

| Date | Submitted | Accepted | Published |
|------|---------------------------|---------------------------|--------------------------------|
| | 31 st May 2024 | 16 th May 2025 | 5 th September 2025 |

WEED CONTROL ON OKRA (*Abelmoschus esculentus* (L.) Moench) WITH SPACING TREATMENT AND WEEDING FREQUENCY

Murrinie ED^{1*}, Fauzi MR¹ and V Krestiani¹



Endang Dewi Murrinie

*Corresponding author email: dewi.murinie@umk.ac.id

ORCID: <https://orcid.org/0000-0002-6783-6916>

¹Faculty of Agriculture, Universitas Muria Kudus, Lingkar Utara Street, Gondangmanis, Kudus 59327, Central Java, Indonesia



ABSTRACT

Okra is a plant of many benefits and high economic value, originating in Africa, so it holds good prospects for intensive cultivation. Okra plants have good adaptability to various climatic conditions, crop yields are still low, however. One of the causes of low yields is the occurrence of intra-specific competition between okra plants and inter-specific competition between okra plants and weeds. Therefore, it is necessary to determine the proper spacing and effective weed control. The purpose of the study was to determine the effect of spacing and weeding frequency on the growth and yield of okra. The experimental design used was a randomized complete block design, consisting of two factors, namely spacing and weeding frequency. Spacing treatment consists of two levels, namely 40 cm x 40 cm and 40 cm x 60 cm. Weeding frequency treatment consists of four levels, namely weeding once (2 weeks after planting / WAP), weeding twice (2 and 4 WAP), weeding three times (2, 4, and 6 WAP), and weeding four times (2, 4, 6, and 8 WAP). The results showed that the spacing of okra did not affect the growth and yield per plant, but it affected the yield per plot due to the different number of plants per plot. The highest number of fruits and weight of okra fruits per plot were obtained at a spacing of 40 cm x 40 cm, namely 251.25 pieces and 3.67 kg, respectively. The frequency of weeding does not affect the growth and yield of okra. Weeding once at 2 weeks of age after planting can suppress weed growth just as well as weeding twice, three times, and four times. Based on the results of the study, it is recommended that okra be planted with a spacing of 40 cm x 40 cm and weed control with one-time weeding at the age of 2 weeks after planting.

Key words: okra, spacing, weeds, weeding frequency, intra-specific competition, inter-specific competition

Citation: Murrinie ED, Fauzi MR and V Krestiani Weed Control on Okra (*Abelmoschus esculentus* (L.) Moench) with Spacing Treatment and Weeding Frequency. *Afr. J. Food Agric. Nutr. Dev.* 2025; **25(7)**: 27354-27365 <https://doi.org/10.18697/ajfand.144.23615>



INTRODUCTION

Okra (*Abelmoschus esculentus* L.) is a plant in the family Malvaceae that is used as vegetable, for industrial raw materials, and in medicinal materials. Okra contains carbohydrates, proteins, fats, vitamins, and minerals. Okra fruit has mucus, which is used as an industrial ingredient and treatment material, among others, for dysentery and recovery for diabetics because it can reduce the body's blood sugar levels [1]. Okra fruit contains 88% water, 2.1% protein, 0.2% fat, 8% carbohydrates, 1.7% fiber, and 0.2% ash [2, 3]. The okra plant is native to Africa, but today it has been widely cultivated in many countries in Asia, Southern Europe, and America [4].

Okra fruit which has many benefits, has good prospects for cultivation because it has high economic value [5, 6]. Okra plants have a fairly good adaptability to various climatic conditions, but the yield of okra plants is still low. One of the causes of low okra yields is the presence of weeds that grow with plants, which causes a decrease in crop quality and quantity. The presence of weeds causes competition in fighting for nutrients, water, light, and growing space. Slower plants mastering the growing space cause weeds to grow faster, so the competitive ability of plants decreases if weed control is not carried out.

