

Original Research Article

<https://doi.org/10.20546/ijcmas.2021.1005.022>

Integrated Weed Management in Coriander (*Coriandrum sativum* L.)

Shilpa Rathod, R. K. Jat, Sanjay Prajapati*, Naresh Solanki and Jay Brahmhatt

Department of Fruit Science, College of Horticulture, Sardarkrushinagar Dantiwada
Agricultural University, Jagudan-382710, Gujarat, India

*Corresponding author

ABSTRACT

Keywords

Hand weeding,
Interculturing,
Pendimethalin,
Oxyfluorfen,
Oxadiargyl,
Pretilachlor,
Quizalofop ethyl
and Weed
management

Article Info

Accepted:
12 April 2021
Available Online:
10 May 2021

A field experiment was conducted during *rabi* season of 2019-20 at College Farm, S. D. Agricultural University, Jagudan. The treatments included of best combinations consisting of physical and chemical methods as well as alone. The studies signified the importance of hand weeding at 25 and 40 DAS or application of post emergence herbicides which could benefit the crops in reducing the different weed density and ultimately reduced the weed dry matter which resulted in increase in the crop yield. Keeping the crop weed free up to harvest recorded higher weed control efficiency (100 %) and lower weed index (0 %). Higher growth and yield attributes under physical method alone and their integration with herbicide treatments might be due to effective control of weeds, significantly reduced crop weed competition resulting in better congenial condition for growth and development of the crop. The maximum seed yield was recorded with weed free up to harvest and was at par with the treatments in which adoption of physical and chemical methods alone and their combinations. The maximum net realization and benefit cost ratio (BCR) were recorded with treatment T₂ *i.e.* Two interculture followed by hand weed at 25 and 40 DAS.

Introduction

Coriander (*Coriandrum sativum* L.) is one of the most important spices crop belonging to the family apiaceae. It is commonly known as “Dhania” or “Dhana”. India is known as the “Land of Spices”. Spices play pivotal role in human diet as well as they give an agreeable flavor and aroma to food, which add greatly to the pleasure of eating. The stem, leaves and

fruits have a pleasant aromatic odour due to the linalool containing essential oil in the fruits. The leaves are used for flavoring the curries, sauces and soups. The dried fruits are extensively used in preparation of curry powder, pickling spices, sausages and seasoning. It is also served as a flavoring agent for food preparations. Coriander is an annual herb. According to the climatic conditions, it is cultivated as a summer or winter annual

crop. At flowering, the glabrous plant can reach height between 0.20 and 1.40 m. The stem is more or less erect and sympodial, monochasial-branched, sometimes with several side branches at the basal node. The colour of the ribbed stem is more or less green and sometimes turns to red or violet during the flowering period. The stem can reach a diameter of up to 2 cm. The leaves are alternate and the first ones are often gathered in a rosette. The flowers have five petals which are pink or sometimes white. The inflorescence is a compound umbel. Fruit is globular and 3 to 4 mm diameter, when pressed break into two locules each having one seed. Fruit has delicate fragrance; Seeds are pale and white to light brown in colour (Khan *et al.*, 2014). Integrated weed management approach involves the use of two or more techniques selected for weed control from five general categories *viz.*, prevention, cultural, mechanical (physical), biological and chemical in a well planned sequence so designed as not to effect the ecosystem. The integrated weed management approach is advantageous because one technique rarely achieve complete control of all weeds in a particular crop and even a relatively few surviving weeds can produce sufficient number of seeds to perpetuate the species. With the intensive farming practices, introduction of high yielding varieties, cultivation by multiple cropping and paucity of labour, the adoption of integrated approach is now a days more relevant to Indian agriculture.

