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Impact of soil solarization on weed infestation and productivity of cumin (*Cuminum cyminum* L.)

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Abstract

An experiment was carried out with ten different treatments including, soil solarization alone; soil solarization combined with other treatments to see the effect on weed infestation and productivity of cumin. The minimum numbers of weed/m^2 and weeds dry matter/m^2 area were recorded in (SS-30 day + *Trichoderma* + NC) and minimum in control. Maximum seed as well as biological yield (q ha^{-1}) was recorded in (SS-30 day + *Trichoderma* + NC) followed by (SS-20 day + *Trichoderma*+ NC). The maximum harvest index (%) was noticed in (SS-20 day + *Trichoderma* + NC) followed by (SS-10 day + *Trichoderma* + NC). The economics of the treatments showed highest net profit approximately ₹ 76117.26 ha-1 was recorded in (SS-30 day + *Trichoderma* + NC) followed by ₹ 67301.26 ha^{-1} in (SS-20 day + *Trichoderma* + NC) while the minimum net return was recorded in control. The highest cost: benefit ratio (BCR) 1.94 was found in (SS-30 day + *Trichoderma* + NC) and minimum (1.24) in control.

Key words: Cumin, dry matter, neem cake, soil solarization, *Trichoderma*, weed infestation, yield.

Cumin (*Cuminum cyminum* L.) is an important seed spice crop of Apiaceae family. It grows to a height of 15-30cm according to environmental conditions. Adaptation to different environmental condition is one of its characters. In addition, culture and harvest time, low water and fertilization requirement and its high economic value makes it valuable in agriculture (Moraghebi and Etemadzadeh, 2006). Cumin is produced in Iran, Lebanon, Cypress, Egypt, India, Syria, China, Indonesia, Mexico and Argentina (Karbacy, 2002). Production of spices in India during 2015-16 was 69.01 lakh tonnes from the cultivated area of 34.57 lakh hectare of which cumin production was 5.03 lakh tonnes from 8.08 lakh hectare area (Anonymous, 2016). India is the largest producer (70% of world production), exporter and consumer of cumin seed across the world (Shastry and Anandaraj, 2014). In India, cumin is cultivated mainly in Rajasthan, Gujarat and in some part of Madhya Pradesh as a r*abi* crop. Although the cumin production as well as productivity still remains low due to pests among them the severe weed competition is one of the key factors that require managing eco-friendly. Cumin seed takes 10-12 days in germination which is more than enough to cover the cumin field by the weeds as weed seed usually take few days only. Moreover, cumin being irrigated crop, weeds emerge up to later stage of crop growth (Maheriya *et al.,* 2008). Cumin, being a short size crop with slow initial growth, heavily infested with several weed species which cause severe competition, resulting in yield reduction of cumin up to 99% (Yadav *et al.*, 2004). Many herbicides such as pendimethalin and fluchloralin, applied as pre-emergence/pre-plant incorporation (PPI) have been found effective for controlling weeds in cumin (Parihar and Singh, 1994), but these dinitroanilines are reported to have residual effects on succeeding crop of pearl millet in western Rajasthan and Gujrat (Yadav e*t al.*, 2004). The present technology available are either less effective or ecologically not viable hence, keeping this in mind the present investigation was carried out to enhance the production and productivity of cumin sustainably.

The experiment was laid down at research farm of ICAR-National Research Centre on Seed Spices, Tabiji, Ajmer, Rajasthan, India during 'Rabi' season of 2014-2015. The experiment was comprised of ten treatments including soil solarization (SS) alone and soil solarization (SS) combined with neem cake and bio-control agent (Trichoderma) viz SS-10 day only, SS-20 day only, SS-30 day only, SS-10 day + BCA, SS-20 day + BCA, SS-30 day + BCA, SS-10 day + BCA + NC, SS-20 day + BCA + NC, SS-30 day + BCA + NC and Control. All the treatments were statistically laid out in randomized block design (RBD) with three replications. Yield attributes and weed observations were recorded, weed infestation, seed yield (q ha^{-1}) and harvest index (%) was calculated and based on this net return of was calculated to see the best treatments among them. White transparent plastic sheet of 100u was used during hottest months (May-

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June) for conducting soil solarization. Data collected as mentioned in table-1 were subjected to statistical analysis through adopting appropriate methods of analysis of variance as described by Cochran and Cox (1967). Whereas, the variance ratios (F-values) were found significant level of probability, the critical difference (CD) values were computed for making comparison among the treatment means. Summary table along with SEm ± and CD were prepared.

Weed flora in the experimental field was consisted mainly of *Chenopodium murale* L., *C. album* L., *Cynodon dactylon* L. *and Cyperus rotundus* L. However, predominant weeds were *C. murale* L. (52.0%), *C. album* L. (8.5%) and *S. rotundus* L. (3.0%). The dry weight of total weeds reduced significantly by all the weed control treatments compared to control (Table 1). Results (Table 1) explained that the minimum average number of weed per m^2 area (8.75) was found during complete crop growth span in (SS-30 day + *Trichoderma* + NC) followed by (11.33) in (SS-30 day + *Trichoderma*), while the maximum average number of weed per m^2 area (55.00) were reported in control. In soil solarized plots the weeds were recorded almost negligible in number and biomass at all the crop growth stages. These findings are in close conformity with other workers such as Othieno and Ahn (1980) in young clonal tea plants, Ibarra-jimenez *et al.*, (2004) in cucumber, Ramakrishna *et al.*, (2006) in groundnut, and Rajablariani *et al.*, (2012) in tomato. Minimum average weeds dry matter (biomass) per m^2 area (3.92 g) was reported in complete crop growth span of plants in (SS-30 day + *Trichoderma* + NC) followed by (3.95 g) in (PM - 30 day + *Trichoderma*), while the maximum average weeds dry matter per m^2 area (21.83 g) was recorded in control. It was also reported that the soil solarization reduced weed pressure in cumin crop. It was emulated that the increase in weed density and their biomass interrupted cumin growth. Similar results earlier researchers were also noted that the weed density on no-plastic mulched plots was over four times higher than weed density for mulched plots. Al-Masoom *et al.*, (1993) and Campiglia *et al.*, (1998) both workers reported that solarization significantly reduced weed pressure and increased head lettuce yields. Solarization mulch color also affects weed density and founded by various workers such as Campiglia *et al.*, (1998), who reported that densities and dry weight yields of weeds on solarized soils were lower for transparent film than for black mulch.

