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RESEARCH PAPER

Influence of different weed management practices on growth and yield of garlic (*Allium sativum* L.)

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Abstract : Field experiments were conducted for two seasons on medium black soils to know the Influence of different weed management practices on growth and yield of garlic (*Allium sativum* L.) . The experiment was conducted with BLG-1 genotype. The experiment was laid out in Randomised 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. Among the different treatments, the herbicides like chlorimuron and chlomazone were highly toxic to garlic crop and resulted in 100 per cent mortality of the crop. While, least toxicity was observed in hand weeding treatments and the herbicides like oxyfluorfen and pendimethalin. The treatment weed free control was superior for all the growth parameters at all the stages of crop growth during all the seasons, and was followed by oxyfluorfen @ 0.10 kg and 0.20 kg a.i. ha^{-1} and pendimethalin @ 1.0 kg a.i. ha^{-1}. While, the least values for all the parameters was observed in unweeded control at all the stages. The yield parameters and yield were significantly higher in weed free control and was followed by oxyfluorfen (0.10 kg a.i./ha), oxyfluorfen (0.20 kg a.i./ha) and pendimethalin (1.0 kg a.i./ha). While, unweeded control recorded the least yield during all the seasons.

Key Words : Weed management, Yield, Garlic, Growth

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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. The world's area and production of garlic is 1.0 million ha and 10.12 million tonnes, respectively. India is next to China in area and production in the world. In India, it is being cultivated over an area of 1.20 ha with a production of 5 lakh tonnes (Pandey and Bhonde, 2001).

Weed infestation is one of the major problems that the farmer is exposed to in the course of crop production 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

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the best ways 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 for two seasons on medium black soils to know the influence of different weed management practices on growth and yield of garlic (*Allium sativum* L.). The experiment was conducted with BLG-1 genotype. The experiment was laid out in Randomised Block Design with three replications having fifteen treatments each. The treatments consisted of six herbicides (chlorimuron, chlomazone, oxyfluorfen, pendimethalin, butachlor and Atrazine) 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. Five plants were tagged randomly in each plot and were used for recording the observations. 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 growth parameters, dry matter production, crop toxicity ratings and yield of garlic as influenced by different weed management practices are presented in Table 1 and 2.

Significant differences were observed among the different treatments for all the growth parameters (Table 1). At 90 days after sowing, weed free control (hand weeding) resulted in the highest plant height (44.39 cm). Among herbicides, the application of oxyfluorfen @ 0.10 kg a.i. ha^{-1} produced significantly superior plant height (44.12 cm) followed by oxyfluorfen @ 0.20 kg a.i. ha^{-1} (43.32 cm) and pendimethalin @ 1.5 kg a.i. ha^{-1} (42.66 cm). The unweeded control resulted in the lowest plant height (33.14 cm). Leaf number also varied significantly among the treatments wherein weed free control (hand weeding) recorded the highest number of leaves (7.51) and among herbicides, oxyfluorfen @ 0.20 kg a.i. ha^{-1} showed the maximum number of leaves (7.06) followed by pendimethalin @ 1.5 kg a.i. ha^{-1} (6.74) and butachlor @ 1.5 kg a.i. ha^{-1} (6.36). The unweeded control recorded the lowest number of leaves (5.36).

Leaf size differed significantly among the treatments and the weed free control (hand weeding) resulted in the highest leaf size (29.42 cm^2) compared to other treatments. But among herbicides, pendimethalin @ 1.5 kg a.i. ha^{-1} measured the highest leaf size of 26.12 cm^2 followed by oxyfluorfen @ 0.20

Table 1 : Growth parameters of garlic as influenced by different weed management practices (mean of two years)

