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EFFECT OF DIFFERENT PLANT SPACING AND MULCHING MATERIALS ON THE GROWTH AND YIELD PERFORMANCE OF OKRA (*Abelmoschus esculentus*) IN THE DRY ZONE OF SRI LANKA

Rifkan A.M.[1], Nawarathna S.L.[1*], Weerasinghe P.O.P.[1], Iqbal S.L.[2], Vidanapathirana N.P.[1], Ketiperachchi K.G.[1]

[1]University of Colombo Institute for Agro-Technology and Rural Sciences
[2]Sri Lanka School of Agriculture, Palamunai

Corresponding Author: supipi@uciars.cmb.ac.lk (https://orcid.org/0000-0003-3824-7191)
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ABSTRACT

Okra (Abelmoschus esculentus) is a globally cultivated economically important crop where weed pressure and inadequate agronomic practices often limit its productivity. A field experiment was conducted at the Sri Lanka School of Agriculture, Palamunai, during the period from November 2024 to March 2025, with the objective of investigating suitable spacing and mulching material for growing okra (Haritha variety) in the dry zone of Sri Lanka. The experiment was laid out in a 3×4 factorial RCBD with three levels of spacing (90cm x 60cm, 75cm x 45cm, and 60cm x 60cm) as the first factor and four levels of mulching material (polythene, paddy straw, paddy husk, and no mulch) as the second factor. Each treatment combination was replicated four times. According to the ANOVA results of the experiment, there was no significant interaction effect ($p>0.05$) observed between plant spacing and mulching materials for the measured growth and yield parameters. Therefore, the main effects were analyzed independently. Spacing had no significant influence ($p>0.05$) on plant height, leaf number, pod length, or total yield, although the 60×60 cm spacing resulted in earlier flowering (31.1 days). With respect to the mulching material used, except for the days to 50% flowering, polythene mulch significantly enhanced leaf number (12.8 leaves at 8 WAP), average pod length (19.39 cm), and total yield per plant (322.38 g) outperforming organic mulches and the no-mulch control. Polythene mulch proved to be the most effective mulching material for improving okra productivity under dry-zone conditions. These results emphasize the necessity of adopting optimal mulching practices to maximize crop performance and resource-use efficiency.

Keywords: Okra (Abelmoschus esculentus), Dry zone agriculture, Polythene mulch, Plant spacing

INTRODUCTION

Okra (*Abelmoschus esculentus*) which belongs to the family Malvaceae, is a highly nutritious and economically valuable crop that is popular globally among farmers in the tropical and subtropical regions (Ibitoye & Kolawole, 2022). The tender pods of okra are consumed as a vegetable, and seeds are used for oil production (Kumar et al., 2013). Okra grows well at temperatures between 20ºC and 30ºC, and in well-drained sandy loam soils with pH 6-7 (Benchasri, 2012).

Weed growth is a major constraint faced by farmers, which significantly hinders crop production, lowering yields and reducing economic returns (Mohammadi, 2012). Weed control using synthetic chemicals is a costly method that also brings about harmful effects on the environment and human health. Therefore, alternative methods such as mulching have been practiced by farmers around the world since ancient times. Mulching can be done either by using synthetic material, such as plastic mulch or by using natural materials such as plant residues (Abouziena & Haggag, 2016). However, there is still a question about which is superior in agriculture (Kader et al., 2019), and therefore the impact of different mulching materials on the growth and yield of crops needs to be a widely studied and important ongoing area of agricultural research.

The choice of the correct spacing in okra cultivation in a field is an important aspect in the optimum growth and productivity of crops. Improperly spaced plants may lead to higher or lower plant populations, resulting in lower yields and low-quality pods (Maurya & Chandler, 2013). Therefore, the present study was conducted with the objective of determining a suitable spacing and a mulching material to improve the productivity of growing okra (*Abelmoschus esculentus*) in the dry zone of Sri Lanka.

MATERIALS AND METHODS

Experimental location and period

This study was conducted at the Sri Lanka School of Agriculture, Palamunai, situated within the dry zone of Sri Lanka, during the period from November 2024 to March 2025. The experimental site is located at 7.2730° N and 81.8538° E, in an elevation of 500m above mean sea level.

Planting material

Seeds of the okra (*Abelmoschus esculentus*) variety '*Haritha*' were used for the experiment. The seed requirement was 4.5kg/ha.

Treatments and experimental design

The experiment was laid out in a 3×4 factorial RCBD (Randomized Complete Block Design) with spacing as the first factor and mulching material as the second factor. Three levels of spacing and four levels of mulching material were tested. Each treatment was replicated four times formulating 12 treatment combinations as shown in Table 1.

