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Application of biodynamic preparations and organic manures for organic production of cumin *(Cuminum cyminum* L.*)*

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ABSTRACT

Cumin (*Cuminum cyminum* L.) is a harbacous and medicinal crop which is one of the most important export crop of India. Export of organic spices is increasing from India and cumin is one of them. This study was conducted to develop package of practice for production of organic cumin. The objective of this field study was to evaluate the effect of biodynamic manure (BD 500 and BD 501) in combination with vermicompost and farm yard manure on growth and yield of cumin. The effect of BD 500 and BD 501 in combination with FYM and vermicompost was evaluated following all practices of organic management for insect – pest and disease control. The results showed that the application of BD 500 and BD 501 along with either FYM @ 6t/ha or vermicompost @ 2t/ha recorded a significant increase of 20.56 and 12.85 percent in seed yield of cumin over the application of FYM @ 6t/ha and Vermicompost @ 2t/ha alone, respectively. The results showed that application of FYM @ 6 t ha^{-1} is significantly superior in enhancing the yield of cumin in comparison to vermicompost @ 2 t ha^{-1} under organic production system. Combined application of biodynamic manure BD 500 and BD 501 with FYM or vermicompost gave an additional yield of 94 to 130 kg ha^{-1} in comparison to sole application of FYM or vermicompost to cumin. Application of BD 500 together with BD 501 had the significant effect on yield of cumin over the application of BD 500 only and gave and additional yield of 48 to 95 kg ha^{-1}. Indeed, integrated use of organic manure + biodynamic preparations (BD 500 and BD 501) resulted into the maximum increase in yield attributes and yield of cumin under organic production system.

Keywords: Biodynamic manure, *Cuminum cyminum,* FYM, Seed yield and Vermicompost.

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INTRODUCTION

Interest in food production without synthetic fertilizers practices are increasing. Such food is commonly referred to as organic (Ramesh *et al*., 11). Various organic technologies have been utilized for about 600 years to make agriculture sustainable while conserving soil, water energy and biological resources (Pimentel *et al.,* 9).

Organic farming is gaining gradual momentum across the world. In India, about 528171 hectare area is under organic farming with 44,926 number of certified organic farms (Willer, 17).

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Biodynamic farming, *i.e*., combining biological and dynamic agriculture practices, has recently emerged as an advancement of organic agriculture. Just as organic farming, the product of biodynamic agriculture are nutritionally superior and they taste better than the conventional food (Steiner, 14), besides having the potential to mitigate some of the negative effects of chemical agriculture. The biological practices usually include a series of organic farming techniques that improve soil health while the dynamic techniques that intended to promote the metaphysical aspects of the farm, *e.g.* planting seeds during certain lunar phases to adapt to the natural rhythms of the planetary system (Pfeiffer, 8). India currently produces approximately 0.115 million tones spices on a certified, cultivated area of 658.4 hectares (APEDA, 1). Cumin *(Cuminum cyminum L.)* is one of the most important export crops of India and state of Rajasthan dominates in production of cumin in India. Being a cash crop, there is a great demand of organic cumin (Sahota, 13). Organic spices in Rajasthan represent a very negligible part of our total spice production. The one of the constraint in increasing the area under organic spice production is lack of suitable organic production practices for different agro-climatic regions. The present investigation was aimed to study the influence of certain biodynamic practices and organic manures on growth and yield of cumin in southern Rajasthan.

MATERIALS AND METHODS

The experiment was conducted for two consecutive years during *rabi*, 2009 and 2010 at Dryland Farming Research Station, Bhilwara of Maharana Pratap University Agriculture and Technology, Udaipur (Rajasthan). The region enjoys a semi-arid climate characterized by extremes of temperature both in summer and winter with average annual rainfall of about 650 mm that is mostly received in rainy season from July to September. The soils of the experimental fields were sandy-loam in texture and alkaline (pH 8.64) in reaction. The soil was low in organic carbon (0.35), available nitrogen (176.0 kg ha^{-1}) and medium in available phosphorus (39.0 kg ha^{-1}), high in available potassium (410.0 kg ha^{-1}) and deficient in DTPA extractable iron (3.2 ppm) and zinc (0.56 ppm). The eight treatments *viz.* vermicompost @ 2t ha^{-1}, FYM @ 6t ha^{-1}, BD500+ Vermicompost@ 2t ha^{-1}, BD500+FYM @ 6t ha^{-1}, BD500+ BD501+Vermicompost@ 2t ha^{-1}, BD500+ BD501+FYM @ 6t ha^{-1} and two absolute control (with and without water spray) were laid out in randomized block design with three replications.

Preparation and application of the biodynamic preparations:

Two biodynamic formulation (BD 500 and BD 501) sourced from the SUPA Biotech (P) Ltd., Nainital, India were tried. BD 500 (horn manure preparation), the "prime starter of biodynamic," is prepared by stuffing the dung of a lactating cow into a horn and burried in the soil during the autumn equinox (September) and taken out during the spring equinox (March). The humified dung from horn is stored in an earthen pot away from sunlight. For preparing the spray solution for one ha, 62.5 g of this martial was dissolved in 40 L of warm (40^0C) water with continuous stirring for 1h (alternately in clock wise and anti-clock wise directions). The liquid mixture was sprinkled as big droplets on soil surface in the evening on day before sowing. For the treatments based on biodynamic calendar, BD 500 was applied on *i.e.* during the lunar descending period, when the effects are supposedly better (Briton,2).

