International J. Seed Spices 5(1), January 2015:41-48

Critical stages of plant weed competition affecting plant growth and yield in ajwain (*Trachyspermum ammi* Sprague)

A. K. Yogi[1], B. Singh[2], R. Singh[2]

[1]Dept. of Horticulture Mahatma Jyoti Rao Phoole University, Jaipur-303 002,Rajasthan

[2]ICAR-National Research Centre on Seed Spices, Ajmer-305 206, Rajasthan

Abstract

The research on ajwain crop is very meagre, it is severely affected by various biotic and abiotic factors which affects the yield potential significantly. Plant weed competition is one of the major factors, besides insect pest and diseases causing significant yield and quality losses. Ajwain being a rabi crop faces severe competition with the weeds like *Chenopodium album, Coronopus didymus, Melilotus spp., Rumex spp., Cyperus rotundus* etc. To enhance the yield potential it is must to have an efficient cost-effective weed management modules.Best growth parameters were observed in weed free condition through out growth period treatment. Maximum (98.91%) loss in yield was recorded with the treatment, weedy throughout under growth period (T_9). Weed count and weed biomass was recorded maximum in T_9'whereas minimum in T_{18}. Critical period for weed competition in ajwain was found to be 63 days after sowing. Weedy period up to 75 DAS gave tough competition to the crop for growth which was reflected in yield attributes and seed yield of ajwain. The maximum yield of 638.15kg/ha was obtained with the treatment weed free throughout growth period, this was also found economically viable which resulted in highest gross return of Rs 99987/ha, net returns Rs 66315/ha and B: C ratio of 1.97. The Benefit: Cost ratio of 0.31 and 1.31 was observed for weed free condition up to 90 DAS (T_{15}) and 120 DAS (T_{17}) respectively.

Key words: Ajwain, critical period, growth parameters, economics, weed, weed management, yield

Introduction

Ajwain (*Trachyspermum ammi* Sprague) is a medicinal spice herb native to India. Ajwain belongs to family Apiaceae having diploid chromosomes (2n=18). The most common Indian name is 'ajwain' and other popular regional names are 'owa' and 'omum'. It is commonly used as spice and is an active ingredient in numerous ayurvedic medicines. The plant parts usually consumed are herbs, volatile oil and seeds. Basically seed possess high medicinal value especially for curing indigestion, stomach pain, cholera, diarrhea, gastric and urine trouble (Shahin *et al.* 10). Ajwain powder is also used with warm water in diseases related with respiration.The major ajwain producing countries are India, Persia, Iran, Egypt, Afghanistan, Pakistan and some countries of North Africa. In India, the state of Rajasthan contributes nearly 73 per cent of total production (Anwer *et al.* 1). In Rajasthan, Chittorgarh, Udaipur, Pratapgarh, Jhalawar, Rajsamand, Kota and Bhilwara are important districts growing ajwain. During 2013-14, 26610 tons of ajwain seed was produced from 39660 hectare area. The present productivity of ajwain is 659 kg/ha (NHB, 7). Initially, all seed spices are slow growing in nature and take 10-15 days for germination, hence they are more prone to severe competition with the weeds for nutrients, light, water and space resulting heavy reduction in yield. Weeds also caused several adversities like harboring of insect pests and diseases, difficulties in harvesting and threshing, deteriorate the quality of produce. Ajwain being a long duration crop (180-210 days) and having slow initial growth which takes more time to cover the field leaving minimum space between two adjacent rows. These factors provide conducive condition for higher growth of weeds which results in substantial reduction of crop growth and yield. Therefore, it is necessary to identify the critical stages of weed control in ajwain to develop effective and economical weed control practices. A total of 2-3 manual weeding and hoeing are required, the first weeding should be done after 30 DAS. The subsequent weeding is done after every 30 days intervals as per requirement. Weeds can also be controlled by a pre-emergence application of Oxadiargyl @0.075 kg/ha or Pendimethalin @ 1kg/ha and Oxadiargyl @.075 kg/ha just after sowing + one hand weeding at 45 DAS (Meena *et al.* 5). Care must be taken that there is sufficient moisture in the soil at the time of application of herbicides to enhance effectiveness of the chemical control. Keeping in view the above facts,

*Corresponding author e-mail: ashayogi58@gmail.com

present investigation was carried out to study the crop-weed competition in depth to know the time and extent of weed competition.

