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Effect of weed management practices on yield and economics of garlic (*Allium sativum* L.)

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Abstract

A field experiment was carried out during *rabi* season of 2015-2016 at AICRP-weed management farm, AAU, Anand to study the effect of mulch and herbicide on yield and economics of garlic (*Allium sativum* L.). Results of an experiment indicated that pre emergence application of pendimethalin 1000 g ha⁻¹ and manual weeding carried out at 20 and 40 DAP along with spreading of paddy straw mulch 5 t ha⁻¹ effectively reduced the density and dry weight of monocot, dicot and total weeds which reflected in increased in bulb yield, net returns as well as B:C in garlic.

Keywords: Garlic, mulch, weed management, economics

Introduction

Garlic is the second most widely used cultivated after onion. The original abode of garlic is said to be Central Asia and Southern Europe especially Mediterranean region. It consists of an under-ground bulb and above ground vegetative part, which also comprises of a flat as well slender leaves. Garlic is now cultivated extensively in countries like China, India, USA, Russia and Korea. China occupies the first position in garlic cultivation in terms of production. India occupies the second position in production (1251.88 million tonnes) and total area (23.05 lakh hectare) under garlic cultivation. The Rajasthan has maximum area of 45.02 lakh hectare. The Madhya Pradesh state has the highest production of about 270 MT of garlic in India, but garlic productivity (12.16 tonnes ha⁻¹) found to be highest under Punjab state. Total area under garlic cultivation in Gujarat is 35,000 ha with total production of 250 MT, which contributes 5.08 % of total garlic production in India (Anon., 2014) ^[1]. It is highly vulnerable to weed infestation due to its slow emergence and slow initial growth, non-branching habit, sparse foliage and shallow root system. Weed infestation in garlic is one of the major factors for loss in yield and bulb yield loss due to weed infestation to the tune of 30-60% (Kumar *et al.*, 2013) ^[4]. *Chenopodium album*, *Chenopodium murale*, *Melilotus indica*, *Cyperus rotundus* and *Asphodelus tenuifolius*. *Chenopodium murale* are the most dominant weeds observed in garlic crop. Weed species could directly be correlated to the soil type of fertility status quality of irrigation water, cropping patterns and agronomic practices followed in area. Careful monitoring of the changing weed flora could be of much practical value in implementing an effective control measure depending upon the threshold value to keep the weeds at bay at an economical variable cost (Singh *et al.*, 2009) ^[11]. Use of pre-plant, pre or post-emergence herbicides may prove as the solution for over dependence on labour in garlic weed control, but their proper doses and time of application is more important for better results with low cost (Kalhapure *et al.*, 2014) ^[3]. Sometimes due to shortage of labour and unexpected rains, hand weeding and mechanical operations are more often either delayed or all left together. In such situations, the herbicidal weed management practices become much more important. Therefore, the studies were conducted to know the efficacy of new herbicides and paddy straw mulch used either alone or in combination at different times to provide good result of weed control for better garlic yield.

Materials and Method

A field experiment was conducted during *rabi* 2015-16 at AICRP-Weed Management Farm, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat) to study the effect of weed management practices on yield and economics of garlic.

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The soil was loamy sand in texture having low in available nitrogen and medium in available phosphorus and high in potassium with pH 7.32. Two mulching treatment viz., M₀: Without straw mulch and M₁: With paddy straw mulch @ 5 t ha⁻¹ and four weed management practices viz., W₁: Pendimethalin @ 1000 g ha⁻¹, W₂: Oxyfluorfen @ 223 g ha⁻¹ (PE), W₃: Manual weeding at 20 and 40 DAP and W₄: Weedy check were tested in split plot design with three replications. The garlic cv. Gujarat Garlic 4 was planted manually keeping the row distance of 15 cm at 600 kg seed ha⁻¹ during last week of November, 2015. Entire quantity of phosphorous (50 kg ha⁻¹), potassium (50 kg ha⁻¹) as well as 50% nitrogen (25 kg ha⁻¹) were applied at the time of planting, while remaining 50% nitrogen (25 kg ha⁻¹) was applied at 30 days after planting. Paddy straw mulch was spread after planting of garlic in respective treatment. The herbicides were applied using Knapsack sprayer fitted with flat fan nozzle as per treatment. For the better and uniform germination of planted cloves, immediately after planting a light irrigation was given and next day the pre-emergence herbicides were applied in respective treatment. The crop was harvested on first week of April. Density and weed dry weight were recorded from randomly selected four spots by using 0.25 m² iron quadrat from net plot area from all treated plot. At the time of harvest, bulb yield was recorded from the net plot area and converted into ha. Data on various observations during the experiment period were statistically analyzed as per the standard procedure developed by Panse and Sukhatme (1967)^[8].