Materials and Methods

The experiment consisted of twelve weed management treatments [*viz.*, T₁: Control, T₂: Two interculture followed by hand weeding at 25 and 40 DAS, T₃: Pendimethalin @ 1.0 kg/ha as pre emergence, T₄: Pendimethalin @ 0.75 kg/ha as pre emergence followed by interculture and hand weeding at 40-45 DAS,

T₅: Pendimethalin 0.5 kg/ha (PE) + Quizalofop ethyl 0.04 kg/ha at 30- 35 DAS, T₆: Tank mixture of Pendimethalin @ 500 g/ha + Oxyfluorfen @ 30 g/ha as pre emergence, T₇: Oxadiargyl @ 100 g/ha as pre emergence, T₈: Oxadiargyl @ 80 g/ha as pre emergence followed by one hand weeding at 45 DAS, T₉: Pretilachlor 1.5 kg/ha as pre emergence, T₁₀: Pretilachlor 1.0 kg/ha as pre emergence followed by interculture and hand weeding at 40-45 DAS, T₁₁: Pretilachlor 1.0 kg/ha (PE) + Quizalofop ethyl 0.04 kg/ha at 20 DAS and T₁₂: Weed free up to harvest] were evaluated on coriander *cv.* Gujarat Coriander 3. The experiment was laid out in Randomized Block Design with three replications. Coriander variety Gujarat Coriander 3 was sown in the first week of November and 30 cm row to row spacing with a seed rate of 15 kg/ha. Irrigation was given immediately after sowing. All other standard cultural practices were followed during the cropping season. Pre and post emergence application of pendimethalin, oxadiargyl, oxyfluorfen, Quizalofop ethyl and Pretilachlor was done with the help of a knapsack sprayer fitted with flood fan nozzle with a spray volume of 600 l/ha. In manual weed control treatments, weeds were uprooted within the row and between the row with inter culturing as per days mentioned in each treatments. In weed free plots, the weeds were removed manually at fifteen days interval for ensuring complete weed free condition. The weed count (density) was taken from the tagged spot of 0.25 m² in the randomly selected each net plot and were calculated and converted into square meter basis for convenience. In order to draw a valid conclusion, the weed count data were subjected to $(\sqrt{X+0.5})$ as suggested by Gomez and Gomez (1984) before statistical analysis. For dry weight of weeds, the weeds were air dried completely till they attained constant weight and finally recorded for each treatment after harvest and converted in to kg/ha. Weed control efficiency and weed

index were calculated by the formulae suggested by Kondap & Upadhyay (1985) and Gill & Kumar (1969). Statistical analysis procedure was followed as suggested by Panse & Sukhatme (1985). The observations were recorded on dry weight of weeds, weed control efficiency, weed index, seed yield and straw yield by adopting appropriate procedure.

Results and Discussion

Growth and yield attributes

Growth and yield attributes of coriander were significantly influenced by different weed management treatments (Table 1). All growth and yield attributing characters *viz.*, plant population, plant height, numbers of branches/plant, numbers of umbels/plant, number of umbellates/umbel, number of seeds/umbellate were significantly maximum under weed free crop condition. Higher growth and yield attributes under physical method alone and their integration with herbicide treatments might be due to effective control of weeds, significantly reduced crop weed competition ultimately resulting in better congenial condition for growth and development of the crop. However these values were minimum under control condition. These findings are also in conformity with those reported by Patil *et al.*, (2020) in coriander, Meena *et al.*, (2009), Meena and Mehta (2010), Yadav *et al.*, (2012) and Birla *et al.*, (2016) in cumin, Meena and Mehta (2009) in fennel, Meena *et al.*, (2015) and Patel *et al.*, (2019) in ajwain.

Seed and straw yield

Seed and straw yield of coriander were significantly influenced by different weed management treatments during the course of investigation (Table 2). The maximum seed yield (1634 kg/ha) was recorded under treatment weed free up to harvest (T₁₂), which

was statistically at par with treatments T₂, T₄, T₅, T₃ and T₆. The maximum straw yield (2242 kg/ha) was recorded in treatment weed free up to harvest, which was found statistically at par with all the treatments except T₁, T₉, T₁₀ and T₁₁. However, significantly minimum seed and straw yield was recorded when weed management practices were not adopted *i.e.* control (T₁). Alone Pretilachlor 1.5 kg/ha as pre emergence or Pretilachlor 1.0 kg/ha (PE) + Quizalofop ethyl 0.04 kg/ha at 20 DAS application of these two herbicides were not found to be effective to control the weeds in coriander. Removal of weeds throughout crop growth period by physical and integrated weed management practices provide better space and resource to the crop plants (light, water, nutrient, space, *etc.*), which ultimately favoured better environment for growth and development of the plant which might be increased yield attributes. Analogous findings have been reported by Patil *et al.*, (2020) in coriander, Mehriya *et al.*, (2008), Yadav *et al.*, (2012) and Birla *et al.*, (2016) in cumin, Meena *et al.*, (2013) in dill seed, Meena and Mehta (2009) in fennel, Meena *et al.*, (2015) and Patel *et al.*, (2019) in ajwain.

