Jefore Ethiopian Journal of Applied Sciences
ISSN: 3006-6263 (Online); 3080-0617 (Print) Volume 1(1), 2025
Journal homepage: www.jejas.org

Research Paper

Effect of Shoot Pruning and In-row Spacing on Yield and Fruit Size of Eggplant (Solanum melongena L.) at Gode, South Eastern Ethiopia

Gizachew Weldesenbet Nuraga

Department of Horticulture, Wolkite University, Wolkite, Ethiopia

Article History:
Received: 29 October 2024
Accepted: 27 December 2024
Published online: 06 February 2025

Keywords:
eggplant, fruit weight, marketable, pruning, yield

Abstract

Eggplant (Solanum melongena L.) is a cultivated herb of the solanaceae family, which is related to tomato and pepper. A field experiment was conducted to study the effect of shoot pruning and in-row spacing on yield and fruit size of eggplant, Black Beauty variety, at Gode. The treatments were 4 X 4 factorial combinations of 4 in-row plant spacing (30 cm, 40cm, 50cm, and 60cm), and 4 levels of shoot pruning (no pruning, pruning to 2 stems, pruning to 3 stems, and pruning to 4 stems on the main stem) arranged in a CRBD with 3 replications. The highest large-sized fruit weight per plant (290.00-310.67g) was obtained from the in-row spacing of 50 or 60cm, irrespective of the pruning level, while the highest very large-sized fruit weight (248.33g) from 2 stem pruning at 60cm in-row spacing, although it was not statistically different from the values registered from 3 and 4 stem pruning at 50 or 60cm in-row spacing. Pruning to 4 stems and zero pruning at 50cm in-row spacing resulted significantly ($p<0.05$) the highest marketable (18.32 and 17.66t) and, highest total fruit yield (18.47 and 17.82t) per hectare respectively, while the highest unmarketable fruit yield (0.35tha-1) was obtained from unpruned plants at 30cm spacing. The result showed that pruning to 4 stems at the in-row spacing of 50cm is optimal to maximize marketable fruit yields in combination with better fruit size. If the costs of pruning exceed the benefits, 50 cm in-row spacing without pruning can be used for a similar higher yield.

1. Introduction

Eggplant (Solanum melongena L.) is a herbaceous plant in the Solanaceae family, related to tomato, pepper, and potato. It is globally significant, producing about 58.7 million metric tons annually, with 86% of this coming from China and India (EPC, 2024). Eggplant ranks as the fifth most economically important solanaceous crop after potato, tomato, pepper, and tobacco (FAO, 2024). Despite its low caloric value, eggplant is recognized for its rich source of dietary fiber, folate, ascorbic acid and various vitamins and minerals (Ghosh et al., 2022). It also exhibits pharmacological properties that could support the development of

Author email: bahrangw@gmail.com

DOI: https://doi.org/10.70984/v69s0a50

antioxidant and anti-inflammatory agents (Docimo et al., 2016; Im et al., 2016).

The yield and quality of eggplant fruits depend on various factors, including planting density and management practices. Spacing plays a vital role in optimizing growth and yield, influenced by soil fertility, moisture, weather conditions, and cultural practices. Iwuagwu et al. (2019) reported that higher fruit weights at 60 cm × 50 cm spacing, with reduced disease incidence compared to narrower spacing. Similarly, Abrham and Shumbulo (2024) observed the highest marketable yields with 40 cm in-row spacing and NPSB fertilizer application of 150 kg/ha.

Pruning is essential for managing the plant's vigorous growth and improving fruit quality. It enhances light penetration and air circulation, reducing disease risk and aiding pest control. Buczkowska (2010) found that intensive pruning increases early yields and first-class fruits, while less pruning leads to more unmarketable produce.

Eggplant is relatively new to Ethiopia, cultivated mainly around Bishoftu and the eastern regions. In 2015, the country produced an estimated 104 tons, with most exported to Djibouti and the UAE (IndexBox, 2024). Consumption grew by 55% from 2014 to 2015, highlighting its growing significance.