Results and Discussion

Effect on Weeds

Table 1: Plant height, density and weed dry weight as well as bulb yield as influenced by mulching and weed management practices

Treatment	Plant height (cm)		Weed density at harvest (No. m ⁻²)			Weed dry weight at harvest (g m ⁻²)			Bulb yield (t/ha)
	60 DAP	At harvest	Monocot	Dicot	Total	Monocot	Dicot	Total	
Paddy straw mulch (M)									
M ₀ : Without straw mulch	32.91	53.02	8.0 (63.16)	8.77 (75.91)	11.80 (138.2)	10.39 (106.9)	11.01 (120.2)	15.10 (227.0)	3.10
M ₁ : Paddy straw mulch 5.0 t ha ⁻¹	36.90	56.28	5.25 (26.56)	5.73 (31.83)	7.73 (58.75)	8.50 (71.25)	8.95 (79.10)	12.30 (150.2)	8.63
S. Em. ±	0.96	1.41	0.01	0.02	0.01	0.23	0.05	0.04	0.15
C. D. at 5 %	NS	NS	0.04	0.15	0.05	0.14	0.34	0.26	0.95
C. V. (%)	9.53	8.96	5.10	4.93	5.80	7.50	7.22	8.71	9.29
Weed management practices (W)									
W ₁ : Pendimethalin 1000 g ha ⁻¹ PE	37.11	56.55	5.22 (26.24)	5.80 (32.64)	7.79 (59.68)	9.05 (80.90)	9.56 (90.39)	13.12 (171.1)	9.40
W ₂ : Oxyfluorfen 223 g ha ⁻¹ PE	35.38	55.14	7.15 (50.12)	7.63 (57.21)	10.40 (107.1)	10.30 (105.0)	10.70 (113.4)	14.82 (228.6)	6.72
W ₃ : Manual weeding at 20 & 40 DAP	34.62	54.81	3.67 (12.46)	4.47 (18.98)	5.65 (30.92)	6.34 (39.19)	7.24 (51.41)	9.58 (90.77)	6.49
W ₄ : Weedy check	32.50	52.10	10.49 (109.0)	11.09 (121.9)	15.23 (230.9)	12.08 (144.9)	12.42 (153.2)	17.29 (297.9)	0.84
S. Em. ±	2.08	2.52	0.07	0.04	0.06	0.07	0.08	0.08	0.31
C. D. at 5 %	NS	NS	0.23	0.14	0.18	0.22	0.26	0.27	0.96
Interaction (M×W)	NS	NS	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.

Note: Data subjected to $\sqrt{(X+1)}$ transformation. Figures in parentheses are means of original values

Effect on Crop

Results on plant height of garlic recorded at 60 DAP and at harvest indicated non significant differences due to mulching as well as weed management practices however, numerically higher plant height was measured under treatment of paddy straw mulch applied 5 t ha⁻¹ and pendimethalin 1000 g ha⁻¹ at 60 DAP and at harvest (Table 1).

Data presented in Table 1 indicated that bulb yield of garlic was significantly increased by mulching wherein;

The dominating weeds as monocot were *Eleusine indica*, *Dactyloctenium aegyptium*, *Digitaria sanguinalis*, *Commelina benghalensis* and *Cyperus iria* while dicot were *Chenopodium album*, *Melilotus alba*, *Digera arvensis*, *Chenopodium murale*, *Boerhavia diffusa*, *Oldenlandia umbellata* and *Phyllanthus niruri* observed in the experimental fields.