Quality parametres

The essential oil content and test weight as influenced by different weed management treatments recorded after harvest (Table 2). A perusal of data showed that different weed management treatments exhibited their non significance. The maximum test weight (14.26 g) was produced by treatment weed free up to harvest (T₁₂), which was found statistically at par with all treatments except T₁, T₇, T₉, T₁₀ and T₁₁. Complete elimination of weeds from the field since the beginning which give the chance to the crop to grow under weed free condition. This condition ultimately resulted in better utilization of nutrients and moisture available in the soil by the crop and might have produced bold seeds.

Table.1 Growth and yield attributes of coriander as influenced by different weed management treatments.

Treatments	Plant population/net plot		Plant height (cm)		No. of branches/plant	No. of umbels/plant	No. of umbellates/umbel	No. of seeds/umbellate
	20 DAS	At harvest	30 DAS	At harvest				
T₁ : Control	276	273	8.26	83.32	4.80	16.25	4.18	4.83
T₂ : Two interculture followed by hand weeding at 25 and 40 DAS	306	301	11.93	101.95	7.11	24.78	6.14	7.11
T₃ : Pendimethalin @ 1.0 kg/ha as pre emergence	299	295	11.51	99.73	6.82	23.70	5.82	6.91
T₄ : Pendimethalin @ 0.75 kg/ha as pre emergence followed by interculture and hand weeding at 40-45 DAS	302	297	11.82	101.48	7.02	24.44	6.06	7.04
T₅ : Pendimethalin 0.5 kg/ha (PE) + Quizalofop ethyl 0.04kg/ha at 30-35 DAS	301	298	11.73	100.05	7.02	24.09	6.06	7.00
T₆ : Tank mixture of Pendimethalin @ 500 g/ha + Oxyfluorfen @ 30 g/ha aspre emergence	299	295	11.31	99.16	6.74	23.02	5.80	6.84
T₇ :Oxadiargyl @ 100 g/ha as pre emergence	296	292	10.92	97.58	6.40	22.64	5.75	6.02
T₈ :Oxadiargyl @ 80 g/ha as pre emergence followed by one hand weeding at 45 DAS	297	295	11.19	98.67	6.45	23.37	5.92	6.64
T₉: Pretilachlor 1.5 kg/ha as pre emergence	292	289	9.82	94.04	6.13	20.88	5.46	5.10
T₁₀: Pretilachlor 1.0 kg/ha as pre emergence followed by interculture and hand weeding at 40-45 DAS	294	291	10.50	97.99	6.27	22.07	5.71	6.47
T₁₁: Pretilachlor 1.0 kg/ha (PE) + Quizalofop ethyl 0.04 kg/ha at 20 DAS	293	289	10.48	96.74	6.13	21.48	5.66	6.22
T₁₂: Weed free up to harvest	307	303	12.75	103.55	7.20	25.58	6.23	7.15
S.Em. ±	6.23	5.43	0.51	3.22	0.23	0.82	0.25	0.25
C.D. at 5 %	NS	NS	1.50	9.43	0.68	2.40	0.74	0.72
C.V. %	3.63	3.21	8.06	5.69	6.20	6.25	7.62	6.60

Table.2 Yield and Quality parameters of coriander as influenced by different weed management treatments.

