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Weed management in ajwain (*Trachyspermum ammi* L.)

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Abstract

A field experiment was conducted to find out a suitable and economical method of weed management in ajwain. The experiment was laid in randomized block design with three replications. Based on the two year study, it was found that besides weed free treatment, significantly higher plant height, number of primary, secondary branches, number of leaves, number of nodes and dry matter accumulation plant^{-1} at (60 DAS, 90 DAS and at harvest) were recorded with the pre-emergence application of oxadiargyl @75 g ha^{-1} + one hand weeding at 45 days after sowing (DAS) and pendimethalin @1 kg ha^{-1} + one hand weeding at 45 DAS. Yield attributes like number of umbels plant^{-1}, number of umbellate pant^{-1}, number of seeds umbel^{-1}, umber of seed umbellate^{-1} and test weight as well as seed and straw yields of ajwain were also higher with the above two treatments. After weed free treatment, the lowest dry weight of weed at harvest, weed index and highest weed control efficiency were obtained with pre-emergence (PE) application of oxadiargyl @75 g ha^{-1} + one hand weeding at 45 DAS. The highest gross returns and net returns per hectare were obtained in weed free treatment. This was followed by pre-emergence application of oxadiargyl @75 g ha^{-1} + one hand weeding at 45 DAS, which recorded the highest B: C ratio (2.62).

Keywords: ajwain, economics, herbicides, weed, weed index, yield

Ajwain (*Trachyspermum ammi* L.), also known as Bishop's weed, is an annual herbaceous plant belonging to family *Apiaceae*, bearing grayish brown fruits. The major ajwain producing countries are India, Persia, Iran, Egypt, Afghanistan, Pakistan and North Africa. During 2007–08, 1120 t of ajwain seed was produced from 19590 ha which accounted for 0.25% and 0.63% of total seed spices production and area, respectively in India. Ajwain seed worth Rs. 75.8 millions was exported from India (Meena *et al*. 2009). The current productivity of ajwain is 572 kg ha^{-1} (Singh 1999; Meena *et al*. 2009). In India it is grown in Gujarat, Rajasthan, Madhya Pradesh and Andhra Pradesh. Major parts of ajwain production in Rajasthan are in Chittorgarh, Udaipur, Jhalawar, Rajsamand, Kota and Bhilwara.

The use of herbicide has revolutionized weed control in seed spices and reduced the cost of production. Unfortunately, until now majority

of the farmers are quite ignorant about the proper doses of herbicides, time of application and their economics. Precise information on weed management in ajwain is essential and inevitable for getting healthy growth of plants. Being a slow growing seed spice, ajwain is more prone to crop weed competition and therefore, the field should be kept weed free at initial stage of establishment by employing available weed control methods. Manual weeding is the commonly employed practice, but availability of labour itself is a problem, besides high cost. Keeping in view the above mentioned facts, the present study was carried out to evaluate economic feasibility of weed management practices in ajwain.

The experiment was conducted on a sandy loam soil of the Research Farm of ICAR-National Research Centre on Seed Spices, Ajmer (Rajasthan) India. Ten treatments consisting of manual weeding at 30 & 60 DAS, pre-emergence application of oxadiargyl @75 g ha^{-1} + one hand weeding at 45 DAS, post-emergence application of oxadiargyl @75 g ha^{-1} at 20 DAS, post-emergence application of oxadiargyl @75 g ha^{-1} at 20 DAS + one hand weeding at 50 DAS, pre-emergence and post- emergence application of oxadiargyl @75 g ha^{-1} at 45 DAS, pre-emergence application of pendimethalin @0.75 kg ha^{-1}, pre-emergence application of pendimethalin @0.75 kg ha^{-1} +one hand weeding at 45 DAS, pre-emergence application of pendimethalin @0.75 kg ha^{-1} + post emergence application of oxadiargyl @75 g ha^{-1} at 45 DAS, weed free and weedy check treatments were laid out in randomized block design with three replications during *rabi* season of 2011–12. The soil of the experimental field was sandy loam having low organic matter (0.23%), available N (178.65 kg ha^{-1}), P (12.0 kg ha^{-1}) and was sufficient in available K (165 kg ha^{-1}), slightly alkaline with pH 8.04 and EC 0.076 dSm^{-1}. The ajwain variety Ajmer Ajwain-1 (AA-1) was sown on 15th October during both the years on the same site at 30 cm row to row and 10 cm plant to plant spacing with a seed rate of 3.3 kg ha^{-1}. Irrigation was given immediately after sowing. All other standard cultural practices were followed during the cropping season. Pre and post emergence application of oxadiargyl and pendimethalin was done with the help of a Knapsack sprayer fitted with flood fan nozzle with a spray volume of 600 L ha^{-1}. In manual weed control treatments, weeds were uprooted and removed at 30 and 60 DAS as per treatments. In weed free plots, the weeds were removed manually at seven days interval for ensuring complete weed free condition. After uprooting of weeds, the weeds were sun dried to constant weight and finally the dry weight was recorded for each treatment and expressed as q ha^{-1}. Weed control efficiency and weed index were calculated by the formulae suggested by Kondap & Upadhya (1985) and Gill & Kumar (1969). Statistical analysis was done as per by Panse & Sukhatme (1985).