Treatments

Table 1. Treatment combinations of the experiment

Treatment Code	Description	
	Spacing	Mulching material
T1	90cm x 60cm	Polythene
T2	90cm x 60cm	Paddy straw
T3	90cm x 60cm	Paddy husk
T4	90cm x 60cm	No mulch
T5	75cm x 45cm	Polythene
T6	75cm x 45cm	Paddy straw
T7	75cm x 45cm	Paddy husk
T8	75cm x 45cm	No mulch
T9	60cm x 60cm	Polythene
T10	60cm x 60cm	Paddy straw
T11	60cm x 60cm	Paddy husk
T12	60cm x 60cm	No mulch

Agronomic practices

After the completion of land preparation, direct seeding of okra seeds was done by planting 2-3 seeds per hill, at a depth of 1-2 cm. Later, thinning out was done, leaving only one healthy plant per hill. Seeds were spaced according to the treatments of the experiment. Fertilizer application was done according to the recommendation for okra cultivation provided by the Department of Agriculture, Sri Lanka. Irrigation was done twice a day until germination, and thereafter continued based on the soil moisture condition. Weed control was achieved through mulching. Different mulches were used based on the treatments of the experiment.

Data collection and analysis

The growth parameters recorded were the number of leaves and plant height, at two-week intervals up to eight weeks after seed sowing. Days to 50% flowering were recorded by counting the number of days from seed sowing until 50% of plants from each treatment had at least one open flower. The yield parameters recorded were the average pod length and total yield per plant. Collected data were subjected to Analysis of Variance (ANOVA) and mean separation (Tukey's Test) using Minitab 19 statistical software at 5% significance level.

RESULTS AND DISCUSSION

Effect of different plant spacing and mulching materials on growth parameters

Plant height

Table 2 shows the analyzed results of the plant height measurements taken at 2,4,6 and 8 WAP of okra. At 2 WAP, plant height showed no significant interaction, ranging narrowly from 7.2cm to 7.7cm. This implies that spacing and mulching treatments had no apparent impact on early seedling development, which might be due to the requirement of fewer nutrients during the seedling stage (Dulala et al., 2024) and the impact of weeds being minimal at this stage.

Plant height showed significant interactive effects at 4 WAP and 6 WAP okra. At 4 WAP, the significantly tallest plants were observed in T1 and T9 followed by T5, all of which used polythene mulch across different spacing levels. These treatments performed noticeably better than the non-mulched treatments (T4, T8 and T12), indicating that polythene mulching promoted early vegetative development. The trend continued at 6 WAP, with T1 and T5 producing the tallest plants among the treatments, highlighting the polythene mulch's beneficial effects at all spacing levels. In contrast, the non-mulched treatments (T4, T8 and T12), produced the significantly shortest plants, indicating that the absence of mulching lowers plant vigour perhaps as a result of higher evaporation, weed pressure, and soil temperature variations (El-Beltagi et al., 2022). Although plant heights at 8 WAP were not statistically significant, the numerical trend remained constant, with T1, T5 and T9 being marginally higher

than the other treatments, suggesting that polythene mulching has long-term advantages, even as vegetative development progresses. Similar research conducted by Jha et al. (2018), using plastic and organic mulches at different levels of spacing also did not produce significant interactive effects for plant height. However, based on the single-factor analysis, the authors noted that plastic mulch produced higher plant heights at 45 days and 60 days after sowing okra seeds. By producing warmer soil temperatures and retaining more soil moisture than bare soil, plastic mulches modify the growing environment for the plant (Gordon et al., 2010), possibly resulting in higher plant heights. In the no-mulch treatment, the absence of a mulch to conserve water, and less favourable soil temperature conditions might have resulted in comparatively lower plant heights among the treatments. A similar result was obtained by Shamla et al. (2017) in their experiment where the non-weeded plots resulted in lower plant heights in okra.