Heavy weed investment is a limiting factor in okra cultivation due to the wide okra plant spacing and slow early growth [7]. According to Sing *et al.* [9], weeds reduce okra yield by 50-90% [8], and, therefore, it is necessary to do weed control. Weed control in okra is generally done mechanically and culturally, one of which is by weeding because it is the most effective method. However, this method requires more time and energy than other methods. The fastest way is to use herbicides, although the use of chemicals alone continuously causes environmental damage [7].

Weed control is an effort to reduce weed populations to a level that does not cause harm to plants. Weed control should be carried out during critical periods of plants for effective and efficient control, because the presence of weeds after critical periods does not cause harm to plants [10]. Several methods of weed control can be done, namely (1) mechanical/physical control (tillage, weeding, removal, clearing, inundation, and burning); (2) cultivation control (use of high-yielding varieties against weeds, selection of planting time, spacing / heavy seeding, multiple cropping, crop rotation and use of mulch); (3) Biological control (procurement of natural enemies, manipulation of natural enemies and management of natural enemies in an area); (4) Chemical control with herbicides [11].

The issue of environmental damage today due to the use of chemicals in the control of plant-disturbing organisms encourages environmentally friendly non-chemical control to be prioritized over chemical methods [12, 13]. The use of herbicides to control weeds causes environmental damage; so, it is necessary to strive for non-



chemical weed control to suppress weed growth. Environmentally friendly ways of weed control include technical culture with spacing plant treatment and mechanical weeding.

Spacing planting aims to provide growing space for each plant to grow well. Spacing planting will affect competition between plants for light, water, and nutrients. In addition to competition between species, plants also compete with weeds (interspecific competition), thus further suppressing plant growth. Optimal planting spacing is expected to minimize intra- and interspecific competition. Diana *et al.* [14] stated that narrower planting spacing not only increases crop yields but also reduces weed density due to faster canopy cover.

In addition to spacing planting, weed control can be carried out mechanically through weeding. Weed control by weeding does not require heavy equipment because it is done by pulling weeds or using simple tools. Weeding is expected to reduce weed populations to suppress plant and weed competition for light, water, and nutrients between weeds and plants. The effectiveness of weeding is determined by the accuracy in setting the timing of weeding, that is, before weeds rival plants in obtaining growth factors.

Land optimization as an effort to increase okra production can be done by adjusting planting spacing and weeding frequency. At a wider spacing, competition or competition between plants to obtain growth factors will be smaller, but the higher the potential for weeds to grow the frequency of weeding must be more frequent. Conversely, tight spacings cause competition between plants to be higher, but the potential for weed growth is getting less so it is expected that the frequency of weeding can be reduced.

Given the increasing environmental damage due to the use of chemicals for agriculture including excessive use of herbicides to control weeds, a study was conducted that aimed to determine the effect of spacing planting and weeding frequency on the growth and yield of okra plants (*Abelmoschus esculentus* L.).

MATERIALS AND METHODS

The study was a factorial experiment that used a randomized complete block design consisting of two factors and repeated three times. The first factor was the spacing, consisting of two levels, namely spacing of 40 cm x 40 cm and 40 cm x 60 cm. The second factor was the frequency of weeding, consisting of four levels, namely once weeding at the age of 2 weeks after planting (WAP), twice weeding at the age of 2 and 4 WAP, three times weeding at the age of 2, 4 and 6 WAP, and four times weeding at the age of 2, 4, 6 and 8 WAP. The observed data was analyzed using R software version 3.1.1 and continued with the *Duncan Multiple Range Test* at 5%.



Tillage is carried out one week before planting and plots are made with 200 cm x 240 cm size. The okra seeds used are Greenie Variety hybrids, planted with a spacing of 40 cm x 40 cm (50,000 plants/ha) and 40 cm x 60 cm (33,333 plants/ha). Fertilizing with NPK compound fertilizer dose of 400 kg/ha, which is given twice, namely 0 and 4 WAP.

Okra harvesting is carried out gradually every three days starting from 43 days after planting to 9 harvests. The harvested okra fruits are those measuring 9-13 cm. Observations were made on plant height at the ages of 2, 4, 6, and 8 WAP when the first flowers appeared, the number of fruits per plant, the weight of fruits per plant, the number of fruits per plot, and the weight of fruits per plot.