Despite its potential, research on eggplant cultivation in Ethiopia is limited, with no established recommendations for pruning and spacing, particularly for arid regions like Gode. Spacing recommendations range widely, and little data exists on production constraints and potential. This study aims to fill these gaps by evaluating the effects of shoot pruning and in-row spacing on the yield and fruit size of the Black Beauty cultivar under irrigated conditions in the hot, dry climate of Gode.

2. Materials and Methods

2.1. Description of the Study Area

The study was carried out at Gode, in the Somali Region, located at 1225 km Southeast of Addis Ababa. The experimental site is situated at a latitude of 5o 57' N, a longitude of 44o 58' E, and an altitude of 320 meters above sea level. The area receives an average annual rainfall of less than 300 mm with mean maximum and minimum temperatures of 36 oC and 24 oC, respectively and the soil type is sandy loam.

The peasants in the study area primarily engage in livestock production. They also cultivate small quantities of fruits (papaya, mango, and banana), vegetables (tomato, onion, and pepper), and cereals (maize and sorghum, mainly used as animal feed in the immature stage). These crops are grown using irrigation from the Wabe Shebele River, supplemented by rainfall.

2.2. Experimental Materials, Design and Procedure

Eggplant (Black Beauty variety), widely cultivated in the country, served as the test material for this study. This variety requires 10–20 days for emergence, 80 days to maturity, and produces attractive dark purple fruits that are oval to elongated-oval, averaging 5–6 inches in length (Hillclimb Media, 1997). The experiment involved a 4 × 4 factorial combination of four in-row spacing [S1 = 30 cm (1.85 plants/m^2), S2 = 40 cm (1.39 plants/m^2), S3 = 50 cm (1.11 plants/m^2), and S4 = 60 cm (0.93 plants/m^2)] and four levels of shoot pruning (P0 = no pruning, P1 = two stems, P2 = three stems, and P3 = four stems per plant). Pruning was conducted twice, at 25 and 40 days after transplanting, to achieve the desired shoot numbers per treatment.

The treatments were arranged in a randomized complete block design with three replications, yielding a total of 48 experimental units. The experiment was conducted at the demonstration site of Gode Agricultural Technical Vocational

Education Training College under irrigated conditions. Plots measuring 10.8 m² (6 m × 1.8 m) were established, separated by a 1 m distance between blocks, with two rows of eggplant (90 cm apart) per plot. Depending on spacing treatments (S1–S4), plots contained 20, 15, 12, or 10 plants.

Seedlings were raised on prepared beds using a sowing method recommended by Chen et al. (2002). Fertilizers, including 82 kg N and 40 kg P, were applied as urea and DAP. DAP was band-applied during transplanting, and urea was side-dressed in two splits: four weeks after transplanting and at pre-flowering. Furrow irrigation was applied every 7–10 days. Cultural practices such as weeding were conducted uniformly across treatments. Pruning was done manually to remove lateral branches, shaping the plants into two, three, or four main branches based on treatment requirements.

Mature fruits were identified by skin glossiness and consistent coloring, and harvesting occurred weekly over one month. Key management practices ensured the uniformity and reliability of the experimental results.

2.3. Data Collection

Data collection involved assessing various parameters from five randomly selected plants per plot, including plant height, leaf number, fruit characteristics (marketable and unmarketable fruit numbers and weights by size category), average fruit weight, fruit length, fruit diameter, percent dry fruit weight, vegetative dry weight, aboveground biomass per plant, and total soluble solids. Yield data from the net harvestable area of each plot was used to calculate the total fruit yield per hectare. Plant height was measured from the soil surface to the plant's tip, while leaf number was determined by averaging the total leaves from the selected plants.

Marketable fruits, free from damage by insects, diseases, or sunburn, were categorized into size classes: small (100–200 g), medium (201–300 g), large (301–400 g), and very large (>400 g). The yield was the cumulative weight of successive harvests over a month. Marketable and unmarketable fruit yields were calculated separately for the net harvestable area, with damaged fruits classified as unmarketable. Total fruit yield per hectare was the sum of both marketable and unmarketable yields.

2.4. Data Analysis

Data were analyzed using the MSTAT-C statistical software (MSTAT-C, 1991). The Least Significant Difference (LSD) test at a 5% probability level was employed to evaluate mean differences among treatments.