Materials and methods

A field experiment was carried out during the Rabi season of 2013-2014 at ICAR- National Research Centre on Seed Spices, Ajmer, Rajasthan. The region falls under agro climatic zone III of Rajasthan. The average annual rainfall is 590 mm, mostly received from south-west monsoon during the last week of June to October. Maximum temperature ranged between 21.71 °C to 33.81°C while minimum temperature ranged between 2.43°C to 18.83°C during growing season. The soil was sandy loam in texture, pH 8 to 8.3 and EC 0.07 to 0.12 ds/m, organic carbon 0.15 to 0.23%, available N 178.5 kg ha^{-1} (low), P_2O_5 12 kg ha^{-1} (medium), K_2O 85 kg ha^{-1} (low), Ca 214.7 kg ha^{-1} (high), Mg 258 kg ha^{-1} (medium) and S 27 kg ha^{-1} (high). The ajwain cultivar Ajmer Ajwain-1 was sown directly on 17 October, 2013 at 30 cm row to row spacing. After sowing selected experimental land was brought to fine tilth by one deep ploughing, three harrowing and levelling. The weed population was removed manually after every 15 days for ensuring complete weed free conditions. In the weedy plots weeds were manually removed in accordance to the schedule of treatment. In weedy check weeds were allowed to grow throughout crop growth period. After uprooting of weeds the weeds were sun dried completely till reached to constant weight and finally the dry weight (g/0.25 m^2) was recorded for each treatment. Monocot, dicot and sedge weed population at one representative site from each plot were taken at 15, 30, 45, 60, 75, 90, 105, 120 days and at harvesting stage using 0.25m^2 quadrate and then converted into number of weeds/m^2. The weed flora emerged during the experimentation were *Cynodondactylon* L, *Digitaria sanguinalis* L, sedges like *Cyprus rotundus* L. and broad leaved weeds like *Chenopodium album* L.; *Melilotus alba* L. and *Anagali sarvensis*. The experiment was laid out in Randomized Block Design (RBD) with three replications and 18 treatments (Weedy and weed free condition).

Results and discussion

Growth parameters

It was evident from the data presented in Table 1 that severe infestation of weed in the plot maintained weedy up to 75 DAS or onwards up to maturity adversely affected the growth and growth attributing characters of ajwain namely plant height, number of primary branch, number of secondary branch and crop plant dry matter accumulation. Keeping the crop free from weeds up to 90 DAS or weedy up to 15 DAS and there after removal of weeds gave more plant height, number of primary and secondary branches and crop dry matter accumulation then weed free up to 75 DAS or weedy up to 60 DAS. The maximum crop dry matter accumulation of 4.68g and 41.67g/plant at 60 and 90DAS were recorded with the treatment weed free throughout growth period. Higher number (9.57 and 13.87) of primary branches/plant were observed in treatment weed free throughout period (T_{18}). The maximum values of all these growth parameters under these treatments might be due to better control of weeds throughout the crop growth period which might have better availability of moisture and nutrients to the crop resulting more favourable condition for crop. Consequently crop attained mate growth having smothering effect on weed. The lowest value of growth attributes under weedy throughout growth period might be due to severe competition by weed for resources which made the crop plant inefficient to take up moisture and nutrients, consequently plant height, dry matter accumulation were adversely affected.These observations are quite close to the results of other workers (Ghahari *et al.* (3) in fenugreek, Patel *et al.* (9), Meena and Mehta (4) in coriander).

Yield and yield attributes

The weed competition adversely affected the yield attributing characters of the ajwain. Data presented in Table 1 showed that maximum number of umbel/plant (244.0), number of umbellate/umbel (14.67), seed yield (638.15 kg/h) and straw yield (2136.24 kg/h) respectively were recorded at weed free throughout growth period. Weed is an important factor lowering yield of ajwain, which is responsible for reducing crop growth by two mechanisms. First by giving competition for resources such as space, light, water, nutrients etc. The second is allellopathy, which involves releasing of toxin into the environment (Bansal *et al.* 2). Similar results also reported by Meena and Mehta, (4).