RESULTS AND DISCUSSION

The results showed that there was no interaction between spacing and weeding frequency on okra plant growth and yield.

The effect of spacing on okra growth and yield

The results showed that spacing did not affect the growth and yield per okra plant, but spacing affected the yield of plants per plot. Plant spacing did not affect plant height at 2, 4, 6, and 8 weeks after planting (Table 1), the appearance of the first flowers, the number of fruits, and the weight of fruits per okra plant (Table 2). However, spacing affects the number and weight of fruits per plot (Table 3).

Plant spacing is one way to increase okra yields. Proper planting spacing can reduce the level of intra-specific competition between plants and inter-specific competition between plants and weeds for sunlight, nutrients, and water [15, 16, 17, 18]. Spacing will also reduce the risk of pests and plant diseases. Planting with tight spacing leads to competition between plants and the risk of pest and disease attacks due to high humidity. Conversely, the wider spacing causes weeds to thrive, thus reducing the yield of okra plants. Determination of proper plant spacing is needed to support photosynthesis. Plant spacing determines the efficiency of growing space utilization, making it easier to maintain and harvest. Plant spacing is influenced by plant type, soil fertility, and soil moisture [16].

The results showed that okra plants planted with a spacing of 40 cm x 40 cm and 40 cm x 60 cm provided growth and results that were not significantly different. Thus, it can be said that at a spacing of 40 cm x 40 cm, there has not been intraspecific competition between okra plants, so there is no difference in growth and yield per plant with a wider spacing. Intraspecific competition is competition between individuals of the same species who have similar ecological requirements, whereas the environment is unable to provide sufficient quantities. Makinde & Macarthy state that the effects of competition between plants may not occur until population density

reaches a certain threshold at which resources become limited [19]. Thus, okra planted with a spacing of 40 cm x 40 cm does not cause competition between plants for sunlight because the headers do not cover each other, nor does competition for nutrients and water occur because root growth is not close to each other. This follows the research of Maurya *et al.* [17] and Parmar *et al.* [18] which showed that a minimum spacing of 40 cm x 60 cm or wider provides higher growth and yield compared to a tighter spacing (30 cm x 40 cm).

Maurya *et al.* [17] stated that the wider spacing will reduce competition between plants so that an optimal photosynthesis process occurs. Brar and Singh add that wider spacing provides more growing room, thus increasing crop yields [20].

Although spacing does not affect growth and yield per plant, spacing does affect okra yield per plot. The highest number and weight of fruits was obtained at a planting distance of 40 cm x 40 cm, namely 251.25 pieces and 3.670 kg, respectively (Table 3). The highest yield per plot at a tighter planting distance was due to a higher plant population at a planting distance of 40 cm x 40 cm (50,000 plants/ha) compared to a planting distance of 40 cm x 60 cm (33,333 plants/ha). This result is in line with the research of Imoloame & Usman which shows that with a tighter spacing, which is 60 cm x 30 cm, it gives a higher total number of pods/plots and fresh weight of okra compared to a spacing of 60 cm x 50 cm [21]. The highest yield per plot at tighter spacing compared to wider spacing, as a result of increased plant population numbers, was also reported in spacing studies on okra [17, 18, 22, 23, 24, 25].

The effect of weeding frequency on okra growth and yield

The frequency of weeding does not affect the growth and yield of okra plants (Tables 1, 2, and 3). The results showed that one-time weeding at the age of 2 WAP was not significantly different from weeding 2, 3, and 4 times. Thus, for okra, it is enough to do weeding once at the age of 2 weeks after planting (WAP) because it can suppress weed growth until harvest.

Imoloame & Usman stated that if weeds on okra are controlled from the beginning of plant growth, it will minimize/suppress the growth of subsequent weeds [21]. Along with plant growth, the okra canopy, which is a plant with wide leaves, will close over each other so that weed growth is hampered due to a lack of sunlight. Based on these results, it is suspected that the critical period of competition between okra plants and weeds occurs from planting until the okra plant is 4 weeks old, because at that time, the land was still open, the okra leaves had not closed to each other, so the weeds still got sunlight for their growth. At the age of 4 WAP onwards, when the next weeding is done, the okra canopies close each other so that weeds do not get sunlight for their growth, and the presence of weeds after the age of 4 WAP does not affect the growth and yield of okra.