3. Results and Discussion

3.1. Plant Growth Parameters

3.1.1. Plant Height

The plant height results showed significant variation based on in-row spacing, with the tallest plants (47.5 cm) recorded at 60 cm spacing. This was statistically similar to the 46.45 cm height at 50 cm spacing, while the shortest plants were observed at 30 cm, statistically comparable to the 40 cm spacing. The trend indicates that plant height increased with wider spacing. This finding aligns with earlier research indicating that reduced competition for light, nutrients, and water at wider spacing promotes vertical growth (Singh et al., 2021). However, some studies have reported contrasting results, where closer spacing led to increased plant height due to light competition causing etiolation, as observed in tomatoes and common Bean (Amare & Gebremedhin, 2020; Karpe et al., 2024).

From the pruning treatments, the tallest plants (46.9 cm) were associated with three-stem pruning, followed closely by two- and four-stem pruning, with unpruned plants being the shortest

(44.4 cm). This increase in height with pruning may be attributed to enhanced apical dominance and nutrient redistribution to fewer growing points. Recent studies echo this observation, suggesting that targeted pruning can improve plant architecture and optimize nutrient use efficiency, particularly under intensive cultivation systems (Singh et al., 2021).

These results provide valuable insights for optimizing eggplant cultivation practices, balancing spacing, and pruning to achieve desirable plant growth and yield outcomes.

Table 1: Effect of spacing and pruning on plant height of eggplant

Treatments	Plant height (cm)	Treatments	Plant height (cm)
Spacing(cm)		Shoot pruning	
30	44.09 c	no pruning	44.39 b
40	45.36 bc	2 stem	46.83 a
50	46.45 ab	3 stem	46.89 a
60	47.54 a	4 stem	45.33 ab
Significance level	***	**	
S. E.	0.51	0.02	
CV (%)	3.86		

, *: significant at P<0.01 and 0.001 respectively, values with the same letter(s) do not differ significantly

3.1.2. Leaf Number

The number of leaves per plant was significantly ($P<0.01$) influenced by the interaction between spacing and pruning system (Table 2). The highest number of leaves (220.7) was observed in plants with a 60 cm in-row spacing and no pruning, whereas the lowest leaf count (102.2) occurred with two-stem pruning at 30 cm spacing. Overall, as pruning severity increased and spacing narrowed, the number of leaves per plant decreased. This result aligns with the findings of Singh et al. (2021) on eggplant, which suggests that plants in sparsely spaced conditions generally have better access to nutrients, moisture, and light. These factors likely promote better photosynthetic activity, supporting increased vegetative growth and leaf formation. Conversely, pruning, which removes the growing meristem, limits new leaf production while fostering the expansion of retained leaves. Although leaf area was not measured in this study, similar findings in eggplant and pepper indicated that fewer shoots result in greater individual leaf area (Ambroszczyk et al., 2008).

Table 2: Effect of spacing and pruning interaction on leaf number per plant

Treatments		Leaf number	Treatments		Leaf number
Spacing	Pruning		Spacing	Pruning	
30cm	No pruning	139.27 h	50cm	No pruning	207.03 b
	2 stem	102.23 j		2 stem	151.70 ef
	3 stem	128.85 i		3 stem	158.33 e
	4 stem	146.83 fg		4 stem	189.63 c
40cm	No pruning	193.47 c	60cm	No pruning	220.73 a
	2 stem	141.65 gh		2 stem	151.92 ef
	3 stem	148.07 fg		3 stem	168.47 d
	4 stem	151.73 ef		4 stem	190.43 c
Significance level		**			
SE		1.85			
CV (%)		1.99			

