NIGERIAN AGRICULTURAL JOURNAL
ISSN: 0300-368X
Volume 51 Number 2, August 2020 Pg. 233-236
Available online at: http://www.ajol.info/index.php/naj

EFFECT OF PLANT SPACING ON GROWTH AND YIELD COMPONENTS OF AFRICAN EGG PLANT (*Solanum macrocarpon*) IN THE NORTHERN GUINEA SAVANNAH OF NIGERIA

[1]Ndagana M.K., [1]Yakubu, A., [2]Saidu, A. and [3]Omonomo, P.

[1]Department of Crop and Forestry, NAERLS/ABU Zaria
[2]Department of Crop Production, FUT Minna
[3]National Centre for Genetic Resources and Biotechnology, North Central Zone, Badeggi, Niger State
Corresponding Authors' email: kolomuhammad3@gmail.com

Abstract
Field experiments were conducted to determine the effect of plant spacing on growth and yield of African eggplant (*Solanum macrocarpon*) at the Teaching and Research farm of the Institute of Agricultural Research, Ahmadu Bello University (IAR/ABU) Zaria, Kaduna State in 2017 and 2018 cropping seasons. The experiment consists of five treatments (plant spacing of; 80 × 30cm, 80 × 50cm, 100 × 50cm, 100 × 60cm and 120×70cm inter and intra-row). Data were collected on both growth and yield parameters. Results showed that close row spacing of 80cm × 30cm significantly reduced number of leaves per plant, number of branches per plant, short plant and wider leaf area. Plant spacing of 120cm × 70cm gave higher growth parameters (number of leaves and branches, plant height and leaf area). Yield and yield components of African eggplant (32.4 and 35.3 for number of fruit per plant, 212.4 and 247.0 for fresh fruit weight and 16.1 and 15.1t/ha for fresh fruit yield in 2017 and 2018 respectively) were obtained at spacing of 120 × 70cm. Based on the findings of this study, eggplant should be cultivated at a spacing of 120cm × 70cm (inter and intra-row spacing) for optimum growth and fruit yield in Zaria, Northern Nigeria.

Keywords: African eggplant, Cultivated, Cropping, Indigenous and spacing

Introduction

African eggplant (*Solanum marcrocarpon*) belongs to *Solanaceae* Family. It is a tropical fruits and leafy vegetable crop depending on the prevailing environmental conditions. When cultivated in humid tropics it will survive for many seasons thus described as perennial plant but in semi-arid or dry weather conditions, it behaves as annual plant due to moisture deficit that accelerate its senescence (Abdullahi *et al.,* 2013). In Nigeria, the Hausa's call it *Yalo*, *Anara* by Igbo's, and *Igbagba* by Yoruba's (Schippers 2000). The leaves and fruits have high economic importance. They are used as food (eaten raw or cooked) as vegetables. In North Western part of Nigeria, especially Katsina, Gusau, Kebbi, Zamfara and Sokoto States, both the young green leaves and fruits are used for soup, stew, sauce or in making African salad (Abubakar, 2017). Emma-Okafor (2017), reported that in many traditional cultures, garden egg including the ~~A~~frican eggplant fruits represent fruitfulness and blessings and are offered at ceremonies, marriages, child naming /dedication and social events as a symbol of goodwill and acceptance of visitors.

African eggplant leaves, roots and fruits have high variety of medicinal values. The roots are used in traditional medium to treat bronchitis, asthma, wounds, abdominal worms and stomach disorders (Guiama, 2010). Abdullahi *et al.,* (2013) observed that leaves of eggplant are used to cure boils, stomach and throat pains. The unripe young green fruits are used as laxative for cardiac diseases and to relieve toothache. In Nigeria, eggplant is grown in almost every region and is one of the most traded indigenous vegetables in local markets (Majubwa *et al.,* 2015). African eggplant fruits have relatively higher carbohydrate (7.2g/100g), fibers (2.0g/100g), calcium (28mg/100g), iron (1.5mg/100g) and considerable amount of beta carotene (0.35mg/100g), ascorbic acid (8mg/100g), riboflavin (0.06mg/100g) and thiamin (0.07mg/100g) (Majubwa *et al.,* 2015). Akpabio *et al.,* (2018), reported that the appropriate spacing of eggplant depends on variety and cropping season. In northern Nigeria where African eggplant is dominant in their farming system, farmers are still having problems on the appropriate spacing that could maximize high yield. Closed spacing reduces growth and yield of eggplant (Akpabio, 2017). Akpabio *et al.,* 2018 reported the appropriate spacing available plant resources. Therefore, this study was carried out to

determine the ideal planting distance (inter and intra-row spacing), for optimum growth and fruit yield of African eggplant (*Solanum marcrocarpon*) in the northern Guinea Savannah.

