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Eco-friendly approaches for the management of diseases and pest in cumin

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Abstract

The field experiment was conducted in All India Coordinate Research Project on Spices at S. K. N. College of Agriculture, Jobner, India during *rabi* seasons of 2010-11, 2011-12, 2012-13 and 2013-14 for the organic management of diseases and pest in cumin. The pooled data over four years revealed that all the organic management practices for diseases and pest in cumin resulted in significantly low incidence of wilt, blight and aphid and significantly maximized seed yield and benefit: cost ratio over the check. The pooled analysis of data further revealed that minimum incidence of wilt (10.60%), Blight (5.90%) and Aphid (26.20%) and maximum seed yield (242.0 kg ha^{-1}) and benefit : cost ratio (1.78) was recorded with soil application of vermi compost @ 2.5.t ha^{-1} + seed treatment with neem seed kernel extract (NSKE) @ 5.0 percent + spray of neem seed kernel extract (NSKE) @ 5.0 percent. Control treatment resulted in maximum incidence of wilt (24.20%), blight (29.24%) and aphid (81.30%) and minimum seed yield (137.0 kg ha^{-1}) and benefit: cost ratio (1.03).

Key words : Aphid, blight, cumin, organic amendment, wilt.

Introduction

Organic farming is gaining global importance with increasing awareness of the consumers towards quality products free from pesticide residues and the environmental protection. In Rajasthan, certified organic farming is practiced on 649 ha area (Annual Report, 2014-15). There is a great scope of up scaling of organic farming in Rajasthan due to low use of fertilizers, pesticides and less chance of severe reduction in yield of crops during conversion period. However, lack of suitable package and practices for organic farming of crops and availability of organic inputs both in time and scale are the main constraints. Among organic exports, spices are important crops in India and their share in total exports is 1.68 per cent. Spices response to the application of organic manures and nutrient management through organic sources can increase the productivity of spices as reported in organic cumin (Sharma *et al.*, 2012). Besides nutrients, management of diseases and pest through organic methods is one of important constraints in enhancing productivity of spices. Demand in food product growing without synthetic fertilizers and pesticide practices are increasing. Such food is commonly referred to as organic (Ramesh *et al.,* 2009). 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.,* 2005). Organic farming is gaining gradual momentum across the world. In India, about 4.43 million hectare area is under organic cultivation and total production of organic products is 3.88 million tons (APEDA, 2011-12) and (FIBL , 2012).

Cumin (*Cuminum cyminum* L.) is an important seed spice crop, India ranks first in terms of the acreage and production. Within India, it is extensively cultivated in Rajasthan, Gujarat and in some parts of Madhya Pradesh as *rabi* crop. The climatic conditions found in the two states of Rajasthan and Gujarat are more favourable for cumin cultivation, these two states contributes more than 90 percent in National area and production status. It is only grown for seed purpose as a cash crop, and the seeds also bear very high export value. It is also used in food and beverages industry as spice and condiment. The increasing population load and globalization has created high demand of cumin both in domestic and international markets. There is need to enhance the productivity levels to meet the increasing demand. The principal constrains to achieve high productivity are high yielding varieties, improper nutrient management and susceptibility of cumin to devastating diseases viz., *Fusarium* wilt, *Alternaria* blight and powdery mildew which are the major yield reducing factors. Popular resistant verities against diseases and pest are not available. As such excessive use of fungicides and insecticides are hazardous to human health and ultimately causes imbalance in the natural ecosystem. In view of the increasing severity of wilt, blight and aphid in Southern

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Rajasthan, the present study was undertaken to evaluate the efficacy of organic amended as spray treatments individually as well as in different combinations to develop an eco–friendly organic management module for wilt, blight and aphid.