**: significant at P<0.01, values with the same letter(s) do not differ significantly

3.2. Yield and Yield Components

3.2.1. Fruit size category (g/plant)

The fresh weight of small (100-200 g), medium (201-300 g), large (301-400 g), very large (>400 g), and total marketable fruit per plant were significantly influenced by the interaction effects of spacing and pruning intensity (Table 3). The weight of small-sized fruits was highest in unpruned plants at the in-row spacing of 40, 50, or 60 cm, with no statistical difference among them. The highest fruit weight for medium-sized fruits was obtained from four-stem pruning treatment at 60 cm spacing and from unpruned plants at 50 and 60 cm in-row spacing, while the lowest was observed from plants pruned to two stems at 50 cm in-row spacing and unpruned plants at 30 cm in-row spacing. Regarding large-sized fruits, statistically similar higher values were recorded from all plants at the in-row spacing of 50 or 60 cm, irrespective of the pruning treatments. On the other hand, the highest very large fruit weight per plant (248.33 g/plant) was obtained from two-stem pruning at 60 cm in-row spacing, though it was not statistically different from the values obtained from three and four-stem pruning at 50 or 60 cm in-row spacing. The highest total marketable fruit weight per plant (882 g/plant) was obtained from four-stem pruning at 60 cm in-row spacing, which was statistically not different from unpruned plants at the same spacing, and four-stem pruning at 50 cm in-row spacing, while the lowest (369.7 g/plant) was recorded at 30 cm in-row spacing coupled with no pruning. In general, total fruit weight per plant increased with wider spacing and reduced pruning intensity. This is likely because wider spacing, combined with an appropriate number of stems per plant, created optimal conditions for growth and increased leaf number, which in turn enhanced assimilate production through maximized light interception. These results are consistent with Muhammad and Singh (2007), who found similar effects of spacing and pruning on fruit size in tomato.

Table 3: Interaction effect of spacing and pruning on different fruit sizes of eggplant

Treatments		Fruit size category (g/plant)				
Spacing	Pruning	Small (100-200 g)	Medium (201-300 g)	Large (301-400 g)	Very large (>400 g)	Total
30cm	No pruning	125.67 cd	172.33 e	71.67 g	0.00 e	369.67 g
	2 stem	63.33 i	175.67 e	175.67 ef	27.33 de	442.00 f
	3 stem	68.67 hi	183.33 de	154.33 f	54.33 cde	460.67 f
	4 stem	92.67 fgh	151.00 g	176.00 ef	55.00 cde	474.67 f
40cm	No pruning	167.00 a	204.00 c	170.67 f	0.00 e	541.67 e
	2 stem	96.33 efg	172.33 e	225.67 cd	84.33 cd	578.67 e
	3 stem	110.00 def	176.33 e	205.33 de	83.67 cd	575.33 e
	4 stem	124.33 cd	223.33 b	255.33 bc	54.33 cde	657.33 d
50cm	No pruning	150.67 abc	250.00 a	283.33 ab	97.00 c	781.00 c
	2 stem	63.67 i	149.33 g	284.33 ab	185.33 b	682.67 d
	3 stem	123.67 cde	167.67 ef	290.00 a	195.67 ab	777.00 c
	4 stem	117.67 def	209.67 bc	310.67 a	225.67 ab	863.67 ab
60cm	No pruning	160.67 ab	241.67 a	281.33 ab	179.67 b	863.33 ab
	2 stem	80.00 ghi	152.00 fg	282.33 ab	248.33 a	762.67 c
	3 stem	120.00 def	197.00 cd	296.67 a	196.67 ab	810.33 bc
	4 stem	124.33 cd	255.00 a	307.00 a	195.67 ab	882.00 a
Significance level		*	**	**	**	**
SE		7.07	4.05	8.86	15.27	16.98
CV (%)		10.87	3.90	6.52	22.62	4.47

*, **: significant at P<0.05 and 0.01, respectively, Means followed by the same letter(s) within the same column are not significantly different at the prescribed level of significance.

3.2.2. *Marketable, Unmarketable, and Total Fruit Yields*

The marketable, unmarketable and total fruit yields per hectare were significantly influenced ($p<0.01$) by the interaction effect of spacing and pruning (Table 4). The highest marketable (18.32 ton/ha) and total fruit yields (18.47 ton/ha) were obtained from plants pruned to four stems at 50 cm in-row spacing, which were statistically comparable to the values obtained from unpruned plants at the same spacing. The high marketable and total fruit yields were likely due to the appropriate plant population at 50 cm in-row spacing, which reduced competition for light and nutrients compared to 60 cm spacing. Plants pruned to four stems and unpruned plants outperformed those with severe pruning at the same in-row spacing, likely due to the higher number of leaves and marketable fruit per plant. This strong association suggests the role of spacing and pruning in optimizing plant growth and yield. Similar findings were reported (Muhammad and Singh, 2007; Singh et al., 2021).

