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Integrated Weed Management in Chilli + Garlic Intercropping System

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A B S T R A C T

Intercropping system plays an important role in increasing land use efficiency and weed suppression. A field experiment entitled "Integrated weed management in chilli + garlic intercropping system" was conducted at the Vegetable Division in Kittur Rani Channamma College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot (Karnataka) during *kharif* 2014 and 2015. The objective of the experiment was to identify the best possible method of weed control for maximizing the productivity of chilli+garlic intercropping system. Among the different chemical treatments, pre-emergent application of alachlor @ 1.5 kg ai/ha + 2 HW at 45 and 60 DAT recorded the lowest pooled dry matter of weeds (2.59 g), lowest monocot (3.57), dicot weeds (3.06) and weed population (4.7) thus exhibited the highest weed control efficiency (87.85%). The yield per ha of green chilli (256.93 q) and garlic (30.80 q), net returns (Rs.1,08,565) and B:C ratio (2.30) were found to be highest and it was followed by treatment with pre-emergent application of pendimethalin at 1.5 kg/ha +2 HW at 45 and 60 DAT.

Introduction

Intercropping is a primitive practice and it has been recognized as useful as it results in a greater crop canopy which may ensure maximum utilization of resources and in addition provides an environment unfavourable for weed growth. Intercropping of chilli with different vegetables offer greater scope to utilize the land and other resources to the maximum extent. Chilli+ garlic intercropping system is one of the most assured intercropping system and suppress the weeds to some extent and increases the yield and is found suitable to northern dry zone of Karnataka.

India has been known as the "Home of Spices" from very ancient time. Both chilli and garlic are used as spice and condiment and are widely used for seasoning and flavouring food Apart from vegetables. Garlic is closely planted between the chilli and shallow rooted bulbous crop. Therefore, intercultural practices are very difficult to undertake and manual weeding during the establishment stage of crop causes physical damage to the crop plants. A most troublesome problem faced by growers is the control of weed particularly during the early stage of crop growth and thus crop suffer heavily from weed competition. The weeds compete for the nutrients, moisture, space and

light and affect growth and development. Weed reduces the yield to the extent of 40-80 per cent and therefore, it is essential to keep the field weed free during the critical period of crop growth (Mohite *et al.*, 2015). Therefore, the aim of the study is to identify the best potential weed control treatment suitable for chilli+ garlic intercropping system.

Materials and Methods

The study was carried out at the Vegetable Division in Kittur Rani Channamma College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot (Karnataka.) during *kharif* season of 2014 and 2015 on well drained red loamy soil to find out the effectiveness of chemicals in weed management in intercropping of chilli (Var 'Byadagi') + garlic (Local Variety). The gross size and net size of the plots were 16.20 m^2 and 11.80 m^2 respectively. Four to five weeks old chilli seedlings were transplanted into main field with a spacing of 75cm × 45 cm and in between the chilli, 2 rows of garlic was planted.

The field experiment was laid out in Randomized Complete Block Design (RCBD) with two replications consisting of 14 treatments including unweeded check (T_1 - Alachlor (PE)-1.5 kg ai/haT_2 - Alachlor (PE)-1.0 kg ai/haT_3 - Alachlor (PE)-1.5 kg ai/ha + 1 HW at 45 DATT_4 - Alachlor (PE)-1.5 kg ai/ha + 2 HW at 45 and 60 DATT_5 - Alachlor (PE)-1.0 kg ai/ha + 1 HW at 45 DATT_6 - Alachlor (PE)-1.0 kg ai/ha + 2 HW at 45 and 60 DATT_7 -Pendimethalin (PE)-1.5 kg ai/haT_8-Pendimethalin (PE)-1.0 kg ai/haT_9 - Pendimethalin (PE)-1.5 kg ai/ha+ 1 HW at 45 DATT_{10} - Pendimethalin (PE)-1.5 kg ai/ha + 2 HW at 45 and 60 DATT_{11} - Pendimethalin (PE)-1.0 kg ai/ha + 1 HW at 45 DATT_{12} - Pendimethalin (PE)-1.0 kg ai/ha + 2 HW at 45 and 60 DATT_{13} - Weed free checkT_{14} - Unweeded check).RDF for chilli, 150:100:125 kg of N: P_2O_5: K_2O with 25 tonnes of FYM (as per package of practice – UHS, Bagalkot) was applied at the time of field preparation. Remaining dose of N (50 %) was applied at 3 split doses *viz.*, after 30, 60 and 90 days of transplanting. During the course of investigation, observations regarding weed population, crop growth parameters and yield parameters at 30, 60, 90 DAT and at the time of harvest were recorded from the randomly selected and tagged plants. The weed index was calculated by the formula given by Gill and Vijayakumar (1969). Besides fixed cost of cultivation, variable costs on spray, manual weeding and cost of herbicide in each treatment was worked out to obtain total cost of production. The net income was obtained after deducting cost of production from value of produces. The mean data was subjected to the statistical analysis using ANOVA and mean separation (LSD) procedures (Gomez and Gomez, 1984).

