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Assessment of critical period of crop-weed competition in coriander (*Coriandrum sativum* L.)

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Abstract

A field experiment was conducted during the rabi season of 2025-26 at the Research Farm, Department of Vegetable Science, CCS Haryana Agricultural University, Hisar, Haryana to determine the critical period of crop-weed competition in coriander (*Coriandrum sativum* L.). The experiment was laid out in a Randomized Block Design with three replications using the variety Hisar Bhoomit (DH-228). Fifteen weed management treatments comprising different weed-free and weedy periods, including season-long weed-free, season-long weedy and pendimethalin 30% EC @ 1.25 kg a.i./ha as a pre-emergence treatment were evaluated. Weed management treatments significantly influenced weed dynamics, yield and economics of coriander. The season-long weed-free treatment recorded the maximum seed yield (1819 kg/ha), biological yield (4835 kg/ha) and harvest index (37.85%), whereas the season-long weedy treatment produced the lowest values due to severe crop-weed competition. Effective weed management significantly reduced weed population and weed dry weight by suppressing weed emergence and biomass accumulation throughout the crop growth period. Among the partial weed-free treatments, maintaining the crop weed-free up to 80 DAS recorded the highest net return (₹81,262/ha) and benefit-cost ratio (1.71), followed closely by weed-free up to 100 DAS. The experimental field was predominantly infested with *Chenopodium album*, *Chenopodium murale*, *Poa annua*, *Fumaria parviflora*, *Convolvulus arvensis*, *Cyperus rotundus*, *Cynodon dactylon*, *Phalaris minor*, *Amaranthus viridis*, *Medicago denticulata* and *Rumex dentatus*. Based on the weed-free and weedy period treatments the critical period of crop-weed competition in coriander was determined to be 20-60 days after sowing (DAS). Therefore, maintaining the crop weed-free during this period is essential to minimize yield loss and maximize productivity. The study concluded that timely weed management during the critical period of crop-weed competition is an effective strategy for improving coriander yield and profitability.

Keywords: Coriander, crop-weed competition, critical period, weed management, weed dynamics, seed yield, economics

Introduction

Coriander (*Coriandrum sativum* L.), popularly known as Dhania in India is one of the oldest cultivated seed spice crops in the world and occupies a prominent position among aromatic and medicinal plants. It belongs to the family Apiaceae (Umbelliferae). The economic importance of coriander is largely attributed to its essential oil content and phytochemical composition. Due to its distinct medicinal and aromatic properties, it has significant demand in the pharmaceutical industry (Patel *et al.*, 2013) ^[10]. Leaves and seeds of coriander are highly valued as food mainly for its high vitamin A and vitamin C. Due to its rich chemical composition, rich taste and aroma, coriander fruits are worthwhile for processing purposes. Coriander fruit possesses its delicate and refreshing flavour mainly due to essential oils, which contains variable volatile compounds, such as linalool, geraniol, α pinene and others (Weiss, 2002) ^[16]. According to the 2024-2025, India's total coriander production stands at 8.44 lakh metric tonnes, covering an area of 6.10 lakh hectares with a productivity of 1.40 MT/hectare (Anonymous, 2024) ^[11]. In India, coriander is largely cultivated in Rajasthan, Madhya Pradesh, Gujarat, Andhra Pradesh, Tamil Nadu, Orissa, Uttar Pradesh and Uttaranchal states *etc.*

Weeds compete with crop plants for water, nutrients, space and solar radiations resulting in reduction of yield by 20 to 50% (Bhan, 1998) ^[12]. Weed management plays a crucial role in crop production, as weeds can significantly reduce both yield and quality. Coriander, a short-stature crop with slow initial growth is severely smothered due to the infestation of weeds at early stages

of growth, which causes severe competition and may result in complete crop failure (Kushwaha *et al.*, 2002) ^[4]. Severe yield losses caused by weed infestation highlight the importance of understanding weed emergence patterns at different stages of crop growth and their competitive interactions with the crop. Identifying the critical period of crop-weed competition is essential for developing effective integrated weed management strategies that minimize yield losses in coriander seed crop. Therefore, the present study was conducted to evaluate weed dynamics, yield and economics due to weed competition and determine the critical period of crop-weed competition in coriander seed crop.