Treatments	Plant height	Number of leaves	Leaf size (cm^2)	Leaf area (dm^2)	S Stem girth (mm)
Chlorimuron @ 9 g a.i. ha^{-1}	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
Chlorimuron @ 12 g a.i. ha^{-1}	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
Oxyfluorfen @ 0.10 kg a.i. ha^{-1}	44.12 (6.68)	6.10 (2.57)	24.60 (5.01)	14.94 (3.93)	5.16 (2.38)
Oxyfluorfen @ 0.20 kg a.i. ha^{-1}	43.32 (6.62)	7.06 (2.75)	25.00 (5.05)	17.65 (4.26)	4.88 (2.32)
Pendimethalin @ 1.0 kg a.i. ha^{-1}	42.27 (6.54)	6.26 (2.60)	24.00 (4.95)	15.02 (3.94)	4.79 (2.30)
Pendimethalin @ 1.5 kg a.i. ha^{-1}	42.66 (6.57)	6.74 (2.69)	26.12 (5.16)	17.65 (4.26)	4.65 (2.27)
Butachlor @ 1.0 kg a.i. ha^{-1}	41.10 (6.45)	6.21 (2.59)	22.73 (4.82)	14.17 (3.83)	4.74 (2.29)
Butachlor @ 1.5 kg a.i. ha^{-1}	38.81 (6.27)	6.36 (2.62)	21.40 (4.68)	13.49 (3.74)	4.43 (2.22)
Atrazine @ 1.0 kg a.i. ha^{-1}	36.22 (6.06)	5.60 (2.47)	21.40 (4.68)	11.96 (3.53)	4.16 (2.16)
Atrazine @ 1.5 kg a.i. ha^{-1}	35.86 (6.03)	5.75 (2.50)	21.12 (4.65)	12.03 (3.54)	4.25 (2.18)
Chlomazone @ 1.0 kg a.i. ha^{-1}	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
Chlomazone @ 1.5 kg a.i. ha^{-1}	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
Unweeded control	33.14 (5.80)	5.36 (2.42)	20.29 (4.56)	10.79 (3.36)	3.50 (2.00)
Hand weeding twice	41.10 (6.45)	6.42 (2.63)	26.54 (5.20)	17.06 (4.19)	4.84 (2.31)
Weed free control (hand weeding)	44.39 (6.70)	7.51 (2.83)	29.42 (5.47)	19.48 (4.47)	5.16 (2.38)
Mean	4.87	2.10	3.80	3.06	1.85
S.E.±	0.07	0.03	0.11	0.11	0.05
C.D.(5%)	0.19	1.08	0.32	0.30	0.13

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

kg a.i. ha^{-1} (25.00cm^2) and oxyfluorfen @ 0.10 kg a.i. ha^{-1} (24.60 cm^2). The lowest leaf size was recorded in unweeded control (20.29 cm^2). Same trend was observed with respect to leaf area also wherein the weed free control recorded the maximum leaf area (19.48 dm^2) and among the herbicides application of oxyfluorfen @ 0.20 kg a.i. ha^{-1} and pendimethalin @ 1.5 kg a.i. ha^{-1} recorded the highest leaf area of 17.65 dm^2 and were followed by pendimethalin @ 1.0 kg a.i. ha^{-1} (15.02 dm^2). Unweeded control showed the least leaf area (10.79 dm^2). Significant differences was observed also for stem girth, wherein, the weed free control and oxyfluorfen @ 0.10 kg a.i. ha^{-1} resulted in the highest girth of 5.16 mm followed by oxyfluorfen @ 0.20 kg a.i. ha^{-1} (4.88 mm) and by pendimethalin @ 1.0 kg a.i. ha^{-1} (4.79 mm). Least girth of stem was seen in unweeded control (3.50 mm).

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) (Table 2). Both the concentrations of these two herbicides were at par with regard to their toxicity. Whereas, the application of herbicides likes oxyfluorfen, pendimethalin, butachlor and atrazine have caused least toxicity at all the stages of crop growth.

Significant variations were observed among the treatments for dry matter production and the weed free control resulted in the highest dry matter production (46.42 q/ha) and was followed by oxyfluorfen @ 0.10 kg a.i. ha^{-1} (37.08q/ha) and pendimethalin @ 1.0 kg a.i. ha^{-1} (36.22q/ha).