BD 501 is "cow horn silica" and is made from quartz crystals ground to alum power consistency, stuffed into a cow horn, buried during spring equinox, and taken out during autumn equinox. The material, stored in glass bottle, and exposed to the sun by the windowsill was used to prepare the BD 501 spray solution by dissolving 2.5 g in 40 L of water, which was prepared for spray in a similar way as that of BD 500. Within an hour, the mixture was sprayed as a fine mist on the plant foliage (*i.e.* before 9.00 am). The application dates corresponded to days when moon was opposite to Saturn in the biodynamic calendar).

Cumin was given the FYM and vermicompost on the basis of nitrogen equivalent dose of @ 30kg N ha^{-1} FYM containing 0.51% N, 0.21% P and 0.62% K, while vermicompost had 1.49% N, 0.89% P and 1.2% K. Sowing was done using treated seeds (*Tricoderma herzanium* @ 8 g kg^{-1} seed, before sowing) of variety RZ-19. Besides a pre sowing irrigation, crop was given four irrigations. Application of BD was done twice first on evening prior to a day before sowing and second 30 DAS. BD 501 was sprayed four times at 2-4 leaf stage and latter on at branching, pre-flowering and seed formation stage. For organic management of crop, neem cake @ 200 kg ha^{-1} *Tricoderma herzanium* @ 2 kg incubated in 200 kg FYM, neem seed kernel pray (5%) at 45 and 60 DAS, fresh neem leaf spray (10%) along with 0.2% garlic spray during 2009-10 and milk whey (10%) during 2010-11 twice during seed formation stage and after10 days of it. The crop was harvested when umbels started yellowing and about 75 % umbels were fully matured. The crop was harvested by manual digging.

RESULTS AND DISCUSSION

Growth & yield attributes

The effect of FYM @ 6 t ha^{-1} in combination of BD 500 on plant population (34.91 per one meter row length) was found significant over the absolute control only and effect of all organic treatments were at par with each other (Table 1). Application of BD 500 and 501 in combination with FYM @6 t ha^{-1} recorded significantly higher plant height (26.51 cm) as compared to absolute control (22.59) *i.e.* T_7 (absolute control) and application of FYM or vermicompost alone. However, effect of all treatments with biodynamic manure on plant height of cumin was non-significant to each other. Results clearly indicate application of bio-dynamitic preparation 501 had a significant effect on plant height of cumin when applied in combination with organic manure (FYM or vermicompost) and BD 500.

The effect of vermicompost or FYM with BD 500 and BD 501 on number of umbels per plant was found statistically significant (Table 2). The umbels per plant varied from 16.02 to 17.83. Application of BD 500 and 501 in combination with vermicompost @ 2 t ha^{-1} gave the maximum number of umbels per plant (17.85) which was at par with treatment T_6 where BD 500 and BD 501 was applied in combination with FYM @ 6 t ha^{-1} (17.80).

Number of seeds / umbel were found statistically significant over control (Table 2). The higher number of seeds per umbel were recorded in BD 500 + BD 501 + FYM @ 6t ha^{-1} (21.15) followed by BD 500 + BD 501 + vermicompost @ 2t ha^{-1} (21.00). Application of both dynamic manure (BD 500 and BD 501) in combination with FYM and vermicompost recorded an increase of 15.96 and 6.98 percent over sole application of FYM (T_2) and vermicompost (T_1), respectively.

The effect of BD 500 and BD 501 in combination with FYM @6 t ha^{-1} on yield attributes of cumin was found statistically significant over absolute control, FYM and vermicompost. Test weight was recorded significantly highest in treatment T_6 (3.51 g) which was at par with T_4 (3.45g) and T_5 (3.44 g). The effect of BD 500 and BD 501 in combination with FYM @ 6t ha^{-1} on seed, straw and biological yield was found significant (Table 4). Data revealed that maximum seed yield of 447.51 kg ha^{-1} was recorded in the treatment T_6 which was 10.86, 13.28, 29.05, 34.46, 36.43 and 55.73 percent higher over T_4, T_5, T_2, T_3, T_1 and T_7. Combined application of biodynamic manure (BD) 500 and 501 with FYM or vermicompost gave an additional yield of 94 to 130 kg ha^{-1} in comparison to sole application of FYM or vermicompost to cumin. Application of BD 500 together with BD 501 had the significant effect on yield of cumin over the application of BD 500 only and gave additional yield of 48 to 95 kg ha^{-1}. Similarly, straw yield showed the same trend.