Treatments	Seed yield (kg/ha)	Straw yield (kg/ha)	Essential oil content (%)	Test weight (g)
T₁ : Control	1128	1733	0.35	10.32
T₂ : Two interculture followed by hand weeding at 25 and 40 DAS	1588	2191	0.44	14.05
T₃ : Pendimethalin @ 1.0 kg/ha as pre emergence	1486	2089	0.41	13.00
T₄ : Pendimethalin @ 0.75 kg/ha as pre emergence followed by interculture and hand weeding at 40-45 DAS	1546	2150	0.42	13.82
T₅ : Pendimethalin 0.5 kg/ha (PE) + Quizalofop ethyl 0.04kg/ha at 30-35 DAS	1501	2103	0.41	13.40
T₆ : Tank mixture of Pendimethalin @ 500 g/ha +Oxyfluorfen @ 30 g/ha aspre emergence	1465	2068	0.40	13.21
T₇ :Oxadiargyl @ 100 g/ha as pre emergence	1406	2012	0.37	12.36
T₈ :Oxadiargyl @ 80 g/ha as pre emergence followed by one hand weeding at 45 DAS	1428	2031	0.38	13.00
T₉: Pretilachlor 1.5 kg/ha as pre emergence	1206	1811	0.35	12.05
T₁₀: Pretilachlor 1.0 kg/ha as pre emergence followed by interculture and hand weeding at 40-45 DAS	1364	1967	0.37	13.20
T₁₁: Pretilachlor 1.0 kg/ha (PE) + Quizalofop ethyl 0.04 kg/ha at 20 DAS	1278	1883	0.36	12.40
T₁₂: Weed free up to harvest	1634	2242	0.44	14.26
S.Em. ±	67.74	91.31	0.03	0.46
C.D. at 5 %	198.64	267.78	NS	1.34
C.V. %	8.27	7.82	13.67	6.13

Table.3 Weed count (numbers/m²) in coriander crop at 30, 60 DAS and at harvest as influenced by different weed management treatments

Treatments	Sedge			Monocot			Dicot			Total		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
T ₁ : Control	2.68	3.19	3.29	3.19	3.89	4.02	3.54	4.34	4.42	5.36	6.57	6.75
T ₂ : Two interculture followed by hand weeding at 25 and 40 DAS	1.35	1.35	1.58	1.47	1.78	2.04	1.78	2.12	2.42	2.73	2.92	3.39
T ₃ : Pendimethalin @ 1.0 kg/ha as pre emergence	1.87	2.27	2.48	1.87	3.14	3.24	1.96	2.80	2.97	3.47	4.67	4.95
T ₄ : Pendimethalin @ 0.75 kg/ha as pre emergence followed by interculture and hand weeding at 40-45 DAS	1.96	1.58	1.78	2.12	1.87	2.27	1.96	2.48	2.61	3.32	3.34	3.76
T ₅ : Pendimethalin 0.5 kg/ha (PE) + Quizalofop ethyl 0.04 kg/ha at 30-35 DAS	2.12	2.12	2.42	2.27	2.55	2.74	2.12	2.61	2.86	3.57	4.10	4.53
T ₆ : Tank mixture of Pendimethalin @ 500 g/ha + Oxyfluorfen @ 30g/ha as pre emergence	2.20	2.61	2.74	2.42	3.19	3.29	2.20	3.14	3.24	3.78	5.08	5.28
T ₇ :Oxadiargyl @ 100 g/ha as pre emergence	2.35	2.86	2.97	2.55	3.76	3.85	2.27	3.67	3.85	4.33	5.90	6.12
T ₈ :Oxadiargyl @ 80 g/ha as pre emergence followed by one hand weeding at 45 DAS	2.48	1.47	1.68	2.80	1.78	2.20	2.42	2.42	2.68	4.28	3.19	3.72
T ₉ : Pretilachlor 1.5 kg/ha as pre emergence	2.55	2.97	3.19	3.08	3.81	3.89	2.86	3.89	4.02	4.65	6.12	6.36
T ₁₀ : Pretilachlor 1.0 kg/ha as pre emergence followed by interculture and hand weeding at 40-45 DAS	2.68	1.68	1.78	3.14	2.27	2.48	2.97	3.08	3.19	4.71	4.06	4.30
T ₁₁ : Pretilachlor 1.0 kg/ha (PE) + Quizalofop ethyl 0.04 kg/ha at 20 DAS	2.20	2.61	2.80	2.42	3.14	3.34	2.12	3.29	3.39	3.75	5.15	5.43
T ₁₂ : Weed free up to harvest	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
S.E.m. ±	0.14	0.12	0.11	0.11	0.13	0.14	0.14	0.16	0.13	0.17	0.22	0.18
C.D. at 5 %	0.40	0.34	0.34	0.33	0.39	0.42	0.42	0.46	0.39	0.49	0.63	0.53
C.V. %	11.42	9.43	8.70	8.49	8.66	8.83	11.11	9.47	7.57	7.83	8.66	6.76