Summarized results (Table 1) depicted that the maximum seed yield (10.2 q ha^{-1}) was recorded in (SS-30 day + *Trichoderma* + NC) followed by (9.7 q ha^{-1}) in (SS-20 day + *Trichoderma* + NC), while the minimum seed yield (2.1 q ha^{-1}) was recorded in control. The maximum harvest index per plant (39.27 %) was recorded in (SS-20 day + *Trichoderma* + NC) followed by (35.99 %) in (SS-10 day + *Trichoderma* + NC). While the minimum harvest index (28.77 %) was reported in control. Earlier workers reported similar effects like three colored plastic mulches such as black, red and yellow were effective and significantly increase the growth of cumin plants (Sharma, *et al.*, 2013), in tomato, Ibarra-jimenez *et al.*, (2004) in cucumber, Sekhon *et al.*,(2005) in Soybean (*Glycine max*) and Meena *et al.*, (2014) in fennel. The presented data (Table 1) mentioned indicate that harvest index was also significantly influenced by different Soil solarization and the maximum harvest index was recorded in (SS-20 day + *Trichoderma* +NC) followed by (SS-10 day + *Trichoderma* + NC) as compared to control. Almost similar results were obtained earlier by Najafabadia *et al.*, (2012) in garlic.

Table 1. Effect of soil solarization (SS) on weed infestation and productivity of cumin

S.no.	Treatments	Number of weeds m^2 $area^{-1}$	Weed dry matter (g m^2 $area^{-1}$)	Seed yield productivity (q ha^{-1})
1.	SS-10 day only	36.67	7.38	7.52
2.	SS-20 day only	24.25	6.21	8.1
3.	SS-30 day only	15.75	3.98	8.3
4.	SS-10 day + *Trichoderma*	30.17	6.87	7.55
5.	SS-20 day + *Trichoderma*	19.42	6.17	8.12
6.	SS-30 day + *Trichoderma*	11.33	3.95	8.23
7.	SS-10 day + *Trichoderma* + NC	26.00	6.95	7.68
8.	SS-20 day + *Trichoderma* + NC	21.58	5.13	9.7
9.	SS-30 day + *Trichoderma* + NC	8.75	3.92	10.2
10	Control	55.00	21.83	2.1
	S. Em±	1.03	0.35	0.27
	CD (P = 0.05)	3.06	1.03	0.80
	CV (%)	7.17	8.26	6.01

Note: SS = Soil solarization **NC =** Neem cake

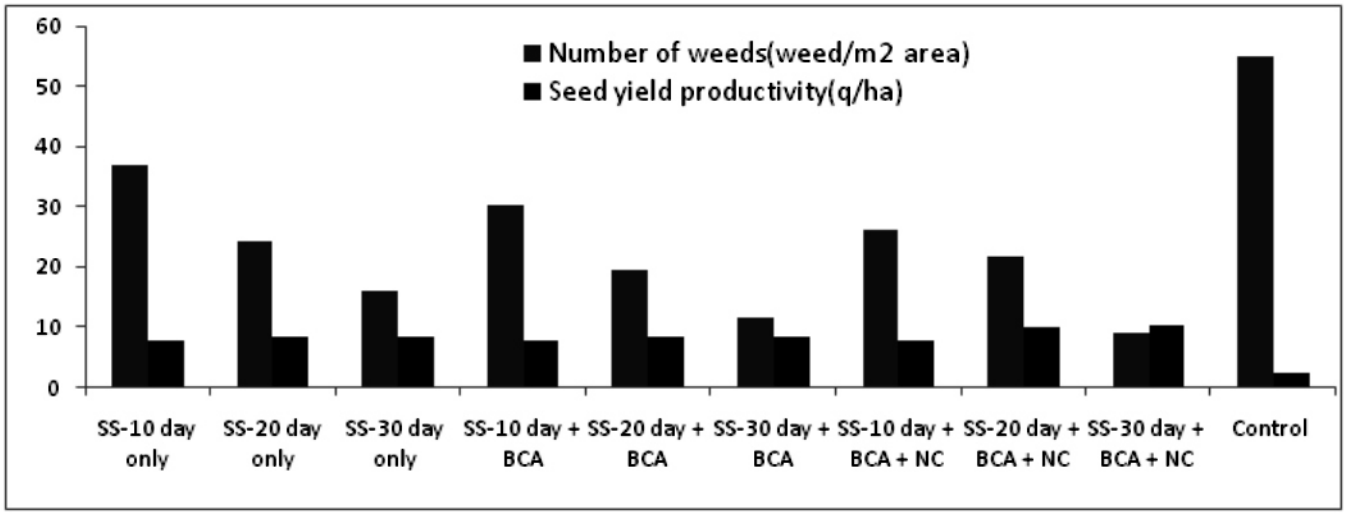

Fig. 1. Relationship between weed infestation and productivity in cumin

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