrieved October 2, 2014. Hosted by the University of North Texas Government Documents Department Documents A to Z Digitization Project website. Retrieved on 2014-07-29.
4. Brickell, C. (1992). The Royal Horticultural Society Encyclopedia of Gardening (Print). London: Dorling Kindersley. pp. 356–357. ISBN 978-0-86318-979-1.
5. Brickell, C. (1992). The Royal Horticultural Society Encyclopedia of Gardening (Print). London: Dorling Kindersley. pp. 356–357. ISBN 978-0-86318-979-1.
6. Dixon, G. R. (2007). Vegetable Brassicas and Related Crucifers (Print). *Crop Production Science in Horticulture 14*. Wallingford: CAB International. P. 35. ISBN 978-1-84593-138-4.
7. Duncan, D. B. (1955). Multiple Ranges and Multiple F- test. 11:1- 42.
8. Egbuchua, C. N. and Enujeke, E. C. (2013). Growth and yield responses of ginger (*Zingiber officinale*) to three sources of organic manures in a typical rainforest zone, Nigeria. *Journal of Horticulture and Forestry*. Department of Agronomy, Delta State University, Asaba Campus, Asaba, Delta State, Nigeria.
9. Faust, J. L. (1996-3-3). Hail the Speedy Radish, in all its Forms. *The New York Times* (via nytimes.com archives). Retrieved 2014-07-29.
10. Gopalakrishnan, T.P. (2007). VegetableCrops. New India Publishing. pp. 244–247. ISBN 978-81-89422-41-7
11. Habu, S.H., Afolayan, S.O., Idris, B.A., Yamadu, J.J., Gwammaja, M.Y., Muhammad, S.M., Junaidu,, I.M. and Giginyu, Y.D (2012). Effect of Different Rates Of Cowdung Manure on growth and yield of radish (*Raphanussativus*). Proceedings of the 30th Annual Conference of the Horticultural Society of Nigeria, 'OWERRI 2012', p. 128.
12. Juan, W. M. C.Arthur, B. C. F. and Edison, L. C. (2010). Cattle manure and N-Urea in Radish crop (*Raphanus sativus*) Cien. Inv. Agr. 31 (1): 45-53.
13. Malik, Y.S., NehraB.K. and Singh, N.(1999). Effect of steckling, planting dates and spacing on seed yield of radish (*Raphanus sativus L.*) Cv. Pusa Chetki. Veg. Sci., 26: 149-151.
14. Muhammad, M., Kutawa, A. B., Tadda, S. A., Muhammad, A., & Adamu, M. (2020). Productivity of okra (Abelmoschus esculentus L. Moench) as Influence by NPK Fertilizer and poultry manure in Northern Sudan Savanna Region of Nigeria. *IJFAF*, *6*, 2456-8791.
15. Musa, M., Bashir, K. A., Tadda, S. A. (2017). Response of cowpea (*Vigna unguiculata* Walp) varieties to phosphorus levels in Sudan savanna of Nigeria. *International Multidisciplinary Research Journal*.7: 23-29.
16. Musa, M., Bashir K. A. and Musa A. (2020). Influence of NPK Fertilizer and Poultry Manure on the Growth of Okra (Abelmoschus esculentus L. Moench) in Northern Sudan Savanna Region of Nigeria. International journal of Horticulture, Agriculture and Food science(IJHAF). 4(6): 196-204.
17. Oke, O. F. (2012). Leaf Area Development and Vine Growth of *Telfairia occidentalis* (Hook. F) In Response to Plant Spacing and Liquid Cattle Manure *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)* e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 8, Issue 12 Ver. II (Dec. 2015), PP 05-10 *www.iosrjournals.org* DOI: 10.9790/2380-081220510 www.iosrjournals.org 5 | Page *Department of Agronomy, Delta State University, Asaba Campus, Nigeria*

18. Pandey, O. P., SrivastavaB.K. and Singh,M.P. (1996). Effect of spacing and fertility levels on the growth, yield and economics of tomato hybrids. Veg. Sci., 23: 9-15.
19. Pervez , M.A., Ayub, C.M., Basharat A. S., Naveed A. V. and Nasir M. (2004). Effect of Nitrogen Levels and Spacing on Growth and Yield of Radish (*Raphanus sativus* L.). *International Journal of Agriculture & Biology* 1560–8530/2004/06–3–504–506 http://www.ijab.org
20. Peterson, C. (1999-05-02.). Radishes: Easy to Sprout, Hard to Grow Right.*The New York Times*, (via nytimes.com archives). Retrieved on 2014-07-29.
21. Sharma, S.K. and K.B. Rastogi, (1992). Effect of nitrogen nutrient and spacing on seed production of cutflowers. *Indian J. Hort.*, 49: 274–6
22. Snedecor, G. W. and Cochrom W. G. (1967). Statistical methods. IOWA State University Press, IOWA, USA. Pp: 456.
23. Steven, B., John, F., Lulu, G., Meredith, K., Dr Judyth, M., Roger M. and Kim, R. (2004) Vegetable Gardening: Growing and Harvesting Vegetables. Murdoch Books. p. 242. ISBN 978-1-74045-519-0.