Materials and Methods

The experiment was conducted during the rabi season of 2025-26 at the Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar, Haryana. The experimental site is situated at 29°10' N latitude and 75°46' E longitude with an elevation of 215.2 m above mean sea level. The soil of the experimental field was sandy loam in texture, slightly alkaline in reaction (pH 7.6), having 0.48 per cent organic carbon, 128.3 kg ha⁻¹ available nitrogen, 15.5 kg ha⁻¹ available phosphorus and 224.8 kg ha⁻¹ available potassium. The experiment was laid out in a Randomized Block Design with three replications using coriander variety Hisar Bhoomit (DH-228). The crop was sown on 19 November 2025 with a spacing of 30 cm × 20 cm using a seed rate of 10 kg ha⁻¹. The experiment consisted of 15 weed management treatments. These included maintaining the crop weed-free up to 20, 40, 60, 80, 100 and 120 DAS followed by weedy thereafter (T₁-T₆), keeping the crop weed-free throughout the growing season (T₇), allowing weeds up to 20, 40, 60, 80, 100 and 120 DAS followed by weed-free conditions (T₈-T₁₃), maintaining weedy conditions throughout the crop season (T₁₄) and applying pendimethalin 30% EC @ 1.25 kg ha⁻¹ as a pre-emergence herbicide (T₁₅). Recommended fertilizer doses of 62.5 kg nitrogen and 50 kg phosphorus per hectare were applied, with the full dose of phosphorus and half dose of nitrogen applied at sowing and the remaining nitrogen top-dressed 6-8 weeks after sowing. Pendimethalin 30% EC (Stomp) @ 3.33 litre/ha was dissolved in 625 liters of water for spraying as pre-emergence as per one hectare area within three days of sowing as a pre-emergence herbicide, whereas hand hoeing for weed removal was carried out at the specified intervals according to

treatment requirements and no weed was left in weed free treatments. To work out the weed count per unit area, a quadrat of 1m x 1m was placed randomly in each treatment plot and number of weeds growing within this area was counted and recorded at 30, 60, 90 and at harvest. For dry weight of weeds were uprooted from the 1.0 m² area selected at random, each time and were oven dried to a constant weight at 65°C for 48 hr and dry weight of weeds for each treatment was recorded at 30, 60, 90 and at harvest. To draw a valid conclusion, the weed count data and weed dry weight were subjected to square root transformation. All other recommended agronomic practices, including irrigation, thinning, plant protection measures and intercultural operations were uniformly followed throughout the crop growing period.

Results and Discussion

Seed yield and biological yield

The application of different weed management treatments resulted in significant differences in the seed and biological yield of coriander as given in Table 1. All the weed-management treatments resulted in significantly higher seed yield, biological yield and harvest index under weed free crop condition. Maximum seed yield (kg/ha) was recorded under the treatment T₇ (1819 kg/ha) which was found to be statistically at par with treatment T₃ (1710kg/ha), T₄ (1781kg/ha), T₅ (1798kg/ha), T₆ (1812kg/ha) and T₈ (1724 kg/ha). Maximum biological yield (kg/plant) was recorded under the treatment T₇ (4835 kg/ha) which was found to be statistically at par with treatment T₃ (4648 kg/ha), T₄ (4709 kg/ha), T₅ (4762 kg/ha), T₆ (4819 kg/ha) and T₈ (4689 kg/ha). Maximum harvest index (%) was recorded under the treatment T₇ (37.85). However, significantly minimum seed yield, straw yield and harvest index was recorded when weed management practices were not adopted *i.e.* Weedy upto harvest (T₇). Maintaining the crop free from weeds throughout the growing season ensured greater availability of essential resources such as light, water, nutrients and space to the crop plants. This created a more favourable environment for plant growth and development resulting in improved yield attributes. Similar research outcomes were reported by Meena *et al.* (2014) ^[5], Patil *et al.* (2020) ^[12], Rathod *et al.* (2021) ^[14] and Priyanka *et al.* (2024) ^[13] in coriander, Patel *et al.* (2019) ^[11] in ajwain, Mehriya *et al.* (2008) ^[8], Yadav *et al.* (2012) ^[17] and Birla *et al.* (2016) ^[3] in cumin.