Materials and methods

A field experiment was conducted in ICAR-All India Coordinate Research Project on Spices at S.K.N. College of Agriculture, Jobner, India during *rabi* seasons 2010-11, 2011-12, 2012-13 and 2013-14 for the organic management of diseases and pest in cumin. The experiment consisted of five organic treatments for pest and diseases management practices *i.e.*, check, soil application of FYM @ 6.0 t ha^{-1} + soil application of *Trichoderma viride* @ 2.5 kg ha^{-1} + spray of *Trichoderma viride* @ 4.0 percent, soil application of FYM @ 10.0 t ha^{-1} + soil application of *Trichoderma viride* @ 2.5 kg ha^{-1} + spray of *Trichoderma viride* @ 4.0 percent, soil application of vermi compost @ 2.5. t ha^{-1} + seed treatment with neem seed kernel extract (NSKE) @ 5.0 percent + spray of neem seed kernel extract (NSKE) @ 5.0 percent and soil application of neem cake @ 2.0 t ha^{-1} + soil application of *Trichoderma viride* @ 2.5 kg ha^{-1} + spray of neem seed kernel extract (NSKE) @ 5.0 percent. The treatments were taken in randomized block design with four replications. The crop variety RZ-19 was sown in plots of 3 x 2.4 meter square in last week of November every year with seed rate of 10 kg ha^{-1}. Required quantity of farm yard manure, neem cake, vermi-compost and *Trichoderma viride* were added in each plot 15 days before sowing and three sprays were given at 45, 60 and 75 day after sowing (DAS) as per treatments in every year. Every year disease severity of wilt was recorded on the basis of total number of plants per plot, number of wilted plants in plot and percentage of wilted plants, *Alternaria* blight was recorded on 20 tagged plants of each plot at weekly interval from the appearance of disease using 0-5 scale; where, 0 = healthy, 1= blight symptoms on tips of leaves, 2 = most of the leaves showing blight symptoms, 3 = symptoms on leaves and umbellets, 4 = symptoms on leaves and umbellets or lesion on the stem and 5 = symptom on leaves, umbels, seed and on the stem and Aphid infestation was recorded on 20 tagged plants in each plot at weekly interval using 0-4 scale; where, 0 = no aphid, 1 = isolated singly on few tender parts, 2 = singly on matured plant parts, 3 = colony countable and 4 = uncountable colony on whole plant and converted into Percent Disease Index (PDI) and converted into angular transformation.

PDI was calculated using the formula = (Y / X) × 100;

Where, Y = No. of diseased plants; X = Total no. of plants per plot

The crop was harvested at maturity and seed yield per plot was recorded.

Results and discussion

On the basis of pooled data over four years the study revealed that all the organic practices for the management of diseases and pest in cumin resulted in significantly low incidence of wilt, blight and aphid and significantly maximized seed yield and benefit: cost ratio over the check in Table 1. The pooled analysis of data further revealed that minimum incidence of wilt (10.60%), Blight (5.90%) and Aphid (26.20%) and maximum seed yield (242.0 kg ha^{-1}) and benefit : cost ratio (1.78) was recorded with soil application of vermi compost @ 2.5. t ha^{-1} + seed treatment with neem seed kernel extract (NSKE) @ 5.0 percent + spray of neem seed kernel extract (NSKE) @ 5.0 percent followed by soil application of neem cake @ 2.0 t ha^{-1} + soil application of *Trichoderma viride* @ 2.5 kg ha^{-1} + spray of neem seed kernel extract (NSKE) @ 5.0 percent. Control treatment resulted in maximum incidence of wilt (24.20%), blight (29.24%) and aphid (81.30%) and minimum seed yield (137.0kg ha^{-1}) and benefit: cost ratio (1.03). This study indicate that organic amendment of soil by adding neem cake, vermi-compost and *Trichoderma viride* were found effective in reducing wilt, blight and powdery mildew diseases and aphid incidence and increasing the yield in cumin. Many root pathogens have been successfully controlled by ploughing organic materials in the soil (Ghaffar, 1993). According to him addition of fresh organic material controlled the growth of pathogenic soil organism's viz. *Macrophomia phaseolina*, *R. solani* and *Fusarium species* by producing either toxic metabolites or parasitizing hyphae of pathogenic fungi or by lying them suppression of wilt symptoms in cumin may be attributed by many causes. The application of FYM, neem cake and vermi-compost to the field increased the multiplication of aerobic microorganisms. These microorganisms might have fixed the available nitrogen and utilized it for decomposition of organic matter. Desai and Kulkarni, 2001, reported that the sclerotial germination of *Macrophomia phaseolina* was inhibited by neem cake. In this way they might have created the scarcity of nitrogen for germination and penetration of chlamydospores of the pathogen and in turn suppressed the disease expression. The uses of bioagents (*Trichoderma*) are able to stimulate growth of plants but suppress the pathogenic expression in leguminous crop (Azcon, 1989), especially of F*. solani*, *F. oxysporium.* Increased aerobic activity of micro-organism increased the released of CO_2, which in turn inhibits the growth of pathogen and helps to build up the crop health. These microorganisms also release some enzymes, which help to improve the crop health and check the growth of pathogenic fungi (Anonymous, 2002). The keys to sustainable management of this disease and pest include use of natural enemies and botanicals (Ragsdale *et al.,* 2011). Chatta and Verma,