Weed population/weed count

Effect of weed competition based on number of weed per 0.25 m^2 area at various growth periods was also recorded. Perusal of data in Table 2 indicated that weed count area at various growth stage was lowest in T_{18} throughout growth period. Whereas, maximum (303.6 after15 DAS) number of weed population was observed in T_7. At all the growth stages the weed count was zero in the treatment T_{18} (weed free throughout growth period) due to the removal of weeds, whenever appeared in the plots. These findings are in close agreement to Meena *et al.* (5) in cumin.

Weed biomass (dry matter)

Dry biomass was recorded for all the nine growth stages for all the weedy treatments (Table 3). There was a gradual increase in the weed biomass with the increasing days of crop growth as depicted in the earlier section, in turn the biomass increased with the increasing days of crop growth. The observation recorded at the nine stages show increasing trend in the weed biomass in each treatment with the increasing days of crop and weed growth, at harvest the weed biomass reached maximum of 240.3 g/0.25 m^2 area in the complete weedy conditions (T_9) from 0.83 g/0.25 m^2 (at 15 DAS) followed by T_{10} (weed free up to 15 days) the weed biomass increased up to 79.2 g/0.25 m^2 at harvest. The weed biomass recorded at all the nine growth stages in weedy treatments increased with crop duration. Keeping the crop free up to 75 DAS, the weed biomass increased with low magnitude due to crop cover. Whereas, in the weed free up to 15 DAS, the weed biomass increased with greater magnitude as there was less crop-weed competition at early stage. The second flush of weed germinated and enhanced the weed biomass at early stage of crop growth, these findings are in close conformity with Zalavadia *et al.* (12) in fenugreek and Meena *et al.* (5) in Ajwain.

Weed control efficiency

Data regarding the effect of different treatments on weed control efficiency are presented in Table 4. Weed control efficiency decreased from 99.67% in conditions weedy upto 15 DAS to zero in conditions weedy throughout growth period. Weed control efficiency improved gradually with the increasing weed free period. Weed control efficiency improved from 49.55% with the treatment weed free up to 15 DAS to 100% with the treatment weed free throughout growth period. These findings are akin to report of Patel *et al.* (8) and Mehriya *et al.* (6).

Weed index (%)

The data pertaining to weed index as influenced by different treatments are presented in Table 4. The different treatments exerted their significant effect on weed index. Increase of weedy period from 15 DAS to 120 DAS increased the weed index gradually from 45.67% to 93.75% and reached to maximum 97.86% in weedy conditions throughout growth period. Among the weed free treatments, maximum weed index of the 98.93% was recorded in the treatment weed free up to 15 DAS which decreased sharply and reached to zero in the treatment weed free throughout growth period treatment. This shows that reduction in the yield of ajwain was associated with presence or absence of weeds at different growth stages. The higher weed biomass resulted more weed index and lower weed biomass reduced the weed index at harvest. The findings are in agreement with the results reported by Yadav and Dahama, (11) and Mehriya *et al.* (6).

Economics

Maximum seed yield (638.15 kg/ha), gross return (Rs 99987/ha), net return (Rs 66315/ha) were obtain at weed free throughout growth period with the B: C ratio 1.97 among the weed free treatments (Table 4). Weed free period beyond 75 DAS gave higher yield and net returns with positive B:C ratio weed free period up to 75 DAS gave significantly lower yield with negative net returns and B:C ratio as compare with weed free period 90 DAS and above these result indicates that increase in ajwain seed yield would be possible with increasing number of weed free days. Among the weedy treatments weedy up to 15 DAS to 30 DAS and there after removal of weeds also gave higher yield with net return of Rs 18267-33102 with positive B: C ratio when weeds were allowed to compete beyond 30 DAS significant reduction in seed yield of ajwain was observed. Hence the present study suggested maintenance of weed free crop up to 75 DAS to achieve better yield as well as higher return.

Acknowledgements

The senior author acknowledges the Director ICAR-National Research Centre on Seed Spices, Ajmer, Rajasthan for giving opportunity and facility to work at NRCSS.

