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Economic feasibility of neem cake, *Trichoderma* and soil solarization on weed management in cumin (*Cuminum cyminu*m L.)

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Abstract

An experiment was carried out in *Rabi* season during 2014-15 at ICAR-National Research Centre on Seed Spices, Ajmer. The experiment was comprised of different treatments including, neem cake, *Trichoderma* and soil solarization. The treatments effect was observed on degree of weed infestation. The minimum number (8.75) of weed/m^2 and weeds dry matter (3.92g/m^2) in a unit area was recorded in (SS-30 day + *Trichoderma* + NC) followed by in (SS-30 day + *Trichoderma*). The maximum number (55.0) of weed/m^2 and weeds dry matter (21.83g/m^2) in a unit area was recorded in control. Maximum productivity (10.2 q ha^{-1}) was recorded in (SS-30 day + *Trichoderma* + NC). The economics of the treatments was worked out to find out the feasibility to adopt them for management of the weeds. The maximum cost benefit ratio (BCR) 1.94 was obtained in (SS-30 day + *Trichoderma* + NC) followed by (SS-30 day + *Trichoderma*) while minimum (1.24) in control.

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

Introduction

Cuminum cyminum L. (cumin) is one of the most important spices and it is considered as a seed spice crop. Cumin belongs to Apiaceae family and it is an annual plant which growing to a height of 15- 30 cm according to environmental conditions. It has been known as one of the most important medicinal plants in Iran (Moraghebi and Aghelpasand, 2008). This is usually referred as *'low volume high value crop'*. Cumin is one of the most remunerative (beneficial) crop in terms of economic value for the arid and semi arid regions. Adaptation to various environmental conditions is one of its important characters. Because of low water and fertilization requirement and its high economic value makes this valuable in agriculture (Moraghebi and Etemadzadeh, 2006). The flavoring property of cumin is due to aromatic essential oil, which can be easily steam distilled *in vitro*. *Cuminum cyminum* exerted antimicrobial, insecticidal, anti-inflammatory, analgesic, antioxidant, anticancer, antidiabetic, antiplatelet aggregation, hypotensive, bronchodilatory, immunological, contraceptive, anti-amyloidogenic, anti-osteoporotic, aldose reductase , alpha-glucosidase and tyrosinase inhibitory effects, protective and central nervous effects (Esmail and Snafi, 2016). The similar anti-fungal substance in cumin oil was earlier reported, that inhibits the growth of *Fusarium oxysporum*, a fungus responsible for wilt disease in several crops (Agrawal and Gour, 1992). Cumin seeds have an aromatic fragrance due to an alcohol called cuminol. Cumin is produced in Iran, Lebanon, Cypress, Egypt, India, China, Indonesia, Syria, Mexico and Argentina (Karbacy, 2002). The total spices production in India (2016-17) was 86.0 lac tonnes (8.6 million tonns) from the cultivated area of 40.31 lac hectare of which cumin production was 5.0 lakh tonnes from 7.8 lakh hectare area (Anonymous, 2018). India is the largest producer (70% of world production), exporter and consumer of cumin seed across the globe (Shastry and Anandaraj, 2014). In India, cumin is cultivated mainly in Rajasthan, Gujarat and in some part of Madhya Pradesh as a *Rabi* crop. Rajasthan and Gujarat state together contribute approximately 90 per cent of total cumin production of the country. Although the cumin production as well as productivity still remains low due to soil borne pests among them the severe weed competition is one of the important factors that are needed to manage eco-friendly. The present strategy 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 sustainably.

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Materials and methods

The experiment was conducted at research farm of ICAR-National Research Centre on Seed Spices (NRCSS); Ajmer, Rajasthan, during ðRabiò season of 2014-2015. Geographically the centre lies on 74^0 35ǫ39ƐE to 74^0 36ǫ 01Ɛlongitude, 26^0 22ǫ12Ɛto 26^0 22ǫ31ƐN latitude and at an altitude of 460.17 m above mean sea level, in Ajmer (Rajasthan). The region falls under agro climatic zone III of Rajasthan. The soil of research farm (NRCSS) is sandy loam, poor in fertility and water holding capacity, having pH 8 to 8.3, EC 0.07 to 0.12 and 0.15 to 0.23% organic carbon, available N 178.5 kg ha^{-1} (low), P_2O_5 12 kg ha^{-1} (medium), K_2O 85 kg ha^{-1} (low), Ca 214.7 kg ha^{-1} (high), Mg 258 kg ha^{-1} (medium), S 27 kg ha^{-1} (high). The experiment was comprised of ten treatments *viz*, soil solarization and soil solarization combined with neem cake and bio-control agent (*Trichoderma*) cited in (Table 1). All the treatments were laid out in randomized block design (RBD) with three replications. Various observations were recorded such as seed yield (q ha^{-1}), number of weed/ m^2(g) and weeds dry matter/m^2 area was calculated and based on this economic feasibility of each treatment obtained to select the best treatments among them. Data collected during the present investigation were subjected to statistical analysis by adopting appropriate methods of analysis of variance as described by Cochran and Cox (1967). Whereas, the variance ratios (F-values) were found significant at 5 per cent level of probability, the critical difference (CD) values were computed for making comparison among the treatment means.