The smallest marketable fruit yield per hectare (13.65 ton/ha) was recorded from two-stem pruning at 60 cm in-row spacing, which was statistically similar to the yield recorded from 30 cm in-row spacing with no pruning. The wide spacing (60 cm) combined with two-stem pruning likely reduced total assimilate production and, therefore, yield per unit area. On the other hand, the narrow 30 cm spacing without pruning led to severe competition among plants, which likely reduced the partitioning of assimilates to the fruits, in line with the findings of Singh et al. (2021) on eggplant and tomato.

The highest unmarketable fruit yield (0.38 ton/ha) was obtained from 30 cm in-row spacing with no pruning (Table 4). An increase in unmarketable fruit yield observed in unpruned plants at closer spacing could be attributed to a higher incidence of disease and insect infestation, compounded by reduced effectiveness of pest control measures. Overall, the unmarketable fruit yield was low, and the total fruit yield was almost similar to the marketable fruit yield (Table 4). The result is consistent with reports by Singh et al. (2021), who noted similar trends in fruit yield under varied plant densities and pruning regimes in long melon cultivation.

Table 4: Interaction effect of spacing/pruning on marketable, unmarketable and total fruit yield of eggplant per hectare (ton/ha)

Treatments		**Fruit yield (ton/ha)**		
Spacing	Pruning	Marketable	Unmarketable	Total
30cm	No pruning	14.12fg	0.35a	14.47fg
	2 stem	14.84def	0.10c-f	14.94ef
	3 stem	15.50bcd	0.19bc	15.69b-e
	4 stem	15.26cde	0.12b-e	15.37c-f
40cm	No pruning	14.94def	0.21b	15.15def
	2 stem	14.65def	0.00f	14.65f
	3 stem	15.50bcd	0.18bcd	15.68b-e
	4 stem	16.41b	0.19bc	16.60b
50cm	No pruning	17.66a	0.16bcd	17.82a
	2 stem	14.06fg	0.00f	14.06gh
	3 stem	16.37b	0.00f	16.37bc
	4 stem	18.32a	0.15b-e	18.47a
60cm	No pruning	16.22bc	0.07def	16.29bc
	2 stem	13.65g	0.00f	13.65g
	3 stem	14.91def	0.00f	14.91ef
	4 stem	15.91bc	0.05ef	15.96bcd
Significance level		**	*	**
SE		0.248	0.037	0.249
CV (%)		2.77	58.79	2.75

*, **: significant at P<0.05 and 0.01, respectively, means followed by the same letter (s) within the same column are not significantly different at the prescribed level of significance.

4. Conclusions

The findings of this study suggest that both total yield and average fruit weight can be optimized by adjusting in-row plant spacing and pruning practices. Since the highest yield and ideal fruit size for fresh market consumption do not always align, decisions must be made based on specific market demands. This study indicates that pruning to four stems at a 50 cm in-row spacing appears to be the most effective approach for maximizing marketable yields while also achieving desirable fruit size. This practice can be considered for profitable eggplant production in similar growing conditions. However, if the cost of pruning outweighs the benefits, a 50 cm in-row spacing without pruning can still result in comparable yields. To draw a final conclusion for the area, further studies assessing economic feasibility and water requirements over multiple seasons and locations are necessary.

Acknowledgments

The author would like to express his heartfelt appreciation and special gratitude to Mr. Abdulahi, South Gode Irrigation Project Manager, for the provision of water pump and operators to irrigate the field throughout the research period. Sincere gratitude should go to Gode ATVET College for provision of the required facilities. Colleagues at Gode ATVET College are very much appreciated for their help right from planting up to field data collection.