Results presented in Table 1 indicated that density and weed dry weight of monocot, dicot and total weeds recorded at harvest were significantly influenced by mulching as well as weed management practices. Density and dry biomass of monocot, dicot and total weeds were recorded significantly lower under paddy straw mulch 5.0 t ha⁻¹ (M₁) spread after planting. This might be due to mulching controls the weeds by smothering seedlings, prevent day light which helps to foster the germination from reaching weed seeds and prevents airborne seeds from taking hold on the soil surface. Further, significantly the lowest density and dry weight of monocot, dicot and total weeds was recorded under manual weeding at 20 and 40 DAP (W₃). The lower density and dry weight of weeds under manual weeding might be due to removal of weeds manually at 20 and 40 DAP hence, weeds recorded significantly the lowest as compared to other treatment. Further, application of pendimethalin 1000 g ha⁻¹ proved superior over oxyfluorfen 223 g ha⁻¹ applied as pre-emergence with respect to reducing density and dry weight of weeds at harvest. These results are conformity with the finding of Hassanein *et al.* (2012)^[2] and Malik *et al.* (2017)^[5]. The highest weed density as well as weed dry biomass was observed under weedy check treatment which was mainly due to absence of weed control practices.

significantly the highest bulb yield of 8.63 t ha⁻¹ was achieved under paddy straw mulch spread at 5.0 t ha⁻¹. The increased in yield under paddy straw mulch indicated their suppressive effect on weed which provide congenial condition for better growth and uptake of nutrient which reflected in increased in bulb yield of garlic. The positive response of mulching on increased in bulb yield of garlic was also reported by Mia *et al.* (1996)^[6] and Rahman *et al.* (2005)^[9]. Among herbicidal treatment, pre-emergence application of pendimethalin 1000 g

ha⁻¹ recorded significantly the highest bulb yield of garlic (9.40 t ha⁻¹). This might be due to pendimethalin effectively reduced the density and dry weed weight of monocot, dicot and total weeds as compared to pre emergence application of oxyfluorfen 223 g ha⁻¹ which resulted in better availability of nutrient for better growth and development of plant and thereby bulb yield. Further, better management of weeds is turn to increased plant height and produced more assimilates synthesized, translocated and accumulated in plants organs which positively reflected on bulb yield.

Economics

Data summarized in Table 2 indicated that application of paddy straw mulch 5.0 t ha⁻¹ with pendimethalin 1000 g ha⁻¹ PE recorded maximum B:C ratio of 4.21 which was closely followed by application of oxyfluorfen 223 g ha⁻¹ PE with paddy straw mulch. Higher benefit: cost ratio could be achieved under said treatment may be attributed to control of germinating weeds by pre-emergence application of herbicides and lesser chance for later germination due to spreading of paddy straw mulch. Similarly, higher B:C ratio under herbicidal application was also observed by Kumar *et al.* (2013)^[4] in garlic.

Table 2: Economics of garlic as influenced by mulching and weed management practices

Treatment	Bulb yield (kg/ha)	Gross realization (₹/ha)	Total cost of cultivation (₹/ha)	Net realization (₹/ha)	B:C
M ₀ W ₁ : No mulch + Pendimethalin 1000 g ha ⁻¹ PE	7876	315040	100474	214566	3.14
M ₀ W ₂ : No mulch + Oxyfluorfen 223 g ha ⁻¹ PE	1884	75360	101230	-25870	0.74
M ₀ W ₃ : No mulch + HW at 20 and 40 DAP	7380	295200	100412	194788	2.94
M ₀ W ₄ : No mulch + Weedy check	740	29600	97836	-68236	0.30
M ₁ W ₁ : Paddy straw mulch 5.0 t ha ⁻¹ + Pendi. 1000 g ha ⁻¹ PE	11246	449840	106806	343034	4.21
M ₁ W ₂ : Paddy straw mulch 5.0 t ha ⁻¹ + Oxy. 223 g ha ⁻¹ PE	10981	439240	107563	331677	4.08
M ₁ W ₃ : Paddy straw mulch 5.0 t ha ⁻¹ + HW at 20 and 40 DAP	10645	425800	106745	319055	3.99
M ₁ W ₄ : Paddy straw mulch 5.0 t ha ⁻¹ + Weedy check	2950	118000	104169	13831	1.13

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