Table 1: Effect of different weed management treatments on seed yield (kg/ha), biological yield (kg/ha) and harvest index (%) of coriander seed crop

Treatments	Seed yield (kg/ha)	Biological yield (kg/ha)	Harvest Index (%)
T-1 Weed free upto 20 DAS and weedy thereafter	1050	2898	36.23
T-2 Weed free upto 40 DAS and weedy thereafter	1488	4303	36.89
T-3 Weed free upto 60 DAS and weedy thereafter	1710	4648	36.14
T-4 Weed free upto 80 DAS and weedy thereafter	1781	4709	36.76
T-5 Weed free upto 100 DAS and weedy thereafter	1798	4762	37.54
T-6 Weed free upto 120 DAS and weedy thereafter	1812	4819	37.76
T-7 Weed free upto harvest	1819	4835	37.85
T-8 Weedy upto 20 DAS and weed free thereafter	1724	4689	36.76
T-9 Weedy upto 40 DAS and weed free thereafter	1547	4237	36.5
T-10 Weedy upto 60 DAS and weed free thereafter	1258	3757	36.13
T-11 Weedy upto 80 DAS and weed free thereafter	1121	3396	35.96
T-12 Weedy upto 100 DAS and weed free thereafter	1101	3276	34.58
T-13 Weedy upto 120 DAS and weed free thereafter	1053	3159	33.33
T-14 Weedy upto harvest	1021	3044	32.70
T-15 Pendimethalin 30% EC @ 1.25 kg/ha as pre-emergence	1540	4225	36.44
C.D. (p=0.05)	154.3	400.7	N/A
C.V. (%)	6.3	5.9	5.48

Economics

The application of different weed management treatments resulted in significant differences in the economics of coriander seed crop as shown in Table 2. The highest net return (₹81,262/ha) was obtained under treatment T₄ (weed free up to 80 DAS and weedy thereafter), followed closely by T₅ (weed free up to 100 DAS and weedy thereafter) with net returns of ₹81,132/ha. A similar trend was observed for the benefit cost ratio. Treatment

T₄ recorded the highest B:C ratio (1.71), followed by T₅ (1.70) indicating superior economic efficiency of maintaining the crop weed-free during the early growth stages. These findings suggest that timely weed management during the critical growth period not only improves crop productivity but also enhances economic returns by maximizing resource-use efficiency and profitability. Similar outcomes were reported by Patil *et al.* (2020) [12] and Rathod *et al.* (2021) [14] in coriander.

Table 2: Effect of different weed management treatments on Net Returns (₹/ha) and B:C ratio

Treatments		Total cost of cultivation	Seed yield (kg/ha)	Gross Returns (₹/ha)	Net Returns (₹/ha)	B:C Ratio
T-1	Weed free upto 20 DAS and weedy thereafter	108648	1050	115500	6852	1.06
T-2	Weed free upto 40 DAS and weedy thereafter	110648	1488	163680	53032	1.48
T-3	Weed free upto 60 DAS and weedy thereafter	112648	1710	188100	75452	1.67
T-4	Weed free upto 80 DAS and weedy thereafter	114648	1781	195910	81262	1.71
T-5	Weed free upto 100 DAS and weedy thereafter	116648	1798	197780	81132	1.70
T-6	Weed free upto 120 DAS and weedy thereafter	118648	1812	199320	80672	1.68
T-7	Weed free upto harvest	120648	1819	200090	79442	1.66
T-8	Weedy upto 20 DAS and weed free thereafter	114648	1724	189640	74992	1.65
T-9	Weedy upto 40 DAS and weed free thereafter	116648	1547	170170	53522	1.46
T-10	Weedy upto 60 DAS and weed free thereafter	116648	1258	138380	21732	1.19
T-11	Weedy upto 80 DAS and weed free thereafter	114648	1121	123310	8662	1.08
T-12	Weedy upto 100 DAS and weed free thereafter	113848	1101	121110	7262	1.06
T-13	Weedy upto 120 DAS and weed free thereafter	112648	1053	115830	3182	1.03
T-14	Weedy upto harvest	106648	1021	112310	5662	1.05
T-15	Pendimethalin 30% EC @ 1.25 kg/ha as pre-emergence	109648	1540	169400	59752	1.54