The weed flora recorded during experimentation, were grasses like *Cynodon dactylon, Digitaria sanguinalis* L. and *Polycurpea corymbosa* L., sedges like *Cyprus rotundus* L. and *Ciria* L. and broad leaved weeds like *Chenopoodium album* L., *Melilotus alba* L., *Convolvulus arvensis* L., *Anagalis arvensis*, *Phyllanthus niruri* L.

Data presented in Table 1 revealed that the weed control treatments significantly influenced various plant growth parameters at different growth stages. Beside the weed free treatment, the highest plant height, number of leaves, number of nodes, primary branches, secondary branches, fresh weight and dry matter accumulation/plant at all the growth stages were recorded with the pre- emergence application of oxadiargyl @75 g ha^{-1} + one hand weeding at 45 DAS which was at par with pre-emergence application of pendimethalin @1 kg ha^{-1} + one hand weeding at 45 DAS. The lowest values of all these parameters were recorded under weedy check. Weeds were effectively controlled under these treatments, hence there

Table 1. Effect of weed management practices on growth parameters in ajwain

Treatments	Plant height (cm)	No. of nodes plant^{-1}	Fresh weight plant^{-1}(g)	Dry weight plant^{-1}(g)	Primary branches plant^{-1}	Secondary branches plant^{-1}	No. of leaves plant^{-1}
Manual weeding at 30 & 60 DAS	88.40	13.67	413.33	77.00	13.93	62.80	111.20
Oxadiargyl @75 g ha^{-1} (PE) + HW at 45 DAS	93.40	15.20	508.00	93.00	15.07	70.00	119.73
Oxadiargyl @75 g ha^{-1} (POE) at 20 DAS	89.80	14.20	428.33	89.33	14.73	65.33	112.20
Oxadiargyl @75 g ha^{-1} (POE) at 20 DAS + HW at 50 DAS	93.33	15.00	441.33	92.50	14.80	67.53	118.13
Oxadiargyl @75 g ha^{-1} (PE) & Oxadiargyl @75 g ha^{-1} (POE) at 45 DAS	90.80	14.87	438.67	91.00	14.77	66.13	115.80
Pendimethalin @0.75 kg ha^{-1} (PE)	84.27	12.67	361.00	59.00	12.73	51.27	106.20
Pendimethalin @0.75 kg ha^{-1} (PE) + HW at 45 DAS	89.33	14.07	418.00	82.50	14.67	64.27	111.70
Pendimethalin @0.75 kg ha^{-1} (PE) + Oxadiargyl @75 g ha^{-1} (POE) at 45 DAS	87.87	12.93	379.33	75.17	13.33	61.33	109.13
Weed free	97.67	16.93	540.00	136.67	17.67	74.47	133.40
Weedy check	79.87	8.60	235.00	18.10	6.67	6.27	39.00
S.Em±	3.37	0.52	15.06	2.55	0.76	2.86	111.20
CD (P<0.05)	10.02	1.55	44.75	7.57	2.27	8.48	119.73

DAS=Days after Sowing; PE=Pre-emergence; POE=Post emergence; HW=Hand Weeding

was no severe competition by weeds for moisture and nutrients which created congenial conditions for growth of the crop. These results corroborated with those reported by Dungarwal *et al.* (2002) in fenugreek and Meena & Mehta (2009) in coriander.

Yield attributes as well as seed and straw yield were significantly influenced with the application of different weed control treatments during both the years. Results revealed that besides weed free treatments the highest yield attributes like earlier initiation of flowering and 50% flowering, maximum number of umbels plant^{-1} (196.33), number of seeds umbels^{-1} (334.40), test weight (0.96 g) and as well as seed yield (821.90 kg ha^{-1}), straw yield (1685.71 kg ha^{-1}) and biological yield (2507.62 kg ha^{-1}) were recorded with the weed free treatment which was at par with pre-emergence application of oxadiargyl @75 g + one hand weeding at 45 DAS. The lowest values of yield attributes and yields were recorded in weedy check (Table 2). Increase in the yield attributes under pre-emergence application of oxadiargyl @75 g ha^{-1} + one hand weeding at 45 DAS might be due to effective control of weeds which ultimately resulted in the better utilization of nutrients and moisture available in the soil by the crop. The results are in accordance with those of Rathore *et al.* (1990), Patel *et al.* (2004), Mehriya *et al.* (2007), Meena & Mehta (2009) and Meena *et al.* (2013) in fenugreek.

