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Effect of crop-weed competition on growth and yield attributes, economics and quality of cumin

B.M. Chaudhari, S.M. Patel* and S.A. Patel

C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar - 385 506

Abstract

Cumin (*Cuminum cyminum* L.) is one of the most important seed spice crops of India since ancient time. A field experiment was laid out to study the effect of crop weed competition on growth and yield attributes, yield, economics and quality of cumin. No significant difference in the growth and yield attributes as well as seed yield were recorded in weed free condition maintained beyond 45 DAS and weedy check up to 15 DAS, but attributes differed significantly with weed free up to 30 DAS as well as weedy check beyond 30 DAS. Allowing weeds to compete with crop after 30 DAS and up to harvest significantly reduced yield attributes and seed yield compared to weedy check up to 15 DAS. Volatile oil content was not influenced significantly due to different crop weed competition treatments. The highest seed yield (470.5 kg ha^{-1}) was recorded in throughout weed free condition, but higher net return (38,905 ₹ ha^{-1}) and BCR (2.36) were recorded with treatment weed free up to 45 DAS due to reduced expenditure on weed management as compared to throughout weed free condition.

Key words : Cumin, crop-weed competition, seed yield, weed dynamics.

Introduction

Cumin (*Cuminum cyminum L.)* is short duration seed spice crop of arid and semi arid regions of India. Due to low requirement of inputs, sensitively to climatic aberrations and higher market price, it is termed as low volume, high value crop bearing risk. The seeds of cumin are used for many purposes *viz*., condiments, medicinal, flavoring and seasoning agents. Cuminaldehyde or cuminal is (36.31 per cent) attributes the specific value added aroma, has carminative, stomatic, anti-diarrheal and dyspepcial medicinal properties (Rathore *et al*., 2013). This crop is widely adapted as an important commercial crop in the arid and semi arid regions of Gujarat and Rajasthan states. Both the states contribute more than 80% in the total cumin production of the country (Malhotra & Vashishtha 2008). In India, during 2016-17, the area and production of cumin were 7.60 lakh hectare and 4.86 lakh tones, respectively with an average productivity of 640 kg ha^{-1}, is the highest in the world (DASD, 2017). During 2016-17, the area and production of cumin were 2.78 lakh hectare and 2.84 lakh tones respectively with an average productivity of 1022 kg ha^{-1} for Gujarat (DOA, 2017). The major growing districts are Mehsana, Banaskantha, Kachchh, Ahmedabad and Surendranagar in Gujarat. Requirement of soil moisture for initial 10-15 days to get proper germination, slow initial growth, short stature of the crop and poor canopy cover provides congenial environment for the luxurious growth of weeds, which offer severe competition for essential resources (water, nutrient and space) and cause yield reduction to the tune of 80 per cent and some time complete crop failure (Yadav *et al.,* 2004). Therefore, effective weed control is prerequisite to get the desired level of yield as well as to increase the resource use efficiency (water and nutrients) as arid and semi arid soils are already deficient in these resources. The removal of the weeds throughout the crop season may not be beneficial and economical, therefore it is necessary to eliminate weeds stipulated time of life span of crop. Zimdahl (1980) defined crop weed competition period as a "span of time between that period after seeding or emergence when weed competition does not reduce crop yield and the time after which weed competition will no longer reduce crop yield". However, knowledge of time of weed removal can play a vital role to avoid extravagant expenses. Moreover, knowledge of the weed flora and critical period of weed removal is of utmost importance to suggest economic and effective weed control practices. Hence, the present investigation was undertaken to assess the weed dynamics and also to identify the effect of critical period of weed removal on yield and its attributes under North Gujarat agro-climatic condition.