References

1. Anwer, M. M., Kakani, R. K. and Khan, M. A. 2011. India's response to world demand of seed spices. *Int. J. Seed Spices*, 1(1): 1-7.
2. Bansal, G. L., Nayyer, H. and Bedi, Y. S. 1992. Allelopathic effect of Eucalyptus *macror rhyncha* and *E. youmanii* on seedling growth of wheat (*Triticuma estivum*) and radish (*Rapahnus sativus*). *Indian J. Agricultural Sciences*, 62(11): 771-772.
3. Ghahari, M., Baradaran, R. and Forutani, R. 2013. Effects of planting density and weeding time on weeds and fenugreek dry matter. Middle-East *J. Sci. Res.*, 18(8): 1171-1176.
4. Meena, S. S. and Mehta, R. S. 2007. Effect of weed management practices on growth and yield of coriander (*Coriandrum sativum* L.). *Int. J. Tropical Agriculture*, 26(1):169-171.

Table 1: Effect of weedy and weed free condition on growth and yield of ajwain

Treatment	Plant height (cm)		Primary branch		Secondary branch		Dry matter accumulation (g/plant)		Number of umbel/ plant	No. of umbellate /umbel	Seed yield (kg /ha)	Straw yield (kg/ha)
	90 DAS	At harvest	90 DAS	At harvest	90DAS	At harvest	60 DAS	90 DAS				
Weedy up to 15 days	34.73	77.40	9.13	11.87	22.93	84.00	3.92	28.17	222.00	14.47	413.15	1401.10
Weedy up to 30 days	33.27	76.53	8.57	11.73	19.40	58.00	3.60	21.33	202.00	12.73	321.48	1107.30
Weedy up to 45 days	33.00	74.33	8.07	11.53	16.27	57.60	2.60	16.17	198.33	13.73	189.81	672.90
Weedy up to 60 days	30.87	72.40	7.80	8.80	12.80	50.07	2.52	14.17	185.33	13.40	140.74	501.70
Weedy up to 75 days	29.93	68.67	7.17	8.53	12.40	47.67	1.73	11.03	173.33	11.93	110.19	393.45
Weedy up to 90 days	27.10	66.00	6.87	8.33	11.20	44.87	1.19	10.50	146.00	11.73	87.96	299.10
Weedy up to 105 days	26.43	46.53	6.80	7.73	9.80	39.47	1.16	9.67	142.00	10.60	39.63	158.40
Weedy up to 120 days	25.73	24.33	6.33	4.40	9.53	15.87	1.14	6.83	27.73	5.73	13.63	54.40
Weedy throughout growth period	25.17	15.33	5.40	3.17	9.47	10.93	1.10	4.33	24.20	3.93	6.85	27.79
Weed free up to 15 days	32.80	64.93	6.13	8.07	11.27	43.90	1.54	7.00	132.00	10.00	27.59	110.40
Weed free up to 30 days	33.90	87.50	6.30	9.27	11.27	44.40	2.50	8.83	150.00	11.93	78.89	315.60
Weed free up to 45 days	35.47	93.00	6.93	10.40	13.53	52.47	2.68	9.00	162.67	12.13	106.30	412.20
Weed free up to 60 days	36.40	100.33	7.33	11.33	13.73	55.93	2.91	12.00	188.67	12.47	146.67	561.99
Weed free up to 75 days	36.57	106.80	7.60	11.60	14.27	58.73	3.14	16.33	193.00	12.40	198.52	717.63
Weed free up to 90 days	36.93	109.67	7.97	11.80	17.33	70.93	3.27	22.00	194.33	13.00	256.11	935.06
Weed free up to 105 days	38.20	110.00	8.40	11.80	18.87	74.87	3.44	23.17	198.67	14.00	392.78	1409.03
Weed free up to 120 days	39.60	110.33	9.10	12.73	23.33	77.53	3.68	30.33	204.00	13.60	466.11	1569.27
Weed free throughout growth period	40.67	113.47	9.57	13.87	25.00	84.80	4.68	41.67	244.00	14.67	638.15	2136.24
CD (P=0.05)	5.75	9.31	0.94	1.14	2.00	3.93	8.39	6.52	13.58	2.13	33.30	15.07

Table 2 : Weed count (number/0.25m^2) in weedy and weed free treatments at different stages of plant growth in ajwain