Results and Discussion

The results of the study showed that among different chemical treatments, the effect of weed control on monocot weeds(3.57), dicot weeds (3.06) and weed population at harvest (4.70) was found to be significantly less in treatment T_4(Alachlor (PE)-1.5 kg ai/ha + 2HW at 45 and 60 DAT). But it was found to be on par with T_{10} (Pendimethalin (PE)-1.5 kg ai/ha + 2HW at 45 and 60 DAT) (Table 1). The treatment T_4 recorded lowest dry weight of weeds at harvest (2.59 g), lowest weed index in chilli and garlic (16.25 and 2.08, respectively) and thus highest weed control efficiency (87.85%) (Table -2). The lower dry weight of weeds in these treatments might be attributed to the less number of weeds. Thus the higher weed control efficiency could be accounted to the lower weed dry weight. These results are of agreement with Ningappa (2013), Shil and Adhikary (2014) and Chaudhari *et al.*, (2017).

Table.1 Effect of weed control treatments on weed parameters in chilli + garlic intercropping

Treatments	Treatment details	Monocot weeds at harvest			Dicot weeds at harvest			Weed population at harvest		
		I year	II year	Pooled	I year	II year	Pooled	I year	II year	Pooled
T_1	Alachlor (PE)-1.5 kg ai/ha	53.80 (7.33)	57.67 (7.59)	55.74 (7.47)	27.89 (5.28)	27.29 (5.22)	27.59 (5.25)	81.69 (9.04)	84.96 (9.22)	83.32 (9.13)
T_2	Alachlor (PE)-1.0 kg ai/ha	62.90 (7.93)	64.50 (8.03)	63.70 (7.98)	36.68 (6.06)	36.29 (6.02)	36.48 (6.04)	99.58 (9.98)	100.79 (10.04)	100.18 (10.01)
T_3	Alachlor (PE)-1.5 kg ai/ha + 1 HW at 45 DAT	37.10 (6.09)	37.16 (6.09)	37.13 (6.09)	17.44 (4.17)	16.19 (4.02)	16.81 (4.10)	54.54 (7.38)	53.34 (7.30)	53.94 (7.34)
T_4	Alachlor (PE)-1.5 kg ai/ha + 2 HW at 45 and 60 DAT	12.43 (3.52)	13.15 (3.62)	12.79 (3.57)	9.87 (3.14)	8.84 (2.97)	9.35 (3.06)	22.30 (4.72)	21.99 (4.69)	22.14 (4.70)
T_5	Alachlor (PE)-1.0 kg ai/ha + 1 HW at 45 DAT	42.00 (6.48)	42.36 (6.51)	42.18 (6.49)	18.92 (4.35)	18.39 (4.28)	18.65 (4.32)	60.92 (7.80)	60.74 (7.79)	60.83 (7.80)
T_6	Alachlor (PE)-1.0 kg ai/ha + 2 HW at 45 and 60 DAT	28.63 (5.35)	30.16 (5.49)	29.40 (5.42)	11.43 (3.38)	11.84 (3.44)	11.63 (3.41)	38.97 (6.24)	40.25 (6.34)	39.61 (6.29)
T_7	Pendimethalin (PE)-1.5 kg ai/ha	60.60 (7.78)	62.18 (7.88)	61.39 (7.83)	33.68 (5.80)	32.39 (5.69)	33.03 (5.75)	94.28 (9.71)	94.57 (9.72)	94.42 (9.72)
T_8	Pendimethalin (PE)-1.0 kg ai/ha	66.80 (8.17)	70.28 (8.38)	68.54 (8.28)	40.22 (6.34)	36.79 (6.06)	38.50 (6.20)	107.02 (10.34)	107.06 (10.35)	107.04 (10.34)
T_9	Pendimethalin (PE)-1.5 kg ai/ha+ 1 HW at 45 DAT	45.03 (6.71)	45.10 (6.71)	45.06 (6.71)	21.43 (4.62)	20.29 (4.50)	20.86 (4.57)	66.46 (8.15)	65.38 (8.09)	65.92 (8.12)
T_{10}	Pendimethalin (PE)-1.5 kg ai/ha + 2 HW at 45 and 60 DAT	14.45 (3.80)	17.09 (4.12)	15.77 (3.97)	10.34 (3.21)	10.09 (3.17)	10.21 (3.20)	25.88 (5.09)	28.92 (5.38)	27.40 (5.23)
T_{11}	Pendimethalin (PE)-1.0 kg ai/ha + 1 HW at 45 DAT	53.23 (7.30)	54.08 (7.35)	53.66 (7.32)	25.52 (5.05)	23.39 (4.83)	24.45 (4.94)	78.75 (8.87)	77.47 (8.80)	78.11 (8.84)
T_{12}	Pendimethalin (PE)-1.0 kg ai/ha + 2 HW at 45 and 60 DAT	31.10 (5.58)	31.60 (5.62)	31.35 (5.60)	11.99 (3.46)	14.89 (3.85)	13.44 (3.66)	43.09 (6.56)	46.49 (6.82)	44.79 (6.69)
T_{13}	Weed free check	0.00 (0.71)	00.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
T_{14}	Unweeded check	105.48 (10.27)	112.54 (10.61)	109.01 (10.44)	65.44 (8.09)	64.39 (8.02)	64.91 (8.06)	170.92 (13.07)	176.92 (13.30)	173.92 (13.19)
Mean		**43.86 (6.22)**	**45.60 (6.34)**	**44.73 (6.28)**	**23.67 (4.55)**	**22.96 (4.48)**	**23.32 (4.52)**	**67.46 (7.64)**	**68.56 (7.77)**	**67.97 (7.67)**
S. Em±		**0.08**	**0.15**	**0.09**	**0.12**	**0.15**	**0.08**	**0.10**	**0.07**	**0.07**
C. D. @ 5%		**0.25**	**0.46**	**0.27**	**0.37**	**0.45**	**0.25**	**0.23**	**0.21**	**0.21**

Table.2 Effect of weed control treatments on weed parameters in chilli + garlic intercropping