Application of biodynamic manure (BD 500 and BD 501 in combination with FYM @ 6t ha^{-1} gave th highest biological yield (1216.21 kg ha^{-1}) and was found statistically significant. (Table 3) .Application of BD 500 and BD 501 in combination with FYM @ 6t ha^{-1} gave the maximum harvest index (37.28%) followed by T_6 (36.22%). Application of BD 500 in combination with FYM or vermicompost could not bring any significant increase in harvest index over the sole application of FYM @ 6 t ha^{-1} or vermicompost 2 t ha^{-1}. However, application of BD 500 in combination with BD 501 with FYM 6 t ha^{-1} or vermicompost 2 t ha^{-1} caused a significant increase in harvest index of cumin over the application of FYM 6 t ha^{-1} + BD 500 and vermicompost 2 t ha^{-1} + BD 501.

To put forth cause and effect relationship between biodynamic manures and plant development , previous evidences are cited here. The concept of biodynamic manure (BD 500 and BD 501) was originally given by Rudolf Steiner (Steiner, 14) who showed that due to application of BD500, significant internal changes do take place in the manure during overwintering in the soil. The principal changes are a significant drop in pH, an increase in aerobic status and production of nitrate. Another aspect is that there is in many case little evident loss of organic matter.

He also reported that application of BD 500 and BD 501 activate natural manure and humus content. (Pfeiffer, 8) reported that spray of biodynamic manure BD 501 enhances the photosynthesis, and as such compliment the activity of the preparation BD 500, which works mostly in the root zone of the plant. It also strengthens the plants against some fungus attack.

Jayasree and George (5) have reported that application of two biodynamic preparations (BD 500 and BD 501) in chilli by adopting a biodynamic calendar resulted better fruit quality of chilli. Stever (15) also reported the promotional effect of application of biodynamic preparations on crop yield and soil qualities.

Previous research on effect of organic manures in enhancing crop and soil productivity have been reported by Liebig & Doran,6; Pimentel *et al.,* Ramesh et al., and Patil, 8. They have reported that importance of organic farming is understandable given the important role soil organic matter plays in maintaining soil productivity through multiple functions. Previous studies have reflected

that with respect to plant nutrients, having an appropriate balance of nutrients for crop growth at critical times in growing season is an essential feature for sustained growth and promotional effect on crop yield (Doran et al., 3, Friend, 4, Wander et. al., 16 and Ramesh, et. al., 11). In light of above evidences, it seems that application of biodynamic preparations in combination with organic manures might have resulted in enhancing yield attributes and yield of cumin under organic production system.

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Table 1. Effect of biodynamic and organic manures on plant population and plant height of cumin under organic production

Treatments	Plant population (One meter length)	Plant height (Cm)
T_1 Vermicompost @ 2 t/ha	33.67	24.36
T_2 FYM @ 6 t/ha	35.42	25.00
T_3 BD500+Vermicompost @ 2 t/ha	35.06	25.26
T_4 BD500+FYM @ 6 t/ha	36.53	25.70
T_5 BD500+BD501+ Vermicompost @ 2 t/ha	33.98	26.20
T_6 BD500+BD501+ FYM @ 6 t/ha	34.91	26.51
T_7 Absolute Control	32.86	22.59
T_8 Absolute Control (water spray)	32.67	22.81
S.Em±	0.92	0.37
CD(0.05)	2.79	1.11

Table 2. Effect of biodynamic and organic manures on yield attributing characters of cumin under organic production

Treatments	No of umbels /plant	No of seeds /umbel	Test weight (g)
T_1 Vermicompost @ 2 t/ha	16.02	18.80	3.24
T_2 FYM @ 6 t/ha	16.03	19.73	3.39
T_3 BD500+Vermicompost @ 2 t/ha	16.72	19.55	3.33
T_4 BD500+FYM @ 6 t/ha	16.77	20.53	3.45
T_5 BD500+BD501+ Vermicompost @ 2 t/ha	17.85	21.18	3.44
T_6 BD500+BD501+ FYM @ 6 t/ha	17.80	21.51	3.52
T_7 Absolute Control	14.44	15.26	2.51
T_8 Absolute Control (water spray)	13.58	15.70	2.50
S.Em±	0.44	0.39	0.04
CD(0.05)	1.32	1.20	0.13

Table 3. Effect of biodynamic and organic manures on yield of cumin under organic production

Treatments	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (Kg ha^{-1})	Harvest index (%)
T_1 Vermicompost @ 2 t ha^{-1}	284.49	671.72	956.20	31.54
T_2 FYM @ 6 t ha^{-1}a	317.50	709.95	1027.45	32.78
T_3 BD500+Vermicompost @ 2 t ha^{-1}	293.32	655.55	948.87	33.18
T_4 BD500+FYM @ 6 t ha^{-1}	398.89	741.32	1140.21	33.91
T_5 BD500+BD501+ Vermicompost @ 2 t ha^{-1}	388.07	719.50	1107.57	36.22
T_6 BD500+BD501+ FYM @ 6 t ha^{-1}	447.51	768.70	1216.21	37.28
T_7 Absolute Control	198.12	457.52	655.63	30.72
T_8 Absolute Control (water spray)	217.97	444.58	662.56	33.41
S.Em±	6.97	13.39	25.47	0.83
CD(0.05)	21.14	40.60	77.24	2.50

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