Note: Selling price of coriander seed = 110 ₹/kg

Weed count

The experimental field was infested with the following weed species during the crop growth period: *Chenopodium album* (Bathua), *Poa annua* (Annual bluegrass), *Chenopodium murale* (Khara Bathua), *Fumaria parviflora* (Pitpapda), *Convolvulus arvensis* (Hirankhuri), *Cyperus rotundus* (Motha), *Amaranthus viridis* (Chaulai), *Cynodon dactylon* (Doob Ghaas), *Medicago denticulata* (Jungli Berseem), *Phalaris minor* (Gulli Danda) and *Rumex dentatus* (Jungli Palak). The data presented in Table 3 showed that weed management treatments significantly affected weed population at different crop growth stages. At 30 DAS, the minimum weed population (0.7 no./m²) was recorded in treatments T₂-T₈, while the maximum (19.7 no./m²) was observed

in T₁₁. At 60 DAS, the lowest weed population (0.7 no./m²) was recorded in T₃-T₉ and the highest (18.5 no./m²) in T₁₃. Similarly, at 90 DAS, the minimum weed population (0.7 no./m²) was observed in T₅-T₁₁, whereas the maximum (16.7 no./m²) was recorded in T₁₃. At harvest, the lowest weed population (0.7 no./m²) was recorded in T₇-T₁₃, while the highest (12.6 no./m²) was observed in T₁₄. The reduced weed population under effective weed management treatments was due to timely weed control, which suppressed weed emergence and growth throughout the crop season. In contrast, continuous weed infestation resulted in higher weed density because of unchecked weed growth. Similar findings were reported by Sagarka *et al.* (2005) [15] and Patil *et al.* (2020) [12] in coriander, Patel *et al.* (2019) [11] in ajwain.

Table 3: Effect of different weed management treatments on number of weeds/m² at 30, 60, 90 DAS and at harvest

Treatments		Number of weeds/m ²			
		30 DAS	60 DAS	90 DAS	At Harvesting
T-1	Weed free upto 20 DAS and weedy thereafter	5.7 (32.8)	6.7 (45.3)	8.7 (76.2)	8.1 (66.7)
T-2	Weed free upto 40 DAS and weedy thereafter	0.7 (0.0)	6.0 (36.5)	8.3 (69.5)	7.8 (60.6)
T-3	Weed free upto 60 DAS and weedy thereafter	0.7 (0.0)	0.7 (0.0)	7.8 (62.0)	7.2 (52.3)
T-4	Weed free upto 80 DAS and weedy thereafter	0.7 (0.0)	0.7 (0.0)	6.7 (44.8)	6.4 (40.6)
T-5	Weed free upto 100 DAS and weedy thereafter	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	6.0 (36.4)
T-6	Weed free upto 120 DAS and weedy thereafter	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	4.9 (24.0)
T-7	Weed free upto harvest	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)
T-8	Weedy upto 20 DAS and weed free thereafter	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)
T-9	Weedy upto 40 DAS and weed free thereafter	19.5 (382.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)
T-10	Weedy upto 60 DAS and weed free thereafter	19.1 (365.0)	18.3 (334.5)	0.7 (0.0)	0.7 (0.0)
T-11	Weedy upto 80 DAS and weed free thereafter	19.7 (391.1)	18.4 (340.8)	0.7 (0.0)	0.7 (0.0)
T-12	Weedy upto 100 DAS and weed free thereafter	18.9 (359.0)	17.7 (313.9)	16.3 (266.9)	0.7 (0.0)
T-13	Weedy upto 120 DAS and weed free thereafter	19.2 (371.0)	18.5 (344.3)	16.7 (281.2)	0.7 (0.0)
T-14	Weedy upto harvest	18.3 (354.0)	18.0 (327.0)	16.0 (255.6)	12.6 (158.9)
T-15	Pendimethalin 30% EC @ 1.25 kg/ha as pre-emergence	10.6 (113.7)	9.8 (96.5)	8.7 (76.5)	8.1 (65.4)
C.D. (p=0.05)		0.9	1.0	0.8	0.7
C.V. (%)		6.0	7.9	8.2	9.5