It is said by Furtado *et al.* [26] that weeds compete with plants in obtaining sunlight, nutrients, and water, besides also inhibiting plant maintenance and harvesting activities. Weed control carried out earlier will further increase the competitiveness of plants against weeds. Research by Karnas *et al.* [27] on sesame shows that weed-free conditions must be maintained from the second week after the emergence of sesame plants, and must be maintained at least until nine weeks of age, so that yield losses are not more than 5%. This is because sesame has a narrow leaf morphology [27], in contrast to okra, which has wide leaves that are immediately close to each other, so weed control is enough to be done once at the age of 2 WAP.

As mentioned by Coleman *et al.* [28], control time is an important factor in weed control. Weed control carried out at the beginning of plant growth risks the emergence of weeds again; on the other hand, delays in weed control result in greater crop and weed competition. Therefore, integrated weed control is required by combining two or more control techniques [28]. In okra, applying a planting distance of 40 cm x 40 cm followed by weeding once at the age of 2 WAP can suppress weed growth, increase yield per plot, reduce weed control costs, and ultimately higher profits obtained by farmers.

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

The results showed that a planting distance of 40 cm x 40 cm did not cause intra-specific competition between okra plants, but was able to minimize plant competition with weeds and increase the number of fruits per plot and the fresh weight of okra per plot. The frequency of weeding does not affect the growth and yield of okra, once weeding at the age of two weeks after planting can suppress weed growth as well as twice, three times, and four times weeding, so that in okra is enough to do weeding once at the age of two weeks after planting.

ACKNOWLEDGEMENTS

The authors would like to thank the Rector of Universitas Muria Kudus, who has given this research support.

Conflict of interest

The authors declare that there are no conflicts of interest.



Table 1: Okra plant height at the age of 2, 4, 6, and 8 weeks after planting (WAP) due to spacing treatment and weeding frequency

| Treatment | Plant height (cm) | | | |
|-------------------------------|-------------------|---------|---------|---------|
| | 2 WAP | 4 WAP | 6 WAP | 8 WAP |
| Plant spacing | | | | |
| 40 cm x 40 cm | 16.70 a | 47.83 a | 76.14 a | 96.72 a |
| 40 cm x 60 cm | 17.23 a | 49.31 a | 77.30 a | 96.50 a |
| Weeding frequency | | | | |
| 1 time on 2 WAP | 17.44 x | 47.67 x | 75.11 x | 95.67 x |
| 2 times on 2 and 4 WAP | 17.13 x | 49.22 x | 77.06 x | 96.61 x |
| 3 times on 2, 4, and 6 WAP | 16.33 x | 46.89 x | 76.84 x | 96.72 x |
| 4 times on 2, 4, 6, and 8 WAP | 16.97 x | 50.50 x | 77.89 x | 97.44 x |

Note: Numbers followed by the same letter in the same column do not differ based on 5% DMRT

Table 2: The appearance of the first flowers, the number of fruits, and the weight of fruits per okra plant due to spacing treatment and weeding frequency

| Treatment | The appearance of the first flowers (days after planting) | Number of fruits per plant | Fruit weight per plant (g) |
|-------------------------------|---|----------------------------|----------------------------|
| Plant spacing | | | |
| 40 cm x 40 cm | 38.67 a | 31.92 a | 468.29 a |
| 40 cm x 60 cm | 38.75 a | 31.83 a | 493.55 a |
| Weeding frequency | | | |
| 1 time on 2 WAP | 39.00 x | 32.50 x | 511.38 x |
| 2 times on 2 and 4 WAP | 38.33 x | 32.00 x | 483.80 x |
| 3 times on 2, 4, and 6 WAP | 39.33 x | 31.33 x | 459.51 x |
| 4 times on 2, 4, 6, and 8 WAP | 38.17 x | 31.67 x | 469.00 x |