Treaments	Treatment details	Dry weight of weeds at harvest (g)			Weed control efficiency at harvest			Weed index in chilli			Weed index in garlic		
		I year	II year	Pooled	I year	II year	Pooled	I year	II year	Pooled	I year	II year	Pooled
T_1	Alachlor (PE)-1.5 kg ai/ha	31.69 (5.63)	35.95 (5.99)	33.82 (5.81)	42.36	35.19	38.77	20.89	24.55	22.62	24.29	31.11	27.70
T_2	Alachlor (PE)-1.0 kg ai/ha	34.27 (5.85)	45.58 (6.74)	39.93 (6.32)	37.72	17.86	27.79	24.25	26.47	25.20	32.09	37.74	34.91
T_3	Alachlor (PE)-1.5 kg ai/ha + 1 HW at 45 DAT	22.76 (4.77)	15.11 (3.88)	18.93 (4.35)	58.60	72.84	65.72	17.62	23.66	20.86	10.66	17.88	14.27
T_4	Alachlor (PE)-1.5 kg ai/ha + 2 HW at 45 and 60 DAT	3.48 (1.86)	10.01 (3.16)	6.74 (2.59)	93.70	82.00	87.85	15.00	16.78	16.25	2.06	2.10	2.08
T_5	Alachlor (PE)-1.0 kg ai/ha + 1 HW at 45 DAT	24.89 (4.99)	19.90 (4.45)	22.39 (4.73)	54.72	64.21	59.46	18.95	24.27	21.25	12.30	19.03	15.66
T_6	Alachlor (PE)-1.0 kg ai/ha + 2 HW at 45 and 60 DAT	11.26 (3.35)	12.57 (3.53)	11.91 (3.45)	79.59	77.41	78.50	16.90	21.08	18.28	5.55	12.07	8.81
T_7	Pendimethalin (PE)-1.5 kg ai/ha	33.98 (5.83)	40.55 (6.36)	37.26 (6.10)	38.19	26.88	32.54	22.81	25.47	23.11	28.29	34.90	31.59
T_8	Pendimethalin (PE)-1.0 kg ai/ha	37.09 (6.09)	49.74 (7.05)	43.41 (6.59)	32.61	10.32	21.47	26.91	32.03	29.35	36.09	41.88	38.99
T_9	Pendimethalin (PE)-1.5 kg ai/ha+ 1 HW at 45 DAT	28.33 (5.32)	26.16 (5.11)	27.24 (5.22)	48.46	52.88	50.67	19.62	22.53	22.12	17.93	24.79	21.36
T_{10}	Pendimethalin (PE)-1.5 kg ai/ha + 2 HW at 45 and 60 DAT	4.15 (2.03)	11.47 (3.38)	7.81 (2.79)	92.47	79.33	85.90	15.30	17.58	17.12	4.01	10.46	7.24
T_{11}	Pendimethalin (PE)-1.0 kg ai/ha + 1 HW at 45 DAT	28.56 (5.34)	31.12 (5.57)	29.84 (5.46)	48.10	43.99	46.05	19.84	26.54	22.15	20.49	27.53	24.01
T_{12}	Pendimethalin (PE)-1.0 kg ai/ha + 2 HW at 45 and 60 DAT	14.03 (3.74)	13.90 (3.71)	13.96 (3.73)	74.48	75.04	74.76	17.53	21.22	20.17	8.62	16.18	12.40
T_{13}	Weed free check	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	100.00	100.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
T_{14}	Unweeded check	55.02 (7.42)	55.39 (7.44)	55.21 (7.43)	0.00	0.00	0.00	67.28	63.62	65.97	53.16	60.10	56.63
Mean		**23.57 (4.50)**	**26.28 (4.79)**	**24.92 (4.66)**	**57.22**	**52.71**	**54.96**	**21.99**	**25.17**	**23.55**	**18.25**	**23.98**	**21.12**
S. Em±		**0.11**	**0.10**	**0.07**	**1.73**	**1.49**	**1.21**	**3.53**	**3.24**	**2.67**	**3.82**	**3.64**	**3.39**
C. D. @ 5%		**0.32**	**0.29**	**0.21**	**5.29**	**4.55**	**3.70**	**10.76**	**9.91**	**7.77**	**11.65**	**11.12**	**10.34**

Table.3 Effect of weed control treatments on growth and yield parameters in chilli