Table.4 Dry weight of weeds and Weed indices of coriander as influenced by different weed management treatments.

Treatments	Dry weight of weeds (kg/ha)	Weed control efficiency (%)	Weed index (%)
T₁ : Control	917	0.00	31.10
T₂ : Two interculture followed by hand weeding at 25 and 40 DAS	113	87.89	2.82
T₃ : Pendimethalin @ 1.0 kg/ha as pre emergence	231	74.78	9.02
T₄ : Pendimethalin @ 0.75 kg/ha as pre emergence followed by interculture and hand weeding at 40-45 DAS	139	85.26	5.38
T₅ : Pendimethalin 0.5 kg/ha (PE) + Quizalofop ethyl 0.04kg/ha at 30-35 DAS	204	77.61	8.21
T₆ : Tank mixture of Pendimethalin @ 500 g/ha + Oxyfluorfen @ 30 g/ha aspre emergence	312	65.84	10.38
T₇ :Oxadiargyl @ 100 g/ha as pre emergence	453	49.90	13.88
T₈ :Oxadiargyl @ 80 g/ha as pre emergence followed by one hand weeding at 45 DAS	175	80.76	12.47
T₉: Pretilachlor 1.5 kg/ha as pre emergence	523	42.22	26.24
T₁₀: Pretilachlor 1.0 kg/ha as pre emergence followed by interculture and hand weeding at40-45 DAS	196	78.86	16.31
T₁₁: Pretilachlor 1.0 kg/ha (PE) + Quizalofop ethyl 0.04 kg/ha at 20 DAS	487	46.63	21.70
T₁₂: Weed free up to harvest	0	100	0.00
S.Em. ±	41.17	-	-
C.D. at 5 %	120.72	-	-
C.V. %	22.82	-	-

Table.5 Economics of coriander as influenced by different weed management treatments.

Treatments	Seed yield (kg/ha)	Straw yield (kg/ha)	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	BCR
T₁ : Control	1128	1733	106692	52550	54142	2.03
T₂ : Two interculture followed by hand weeding at 25 and 40 DAS	1588	2191	149493	56710	92783	2.64
T₃ : Pendimethalin @ 1.0 kg/ha as pre emergence	1486	2089	139980	54625	85355	2.56
T₄ : Pendimethalin @ 0.75 kg/ha as pre emergence followed by interculture and hand weeding at 40-45 DAS	1546	2150	145563	56871	88692	2.56
T₅ : Pendimethalin 0.5 kg/ha (PE) + Quizalofop ethyl 0.04 kg/ha at 30-35 DAS	1501	2103	141372	55778	85594	2.53
T₆ : Tank mixture of Pendimethalin @ 500 g/ha + Oxyfluorfen @ 30 g/ha as pre emergence	1465	2068	138027	54140	83887	2.55
T₇ : Oxadiargyl @ 100 g/ha as pre emergence	1406	2012	132549	54376	78173	2.44
T₈ : Oxadiargyl @ 80 g/ha as pre emergence followed by one hand weeding at 45 DAS	1428	2031	134586	56220	78366	2.39
T₉ : Pretilachlor 1.5 kg/ha as pre emergence	1206	1811	113946	54848	59098	2.08
T₁₀ : Pretilachlor 1.0 kg/ha as pre emergence followed by interculture and hand weeding at 40-45 DAS	1364	1967	128634	56898	71736	2.26
T₁₁ : Pretilachlor 1.0 kg/ha (PE) + Quizalofop ethyl 0.04 kg/ha at 20 DAS	1278	1883	120642	56160	64482	2.15
T₁₂ : Weed free up to harvest	1634	2242	153759	62950	90809	2.44