Materials and methods

In order to evaluate the effect of crop weed competition on growth and yield attributes, yield, economics and quality

*Corresponding author email: shileshp1967@gmail.com

of cumin, an investigation was carried out at the Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, S. D. Agricultural University, Sardar krushinagar during *rabi* season of 2017-18. The soil of the experimental site was loamy-sand in texture with electrical conductivity of 0.11 dS m^{-1} and pH 7.61. The soil was low in organic carbon (0.31%) and low in available nitrogen (136.56 kg ha^{-1}), medium in available phosphorus (43.41 kg ha^{-1}) and medium in available potassium (253.02 kg ha^{-1}). The experiment consisted of 10 different treatments including T_1 : weed free up to 15 DAS, T_2: weed free up to 30 DAS, T_3 : weed free up to 45 DAS, T_4 : weed free up to 60 DAS, T_5 : weed free up to harvest, T_6: weedy check up to 15 DAS, T_7 : weedy check up to 30 DAS, T_8 : weedy check up to 45 DAS, T_9 : weedy check up to 60 DAS and T_{10} : weedy check up to harvest. The experiment was laid out in RBD with three replications. Cumin variety 'GC 4' was treated with thiram @ 3.0 g per kg seed to protect the crop against fungal diseases and sown in rows at 30 cm apart, using a seed rate of 10 kg ha^{-1} on 8th November, 2017. The crop was fertilized with recommended dose of nitrogen (40 kg ha^{-1}) and phosphorus (15 kg ha^{-1}) uniformly. The full dose of phosphorus and 1/3rd dose of nitrogen were applied as basal dose in the previously opened furrow in form of Urea and DAP, respectively. The remaining 2 /3rd dose of nitrogen were applied in two equal splits at 8 to 10 and 30 DAS. The crop was harvested on 24th February, 2018. The observations on various growth and yield attributes were recorded during the course of investigation. The economics of various crop weed competition treatments were computed considering the weeding cost of each treatment over weedy check and gross return was worked out on prevailing market price of cumin. The volatile oil content (%) of seed was estimated as per steam distillation method (A.O.C.A., 1970).

Results and discussion

Effect on growth and yield attributes

Growth and yield attributing parameters showed significant variation due to different crop weed competition treatments (Table 1). Maximum plant height, branches $plant^{-1}$, umbels $plant^{-1}$, umbellate $umbel^{-1}$, seeds $umbel^{-1}$ and test weight were obtained in the plots kept weed free up to harvest and minimum in season long weedy check. Plots kept weed free up to 45, 60 DAS and at harvest as well as weedy check up to 15 DAS also resulted in significant improvement in all growth and yield attributes which were statistically at par with each other. The positive influence of these treatments leading to least crop weed competition had increased the availability of nutrient for longer period, which helped to produce enhance growth and yield parameters in cumin. These results are in line with those reported by Mehriya *et al*., (2007) and Patel *et al*. (2016) in cumin. Treatment T_{10}: weedy check up to harvest recorded minimum values of all the growth and yield attributes. Higher seed yield (470.5 kg ha^{-1}) was achieved in the treatment weed free up to harvest condition, which was statistically at par with the treatments weed free up to 45 and 60 DAS as well as weedy check up to 15 DAS. This might be because of lesser crop weed competition at early growth period, which positively contributed to higher growth and yield attributing parameters resulting in to higher seed yield. Kumar (2001) also reported significant increase in the seed yield of cumin with increase in duration of weed free condition. Weeds allowed to compete with crop plants up to 30, 45 and 60 DAS reduced the seed yield by 22.06, 37.66 and 53.94 per cent, respectively over season long weed free environment. Maintaining weed free environment at early stage only (up to 15 DAS), significantly reduced seed yield, which was 31.62 per cent lower than season long weed free period. Results on seed yield indicated that early removal of weeds (up to 15 DAS) is not enough to check the weeds that emerged at later stage, while weeding at later stage is not capable to recover the loss caused due to delay in weeding. The results are in conformity with the findings of Mehriya *et al*., (2007) and Meena *et al*. (2009) in cumin. Weedy check, up to harvest recorded lowest seed yield (94.3 kg ha^{-1}), which was 79.95 per cent lower over weed free up to harvest treatment (Table 1). Volatile oil was not significantly affected by different crop weed competition treatments (Table 1). These results corroborate are in accordance with the finding of Patel *et al*., (2016) in cumin.