Treatments	Treatment details	Plant height at harvest (cm)			No. of branches per plant at harvest			Dry weight of plant at harvest (g)			No. of fruits per plant		
		I year	II year	Pooled	I year	II year	Pooled	I year	II year	Pooled	I year	II year	Pooled
T_1	Alachlor (PE)-1.5 kg ai/ha	73.00	72.00	72.50	11.46	12.55	12.00	73.94	76.71	75.32	84.74	85.99	85.36
T_2	Alachlor (PE)-1.0 kg ai/ha	69.00	67.50	68.25	9.71	10.80	10.25	70.49	73.26	71.87	80.62	82.00	81.31
T_3	Alachlor (PE)-1.5 kg ai/ha + 1 HW at 45 DAT	89.00	90.00	89.50	17.96	19.05	18.50	88.39	91.32	89.85	94.45	95.85	95.15
T_4	Alachlor (PE)-1.5 kg ai/ha + 2 HW at 45 and 60 DAT	99.00	100.00	99.50	23.74	25.14	24.44	104.83	107.65	106.24	118.67	120.01	119.34
T_5	Alachlor (PE)-1.0 kg ai/ha + 1 HW at 45 DAT	82.00	82.50	82.25	15.15	16.20	15.67	84.61	87.64	86.12	92.40	93.94	93.17
T_6	Alachlor (PE)-1.0 kg ai/ha + 2 HW at 45 and 60 DAT	95.00	96.00	95.50	19.34	20.44	19.89	97.07	99.84	98.45	102.33	104.00	103.16
T_7	Pendimethalin (PE)-1.5 kg ai/ha	71.00	69.50	70.25	10.46	11.66	11.06	73.47	76.47	74.97	83.31	84.67	83.99
T_8	Pendimethalin (PE)-1.0 kg ai/ha	64.00	62.50	63.25	8.36	9.56	8.96	64.47	67.47	65.97	78.62	79.95	79.28
T_9	Pendimethalin (PE)-1.5 kg ai/ha+ 1 HW at 45 DAT	79.00	78.00	78.50	14.18	15.28	14.73	82.35	85.35	83.85	89.83	90.84	90.33
T_{10}	Pendimethalin (PE)-1.5 kg ai/ha + 2 HW at 45 and 60 DAT	97.00	98.00	97.50	20.82	21.87	21.34	100.50	103.12	101.81	103.52	104.81	104.16
T_{11}	Pendimethalin (PE)-1.0 kg ai/ha + 1 HW at 45 DAT	74.00	73.00	73.50	12.62	13.82	13.22	80.37	83.37	81.87	88.94	90.46	89.70
T_{12}	Pendimethalin (PE)-1.0 kg ai/ha + 2 HW at 45 and 60 DAT	93.00	93.50	93.25	18.57	19.72	19.15	94.78	97.56	96.17	99.56	101.45	100.50
T_{13}	Weed free check	100.00	101.00	100.50	26.17	27.52	26.84	110.99	114.04	112.52	124.19	125.43	124.81
T_{14}	Unweeded check	62.00	60.50	61.25	8.04	9.09	8.57	40.71	41.86	41.28	48.24	49.73	48.98
Mean		**81.93**	**81.71**	**81.82**	**15.47**	**16.62**	**16.04**	**83.35**	**86.12**	**84.73**	**92.10**	**93.51**	**92.80**