Note: The original data given in the parantheses were subjected to square root transformation ($\sqrt{x + 0.5}$) before analysis

Dry weight of weeds

The data presented in Table 4 indicated that weed management treatments significantly influenced weed dry weight at different growth stages of coriander. At 30 DAS, the minimum weed dry weight (0.7 g/m²) was recorded in treatments T₂-T₈, while the maximum (5.9 g/m²) was observed in T₁₁. At 60 DAS, the lowest weed dry weight (0.7 g/m²) was recorded in T₃-T₉ and the highest (9.2 g/m²) in T₁₃. Similarly, at 90 DAS, the minimum weed dry weight (0.7 g/m²) was observed in T₅-T₁₁, whereas the maximum (15.6 g/m²) was recorded in T₁₄. At harvest, the lowest weed dry

weight (0.7 g/m²) was recorded in T₇-T₁₃, while the highest (20.5 g/m²) was observed in T₁₄.

The lower weed dry weight under effective weed management treatments was attributed to efficient suppression of weed growth and reduced biomass accumulation, whereas continuous weed infestation resulted in greater weed biomass. Comparable results were obtained by Nagar *et al.* (2009)^[9], Patil *et al.* (2020)^[12] and Rathod *et al.* (2021)^[14] in coriander, Patel *et al.* (2019)^[11] in ajwain, Meena *et al.* (2009)^[7] in cumin, Meena *et al.* (2013)^[6] in dill seed.

Table 4: Effect of different weed management treatments on weed dry weight (g/m²) at 30, 60, 90 DAS and at harvest

Treatments		Weed dry weight (g/m ²)			
		30 DAS	60 DAS	90 DAS	At Harvesting
T-1	Weed free upto 20 DAS and weedy thereafter	1.7 (2.6)	2.9 (8.3)	6.8 (46.2)	9.3 (86.3)
T-2	Weed free upto 40 DAS and weedy thereafter	0.7 (0.0)	2.4 (5.4)	5.7 (32.4)	8.6 (74.1)
T-3	Weed free upto 60 DAS and weedy thereafter	0.7 (0.0)	0.7 (0.0)	5.0 (25.5)	7.9 (63.2)
T-4	Weed free upto 80 DAS and weedy thereafter	0.7 (0.0)	0.7 (0.0)	3.4 (11.5)	6.4 (41.4)
T-5	Weed free upto 100 DAS and weedy thereafter	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	4.7 (22.1)
T-6	Weed free upto 120 DAS and weedy thereafter	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	2.2 (4.6)
T-7	Weed free upto harvest	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)
T-8	Weedy upto 20 DAS and weed free thereafter	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)
T-9	Weedy upto 40 DAS and weed free thereafter	5.5 (30.3)	0.7 (0.0)	0.7 (0.0)	0.7 (0.0)
T-10	Weedy upto 60 DAS and weed free thereafter	5.1 (26.0)	8.9 (80.1)	0.7 (0.0)	0.7 (0.0)
T-11	Weedy upto 80 DAS and weed free thereafter	5.9 (34.4)	9.0 (81.6)	0.7 (0.0)	0.7 (0.0)
T-12	Weedy upto 100 DAS and weed free thereafter	5.2 (27.3)	8.9 (79.5)	15.1 (229.0)	0.7 (0.0)
T-13	Weedy upto 120 DAS and weed free thereafter	5.6 (32.2)	9.2 (84.7)	15.3 (236.6)	0.7 (0.0)
T-14	Weedy upto harvest	5.2 (27.0)	9.1 (82.7)	15.6 (245.5)	20.5 (421.4)
T-15	Pendimethalin 30% EC @ 1.25 kg/ha as pre-emergence	2.7 (7.0)	5.0 (24.6)	7.7 (60.1)	10.7 (114.6)
C.D. (p=0.05)		1.7	0.4	0.5	0.6
C.V. (%)		8.2	7.3	6.1	7.2

