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RESEARCH ARTICLE

Effect of different herbicides on weed growth and yield of garlic (*Allium sativum* L.)

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ABSTRACT

Field experiments were conducted on medium black soil to know the effect of different herbicides on growth and yield of garlic. The experiment was conducted with BLG-1 genotype. The experiment was laid out in Randomized Block Design with three replications having fifteen treatments each. The treatments consisted of six herbicides with two concentrations each along with two manual weeding treatments and an unweeded control. The cultural practices were practiced as per the package of practices of University of Agricultural Sciences, Dharwad. Significant differences were observed among the treatments for all the weed parameters at all the stages of observation. Among herbicides, chlorimuron @ 9 and 12 g a.i. ha^{-1} recorded the least population of weeds (7.39 and 8.20, respectively) and was followed by chlomazone @ 1.0 and 1.5 kg a.i. ha^{-1} (9.74 and 11.84, respectively). Application of chlorimuron @ 9 and 12 g a.i.ha^{-1} recorded the lowest fresh weight (14.94 and 15.98 g, respectively) and dry weight (3.38 and 2.49 g, respectively) of weeds and was followed by application of chlomazone @ 1.0 and 1.5 kg a.i. ha^{-1} (22.35 and 24.30 g of fresh weight and 4.56 and 5.70 g of dry weight, respectively). Yield of garlic bulbs varied significantly wherein application of Oxyfluorfen @ 0.10 g a.i. ha^{-1} resulted in the production of highest yield (37.08 q/ha) and was on par with the application of Pendimethalin @ 1.0 kg a.i. ha^{-1} (36.22 q/ha) followed by Oxyfluorfen @ 0.20 g a.i. ha^{-1} (32.91 q/ha) and Pendimethalin @ 1.5 kg a.i. ha^{-1} (31.31 q/ha). The lowest yield (14.79 q/ha) was recorded in the unweeded control.

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INTRODUCTION

Garlic (*Allium sativum* L.) is one of the most important and widely consumed bulbous spice crops belonging to the family Alliaceae. It is grown for its bulbs throughout India. The bulbs can be consumed as a spice or condiment in the form of various processed products such as garlic paste, pickles and in several food preparations like chutneys, curried vegetables, curry powders, meat preparations *etc.* Garlic is among the most ancient cultivated vegetables giving pungency. It is native of Central Asia and Southern Europe especially Mediterranean region. It is being grown in India and China in large areas.

In the course of crop production farmers face a lot of

problems apart from the non-availability of better inputs. One of such problems is the weed infestation. Garlic is a shallow rooted, narrowly spaced crop with slow initial growth and short stature. Therefore, it is incapable to compete with aggressive weeds and weeds may reduce the bulb yields to the extent of 40 to 60 per cent (Sandhu *et al*., 1997). Weed control in garlic by hand weeding is becoming expensive, time consuming and laborious. Sometimes due to scarcity of labour at critical stage of crop growth, the yield levels may reduce drastically. One of the best way to overcome this problem is to use the herbicides. But the effectiveness of herbicides is determined by the factors like soil type, organic matter content of the soil, weather conditions etc. Therefore, it is essential to screen the herbicides for their effective doses under particular agroclimatic conditions for effective control of weeds in garlic. Keeping the above factors in view, the present investigation was undertaken.

MATERIALS AND METHODS

Field experiments were conducted to know the effect of different herbicides on weed growth and yield of garlic (*Allium sativum* L.) during *Kharif* and *Rabi* seasons on medium black soils. The experiment was conducted with BLG-1 genotype. The experiment was laid out in Randomized Block Design with three replications having fifteen treatments each. The treatments consisted of six herbicides with two concentrations each along with two manual weeding treatments and an unweeded control. The cultural practices were followed as per the package of practices of University of Agricultural Sciences, Dharwad. In each plot, 0.5 m^2 area was marked for recording the observations on weeds. Fisher's method of analysis of variance as given by Panse and Sukhatme (1967) was applied for analysis and interpretation of data.

RESULTS AND DISCUSSION

The pooled data pertaining to the weed parameters and yield of garlic as influenced by different weed management practices are presented in Table 1and 2.