S. Em±		**4.20**	**4.05**	**4.12**	**0.81**	**1.44**	**1.02**	**3.05**	**5.79**	**4.29**	**3.34**	**5.71**	**4.31**
C. D. @ 5%		**12.82**	**12.37**	**12.59**	**2.46**	**4.41**	**3.13**	**9.30**	**17.70**	**13.11**	**10.21**	**17.44**	**13.18**

Table.4 Effect of weed control treatments on yield and yield attributes in chilli

Treatments	Treatment details	Fruit weight per plant (kg)			Yield per plot (kg)			Yield per ha (q)		
		I year	II year	Pooled	I year	II year	Pooled	I year	II year	Pooled
T_1	Alachlor (PE)-1.5 kg ai/ha	0.94	0.98	0.96	35.80	37.32	36.56	220.32	230.39	225.70
T_2	Alachlor (PE)-1.0 kg ai/ha	0.92	0.96	0.94	34.88	36.40	35.64	214.64	224.68	219.99
T_3	Alachlor (PE)-1.5 kg ai/ha + 1 HW at 45 DAT	0.99	1.03	1.01	37.48	39.00	38.24	230.65	240.74	236.05
T_4	Alachlor (PE)-1.5 kg ai/ha + 2 HW at 45 and 60 DAT	1.08	1.12	1.10	40.86	42.38	41.62	251.46	261.62	256.93
T_5	Alachlor (PE)-1.0 kg ai/ha + 1 HW at 45 DAT	0.98	1.02	1.00	37.32	38.84	38.08	229.67	239.76	235.07
T_6	Alachlor (PE)-1.0 kg ai/ha + 2 HW at 45 and 60 DAT	1.01	1.05	1.03	38.41	39.93	39.17	236.37	246.48	241.79
T_7	Pendimethalin (PE)-1.5 kg ai/ha	0.93	0.97	0.95	35.35	36.87	36.11	217.56	227.61	222.92
T_8	Pendimethalin (PE)-1.0 kg ai/ha	0.90	0.94	0.92	34.20	35.72	34.96	210.46	220.49	215.80
T_9	Pendimethalin (PE)-1.5 kg ai/ha+ 1 HW at 45 DAT	0.97	1.01	0.99	36.79	38.31	37.55	226.39	236.47	231.78
T_{10}	Pendimethalin (PE)-1.5 kg ai/ha + 2 HW at 45 and 60 DAT	1.03	1.07	1.05	39.16	40.68	39.92	240.96	251.08	246.39
T_{11}	Pendimethalin (PE)-1.0 kg ai/ha + 1 HW at 45 DAT	0.95	0.99	0.97	36.23	37.75	36.99	222.94	233.01	228.32
T_{12}	Pendimethalin (PE)-1.0 kg ai/ha + 2 HW at 45 and 60 DAT	1.00	1.04	1.02	37.87	39.39	38.63	233.04	243.14	238.45
T_{13}	Weed free check	1.11	1.16	1.14	42.21	44.11	43.16	259.75	272.28	266.42
T_{14}	Unweeded check	0.41	0.43	0.45	15.39	16.15	16.91	94.71	99.69	104.38
Mean		**0.94**	**0.98**	**0.97**	**35.89**	**37.35**	**36.68**	**220.64**	**230.53**	**226.43**
S. Em±		**0.95**	0.04	**0.04**	**1.32**	1.66	**1.36**	**8.15**	**10.23**	**8.38**
C. D. @ 5%		**2.81**	0.29	**0.15**	**3.64**	4.96	**4.78**	**24.77**	31.25	**25.85**