Economics

Higher net return of (38905 ₹ ha^{-1}) was achieved with treatment weed free up to 45 DAS and was closely followed by treatments weedy check up to 15 DAS (38770 ₹ ha^{-1}), weed free up to harvest (38766 ha^{-1}) and weed free up to 60 DAS (38047 ₹ ha^{-1}). The respective rise in percentage for net return in to treatments T_3, T_6, T_5 and T_4 were 494.69, 493.32, 493.28 and 485.98 per cent higher over T_{10}, respectively. The lowest net return of (-) 9857 ₹ ha^{-1} was recorded with treatment T_{10} : unweeded control (Table 2). Higher value of BCR i.e., 2.36 was attained when crop was kept weed free up to 45 DAS (T_3) and was closely followed by treatments T_6 (2.28), T_4 (2.26) and T_5 (2.22). The lowest BCR (0.59) was registered under T_{10} : unweeded control. The reduction in the net return and BCR could be attributed to the production of lower seed yield due to higher crop weed competition in weedy check compared to weed free condition. These findings are in

close proximity with those reported by Patel *et al*., (2016) in cumin.

Quality

The results indicated that different crop weed competition treatments did not emerge into any significant effect on volatile oil content (Table 1). There was no beneficial or harmful effect on volatile oil content due to different crop weed competition treatments. Yadav (2008) and Patel *et al.,* (2016) observed the same trend for volatile oil content in the cumin.

Table 1. Growth and yield attributes, yield and quality of cumin as influenced by various crop weed competition treatments

Treatments	Plant height (cm)	No. of branches plant^{-1}	No.of umbels plant^{-1}	No. of umbellates umbel^{-1}	No. of seeds umbellate^{-1}	1000 seeds weight (g)	Seed yield (kg ha^{-1})	Volatile oil (%)
T1	23.30	5.90	13.20	3.73	4.33	4.23	321.7	4.6
T2	24.87	6.60	16.27	4.13	6.03	4.37	331.7	4.7
T3	27.20	7.37	22.60	5.20	6.43	4.56	450.6	4.8
T4	28.37	7.80	23.33	5.37	6.80	4.72	455.4	4.9
T5	30.17	9.03	26.23	6.13	8.03	5.12	470.5	5.0
T6	28.73	8.20	24.27	5.77	6.83	4.82	460.2	4.9
T7	27.00	7.07	19.23	4.93	6.10	4.71	366.7	4.8
T8	23.77	6.73	17.53	4.17	4.67	4.49	293.3	4.7
T9	22.30	6.50	14.37	3.63	2.77	4.22	216.7	4.6
T10	20.13	5.00	9.43	3.03	2.07	3.75	94.3	4.5
S.Em. ±	1.69	0.62	2.12	0.37	0.58	0.30	29.06	0.21
CD (P=0.05)	5.04	1.85	6.31	1.10	1.71	0.89	86.34	NS
CV %	9.37	12.52	16.10	11.37	15.06	9.36	11.88	6.32

Table 2. Economics of cumin as influenced by different crop weed competition treatments

Treatments	Seed yield (kg ha^{-1})	Gross return (₹ ha^{-1})	Total cost of cultivation (₹ ha^{-1})	Net return (₹ ha^{-1})	BCR
T1	321.7	48255	25562	22693	1.89
T2	331.7	49755	27122	22633	1.83
T3	450.6	67587	28682	38905	2.36
T4	455.4	68309	30262	38047	2.26
T5	470.5	70568	31802	38766	2.22
T6	460.2	69032	30262	38770	2.28
T7	366.7	55005	28682	26323	1.92
T8	293.3	43995	27122	16873	1.62
T9	216.7	32505	25562	6943	1.27
T10	94.3	14145	24002	-9857	0.59

*Price of cumin ₹ 150 kg^{-1}.

Conclusion

Based on one year investigation, it is concluded that crucial period of crop weed competition of cumin is up to 45 DAS so to achieve remunerative higher seed yield and enhanced net return.

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