Table 2. Plant height (cm) of okra at 2,4,6, and 8 WAP

Treatment Code	Plant height (cm)			
	2 WAP	4 WAP	6 WAP	8 WAP
T1	7.70 ± 0.03	27.16 ± 0.02^{a}	53.87 ± 0.07^{ab}	87.16 ± 0.31
T2	7.35 ± 0.03	23.48 ± 0.03^{d}	51.06 ± 0.07^{cde}	79.20 ± 0.22
T3	7.31 ± 0.01	22.74 ± 0.07^{e}	50.73 ± 0.08^{de}	71.90 ± 0.19
T4	7.20 ± 0.06	21.28 ± 0.07^{f}	49.10 ± 0.09^{f}	66.01 ± 0.22
T5	7.57 ± 0.00	26.56 ± 0.04^{b}	54.09 ± 0.13^{a}	86.73 ± 0.21
T6	7.26 ± 0.01	23.76 ± 0.07^{d}	51.46 ± 0.12^{c}	78.54 ± 0.19
T7	7.27 ± 0.04	24.71 ± 0.19^{c}	51.19 ± 0.07^{cd}	71.40 ± 0.13
T8	7.24 ± 0.03	21.62 ± 0.03^{f}	48.83 ± 0.07^{f}	65.98 ± 0.04
T9	7.49 ± 0.02	27.00 ± 0.05^{a}	53.40 ± 0.19^{b}	87.08 ± 0.04
T10	7.27 ± 0.01	22.69 ± 0.03^{e}	50.63 ± 0.03^{e}	78.91 ± 0.22
T11	7.26 ± 0.09	22.88 ± 0.09^{e}	51.11 ± 0.06^{cde}	71.80 ± 0.06
T12	7.25 ± 0.00	21.58 ± 0.03^{f}	48.83 ± 0.04^{f}	65.88 ± 0.18
Significance	ns	*	*	ns

Values represent mean ± standard error of four replicates. '' represents significant difference and 'ns' represents non-significant difference at 0.05 level of probability. According to Tukey's Test, means in the same column followed by dissimilar letter/s in superscripts indicate significant difference at 0.05 level of probability.*

Number of leaves per plant

There was no significant interaction effect ($p>0.05$) observed between spacing and mulching materials on leaf number. Therefore, the individual effect of spacing and mulching material was analyzed as shown in Table 3.

Table 3. Number of leaves per okra plant

Treatment	Number of leaves per plant			
	2 WAP	4 WAP	6 WAP	8 WAP
Mulching				
Polythene	5.48 ± 0.04^{a}	8.67 ± 0.03^{a}	10.55 ± 0.04^{a}	12.80 ± 0.05^{a}
Paddy straw	5.30 ± 0.03^{b}	8.43 ± 0.06^{ab}	10.35 ± 0.03^{ab}	12.22 ± 0.10^{bc}
Paddy husk	5.28 ± 0.05^{b}	8.51 ± 0.08^{ab}	10.08 ± 0.15^{b}	11.87 ± 0.17^{c}
No mulch	5.24 ± 0.04^{b}	8.42 ± 0.07^{b}	10.24 ± 0.03^{ab}	12.29 ± 0.07^{b}
Significance	*	*	*	*
Spacing				
90cm x 60cm	5.31 ± 0.05	8.53 ± 0.05	10.26 ± 0.08	12.37 ± 0.15
75cm x 45cm	5.31 ± 0.04	8.53 ± 0.06	10.31 ± 0.08	12.24 ± 0.12
60cm x 60cm	5.36 ± 0.04	8.47 ± 0.06	10.35 ± 0.08	12.27 ± 0.10
Significance	ns	ns	ns	ns

Values represent mean ± standard error of four replicates. '' represents significant difference and 'ns' represents non-significant difference at 0.05 level of probability. According to Tukey's Test, means in the same column followed by dissimilar letter/s in superscripts indicate significant difference at 0.05 level of probability.*

According to the analyzed results, the polythene mulch produced the significantly highest number of leaves at 2WAP and 8 WAP compared to other types of mulching tested in the experiment. This result is consistent with earlier research conducted by Ashrafuzzaman et al. (2011), showing that mulching, especially with black polythene, enhances microclimatic conditions which improve vegetative growth producing a higher number of leaves per plant in chili crop. Another possible explanation for polythene mulch's better performance is that it suppresses weeds more successfully than organic

mulches (Kader et al., 2019), which lessens competition for water and nutrients.

Except for 6WAP, the no mulch treatment did not match the leaf production under polythene mulch, but it performed comparably to paddy husk and paddy straw at all phases. A similar study conducted by Jayaweera et al. (2024) with turmeric produced no significant results between the treatments; control (no mulching), rice straw mulch, paddy husk mulch and cinnamon residue mulch.

In contrast to mulching, spacing levels tested in the present experiment showed no significant effects at any growth stage in the present study, confirming that differences in spacing of okra plants have no influence on the vegetative growth in terms of leaf production. Similar results were observed by Jha et al. (2018) who observed no significant effects for the leaf number of okra grown at different levels of spacing.