Price- Coriander seed -140/kg, Pendimethalin-390/lit, Oxadiargyl-9420/kg, Oxyfluorfen-1600/lit, Pretilachlor-500/lit, Quizalofop ethyl-1380/lit
 Selling Price- Coriander seed-90/kg, Coriander straw-3/kg

This result was supported by Mehriya *et al.*, (2008), Meena *et al.*, (2009), Yadav *et al.*, (2012) and Birla *et al.*, (2016) in cumin, Meena *et al.*, (2015) and Patel *et al.*, (2019) in ajwain.

Weed Count

Significantly maximum total weed count was recorded under control condition where as it was significantly lowest with treatments T₁₂ and T₂ at 30 DAS, 60 DAS and at harvest (Table 3). Various herbicides were equally effective the controlling sedges and monocot weeds. The studies signified the importance of hand weeding at 25 and 40 DAS or application of post emergence herbicides which could benefit the crops by reducing the different weeds which ultimately reduced the weeding frequency during crop weed competition period of crop. Effective control of weeds either by manual weeding or herbicides or integrated approach. The removal of weeds at regular interval through hand weeding accounted for less count of total density of weeds. These findings are in concurrence with those of Sagarka *et al.*, (2005) and Patil *et al.*, (2020) in coriander, Birla *et al.*, (2016) in cumin and Patel *et al.*, (2019) in ajwain.

Dry weight of weeds

Significantly the highest weed dry matter was recorded with control at harvest shows in Table 4. The studies suggested the importance of hand weeding at 25 and 40 DAS or application of post emergence herbicides which could benefit the crops by reducing the weed dry matter and ultimately increasing the crop yield. These findings are in concurrence with those of Meena and Mehta (2010) and Patil *et al.*, (2020) in coriander, Meena *et al.*, (2009) in cumin, Meena and Mehta (2009) in fennel, Meena *et al.*, (2013) in dill seed, Meena *et al.*, (2015) and Patel *et al.*, (2019) in

ajwain.

Weed control efficiency and Weed index

Keeping the crop weed free up to harvest recorded higher weed control efficiency (100 %) and lower weed index (0%) values followed by two interculture followed hand weeding at 25 & 40 DAS (87.89 % and 2.82 %) and application of Pendimethalin @ 0.75 kg/ha as pre emergence followed by interculture and hand weeding at 40-45 DAS (85.26 % and 5.38 %), respectively. Elimination of weeds by manual weeding and by herbicides. The combined effect on dry weight of weeds and seed yield might have been responsible for excellent weed indices. These findings are report of Patil *et al.*, (2020) in coriander, Mehriya *et al.*, (2008), Meena *et al.*, (2009) and Meena and Mehta (2010) in cumin, Meena and Mehta (2009) in fennel, Meena *et al.*, (2013) in dill seed, Meena *et al.*, (2015) and Patel *et al.* (2019) in ajwain.

Economics

The maximum seed yield, gross realization and cost of cultivation were recorded under treatment T₁₂ :Weed free up to harvest (Table 5), whereas, the maximum net realization and benefit cost ratio (BCR) were recorded with treatment T₂ *i.e.* Two interculture followed by hand weeding at 25 and 40 DAS. The higher seed yield under these treatments as a result of better weed control is responsible for higher net realization per hectare.

Based on the results of the experiment, it was concluded that weed free up to harvest in coriander is beneficial for obtaining maximum seed and straw yield. Two interculture followed by hand weeding at 25 and 40 DAS is beneficial for higher economic returns. However, application of pendimethalin @ 1.0 kg/ha as pre emergence

may also be employed for weed management in coriander under scarcity of labour.

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How to cite this article:

Shilpa Rathod, R. K. Jat, Sanjay Prajapati, Naresh Solanki and Jay Brahmhatt. 2021. Integrated Weed Management in Coriander (*Coriandrum sativum* L.). *Int.J.Curr.Microbiol.App.Sci*. 10(05): 160-169. doi: <https://doi.org/10.20546/ijcmas.2021.1005.022>