Table 1. Organic management of diseases and pest in cumin (Pooled data of over four year)

Treatments	Wilt (%)	Blight (%)	Aphid (%)	Yield (kg ha^{-1})	B:C Ratio
Soil application of FYM @ 6.0t ha^{-1} + soil application of *Trichoderma viride* @ 2.5kg ha^{-1} + spray of *Trichoderma viride* @ 4.0 percent	17.50 (24.72)	9.90 (18.35)	47.50 (43.57)	210	1.71
Soil application of FYM @10.0 t ha^{-1} + soil application of *Trichoderma viride* @ 2.5 kg ha^{-1} + spray of *Trichoderma viride* @ 4.0percent	12.20 (20.45)	8.90 (17.39)	45.00 (42.12)	228	1.76
Soil application of vermi compost @ 2.5 t ha^{-1} + seed treatment with neem seed kernel extract @ 5.0 percent + spray of neem seed kernel extract @ 5.0 percent	10.60 (18.97)	5.90 (13.98)	26.20 (30.80)	242	1.78
Soil application of neem cake @ 2.0 t ha^{-1} + soil application of *Trichoderma viride* @ 2.5 kg ha^{-1} + spray of NSKE @ 5.0percent	9.20 (17.65)	4.90 (12.76)	26.20 (30.80)	255	1.48
Check	24.20 (29.43)	23.80 (29.24)	81.30 (64.38)	137	1.03
CD (P=0.05)	3.14	3.24	3.00	22.7	-
CV	9.16	11.46	4.61	8.1	-

*Data in parenthesis indicate angular transformation of percent values

2010, reported that the module comprising soil application of neem cake @ 2 q ha^{-1} + seed treatment with *Trichoderma* @ 8 g kg^{-1} seed + spray of Azadirachtin (0.1%) is effective for organic pest and disease management in cumin. Prasad, 1994, reported that neem products are effective against mustard aphid. Srivastava *et al.,* 2005 have also reported the effectiveness of neem oil to control aphids. The use of persistent bio-insecticide acquires special concern on cumin, because it is a common vegetable cum spice in Indian dietary system. So, the increasing concern for environmental safety and global demand for pesticide residue free has evoked interest of eco–friendly methods of pest management viz., plant diversities and use of bio pesticides as important components in organic farming. Thus the, module involving soil application of vermi compost @ 2.5 t ha^{-1} + seed treatment with neem seed kernel extract (NSKE) @ 5.0 percent + spray of neem seed kernel extract (NSKE) @ 5.0 percent among the treatments for successful management of wilt, blight and aphid. The module seems quite economical and may be useful for disease and pest management in organic farming of other crops.

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