Materials and Methods

Field experiments were conducted in the Institute for Agricultural Research (IAR) Farm, Ahmadu Bello University Zaria (ABU), in 2017 and 2018 cropping seasons. Zaria is located at latitude $11^0$11" N and longitude $7^0$38" E and altitude of 650m above sea level. The experimental site was cleared, ploughed and harrowed on 3rd April, 2017 and 2018 each. The experiment design was a randomized complete block design in four replications. Treatments were five planting spacing of 80cm × 30cm, 80cm × 50cm, 100cm × 50cm, 100cm × 60cm and 120cm×70cm inter and intra-row spacing respectively. There were twenty (20) plots and each plot measured 6m ×6m given an area of $36m^2$. Samaru ESM 31 eggplant variety seeds were collected from IAR/ABU Zaria. The seeds were sown in nursery beds for three weeks before transplanted to the experimental plots. Transplanting of eggplant (*Solanum marcrocarpon*) was done at the rate of one seedling per stand according to the schedule spaces (80× 30cm, 80 × 50cm 100 ×50cm, 100 × 60cm, and 120 × 70cm inter and intra-row spacing respectively for both 2017 and 2018 cropping seasons. Data were collected at 4, 8, and 12 weeks after transplanting (WAT) from three tagged plant in the net plot. Data collected include: number of leaves (visual counting of the leaf of eggplant), number of branches (visual counting of branches), and leaf area (LA). Estimates of leaf area were obtained by the equation, leaf area (cm^2) =

is the weight (g) of the area covered by the leaf outline on a millimeter graph paper, and y is the weight of one cm^2 of the same graph paper (Bignami and Rossini, (1996). Others are number of fresh fruits (visual counting of fruit per plant), fresh fruit yield per hectare (t/ha). The yield of the crop is then calculated using the following formula modified from Sapkota *et al.,* (2016) thus;

Fruit yield (kg/ha) = [(number of fruits per branch × number of branches per m^2/100) × (weight of 100 − fruit (g)/1000) × 10,000]

Statistical analysis

Data collected were analyzed using analysis of variance (ANOVA) procedure for randomized complete block design experiments and treatment means were separated using Least Significant Difference (LSD) using SAS (2010).

Results and Discussion

Number of leaves

Plant spacing significantly ($P \leq 0.05$) influenced the growth and yield of African eggplant. Number of leaves per plant increased significantly ($P \leq 0.05$) with increase in plant spacing (80x30cm intra and 120x70cm inter-row spacing respectively) (Table 1). There were greater or higher number of leaves per plant in the wider inter and intra-row spacing than the narrow spacing. Akpabio *et al.,* (2018) reported that wider spacing increases plant vegetative growth.

Number of branches

The effect of spacing on number of branches per plant is also presented in Table 1. The result shows that the highest number of leaves (65.1) in 2017 and (62.5) 2018, and branches (15.4) in 2017 and (15.3) 2018 at 12 WAT were recorded at wider row spacing of 120cm × 70cm in the two cropping seasons. This observation was in conformity with Akpabio *et al.,* (2018), who reported that wider spaced plants had more number of branches when compared to other spacing. This could be due to positive effect of wider intra-row spacing where there is minimum competition for growth resources between plants (Mani *et al.,* 2000).

Plant height

Plant height and leaf area index decreased significantly in wider row spacing than in closer spacing (Table 2). Closer spacing with narrow intra-row spacing resulted in taller plants with high leaf area index. This could be due to the high plant population which resulted in high competition for growth resources. The views agree with that of Mani and Mahdi (2017), who reported significant increase in plant height and LAI in narrow intra-row spacing of the eggplant.

Leaf area

Leaf area was significantly higher in wider inter and intra-row spacing (Table 2). The highest leaf area (cm^2) (74.3, 88.4, 96.4 and 73.4, 79.7, 91.9 at 4, 8 and 12 WAT for 2017 and 2018 respectively) were recorded with wider spacing of 120cm and 70cm. The narrow spacing had the least leaf area value. This could be due to effect of wider spacing where there is minimum competition for growth resources between plants (Mani, *et al.,* 2000).

Number of fruit per plant

Number of fruit per plant as influenced by inter and intra-row spacing were significantly different ($p<0.05$) in both cropping seasons (Table 3). More number of fruit per plant (32.4) was observed at inter and intra-row spacing of 120cm x 70cm compared to other spacing. The lowest number of fruit was recorded with spacing of 80cm x 30cm. Akpabio *et al.,* (2018), revealed that decrease in plant spacing resulted to decrease in yield caused by competition for plant resources, mutual shading within canopy and compensatory etiolation.