Treatments	15 DAS	30DAS	45DAS	60DAS	75DAS	90DAS	105DAS	120DAS	At harvesting
Weedy up to 15 days	15.2(243)	1(0)	1.0 (0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)
Weedy up to 30 days	14.7(217.6)	11.6(141.3)	1.0 (0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)
Weedy up to 45 days	16.8(287.3)	14.0(197.3)	8.8(80.3)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)
Weedy up to 60 days	15.0(226.3)	12.5(156.7)	10.6(116.3)	11.0(121.7)	1(0)	1(0)	1(0)	1(0)	1(0)
Weedy up to 75 days	15.1(236.6)	14.1(198.3)	11.4(134.7)	10.7(115.7)	7.0(50.3)	1(0)	1(0)	1(0)	1(0)
Weedy up to 90 days	15.2(235)	12.7(162.3)	9.6(92.7)	11.1(123.3)	7.9(66.3)	6.9(46.6)	1(0)	1(0)	1(0)
Weedy up to 105 days	17.3(303.6)	14.7(217.7)	10.3(107.0)	10.2(104.7)	8.2(62.3)	7.3(52.3)	6.6(43.6)	1(0)	1(0)
Weedy up to 120 days	16.9(290.3)	13.9(193.0)	10.0(99.7)	10.6(118.3)	8.4(69.6)	8.0(64.3)	7.0(49)	6.7(45.3)	1(0)
Weedy throughout growth period	16.7(279.6)	13.7(188.7)	9.6(93.0)	10.2(105.3)	8.9(74.3)	8.6(72.6)	7.8(60)	7.5(54.6)	6.5(43)
Weed free up to 15 days	1(0)	3.0(8.3)	2.5(5.7)	3.5(12.0)	3.8(14)	5.6(31)	6.0(36)	3.7(13)	3.3(10.3)
Weed free up to 30 days	1(0)	1(0)	2.3(4.7)	2.7(6.7)	3.4(10.6)	4.5(20)	4.3(16.6)	3.4(10.6)	2.9(8)
Weed free up to 45 days	1(0)	1(0)	1(0)	2.3(4.3)	2.9(7.6)	3.4(10.6)	3.2(9.3)	2.9(8)	3.1(8.6)
Weed free up to 60 days	1(0)	1(0)	1(0)	1(0)	2.6(6)	3.0(8)	2.6(6)	3.3(9.6)	2.8(7)
Weed free up to 75 days	1(0)	1(0)	1(0)	1(0)	1(0)	2.6(5.6)	2.5(5.3)	3.2(9.6)	2.7(6.3)
Weed free up to 90 days	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	2.3(4.6)	2.1(3.3)	1.8(2.3)
Weed free up to 105 days	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1.8(2.3)	1.7(2)
Weed free up to 120 days	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	8.5(1.3)
Weed free throughout growth period	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)
CD(P=0.05)	2.90	1.58	1.74	1.33	1(0)	1(0)	1(0)	1(0)	1(0)

Data were transformed $\sqrt{(X+1)}$, original values are given in parenthesis

Table 3 : Weed biomass (g/0.25m^2) in weedy and weed free treatments at different growing stagesin ajwain

Treatments	15DAS	30DAS	45DAS	60DAS	75DAS	90DAS	105DAS	120DAS	At harvesting
Weedy up to 15 days	1.3(0.80)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)
Weedy up to 30 days	1.2(0.47)	3.1(8.24)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)
Weedy up to 45 days	1.3(0.72)	2.4(4.86)	6.4(40.6)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)
Weedy up to 60 days	1.2(0.57)	2.6(5.82)	6.2(37.74)	9.1(83.02)	1(0)	1(0)	1(0)	1(0)	1(0)
Weedy up to 75 days	1.3(0.81)	2.5(5.36)	6.4(40.78)	8.9(79.29)	10.2(103.35)	1(0))	1(0)	1(0)	1(0)
Weedy up to 90 days	1.2(0.57)	3.1(8.78)	5.8(32.91)	8.4(69.95)	10.6(112.09)	12.7(164)	1(0)	1(0)	1(0)
Weedy up to 105 days	1.3(0.61)	2.9(7.47)	6.3(39.78)	9.3(86.11)	11.4(130.64)	13.7(187.1)	12.7(170.1)	1(0)	1(0)
Weedy up to 120 days	1.3(0.53)	2.7(6.82)	5.6(31.31)	7.9(61.64)	10.7(120.12)	13.8(188.6)	14.8(218.3)	13.2(225.2)	1(0)
Weedy throughout growth period	1.3(0.83)	3.1(8.82)	6.4(41.08)	9.6(91.32)	12.4(153.03)	14.1(198.5)	15(224.9)	15.1(228.8)	15.6(240.3)
Weed free up to 15 days	1(0)	2.0(3.17)	4.0(15.33)	6.2(37.83)	6.8(46.68)	7.4(53.5)	8.5(72.8)	9.5(71.03)	9.8(95.5)
Weed free up to 30 days	1(0)	1(0)	1.8(2.37)	4.0(15.16)	5.7(33.20)	7.0(48.5)	7.8(60.8)	8.4(58.3)	8.9(79.2)
Weed free up to 45 days	1(0)	1(0)	1(0)	1.6(1.63)	4.5(20.13)	6.1(36.86)	6.8(86.3)	7.6(28.3)	8.0(64.5)
Weed free up to 60 days	1(0)	1(0)	1(0)	1(0)	2.2(4.64)	3.7(15.16)	4.6(22)	5.2(7.4)	5.7(34.1)
Weed free up to 75 days	1(0)	1(0)	1(0)	1(0)	1(0)	1.5(1.55)	2.6(6.94)	2.8(2.2)	3.1(8.8)
Weed free up to 90 days	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1.3(0.85)	1.7(1.1)	2.5(5.8)
Weed free up to 105 days	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1.4(1)	1.5(1.4)
Weed free up to 120 days	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1.2(0.6)
Weed free throughout growth period	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)
CD(*P*=0.05)	0.01	0.08	0.10	0.15	0.91	1.1	1.25	1.24	1.25

