Bangladesh J. Bot. **54**(4): 1089-1092, 2025 (December) **- Short communication**
DOI: https://doi.org/10.3329/bjb.v54i4.86581

# EFFECTS OF ENVIRONMENT FRIENDLY WEED CONTROL METHODS AND YIELDS OF GARLIC (*ALLIUM SATIVUM* L.)

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*Keywords:* Garlic, Mulches, Weed control, Yield

**Abstract**

The research work was conducted to explore the effects of different practices of weed management upon the growth of weed and yields of garlic at the Agricultural Research Institute, Mingawara Swat, Khyber Pakhtunkhwa, Pakistan. The experiment was carried out in a Randomized Complete Block Design (RCBD) having three replications and seven weed management treatments such as $T_1$, $T_2$, $T_3$, $T_4$, $T_5$, $T_6$, and $T_7$. Lowest weed density, fresh and dry biomass of weeds and maximum yield components of garlic, including average bulb weight, number of cloves per bulb, and overall bulb yield were found in treatment $T_5$ and $T_6$. Therefore hand weeding and the use of *Eucalyptus camaldulensis* leaf extract at 125 g/l proved to be environmentally friendly, effective in suppressing weeds and improving garlic bulb yields.

Garlic (*Allium sativum* L.) species of Alliaceae family, with a compound bulb has 10 to 16 cloves surrounded by membranous coat (Guerra *et al*. 2024). Garlic, which is grown all over the world and is used in medicine and condiments as a highly nutritious food (Huang *et al.* 2023). According to the Food and Agricultural Organization (FAO) United Nations the global production of garlic is estimated to be approximately 22.23 million tons (MMT). Asia is the world's largest garlic-producing continent and produces eighty percent of the world's garlic while China produced 18.56 MMT of garlic in 2010, accounting for more than 77% of the world's production (FAO 2020).

Production of Garlic in Pakistan between the years of 2022 and 2023 was 115391 tons, covering an area of 12993 hectares (MNFSR 2023). Compared to other advanced nations, Pakistan produces less garlic on average. In addition to other factors, the primary cause of low yield in the garlic crop is weed invasion (Siddhu *et al*. 2018).Weeds have a significant impact on the growth and yield of garlic crop during the early stages of development (Khalili *et al*. 2023).

Weed management is critical to ensure the optimum development of garlic crops, mainly at the initial growth stage (Khan *et al*. 2023). Weeds can be controlled through various methods such as chemical, mechanical, physical, biological and cultural (Adnan *et al.* 2021). Chemical weed control disrupts the ecological balance and has negative effect on health (Radicetti *et al*. 2021). Cultural practices and the use of allelochemicals of plants and mulching are the good and positive management of weeds control (Pavlović *et al*. 2022). Allelopathy is one of the natural and ecological method used to control weeds and hence improve agricultural yields (Messiha *et al*. 2021). These mulching is fresh, active, and chemical free cultural weed control method (El-Beltagi *et al.* 2022). Mulch has a positive impact on both the quantity and quality of cloves, as well as on the production of bulb crops (Song *et al*. 2024). Mulches helps in controlling the temperature and moisture of the soil, as well as reducing salt and controlling weeds (Yimer 2020). Mulches prevent sunlight from entering as a result weed growth is completely halted (Game *et al.* 2017). The present study was designed to formulate an alternative weed management method that effectively controls garlic weeds, enhances garlic yield, and positively impacts the environment.

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The experiments were performed from October to May 2021-2022 at the agricultural research institute Mingawara swat (34.57°~35.9°`N, 71.9°~72.8°`E) in KPK province of Pakistan. The experiment encompassed seven treatments viz., $T_1$ [White plastic mulch], $T_2$ [Saw dust mulch], $T_3$ [wheat straw mulch], $T_4$ [Newspapers mulch], $T_5$[leaf aqueous extracts (*Eucalyptus camaldulensis* 125 g/l)], $T_6$ [Hand weeding], and $T_7$[Control ].

The research work was carried out in a Randomized Complete Block Design (RCBD) having three replications. The seeds of swat garlic type were selected on properly prepared soil rages. Mulches were applied after germination. The plant aqueous extracts of *E. camaldulensis* were utilized after the seeds have been sown at the recommended rate. These plant aqueous extracts (2 kg) were collected at flowering stage. Each plant species collected samples were thoroughly dried in an oven at 65°C for 48 hrs to remove any dust or debris that may have been attached to them. Each sample was cut into pieces of 0.5 cm and was ground in a grinder (Plant grinder machine PGM-2 made in Pakistan). The grounded samples were weighed individually on an electric balance before being discharge into distilled water at a rate of (125 g/l) at room temperature (25°C) for 24 hrs.

The plant powder and tape water mixture were separated with the help of muslin fabric and was kept in various containers. In each plots aqueous extracts were applied as post-emergence and after 35 and 45 days sowing the crop, hand weeding was done. The appropriate quantity of water was applied to the crop. Urea, single super phosphate (SSP), and sulphate of potash (SOP), respectively, was used to apply NPK at 100-90-60 kg/ha. The seed were received a full dose of phosphorus, potassium, and half of the nitrogen earlier to sowing, while partially of the nitrogen was utilized 30-45 days after sowing. The data were independently subjected to analysis of variance by using MSTATC computer software and means were separated by using Fisher's Protected LSD test.