Fresh fruit weight

The effect of plant row spacing significantly influenced fresh fruit weight of African eggplants (Table 3). Fresh fruit weight per plant was higher in wider intra-row spacing than in narrow row spacing. Spacing of 120cm x 70cm have the heaviest (212.4g) fruit weight, and spacing of 80cm x 30cm with the lowest value of 78.72g. Fresh fruit weights per plant increased with increasing inter and intra-row spacing from 80 x 30cm to 120cm x 70cm. Idoko *et al.,* (2017) revealed that significant increase in spacing increased fruit weight of eggplant.

Fresh fruit yield

Results showed that on hectare basis, fresh fruit yield per hectare was significantly ($p \leq 0.05$) higher in wider inter and intra-row spacing than narrow spacing (Table 3). The highest eggplant yield of 16.14t/ha in 2017 and 15.16t/ha in 2018 were obtained with spacing of 120cm ×70cm in 2017 and 2018 cropping seasons. The highest fruit yield per hectare recorded in wider spacing with this study could be because wider spaced plants had lower competition for soil nutrients and light plant resources in each plot. Wider spacing had closer spacing with more plants per plot each contributing to the total yield per plot; thus, resulting in higher yield per hectare than wider row plots. This result agrees with Idoko *et al.,* (2017), who reported higher fruit yield per hectare with wider spacing.

Conclusion

Based on the findings of the study, eggplant should be cultivated at a spacing of 120cm. x 70cm with inter and intra-row spacing for maximum growth and yield at Zaria location of Northern Guinea savanna in Nigeria

References

Abdullahi, A.N., Muhammad, N.B., Hasiya, M.N. and Imam, A.A. (2013). Does the African garden egg offer protection against experimentally induce ulcers? *Asian pacific Journal of Tropical Medicine*, 4(2):163-166.

Abubakar, D.N. (2017). The potential benefit of African Egg Plant. Proceeding of 17th National Annual Conference of Horticultural Society of Nigeria held at Moor Plantation, Ibadan, Oyo State, November 7-10th, 2017. Pp.121-125

Akpabio, I.I. (2017). Effect of Pant Spacing on the Growth and Yield of Eggplant (*Solanum melongena*). Unpublished B. Agric. Thesis, Department of Crop Science, University of Uyo. Nigeria.

Akpabio, I.I., Harry, G.I., Idem, N.U and Udom, G.N. (2018). Response of Garden Egg (*Salonum gilo L.*) to varying Rates of Oragnic Fertilizer and Spacing in Uyo rainforest Zone of Nigeria. Proceedings of 5th Annual Conference, Crop Science Society of Nigeria. Pp. 58-65.

Bignami C. and Rossini, F. (1996). Image analysis estimation of leaf area index and plant size of young hazelnut plants. *Journal of Horticultural Science and Biotechnology*, 71(1):113–121.

Emma-Okafor, L.C., Oculi, N.A., Obiefuna, J.C., Algba, R.A. and Keyagha, E.R. (2017). Yield Enhancement in African Eggplant (*Solanum marcrocarpon*) production using poultry manure and ash mixture in Owerri, Nigeria. Proceedings of the National Annual Conference of Crop Science Society of Nigeria, held at the University of Uyo, Akwa-Ibom State, Nigeria, Pp.100-103.

Guiama, V.D., Libougs, D.G., Ngah, E., Beeka, R.G., Ndi, K.C., Maloga, B.A. (2010). Milk Clothing potential of fruit extract from *Solanium esculenta*, *Solanum marcrocarpon* and *Solanum melongene*. *African Journal of Biotechnology,* 9(12):1797-1802.

Idoko, J.A., Ugoo, T.R. and Sang, P.O. (2017). Effect of intra-row spacing on the growth and yield of Sweet potato (*Ipomea batatas L.*), *Maize (Zea mays L.*) and Soya bean (*Glycine mass L.*) inter crops in Makurdi, Benue State. Proceedings of the 4th National Annual Conference of Crop Science Society of Nigeria held at the University of Uyo, Akwa-Ibom State, October 7-11. Pp.150-159.

Majubwa, R.O., Msogoya, T.J. and Maerere, A.P. (2015). Effects of Local Storage Practices on Deterioration of African Eggplant (*Solanum aethiopicum L.*) fruits. *Tanzania Journal of Agricultural Sciences,* 14 (2):106-111.

Mani, M.A., Amos, A.R. and Fanon, F. (2000). Effects of varying intra-row spacing on inter cropped yields of Egusi melon (*Catullus lunates Thumb*) and Maize (*Zea mays L*) at Makurdi, Nigeria. *International Journal of Agronomy and Agricultural Research*, 2(1):22-29.