Application of different treatments significantly affected dry weight of weed, weed control efficiency and weed index. Besides weed free treatment, the lowest dry weight of weed (3.97 q ha^{-1}) and weed index (7.6%) at harvest and highest weed control efficiency (95.48%) were recorded with pre-emergence application of oxadiargyl @75 g + one hand weeding at 45 DAS. The higher weed control efficiency, lower weed index and dry weight of weed under pre-emergence application of oxadiargyl @75 g + one hand weeding at 45 DAS was due to effective control of weeds from the field and weeds that

Table 2. Effect of weed management practices on yield attributes and yield of ajwain

Treatments	No. of umbels plant^{-1}	No. of seeds umbel^{-1}	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Test weight (g)
Manual weeding at 30 & 60 DAS	184.07	285.53	603.50	1333.33	1936.83	0.94
Oxadiargyl @75 g ha^{-1} (PE) + HW at 45 DAS	190.53	327.87	764.76	1571.43	2336.19	0.96
Oxadiargyl @75 g ha^{-1} (POE) at 20 DAS	187.13	297.33	690.98	1466.67	2157.65	0.94
Oxadiargyl @75 g ha^{-1} (POE) at 20 DAS + HW at 50 DAS	190.40	311.93	740.79	1542.86	2283.65	0.95
Oxadiargyl @75 g ha^{-1} (PE) & Oxadiargyl @75 g ha^{-1} (POE) at 45 DAS	189.27	310.07	698.41	1571.43	2269.84	0.95
Pendimethalin @0.75 kg ha^{-1} (PE)	181.73	268.07	341.90	752.38	1094.29	0.93
Pendimethalin @0.75 kg ha^{-1} (PE) + HW at 45 DAS	185.47	296.73	646.50	1352.38	1998.89	0.94
Pendimethalin @0.75 kg ha^{-1} (PE) + Oxadiargyl @75 g ha^{-1} (POE) at 45 DAS	182.70	280.73	535.08	1123.81	1658.89	0.93
Weed free	196.33	334.40	821.90	1685.71	2507.62	0.96
Weedy check	12.40	193.20	143.50	333.33	476.83	0.92
S.Em±	7.76	10.66	23.47	55.58	72.89	0.03
CD (P<0.05)	23.06	31.69	69.75	165.13	216.56	0.10

DAS=Days after Sowing; PE=Pre-emergence; POE=Post emergence; HW=Hand Weeding

Table 3. Effect of weed management practices on weed control efficiency, weed index and dry weight of weed as well as gross return, net return and B: C ratio

Treatments	Dry weight at harvest (q ha^{-1})	Weed control efficiency	Weed index (%)	Gross return Rs. ha^{-1} (%)	Net return Rs. ha^{-1}	B:C of weed
Manual weeding at 30 & 60 DAS	10.09	88.57	28.56	63016.6	37084.6	1.43
Oxadiargyl @75 g ha^{-1} (PE) + HW at 45 DAS	3.97	95.48	7.16	79618.8	57286.8	2.72
Oxadiargyl @75 g ha^{-1} (POE) at 20 DAS	7.39	91.57	21.31	71961.3	52629.3	2.56
Oxadiargyl @75 g ha^{-1} (POE) at 20 DAS + HW at 50 DAS	5.14	94.28	9.66	77221.8	54889.8	2.45
Oxadiargyl @75 g ha^{-1} (PE) & Oxadiargyl @75 g ha^{-1} (POE) at 45 DAS	6.03	93.08	17.42	72983.8	52751.8	2.60
Pendimethalin @0.75 kg ha^{-1} (PE)	8.99	89.97	21.98	35694.7	16199.7	0.83
Pendimethalin @0.75 kg ha^{-1} (PE) + HW at 45 DAS	92.58	80.71	56.92	67354.7	44859.7	1.99
Pendimethalin @0.75 kg ha^{-1} (PE) + Oxadiargyl @75 g ha^{-1} (POE) at 45 DAS	12.21	86.38	33.52	55755.6	35360.6	1.73
Weed free	0.00	100.00	0.00	85561.4	56629.4	1.95
Weedy check	93.20	0.00	54.43	15016.6	-415	-0.02
S.Em±	2.06	3.23	1.22			

Selling price of ajwain seed Rs. 102 kg^{-1}; DAS=Days after Sowing; PE=Pre-emergence; POE=Post emergence; HW=Hand Weeding

escaped from herbicidal control were removed by hand weeding at 45 DAS. The combined effect of herbicide and hand weeding at 45 DAS resulted in remarkably less dry weight of weeds (Table 3). These findings are akin to the reports of Patel *et al.* (2004), Mehriya *et al.* (2007) and Meena *et al.* (2013) in fenugreek.

Gross return, net return and B: C ratio were significantly influenced by different weed control treatments. The highest gross return of Rs. 85,561.4 ha^{-1} was obtained in weed free treatment followed by pre-emergence application of oxadiargyl @ 75 g ha^{-1} + one hand weeding at 45 DAS (Rs. 79,618.8 ha^{-1}). However, the highest net return (Rs. 57,286.8 ha^{-1}) and B:C ratio (2.72) were recorded with the application of oxadiargyl @75 g ha^{-1} (PE) + one hand weeding at 45 DAS. Hence it is inferred that pre-emergence application of oxadiargyl @75 g ha^{-1} + one hand weeding at 45 DAS is the best economically feasible weed control treatment resulting in efficient weed control which ultimately leads to higher yields. Yadav *et al*. (2004) reported that application of oxadiargyl @50 g ha^{-1} produced higher seed yield of cumin, which was at par with pendimethalin at 1.0 kg ha^{-1}.

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