Note: The original data given in the parantheses were subjected to square root transformation ($\sqrt{x + 0.5}$) before analysis

Conclusion

Based on one year study, it may be concluded that weed management practices significantly influenced weed dynamics, yield and economics of coriander. Maintaining the crop weed-free throughout the growing season produced the highest seed yield (1819 kg/ha), biological yield (4835 kg/ha) and harvest index (37.85%). The critical period of crop-weed competition in coriander was found in between 20 to 60 DAS. Therefore, the

crop should be kept weed-free during this period to prevent significant yield loss. Economically maintaining the crop weed-free up to 80 DAS followed by weedy conditions proved to be the most profitable treatment recording the highest net return (₹81,262/ha) and benefit-cost ratio (1.71). Thus, timely weed management during the critical period is essential for maximizing coriander productivity and profitability.

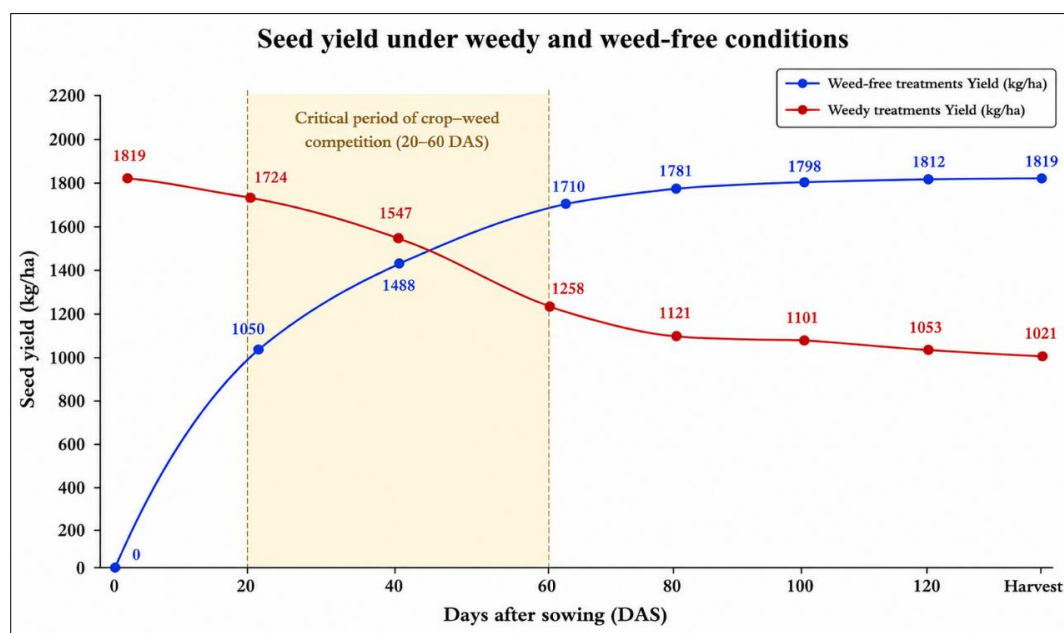


Fig 1: Critical period (20-60 DAS) of crop-weed competition in coriander crop

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