Table.5 Effect of weed control treatments on growth parameters in garlic

Treatments	Treatment details	Plant height at 90 DAT (cm)			No. of leaves per plant at 90 DAT		
		I year	II year	Pooled	I year	II year	Pooled
T_1	Alachlor (PE)-1.5 kg ai/ha	32.15	32.35	32.25	9.10	9.30	9.20
T_2	Alachlor (PE)-1.0 kg ai/ha	30.00	29.85	29.93	8.45	8.65	8.55
T_3	Alachlor (PE)-1.5 kg ai/ha + 1 HW at 45 DAT	37.00	36.95	36.98	10.35	10.55	10.45
T_4	Alachlor (PE)-1.5 kg ai/ha + 2 HW at 45 and 60 DAT	42.40	41.55	41.98	12.00	12.20	12.10
T_5	Alachlor (PE)-1.0 kg ai/ha + 1 HW at 45 DAT	36.65	35.85	36.25	10.05	10.35	10.20
T_6	Alachlor (PE)-1.0 kg ai/ha + 2 HW at 45 and 60 DAT	39.75	39.50	39.63	11.45	11.15	11.05
T_7	Pendimethalin (PE)-1.5 kg ai/ha	31.05	31.00	31.03	8.80	9.00	8.90
T_8	Pendimethalin (PE)-1.0 kg ai/ha	28.25	28.50	28.38	8.05	8.25	8.15
T_9	Pendimethalin (PE)-1.5 kg ai/ha+ 1 HW at 45 DAT	35.25	35.45	35.35	9.70	9.90	9.80
T_{10}	Pendimethalin (PE)-1.5 kg ai/ha + 2 HW at 45 and 60 DAT	41.65	40.75	41.20	11.25	12.00	11.85
T_{11}	Pendimethalin (PE)-1.0 kg ai/ha + 1 HW at 45 DAT	35.00	34.30	34.65	9.40	9.60	9.50
T_{12}	Pendimethalin (PE)-1.0 kg ai/ha + 2 HW at 45 and 60 DAT	37.70	38.50	38.10	10.60	10.80	10.70
T_{13}	Weed free check	43.00	44.50	44.25	12.40	12.70	12.60
T_{14}	Unweeded check	19.00	18.50	18.75	7.00	6.70	7.10
Mean		**34.92**	**34.83**	**34.91**	**9.90**	**10.08**	**10.01**
S. Em±		**1.28**	**1.25**	**1.28**	**0.36**	**0.38**	**0.36**
C. D. @ 5%		**3.92**	**3.81**	**3.92**	**1.11**	**1.15**	**1.10**

Table.6 Effect of weed control treatments on yield and yield attributes in garlic