The important weed species of monocots, dicots and sedges were observed in the experimental field. Important monocot species included *Cynodon dyctylon*, *Panicum repens* and *Digitaria marginata* and the dicot species were *Parthenium hysterophorus, Tridax procumbens*, *Mimosa pudica*, *Commelina benghalensis*, *Amaranthes viridis* and *Euphorbia hirta.*

Significant difference was noticed among the treatments for total weed population during all the stages of crop growth. At 90 DAS, weed free control (hand weeding) recorded the lowest (0.0) number of weeds while, the unweeded control showed the highest population (102.52). Among herbicides, chlorimuron @ 9 and 12 g a.i. ha^{-1} recorded the least population of weeds (7.39 and 8.20, respectively) and was followed by

Table 1: Weed population, fresh weight of weeds (g), dry weight of weeds (g) and weed control efficiency (%) of different weed management practices in garlic

Treatments	Weed population	Fresh weight of weeds (g)	Dry weight of weeds (g)	Weed control efficiency (%)
Chlorimuron @ 9 g a.i. ha^{-1}	7.39 (2.81)	14.94 (3.93)	3.38 (1.97)	3.38 (1.97)
Chlorimuron @ 12 g a.i. ha^{-1}	8.20 (2.95)	15.18 (3.96)	2.49 (1.73)	2.49 (1.73)
Oxyfluorfen @ 0.10 kg a.i. ha^{-1}	15.42 (3.99)	24.50 (5.00)	5.55 (2.46)	5.55 (2.46)
Oxyfluorfen @ 0.20 kg a.i. ha^{-1}	14.87 (3.92)	31.19 (5.63)	6.52 (2.65)	6.52 (2.65)
Pendimethalin @ 1.0 kg a.i. ha^{-1}	20.94 (4.63)	33.96 (5.87)	7.85 (2.89)	7.85 (2.89)
Pendimethalin @ 1.5 kg a.i. ha^{-1}	17.39 (4.23)	33.96 (5.87)	9.48 (3.16)	9.48 (3.16)
Butachlor @ 1.0 kg a.i. ha^{-1}	24.40 (4.99)	48.64 (7.01)	11.54 (3.47)	11.54 (3.47)
Butachlor @ 1.5 kg a.i. ha^{-1}	28.77 (5.41)	75.54 (8.72)	18.68 (4.38)	18.68 (4.38)
Atrazine @ 1.0 kg a.i. ha^{-1}	31.88 (5.69)	53.67 (7.36)	11.54 (3.47)	11.54 (3.47)
Atrazine @ 1.5 kg a.i. ha^{-1}	30.30 (5.55)	81.04 (9.03)	18.59 (4.37)	18.59 (4.37)
Chlomazone @ 1.0 kg a.i. ha^{-1}	9.74 (3.20)	22.35 (4.78)	4.56 (2.25)	4.56 (2.25)
Chlomazone @ 1.5 kg a.i. ha^{-1}	11.84 (3.52)	24.30 (4.98)	5.70 (2.49)	5.70 (2.49)
Unweeded control	102.52 (10.15)	291.23 (17.08)	71.24 (8.47)	71.24 (8.47)
Hand weeding twice	34.19 (5.89)	104.56 (10.25)	18.16 (4.32)	18.16 (4.32)
Weed free control (hand weeding)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
S.E.±	0.28	0.49	0.26	0.13
C.D.(5%)	0.80	1.38	0.74	0.37

DAS = Days after sowing, CD = Critical difference at 5% level of significance, NS = Non-significant, Figures in the parenthesis indicates transformed values $\sqrt{x} + 0.5$

chlomazone @ 1.0 and 1.5 kg a.i. ha^{-1} (9.74 and 11.84, respectively).

Fresh weight and dry weight of weeds also varied significantly among the treatments. At 90 days, the weed free control (hand weeding) recorded the lowest fresh weight and dry weight (0.0 g) of weeds. While, the highest was noticed in unweeded control. Among the herbicides, application of chlorimuron @ 9 and 12 g a.i. ha^{-1} recorded the lowest fresh weight (14.94 and 15.18 g, respectively) and dry weight (3.38 and 2.49 g, respectively) of weeds and was followed by application of chlomazone @ 1.0 and 1.5 kg a.i. ha^{-1} (22.35 & 24.30 g of fresh weight and 4.56 & 5.70 g of dry weight, respectively).

Yield of garlic bulbs varied significantly wherein application of Oxyfluorfen @ 0.10 g a.i. ha^{-1} resulted in the production of highest yield (37.08 q/ha) and was on par with the application of Pendimethalin @ 1.0 kg a.i. ha^{-1} (36.22 q/ha) followed by Oxyfluorfen @ 0.20 g a.i. ha^{-1} (32.91 q/ha) and Pendimethalin @ 1.5 kg a.i. ha^{-1} (31.31 q/ha). The lowest yield (14.79 q/ha) was recorded in the unweeded control (Table 2).