Mani, M.A. and Mahdi, A.U. (2017). Effect of intra-row and inter-row on plant height and leaf area index (LAI) of popcorn in Zaria, Northern Guinea Agro-ecological Zone.

Schippers, R.R. (2000). African indigenous vegetables, an over view of the Cultivated Species Chatham UK Natural resources Institute/ACP-EU. Pp.147-176.

Sapkota, T.B., Jat, M.L., Jat, R.K., Kapoor, P. and Stirling, C. (2016). Yield estimation of food and non-food crops in smallholder production systems, Chapter 8. In Methods for Measuring Greenhouse Gas Balances and Evaluating Mitigation Option in Smallholder Agriculture; Rosenstock, T.S., Ed.; Springer Open: Cham, Switzerland, 2016. Pp. 163–174.

Table 1: Effects of Inter and Intra-row Spacing on the Number of Leaves and Number of Branches of African Eggplant per plant at 4, 8 and 12 Weeks after Transplanting in 2017 and 2018 Cropping Seasons

Plant Spacing (cm)	No. of Leaves per Plant						No. of branches per Plant					
	2017 Cropping Season			2018 Cropping Season			2017 Cropping Season			2018 Cropping Season		
	4WAT	8WAT	12WAT	4WAT	8WAT	12WAT	4WAT	8WAT	12WAT	4WAT	8WAT	12WAT
80 × 30cm	8.21	1.1	1.1	1.1	1.1	1.1	1.1	23.7	35.3	15.2	25.2	36.8
80 × 50cm	9.33	1.3	1.3	1.3	1.3	1.3	1.3	34.5	42.2	18.4	47.5	46.4
100 × 50cm	19.1	3.0	3.0	3.0	3.0	3.0	3.0	49.9	69.7	35.4	47.3	70.4
100 × 60cm	23.4	3.5	3.5	3.5	3.5	3.5	3.5	79.3	89.6	70.1	82.1	86.4
120 × 70cm	24.1	3.6	3.6	3.6	3.6	3.6	3.6	96.4	78.4	73.4	91.9	79.7
Mean	16.8	2.5	2.5	2.5	2.5	2.5	2.5	56.8	63.0	42.5	58.8	63.9
LSD $_{(P<0.05)}$	1.2	1.6	3.2	1.1	1.4	3.2	1.4	4.5	12.6	1.3	3.3	10.4

Table 2: Effects of Inter and Intra-row Spacing on the Plant Height and Leaf Area Index of African Eggplant at 4, 8 and 12 Weeks after Transplanting in 2017 and 2018 Cropping Seasons

Plant Spacing (cm)	Plant Height (cm)						Leaf Area (cm^2)					
	2017 Cropping Season			2018 Cropping Season			2017 Cropping Season			2018 Cropping Season		
	4WAT	8WAT	12WAT	4WAT	8WAT	12WAT	4WAT	8WAT	12WAT	4WAT	8WAT	12WAT
80 × 30cm	10.3	20.7	31.3	15.3	24.1	47.4	13.4	23.7	35.3	15.2	25.2	36.8
80 × 50cm	12.2	23.5	35.7	17.1	26.5	49.2	19.2	34.5	42.2	18.4	47.5	46.4
100 × 50cm	14.3	25.2	42.7	18.3	28.7	57.4	32.2	49.9	69.7	35.4	49.3	70.4
100 × 60cm	15.4	31.3	63.4	18.9	33.2	58.7	63.5	79.3	78.4	70.1	82.1	79.7
120 × 70cm	17.6	34.2	84.2	19.7	36.1	86.3	74.3	96.4	89.6	73.4	91.9	86.4
Mean	0.5	1.4	8.3	4.2	5.4	7.3	1.4	4.5	12.6	1.3	3.3	10.4
LSD $_{(P<0.05)}$	17.6	34.2	84.2	18.4	36.1	86.3	13.43	23.67	35.27	15.24	25.17	36.8

Table 3: Effect of Spacing on the Yield and Yield Components of African Eggplant (*Solanum macrocarpon*) in 2017 and 2018 Cropping Seasons

Plant Spacing (cm)	No. of Fruits per Plant		Fresh Fruit weight per Plant (g)		Fresh Fruit yield per Hectare (t/ha)	
	2017	2018	2017	2018	2017	2018
80 × 30cm	13.3	12.2	78.7	69.5	6.4	5.4
80 × 50cm	15.8	16.1	121.3	129.3	8.5	8.2
100 × 50cm	19.4	21.3	137.3	141.4	10.5	10.3
100 × 60cm	24.3	27.2	162.2	172.3	12.6	11.2
120 × 70cm	32.4	35.3	212.4	247.0	16.1	15.1
LSD $_{(P<0.05)}$	3.1	3.2	7.3	6.4	0.51	0.52