Treatments	Treatment details	Dry weight of plant at 90 DAT (g)			Yield per plant (g)			Yield per plot (kg)			Yield per ha (q)		
		I year	II year	Pooled	I year	II year	Pooled	I year	II year	Pooled	I year	II year	Pooled
T_1	Alachlor (PE)-1.5 kg ai/ha	5.22	4.37	4.79	8.84	8.94	8.95	3.69	3.67	3.68	23.00	22.00	22.50
T_2	Alachlor (PE)-1.0 kg ai/ha	4.32	3.21	3.77	8.47	8.80	8.64	3.31	3.32	3.31	20.40	20.45	20.65
T_3	Alachlor (PE)-1.5 kg ai/ha + 1 HW at 45 DAT	5.62	4.72	5.17	9.06	9.19	9.11	4.36	4.38	4.37	27.00	27.50	27.25
T_4	Alachlor (PE)-1.5 kg ai/ha + 2 HW at 45 and 60 DAT	6.07	5.34	5.71	9.47	9.89	9.59	4.78	5.28	5.03	29.50	34.05	31.80
T_5	Alachlor (PE)-1.0 kg ai/ha + 1 HW at 45 DAT	5.53	4.67	5.10	9.00	9.15	9.08	4.28	4.32	4.30	26.50	27.00	26.75
T_6	Alachlor (PE)-1.0 kg ai/ha + 2 HW at 45 and 60 DAT	5.85	5.16	5.50	9.23	9.44	9.23	4.61	4.71	4.66	28.45	29.00	28.70
T_7	Pendimethalin (PE)-1.5 kg ai/ha	4.96	3.31	4.13	8.60	8.82	8.89	3.50	3.46	3.48	21.90	22.40	22.15
T_8	Pendimethalin (PE)-1.0 kg ai/ha	4.22	3.10	3.66	8.18	8.15	8.16	3.12	3.10	3.11	19.10	19.05	19.05
T_9	Pendimethalin (PE)-1.5 kg ai/ha+ 1 HW at 45 DAT	5.41	4.56	4.98	8.97	9.07	9.02	4.00	4.01	4.00	24.80	25.40	25.10
T_{10}	Pendimethalin (PE)-1.5 kg ai/ha + 2 HW at 45 and 60 DAT	5.96	5.30	5.63	9.29	9.47	9.45	4.68	4.79	4.74	28.90	31.00	29.95
T_{11}	Pendimethalin (PE)-1.0 kg ai/ha + 1 HW at 45 DAT	5.32	4.46	4.89	8.95	9.05	9.00	3.88	3.86	3.87	24.00	24.50	24.25
T_{12}	Pendimethalin (PE)-1.0 kg ai/ha + 2 HW at 45 and 60 DAT	5.70	4.79	5.24	9.21	9.29	9.15	4.46	4.48	4.47	27.60	28.30	27.95
T_{13}	Weed free check	7.00	5.70	6.54	11.18	11.99	11.59	4.88	5.39	5.13	30.10	37.00	33.65
T_{14}	Unweeded check	2.85	2.93	2.89	3.66	4.36	3.88	2.28	2.09	2.19	14.11	14.10	14.09
Mean		**5.29**	**4.40**	**4.86**	**8.72**	**8.97**	**8.84**	**3.98**	**4.06**	**4.02**	**24.67**	**25.84**	**25.28**
S. Em±		**0.41**	**0.43**	**0.21**	**0.40**	**0.39**	**0.34**	**0.19**	**0.26**	**0.21**	**1.16**	**2.45**	**1.70**
C. D. @ 5%		**1.25**	**1.32**	**0.64**	**1.29**	**1.67**	**1.40**	**0.58**	**0.81**	**0.65**	**4.94**	**7.43**	**5.22**

Table.7 Effect of weed control treatments on economics in chilli +garlic intercropping