Statistical analysis of the data indicated significance differences among the treatments for weed and yield parameter under study. The result obtained in Table 1 revealed that weed density ranged from 209.33-23.00 $m^{-2}$. The treatment $T_6$ exhibited the lowest weed density of 23.00 $m^{-2}$ which may be due to more mortality by uprooting and mechanical injury of weeds followed by the treatment $T_5$ 28.67 $m^{-2}$, might be due to considerable phototoxic effects on weeds that reduced their population to a significant level as compared to other treatments. The treatment $T_7$ showed highest 209.33 $m^{-2}$ recorded weed density which may be attributed due to no check on weed growth. Similar findings are in conformity with the results of Sangani *et al*. (2024) and Bohara *et al.* (2025).

The data recorded for weed fresh biomass varied from 528.5-57.83 kg/ha and dry weed biomass 216.9-20.633 kg/ha as effected by a variety of treatment is given in Table 1. The statistical analysis of the data revealed that different weed management practice had a significant impact on fresh and dry weed biomass (kg/ha). The treatment $T_6$ showed the minimum fresh weed biomass at 57.83 kg/ha and dry weeds biomass 20.633 kg/ha whereas the treatment $T_5$ recorded the lowest fresh weed biomass at 223.5 kg/ha and dry weeds biomass (68.50 kg/ha).The treatment $T_7$ showed the maximum fresh weed biomass at 528.5 kg/ha and dry weeds biomass (216.9 kg/ha). Hand weeding and the use of *E. Camaldulensis* extract were the most effective methods for controlling weeds in garlic cultivation as reported by Mwamula *et al*. (2022) and Schandry *et al*. (2020).

The number of cloves $bulb^{-1}$ in garlic ranged from 12.833-7.733 (Table 1). Data showed that treatment $T_6$ indicated highest (12.833) cloves $bulb^{-1}$followed by the treatment $T_5$ (12.133) while the treatment $T_7$ showed the lowest number of clove $bulb^{-1}$.These findings are consistent with those of Almarie (2021) and Shahzad *et al.* (2023) who reported higher garlic crop growth where weed growth were suppressed by the aqueous extract of *E. camaldulinsis* and hand weeding due to which the actual crop growth increases as compared to the control treatments.

Data of Average bulb weight weed ranged from 50.11-22.12 g and the highest average bulb weight of 50.11 g was recorded in treatment $T_6$, followed by treatment $T_5$ attributed to the availability of nutrient in garlic crop at maximum level while plant extract had also great influence for controlling weeds enable the crop to grow more and get maximum bulb weight. This field study aligns with the findings of Rajendra *et al*. (2023) and Manisankar *et al*. (2021).

Data regarding yield of bulbs kg/ha ranged from 6738.1-1405.3 kg/ha was significantly influenced by various weed control methods. The findings indicated that the maximum bulb yield of 6738.1 kg/ha was observed in the treatment $T_6$ followed by the treatment $T_5$ (5897.0 kg/ha) while the treatment $T_7$ showed the minimum (1405.3 kg/ha) bulb yield. The superior bulb yield observed in treatments involving hand weeding and plant extracts can be attributed to reduced weed competition with the vegetable plants, thereby enabling the crop to fully exploit the available growth resources in the soil as reported Nwagwu and Asukwo (2019) and Samanta *et al*. (2022).

**Table 1. Effects of different weed management on weed and yield parameter of garlic.**

| Treatments | Weed density ($m^{-2}$) | Fresh weed biomass (kg/ha) | Dry weed biomass (kg/ha) | Number of cloves $bulb^{-1}$ | average bulb weight (g) | bulb yield (kg/ha) |
|---|---|---|---|---|---|---|
| $T_1$ | 42.33 d | 318.3 bc | 114.5 bcd | 11.500 a | 47.75 b | 4062.1 c |
| $T_2$ | 66.67 bc | 382.5 b | 132.33 b | 11.333 a | 43.13 d | 3953.1 c |
| $T_3$ | 78.33 b | 393.6 b | 126.4 b | 11.333 a | 44.20 d | 3693.7 cd |
| $T_4$ | 49.00 c | 345.3 c | 128 b | 11.133 a | 44.15 bc | 3147.4 d |
| $T_5$ | 33.67 cd | 223.5 c | 68.50 e | 12.133 a | 48.33 b | 5897.0 a |
| $T_6$ | 23.00 d | 57.83 d | 20.633 f | 12.833 a | 50.11 a | 6738.1 a |
| $T_7$ | 209.33 a | 528.5 a | 216.9 a | 7.733 b | 22.12 e | 1405.3 e |
| LSD (0.05) | 16.173 | 88.02 | 30.35 | 0.7778 | 1.0236 | 796.99 |

In the respective column the means followed by different letters are significantly different.

The current study concludes that hand weeding and the use of aqueous extracts from *Eucalyptus camaldulensis* L. were found to be highly effective in controlling weeds, proving to be environmentally safe and resulting the highest garlic bulb yield.

## Acknowledgements

The authors are very much thankful to the Agriculture Research Institute Mingawara Swat Khyber Pakhtunkhwa, Pakistan for providing support to conduct this field experiment.

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*(Manuscript received on 10 March, 2025; revised on 07 December, 2025)*