Note: Numbers followed by the same letter in the same column do not differ based on 5% DMRT



Table 3: Number of fruits and fruit weight per plot due to spacing treatment and weeding frequency

| Treatment | Number of fruits per plot | Fruit weight per plot (kg) |
|-------------------------------|---------------------------|----------------------------|
| Plant spacing | | |
| 40 cm x 40 cm | 251.25 a | 3.670 a |
| 40 cm x 60 cm | 220.00 b | 3.287 b |
| Weeding frequency | | |
| 1 time on 2 WAP | 231.25 x | 3.452 x |
| 2 times on 2 and 4 WAP | 232.08 x | 3.444 x |
| 3 times on 2, 4, and 6 WAP | 236.11 x | 3.467 x |
| 4 times on 2, 4, 6, and 8 WAP | 243.06 x | 3.552 x |

Note: Numbers followed by the same letter in the same column do not differ based on 5% DMRT

REFERENCES

1. **Dantas TL, Alonso Buriti FC and ER Florentino** Okra (*Abelmoschus esculentus* L.) as a potential functional food source of mucilage and bioactive compounds with technological applications and health benefits. *Plants*. 2021; **10**: 1-14.
2. **Akanbi WB, Togun AO, Adediran JA and EAO Ilupeju** Growth, dry matter and fruit yields components of okra under organic and inorganic sources of nutrients. *Am. Eurasian J. Sustain. Agric.* 2010; **4 (1)**: 1-13.
3. **Murrinie ED, Fauzi MR and V Krestiani** The effect of planting spacing and weeding frequency on changes in weed composition in okra plants. In *Faculty of Agriculture and Fisheries Universitas Muhammadiyah Purwokerto Conference Proceedings 2023*; **Vol. 5**: 203-210.
4. **Ajewole TO, Ayesa AS, Popoola KM, Ajiboye MD, Oluwole BR and OS Kolawole** Effects of fresh shoot biomass of siam weed *Chromolaena odorata* (L.) King and H. Robinson on the germination and growth of okra *Abelmoschus esculentus* (L.) Moench. *Afr. J. Food Agric. Nutr. Dev.* 2021; **21(7)**: 18404-18413.
5. **Ichsan MC, Riskiyandika P and I Wijaya** Response productivity okra (*Abelmoschus esculentus*) granting of dose of fertilizer and fertilizer N Petroganik. *Agrotrop Journal Ilmu-Ilmu Pertanian*. 2016; **14(1)**: 29-31.
6. **Nwaoguala CNC, Law-Ogbomo KE and AU Osaigbovo** Influence by artificial defoliation and NPK fertilizer application on growth and yield of okra (*Abelmoschus esculentus* (L.) Moench). *African Journal of Food, Agriculture, Nutrition and Development*. 2015; **15(2)**: 9794-9806.
7. **Shamla K, Sindhu PV and MV Menon** Effect of weed management practices on growth and yield of okra (*Abelmoschus esculentus* (L.) Moench.). *Journal of Tropical Agriculture*. 2017; **55 (1)**: 57-62.
8. **Singh G, Bhan VM and SS Tripathi** Weed control in okra (*Abelmoschus esculentus* (L.) Moench). *Indian J. Weed Sci.* 1982; **14(1)**: 19-23.
9. **Widayat D and CO Purba** Productivity and losing yield of Ciherang cultivar rice plant (*Oryza sativa* L.) on plant spacing combination and different weeding frequency. *Jurnal Kultivasi*. 2015; **14(1)**: 17-24.