Data were transformed $\sqrt{(X+1)}$, original values are given in parenthesis

Table 4 : Effect of weedy and weed free condition on weed control efficiency (WCE %), weed index (WI %), cost of cultivation, net return and B: C ratio in ajwain

Treatments	WCE (%)	WI (%)	Costofcultivation (Rs/ha)	Net return (Rs/ha)	B:C ratio
Weedy up to 15 days	100.00	45.67	31672	33102	1.05
Weedy up to 30 days	100.00	49.22	32172	18267	0.57
Weedy up to 45 days	100.00	70.16	32672	-2856	-0.09
Weedy up to 60 days	100.00	77.77	33172	-11063	-0.33
Weedy up to 75 days	100.00	82.63	33172	-15855	-0.48
Weedy up to 90 days	100.00	86.13	32672	-18873	-0.58
Weedy up to 105 days	100.00	93.75	32672	-26415	-0.81
Weedy up to 120 days	59.54	97.86	32672	-30523	-0.93
Weedy throughout growth period	0.00	98.93	25672	-24581	-0.96
Weed free up to 15 days	49.55	95.65	28172	-23811	-0.85
Weed free up to 30 days	58.16	87.58	28672	-16205	-0.57
Weed free up to 45 days	65.93	83.25	29172	-12402	-0.43
Weed free up to 60 days	81.68	76.89	29672	-6543	-0.22
Weed free up to 75 days	95.35	68.73	30172	-311	-0.01
Weed free up to 90 days	96.94	59.65	30672	9613	0.31
Weed free up to 105 days	99.26	38.10	31172	30566	0.98
Weed free up to 120 days	99.68	26.96	31672	41381	1.31
Weed free throughout growth period	100.00	0.00	33672	66315	1.97
CD(*P*=0.05)	0.59	6.88			

Data were transformed $\sqrt{(X+1)}$, original values are given in parenthesis

5. Meena, S. S., Kakani, R. K. and Mehta, R. S. 2009. Economic feasibility of weed management practices in cumin (*Cuminum cyminum* L.). *J. Spi. Aromatic Crops*,18 (1):9-12.

6. Mehriya, M. L., Yadav, R. S., Jangir, R. P. and Poonia, B. L. 2007. Nutrient utilization by cumin and weed as influenced by different weed control method. *Indian J. Agronomy*, 52: 176-179.

7. National Horticulture Board (NHB) Database, 2014.

8. Patel, R. H., Oliver, J. and Usadadia, V. P. 2005. Influence of irrigation schedule and weed management practices on growth and yield of fenugreek (*Trigonella foenum graecum* L.). *J Weed Sci*., 37: 237-239.

9. Patel, J. C., Patel, P. P. and Jat, G. L. 2007. Integrated weed management in fenugreek (*Trigonella foenum graecum* L.). Production Development, quality and Export of seed spices, S. K. Malhotra and B. B. Vashistha

Received : September 2014; Revised : November 2014; Accepted : December 2014.