Effect of different plant spacing and mulching materials on yield parameters

Days to 50% flowering

For days taken to 50% flowering, no significant interaction effect ($p>0.05$) was observed between mulching materials and spacing. Therefore, the individual effect of spacing and mulching material was analyzed as shown in Table 4. The analyzed results showed that there was no significance ($p>0.05$) in the days to 50% flowering of okra with respect to the different mulching materials used, with all treatments showing similar flowering times. However, spacing had a significant effect on flowering time, with 60×60 cm spacing resulting in earlier flowering compared to 90×60 cm spacing. Increased competition for resources may have caused rapid phenological development as a stress response, which could explain the early flowering seen at closer spacing. In research conducted by Jena & Mohanty (2021), testing different levels of spacing for chrysanthemum, the first flower bud was produced at the closest spacing, suggesting that due to the competition for nutrients, water and sunlight, the plants enter the reproductive phase sooner. Wider spacing, on the other hand, may have caused a delay in flowering since there is less competition between plants, allowing greater vegetative growth before reaching the reproductive stage.

Average pod length

There was no significant interaction effect ($p>0.05$) observed between spacing and mulching materials on the average pod length. Therefore, the individual effect of spacing and mulching material was analyzed as shown in Table 4. The significantly longest pods were produced by plants grown with polythene mulch, outperforming all other mulching treatments. In contrast to mulching, spacing showed no significant results, indicating that inter-row and intra-row spacing between okra plants does not influence pod length appreciably. This lack of response could suggest that pod elongation is more strongly influenced by plant physiological and environmental factors such as nutrient availability and moisture content (which are directly influenced by mulching) rather than plant population.

Total yield per plant

There was no significant interaction effect ($p>0.05$) observed between spacing and mulching materials on the total yield per plant. Therefore, the individual effect of spacing and mulching material was analyzed as shown in Table 4. According to the ANOVA results, the type of mulching material used had a significant effect on the total yield per plant. The highest yield recorded was from plants that had polythene mulch, followed by those mulched with paddy straw and paddy husk. The no-mulch treatment resulted in the lowest yield. In contrast, plant spacing showed no statistically significant differences in total yield per plant. Similar results were observed by Jha et al. (2018) in an experiment testing different levels of mulching with spacing. The researchers observed no significant interaction between the treatment combinations, with silver plastic mulch performing best in a single-factor analysis. In another experiment conducted by Akhila et al. (2018), the use of a black polythene as the mulching material in an okra cultivation displayed better growth and yield parameters, possibly due to successful weed suppression, maintenance of optimum soil moisture content and soil temperature. In addition, the solarization effect brought about by the plastic mulch increases the availability of nutrients leading to higher yields (Olabode et al., 2007) as a result of the modification of the physico-chemical properties of soil (Bahadur et al., 2018).

Table 4. Days to 50% flowering, average pod length, and total yield per plant of okra

Treatment	Days to 50% flowering	Average pod length (cm)	Total yield per plant (g)
Mulching			
Polythene	31.50 ± 0.32	19.39 ± 0.13[a]	322.38 ± 1.28[a]
Paddy straw	31.71 ± 0.32	17.63 ± 0.16[b]	284.11 ± 1.41[b]
Paddy husk	31.54 ± 0.20	16.43 ± 0.16[c]	281.59 ± 3.14[c]
No mulch	31.87 ± 0.27	18.05 ± 0.18[b]	274.26 ± 1.12[b]
Significance	ns	*	*
Spacing			
90cm x 60cm	32.10 ± 0.25[a]	17.91 ± 0.33	290.32 ± 5.00
75cm x 45cm	31.72 ± 0.20[ab]	17.84 ± 0.24	289.70 ± 5.32
60cm x 60cm	31.14 ± 0.21[b]	17.88 ± 0.34	291.73 ± 4.96
Significance	*	ns	ns

Values represent mean ± standard error of four replicates. '' represents significant difference and 'ns' represents non-significant difference at 0.05 level of probability. According to Tukey's Test, means in the same column followed by dissimilar letter/s in superscripts indicate significant difference at 0.05 level of probability.*

CONCLUSIONS

Considering the different levels of spacing tested in this experiment, except for the days to 50% flowering, no significant effects were observed in the number of leaves per plant, average pod length and the total yield. Although the 60 × 60 cm spacing promoted earlier flowering, yield per unit area was not evaluated in the present study. Therefore, further studies incorporating area-based yield calculations are needed to arrive at a conclusive agronomic suggestion regarding the ideal plant spacing for okra farming in the Dry Zone of Sri Lanka. With respect to the mulching material used, except for the days to 50% flowering, the number of leaves per plant (2 WAP and 8 WAP), average pod length and the total yield per plant showed significant results for polythene mulch compared to paddy straw, paddy husk and the no-mulch treatment. Hence, it can be concluded that polythene mulch is the most effective mulching material for achieving the highest okra yield under the conditions of this study.