10. **Hossain MA, Karim MF and AFM Maniruzzaman** Response of summer mungbean to levels of field management. *J. Application Agriculture*. 1990; **5(2)**: 289–292.
11. **Barberi P** Preventive and cultural methods for weed management *In*: Labrada, R (Ed.), FAO Plant Production and Protection Paper: Weed Management for Developing Countries. *Food and Agricultural Organization of the United Nations*, 2003.
12. **Eze SC and BC Echezona** Agricultural pest control programmes, food security and safety. *Afr. J. Food Agric. Nutr. Dev.* 2012; **12(5)**: 6582- 6592.
13. **Tsion K and W Steven** An overview use and impact of organic and synthetic farm inputs in developed and developing countries. *Afr. J. Food Agric. Nutr. Dev.* 2019; **19(3)**: 14517- 14540.
14. **Diana NE, Widaryanto E and SY Tyasmoro** Study of plant spacing for maximization of growth and yield of sesame (*Sesamum indicum* L.). *Perspektif, Rev. Pen. Tan. Industri.* 2022; **21(1)**: 38-40.
15. **Indriana JNN, Suryawati S and S Fatimah** The effect of plant distance pattern on growth and production of *Abelmoschus esculentus* (L.) Moench. *Agrovigor: Jurnal Agroekoteknologi.* 2023; **16(1)**: 28-34.
16. **Arifah SH, Astininngrum M and YE Susilowati** The effectiveness of manure and plant spacing on okra plant yields (*Abelmoschus esculentus*, L. Moench). *Vigor: Jurnal Ilmu Pertanian Tropika dan Subtropika.* 2019; **4(1)**: 38-42.
17. **Maurya RP, Bailey JA and JSt. A Chandler** 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.* 2013; **1(4)**: 48-54.
18. **Parmar PN, Bhanvadia AS, Chaudhary MM and AP Patel** Effect of spacing and levels of nitrogen on growth and seed yield of okra (*Abelmoschus esculentus* L. Moench) during Kharif season. *Journal of Pure and Applied Microbiology.* 2016; **10(1)**: 485-488.
19. **Makinde SCO and AP Macarthy** Effects of intraspecific competition on some agronomic attributes of *Celosia argentea* (L) in a field trial. *Biol. and Envir. Sci. J. for the Tropics.* 2006; **3(3)**: 115-121.

20. **Brar NS and D Singh** Impact of nitrogen and spacing on the growth and yield of okra *Abelmoschus esculentus* (L.) Moench]. MATEC Web of Conferences MATEC 57 ICAET. 2016.
21. **Imoloame EO and M Usman** Weed biomass and productivity of okra (*Abelmoschus esculentus* (L.) Moench) as influenced by spacing and pendimethalin-based weed management. *Journal of Agricultural Sciences*. 2018; **63(4)**: 379-398.
22. **Paththinige SS, Upashantha PSG, Ranaweera Banda RM and RM Fonseka** Effect of plant spacing on yield and fruit characteristics of okra (*Abelmoschus esculentus*). *Tropical Agricultural Research*. 2008; **20**: 336 – 342.
23. **Talukder MAH, Mannaf MA, Alam MK, Salam MA and MMU Amin** Influence of sowing time, plant spacing and picking interval on the growth and yield of okra. *Pakistan Journal of Biological Sciences*. 2003; **6(18)**: 1626-1630.
24. **Gorachand M, Malik SC and G Mondal** Growth and yield of bhindi (*Abelmoschus esculentus* (L.) Moench) as influenced by time of sowing and planting density. *Orissa J. Hort*. 1990; **18**: 26-31.
25. **Randhawa GS and MS Pannun** The effects of row spacing and level of nitrogen on the growth and yield of okra (*Abelmoschus esculentus* (L.) Moench). *J. Res., Punjab Agric. Univ., Pakistan*. 1969; **6**: 320-324.
26. **Furtado JAL, Almeida EIB, Taverny de Oliveira LB, Clementino dos Santos A, Vieira da Costa T, Marcelo de Sousa da Silva, Souza JBC, da Silva Sousa W, Ponte WIS and JRB Freitas** Spatial relation of weed competition and soil fertility in soybean farming. *Australian Journal of Crop Science*. 2022; **16(07)**: 899-906.
27. **Karnas Z, Isik D, Tursun N and K Jabran** Critical period for weed control in sesame production. *Weed Biology and Management*. 2019; **(19)**: 121–128.
28. **Coleman MJ, Kristiansen P, Sindel BM and C Fyfe** Imperatives for integrated weed management in vegetable production: Evaluating research and adoption. *Weed Biology and Management*. 2024; **24**: 3-14.