Visual observations on crop toxicity ratings were recorded at 15, 30 and 45 days after sowing. Considerable variation was observed in crop toxicity ratings among the herbicides. Application of chlorimuron (9 and 12 g a.i./ha) and chlomazone (1.0 and 1.5 kg a.i./ha) caused the highest injury to the crop which varied from 3.50 to 4.33 rating (at 15 DAS), 4.17 to 4.50 rating (at 30 DAS) and 4.50 to 5.0 rating (at 45 DAS). Both the concentrations of these two herbicides were on par with regard to their toxicity. Whereas the application of herbicides like oxyfluorfen, pendimethalin, butachlor and atrazine have caused least toxicity at all the stages of crop growth.

The weed free control treatment kept the garlic plots absolutely free from weeds throughout the growth period of garlic since the weeds have been removed as and when they emerged. This resulted in the lowest weed population (0.0), fresh and dry weight of weeds (0.0 g) and highest weed control efficiency (100%). However, among the herbicides, chlorimuron and chromazone at both the concentrations were quite effective in checking the weed population during all the stages of observations followed by oxyfluorfen and pendimethalin. In the initial stages of observation, both the concentrations were effective but in the later stages only higher level of concentration was quite effective since the higher doses of herbicides will have their action for long time. The weed control efficiency was maximum at all the stages with the application of chlorimuron and chlomazone followed by oxyflourfen and pendimethalin. This might be due to their effectiveness in controlling the weed population, checking their growth and thereby reduction in fresh and dry weight of weeds. Similar trend was observed by Porwal (1995) and Yadav and Yadav (2003) in garlic.

Superiority of any weed management practice lies in the evaluation of its yield levels. The treatment weed free control resulted in maximum yield (46.42 q/ha) compared to other treatments. This was possible because of luxuriant growth of

Table 2 : Crop toxicity ratings and yield (q/ha) of garlic as influenced by different weed management practices in garlic

Treatments	Crop toxicity ratings	Yield (q/ha)
Chlorimuron @ 9 g a.i. ha^{-1}	4.50	0.00 (0.71)
Chlorimuron @ 12 g a.i. ha^{-1}	5.00	0.00 (0.71)
Oxyfluorfen @ 0.10 kg a.i. ha^{-1}	1.00	37.08 (6.13)
Oxyfluorfen @ 0.20 kg a.i. ha^{-1}	1.00	32.91 (5.78)
Pendimethalin @ 1.0 kg a.i. ha^{-1}	1.00	36.22 (6.06)
Pendimethalin @ 1.5 kg a.i. ha^{-1}	1.00	31.31 (5.64)
Butachlor @ 1.0 kg a.i. ha^{-1}	1.17	28.55 (5.39)
Butachlor @ 1.5 kg a.i. ha^{-1}	1.17	27.37 (5.28)
Atrazine @ 1.0 kg a.i. ha^{-1}	1.17	25.31 (5.08)
Atrazine @ 1.5 kg a.i. ha^{-1}	1.17	24.20 (4.97)
Chlomazone @ 1.0 kg a.i. ha^{-1}	4.84	0.00 (0.71)
Chlomazone @ 1.5 kg a.i. ha^{-1}	4.84	0.00 (0.71)
Unweeded control	1.00	14.79 (3.91)
Hand weeding twice	1.00	31.88 (5.69)
Weed free control (hand weeding)	1.00	46.42 (6.85)
S.E.$\pm$	0.24	0.10
C.D. (5%)	0.74	0.29

DAS = Days after sowing, CD = Critical difference at 5% level of significance, Figures in the parenthesis indicates transformed values $\sqrt{x} + 0.5$

garlic plant at all the stages of bulb growth due to zero competition from weeds for water, light, nutrients, space and other resources. While, unweeded control recorded the lowest yield, which might be due to severe competition from weeds in the entire period of crop growth.

Among the herbicides, oxyfluorfen (0.10 kg a.i. ha^{-1}) and pendimethalin (1.0 kg a.i. ha^{-1}) were more or less equally effective in increasing the yield which inturn influenced by reduction in crop weed competition, maximum weed control efficiencies and thereby improved availability of moisture, nutrients, light and space at critical stages of crop growth for the maximum production of these yield attributing parameters. Similar results were reported by Durante and Cuocolo (1989), Pande *et al.* (1993), Faraz *et al.* (1994) and Sandhu *et al.* (1997) in garlic.

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