Yield of garlic bulbs varied significantly wherein the weed free control recorded the highest yield (46.42 q/ha) and among the herbicides, the application of oxyfluorfen @ 0.10 g a.i. ha^{-1} resulted in the production of highest yield (37.08 q/ha) and was at 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.

Before using any herbicide it is important to know their toxic effects on the crop. The toxicity was determined by visual observation. Among the herbicides tried, both chlorimuron (9 and 12 g a.i. ha^{-1}) and chlomazone (1.0 and 1.5 kg a.i. ha^{-1}) were highly toxic to garlic crop and resulted in 95-100 per cent mortality. While, the remaining herbicides were non-toxic to garlic crop. Similar results were reported by Skumriew and Boiadjiev (1995) in garlic.

Superiority of any weed management practices lies in the evaluation of their yield levels. The treatment weed free control resulted in maximum yield (46.42 q/ha) compared to other treatments. This might be due to the fact that the garlic plots were kept absolutely free from weeds throughout the growth period of garlic. This resulted in the luxuriant growth of garlic plant due to zero competition from weeds for water, light, nutrients, space and other resources. 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 was influenced by growth parameters

Table 2: Crop toxicity ratings, dry matter production and yield of garlic as influenced by different weed management practices (mean of two years)

Treatments	Crop toxicity ratings	Dry matter production	Yield (q/ha)
Chlorimuron @ 9 g a.i. ha^{-1}	4.50	0.00 (0.71)	0.00 (0.71)
Chlorimuron @ 12 g a.i. ha^{-1}	5.00	0.00 (0.71)	0.00 (0.71)
Oxyfluorfen @ 0.10 kg a.i. ha^{-1}	1.00	45.14 (6.76)	37.08 (6.13)
Oxyfluorfen @ 0.20 kg a.i. ha^{-1}	1.00	42.92 (6.59)	32.91 (5.78)
Pendimethalin @ 1.0 kg a.i. ha^{-1}	1.00	42.20 (6.53)	36.22 (6.06)
Pendimethalin @ 1.5 kg a.i. ha^{-1}	1.00	40.58 (6.41)	31.31 (5.64)
Butachlor @ 1.0 kg a.i. ha^{-1}	1.17	41.26 (6.46)	28.55 (5.39)
Butachlor @ 1.5 kg a.i. ha^{-1}	1.17	38.39 (6.24)	27.37 (5.28)
Atrazine @ 1.0 kg a.i. ha^{-1}	1.17	43.79 (6.6)	25.31 (5.08)
Atrazine @ 1.5 kg a.i. ha^{-1}	1.17	37.59 (6.17)	24.20 (4.97)
Chlomazone @ 1.0 kg a.i. ha^{-1}	4.84	0.00 (0.71)	0.00 (0.71)
Chlomazone @ 1.5 kg a.i. ha^{-1}	4.84	0.00 (0.71)	0.00 (0.71)
Unweeded control	1.00	30.56 (5.57)	14.79 (3.91)
Hand weeding twice	1.00	41.78 (6.50)	31.88 (5.69)
Weed free control (hand weeding)	1.00	52.13 (7.25)	46.42 (6.85)
S.E.$\pm$	0.07	0.03	0.11
C.D.(5%)	0.19	1.08	0.32

like plant height, number of leaves, leaf area, stem girth and dry matter production of garlic. Oxyfluorfen and pendimethalin recorded their superiority in promoting these characters. These treatments resulted in more production of leaves due to uninterruption from the weeds for the leaf growth, because of their highest weed control efficiencies. Due to more and more production of leaves, the leaf area was increased and hence more will be the photosynthetic area of the garlic plant. Due to more photosynthetic area,the production of photosynthates and translocation of photosynthates from source to sink will be maximum which inturn helps in luxuriant growth of garlic plant by increasing the plant height, stem girth and dry matter production. These findings are in line with the findings of Vora and Mehta (1999) and Porwal (1995) in garlic.

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