Treatments	Treatment details	Gross returns (Rs)	Cost of cultivation (Rs)	Net returns (Rs)	B:C ratio
T_1	Alachlor (PE)-1.5 kg ai/ha	1,57,850	79,500	78,350	1.98
T_2	Alachlor (PE)-1.0 kg ai/ha	1,51,295	79,200	72,095	1.91
T_3	Alachlor (PE)-1.5 kg ai/ha + 1 HW at 45 DAT	1,72,525	81,500	91,025	2.11
T_4	Alachlor (PE)-1.5 kg ai/ha + 2 HW at 45 and 60 DAT	1,92,065	83,500	1,08,565	2.30
T_5	Alachlor (PE)-1.0 kg ai/ha + 1 HW at 45 DAT	1,71,035	81,200	89,835	2.10
T_6	Alachlor (PE)-1.0 kg ai/ha + 2 HW at 45 and 60 DAT	1,78,295	83,200	95,095	2.14
T_7	Pendimethalin (PE)-1.5 kg ai/ha	1,55,760	79,276	76,484	1.96
T_8	Pendimethalin (PE)-1.0 kg ai/ha	1,46,000	79,050	66,950	1.84
T_9	Pendimethalin (PE)-1.5 kg ai/ha+ 1 HW at 45 DAT	1,66,090	81,275	84,815	2.04
T_{10}	Pendimethalin (PE)-1.5 kg ai/ha + 2 HW at 45 and 60 DAT	1,83,095	83,275	99,820	2.19
T_{11}	Pendimethalin (PE)-1.0 kg ai/ha + 1 HW at 45 DAT	1,62,660	81,050	81,610	2.00
T_{12}	Pendimethalin (PE)-1.0 kg ai/ha + 2 HW at 45 and 60 DAT	1,75,125	83,050	92,075	2.10
T_{13}	Weed free check	2,00,510	92,600	1,07,910	2.16
T_{14}	Unweeded check	80,370	78,600	1,770	1.02
Mean		-	-	-	-
S. Em±		-	-	-	-
C. D. @ 5%		-	-	-	-

Treatment T_4 was found significant for highest plant height (99.50cm), number of branches/ plant (24.44), dry weight of plant (106.24 g) and number of fruits/plant (119.34) in chilli (Table 3). The results showed that highest fruit weight /plant (1.10kg) was recorded in T_4 followed by T_{10} (1.05kg) and minimum was recorded from the unweeded check, T_{14} (0.45 kg). Reduced yield from the unweeded plot may be attributed to increased competition for light, soil moisture and nutrients. Rajkumara(2009) found similar results on fruit weight of chilli against different control measures. Fruit yield per plot (41.62 kg) and yield per ha (256.93 q) of green chilli was found highest in T_4 while lowest was found in T_{14} (16.91kg and 104.38 q, respectively) (Table - 4). Ningappa (2013) and Shil and Adhikary (2014) also reported similar findings in chilli.

Yield and yield components of garlic varied significantly among various weed control treatments. Treatment T_4 was recorded significantly higher plant height (41.98 cm) and number of leaves/plant at harvest (12.10) in garlic (Table- 5). Weed free check recorded significantly highest dry weight of plant (6.54g), yield per plant (11.59 g), yield per plot (5.13 kg) and yield per ha (33.65 q). Among the chemical treatments, T_4 recorded highest dry weight of plant (5.71 g), yield per plant (9.59 g), yield per plot (5.03 kg) and yield per ha (31.80q)followed by T_{10} (Table - 6). The increase in plant dry matter and yield per plant in these treatments could be attributed to lower weed count and higher weed control efficiency which ultimately resulted in better crop growth leading to higher productivity. The similar results were quoted by Singh *et al.,* (2002), Mohammad and Imran (2003) and Siddu *et al.,* (2018) in garlic.

The economics of chilli +garlic intercropping indicated that weed free check recorded highest gross returns (Rs.2,00,510) followed by T_4 (Rs.1,92,065). Cost of cultivation was highest in weed free check (Rs.92,600) followed by T_4 (Rs.83,500). The higher cost of cultivation is due to increased labour charges incurred during hand weeding. Highest net returns (Rs.1,08,565) and benefit: cost ratio (B:C ratio) (2.30) was achieved by T_4followed by T_{10} (Table 7). The higher B:C ratio in T_4 is due to higher net returns and lower cost of cultivation in comparison with weed free check. These results are in line with the findings reported by Biradar (1999) and Singh *et al.,* (2011).

In conclusion, pre-emergent application of alachlor @ 1.5 kg ai/ha + 2 HW at 45 and 60 DAT recorded the lowest pooled dry matter of weeds, population of monocot and dicot weeds and thus exhibited the highest weed control efficiency, highest yield per ha, net returns and B:C ratio in chilli + garlic intercropping system. Thus it can be recommended as the best weed control treatment for chilli + garlic intercropping system.

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