REFERENCES

Abouziena, H. F., & Haggag, W. M. (2016). Weed control in clean agriculture: a review1. *Planta daninha*, *34*(2), 377-392.

Akhila, P., Meena, S., Srinivasa Rao, C. H. N. V., Kumar, D., Gopi, B., & Tejaswini, V. (2018). Comparison of growth and yield performance of okra crop under mulching systems. *International Journal of Current Microbiology and Applied Sciences*, *7*, 3670-3679.

Ashrafuzzaman, M., Halim, M. A., Ismail, M. R., Shahidullah, S. M., & Hossain, M. A. (2011). Effect of plastic mulch on growth and yield of chilli (Capsicum annuum L.). *Brazilian archives of biology and technology*, *54*, 321-330.

Bahadur, S., Pradhan, S., Verma, S., Maurya, R., & Verma, S. K. (2018). Role of plastic mulch in soil health and crop productivity. *Climate change and its implications on crop production and food security*, 338-344.

Benchasri, S. (2012). Okra (Abelmoschus esculentus (L.) Moench) as a valuable vegetable of the world. *Field & Vegetable Crops Research/Ratarstvo i povrtarstvo*, *49*(1).

Dulala, S., Niraulaa, R. K. D., & Neupaneb, S. (2024). Effect of spacing on growth and production of okra in mahottari, nepal. *Agribusiness*, *8*(2), 72-77.

El-Beltagi, H. S., Basit, A., Mohamed, H. I., Ali, I., Ullah, S., Kamel, E. A., ... & Ghazzawy, H. S. (2022). Mulching as a sustainable water and soil saving practice in agriculture: A review. *Agronomy*, *12*(8), 1881.

Gordon, G. G., Foshee III, W. G., Reed, S. T., Brown, J. E., & Vinson III, E. L. (2010). The effects of colored plastic mulches and row covers on the growth and yield of okra. *HortTechnology*, *20*(1), 224-233.

Ibitoye, D. O., & Kolawole, A. O. (2022). Farmers' appraisal on okra [Abelmoschus esculentus (L.)] production and phenotypic characterization: a synergistic approach for improvement. *Frontiers in plant science*, *13*, 787577.

Jayaweera, W. M. C. S., Amarasinghe, S. R., & Ranawake, A. L. (2024). Effect of Paddy Straw,

Paddy Husk, and cinnamon residue as mulching in turmeric (Curcuma longa L.) cultivation in low country Wet Zone in Ultisols. *AGRIEAST: Journal of Agricultural Sciences*, *18*(2).

Jena, S. and Mohanty, C.R. (2021). Effect of spacing on growth and flowering of annual chrysanthemum (*Chrysanthemum coronarium* L.). *Journal of Pharmacognosy and Phytochemistry 10(2):* 1045–1050.

Jha, R. K., Neupane, R. B., Khatiwada, A., Pandit, S., & Dahal, B. R. (2018). Effect of different spacing and mulching on growth and yield of Okra (*Abelmoschus esculentus* L.) in Chitwan, Nepal. *Journal of Agriculture and Natural Resources*, *1*(1), 168-178.

Kader, M. A., Singha, A., Begum, M. A., Jewel, A., Khan, F. H., & Khan, N. I. (2019). Mulching as water-saving technique in dryland agriculture. *Bulletin of the National Research Centre*, *43*(1), 147.

Kumar, D. S., Tony, D. E., Kumar, A. P., Kumar, K. A., Rao, D. B. S., & Nadendla, R. (2013). A review on: Abelmoschus esculentus (Okra). *International Research Journal of Pharmaceutical and Applied Sciences*, *3*(4), 129-132.

Maurya, R. P., Bailey, J. A., & Chandler, J. S. A. (2013). Impact of plant spacing and picking interval on the growth, fruit quality and yield of okra (Abelmoschus esculentus (L.) Moench). *American Journal of Agriculture and forestry*, *1*(4), 48-54.

Mohammadi, G. R. (2012). Living mulch as a tool to control weeds in agroecosystems: a review. *Weed control*, *29*, 75-100.

Olabode, O. S., Ogunyemi, S., & Adesina, G. O. (2007). Response of okra (Abelmoschus esculentus (L). Moench) to weed control by mulching. *Journal of Food Agriculture and Environment*, *5*(3/4), 324.

Shamla, K., Sindhu, P. V., & Menon, M. V. (2017). Effect of weed management practices on growth and yield of okra (Abelmoschus esculentus (L.) Moench.). *Journal of Tropical Agriculture*, *55*(1), 57-62.