References

Abrham, Y. and Shumbulo, A. (2024). Growth, yield and quality response of Eggplant (*Solanum melongena* L.) to blended NPSB fertilizer rates and intra-row spacing in Boloso Bombe district, Wolaita zone, South Ethiopia**.** *Heliyon*, 10(15), e35671. https://doi.org/10.1016/j.heliyon.2024.e35671

Amare, G., and Gebremedhin, H. (2020). Effect of plant spacing on yield and yield components of tomato (*Solanum lycopersicum* L.) in Shewarobit, Central Ethiopia. *Scientifica*, *2020*, 8357237. https://doi.org/10.1155/2020/8357237

Ambroszczyk, A.M., Cebula, S. and Sękara, A. (2008). The effect of plant pruning on the light conditions and vegetative development of eggplant (Solanum melongena L.) in greenhouse cultivation. *Journal of Fruit and Ornamental Plant Research* 68: 57-70. https://doi.org/10.2478/v10032-008-0005-4

Ara, N., M. Bashar, K., Begum, S. and Kakon S. S. (2007). Effect of spacing and stem pruning on the growth and yield of tomato. *Int. J. Sustain. Crop Prod.* 2(3): 35-39. *https://ggfjournals.com/assets/uploads/8.35-39_.pdf*

Buczkowska, H. (2010). Effect of plant pruning and topping on yielding of eggplant in unheated foil tunnel. *Acta Sci Pol Hortorum Cultus*. 9(3):105–115. https://czasopisma.up.lublin.pl/asphc/article/view/3372/2335

Chen, N.C., Kalb, T., Talekar, N.S., Wang J.F. and Ma, C.H. (2002). Suggested Cultural Practices for Eggplant. Retrieved from https://worldveg.tind.io/record/39458?v

Docimo, T., Francese, G., Ruggiero, A., Batelli, G., De Palma, M., Bassolino, L., et al. (2016). Phenylpropanoids accumulation in eggplant fruits: characterization of biosynthetic genes and regulation by a MYB transcription factor. Front. Plant Sci. 6:1233. https://doi.org/10.3389/fpls.2015.01233

EPC, Eggplant Production by Country (2024). World Population Review. Retrieved December 1, 2024 from https://worldpopulationreview.com/country-rankings/eggplant-production-by-country

FAO. (2024). Global eggplant statistics. Food and Agriculture Organization Statistical Yearbook 2024. Rome: FAO.

Ghosh, S.K. (2022). Eggplant (Solanum melongena L.) and Climate Resilient Agricultural Prac. In: Climate Change Dimensions and Mitigation Strategies for Agricultural Sustainability (1st ed.), New Delhi. http://dx.doi.org/10.30954/NDP-climatev2.4

Hillclimb Media, (1997). Eggplant, black beauty seeds and bulbs. Retrieved from http://www.burpee.com/product/vegetable/eggplant/eggplant+blackbeauty

Im, K., Lee, J. Y., Byeon, H., Hwang, K. W., Kang, W., Whang, W. K., and Min, H. (2016). In Vitro antioxidative and anti-inflammatory activities of the ethanol extract of eggplant (Solanum melongena) stalks in macrophage RAW 264.7 cells. Food and Agricultural Immunology, 27(6), 758–771. https://doi.org/10.1080/09540105.2016.1150427

IndexBox. (2024). Ethiopian eggplant production trends. Retrieved from https://app.indexbox.io

Iwuagwu, C. C., Okeke, D. O., Onejeme, F. C., Iheaturu, D. E., Nwogbaga, A. C., and Salaudeen, M. T. (2019). Effect of plant spacing on yield and disease assessment on two varieties of eggplant (*Solanum melongena* l.) in Awka. *East. African. Scholars. J. Agric. Life Sci*, 2, 281-288.

Karpe M, Marcelis LFM and Heuvelink, E. (2024). Dynamic plant spacing in tomato results in high yields while mitigating the reduction in fruit quality associated with high planting densities. *Front. Plant Sci. 15:1386950*. https://doi.org/10.3389/fpls.2024.1386950

Muhammad, A. and Singh, A. (2007). Intra-Row Spacing and Pruning Effects on Fresh Tomato Yield in Sudan Savanna of Nigeria. *Journal of Plant Science, 2: 153-161*. https://doi.org/10.3923/jps.2007.153.161

Singh, A. K., Sabir, N., Jat, G. S., Singh, J., Singh, V., Singh, A., Kumar, A., & Kumar, J. (2021). Effect of spacing and pruning on growth, yield and economics of long melon (*Cucumis melo* var. utilissimus) under naturally ventilated polyhouse. *The Indian Journal of Agricultural Sciences*, *91*(6), 885–889. http://dx.doi.org/10.56093/ijas.v91i6.114293