Results and discussion

Results summarized in 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 test weight (weight of 1000 seeds) was found in (3.21 g) highest in (SS-30 day + *Trichoderma* + NC). The minimum average number of weed per m^2 area (8.75) was found at 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 (55.0) were reported in control. In soil solarized plots the weeds were recorded almost negligible in biomass at all the crop growth stages. The increase in weed density and their biomass to such an extreme level may interrupt cumin growth. These findings are in close conformity with Ibarra-jimenez *et al.,* (2004) in cucumber, Ramakrishna *et al.,* (2006) in groundnut. Results in (Table 1) explain that the minimum

Table 1. Combined effect of soil solarization (SS), neem cake and weed infestation on weed infestation and productivity of cumin

Treatments	Number of weeds (weed/m^2)	Dry weed weight (g/m^2)	Seed yield (q ha^{-1})	CB ratio
Soil solarization 10 day	36.67	7.38	7.52	1.36
Soil solarization 20 day	24.25	6.21	8.1	1.45
Soil solarization 30 day	15.75	3.98	8.3	1.79
Soil solarization 10 day with *Trichoderma*	30.17	6.87	7.55	1.70
Soil solarization 20 day with *Trichoderma*	19.42	6.17	8.12	1.76
Soil solarization 30 day with *Trichoderma*	11.33	3.95	8.23	1.86
Soil solarization 10 day with *Trichoderma* + NC	26.00	6.95	7.68	1.79
Soil solarization 20 day with *Trichoderma* + NC	21.58	5.13	9.7	1.82
Soil solarization 30 day with *Trichoderma* + NC	8.75	3.92	10.2	1.94
Control	55.00	21.83	2.1	1.24
S. Em±	1.03	0.35	0.27	0.11
CD (P = 0.05)	3.06	1.03	0.80	0.30
CV (%)	7.17	8.26	6.01	6.05

Note: SS-Soil solarization, NC- Neem cake, CB-Cost benefit

average weeds dry matter 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 reported in control. It was also reported that the soil solarization reduced weed pressure in polyethylene covered treatments. Similar to the our results earlier researchers 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) reported that solarization significantly reduced weed pressure and increased head lettuce yields. Solarization mulch color also affects weed density and founded by several workers, who reported that densities and dry weight yields of weeds on solarized soils were lower for transparent film than for black mulch. Three colored plastic mulches such as black, red and yellow were effective and significantly increase the growth of cumin plants (Sharma, *et al*., 2013) and fennel (Meena *et al.,* 2014).

Summarized results (fig. 1) depicted that the highest seed yield (10.2q ha^{-1}) was recorded in treatment SS -30 day + NC followed by (9.7q ha^{-1}) in treatment SS -20 day + NC, while the minimum seed yield (2.1q ha^{-1}) was recorded in control. Result were similar with earlier researchers. Soil solarization showed positive effect on plant growth, plant vigour, seed setting and seed quality. Three different coloured plastic mulches such as black, red and yellow were effective and significantly increase the growth of cumin plants (Sharma *et al*., 2013). Economic feasibility of the treatments was calculated on the basis of cost of production and economic return from the treatments and showed as cost-benefit ratio for each treatment. The maximum cost benefit ratio (1.94) was obtained in SS-30 day + *Trichoderma* + NC followed by (1.86) in SS-30 day + *Trichoderma'* while it was minimum (1.24) in control.

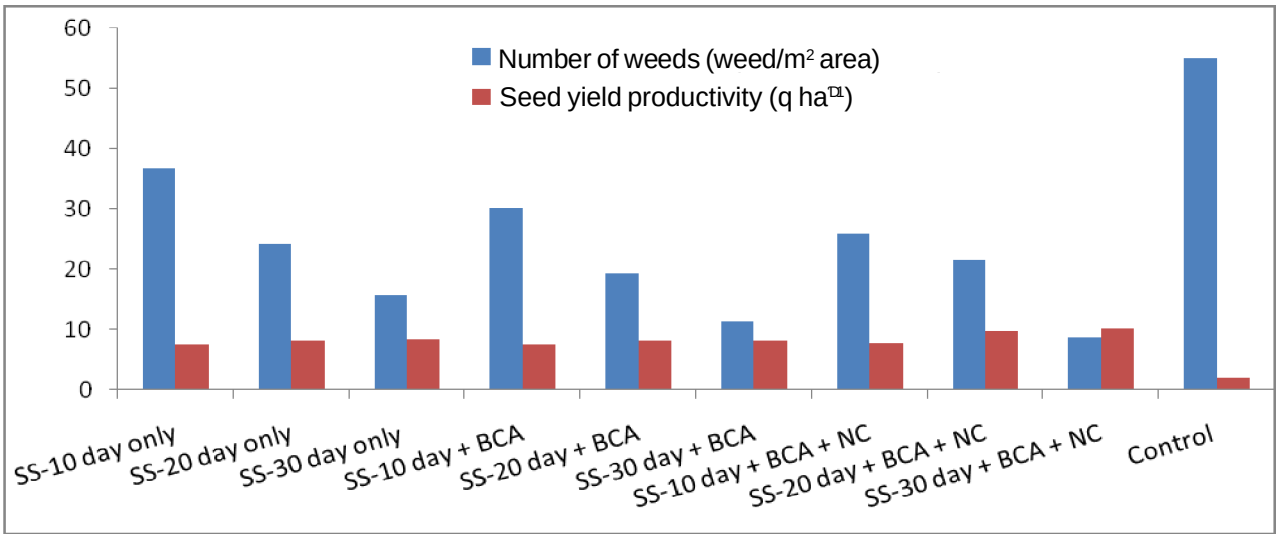

Fig. 1. Relationship between weed infestation cumin productivity

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