RESEARCH ARTICLE

EFFICACY OF BIOCONTROL AGENTS, PLANT EXTRACTS AND ORGANIC AMMENDMENT AGAINST BLIGHT, POWDERY MILDEW AND WILT DISEASES IN CUMIN

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Abstract: Field experiment was conducted to study the effect of the different organic modules for management of *Alternaria blight Powdery mildew* and wilt diseases of cumin (Cuminum cyminum L.).Treatment module comprising of seed treatment with *Trichoderma herzeanum*@8g/kg seed + three foliar spray of Azadirachtin @2ml/lit.at 45-60DAS+ 60-75DAS+and at 90-100 DAS was found significantly superior over control and gave maximum seed yield of cumin 5.76q/ha. in comparison to control which gave only 3.43q/ha. cumin seed yield.This organic module was found superior in respect to disease control and effectively controlled all three diseases and record minimum disease intensity of *Alternaria blight(*12.49%) *Powdery mildew* 14.93% and wilt (6.20%). Where as in control 26.33.% ,28.66% and12.28%disease intensity was observed respectively. This module gave the highest net return of Rs.28013 /over control.

Keywords Cumin, *Alternaria blight, Powdery mildew, Trichoderma viride, Azedirachtin*

INTRODUCTION

Cumin is one of the most important spice seed crops of India and state of Rajasthan dominates in production ofcumin in India. Being a cash crop, there is a great demand of organic cumin (Sahota, 13) Organic cumin in Rajasthan represent a very negligible part of our total cumin production. The one of the constraints in increasing the area under cumin production is lake of suitable organic production practices for different agro climate regions. The present investigation was aimed to study the influence of certain bioagent, organic manures bio pesticides on diseases control and yield of cumin in southern Rajasthan.

Organic farming is gaining gradual momentum across the world. In India about 5,28,171 hectare area is under organic farming with 69,256 numbers of certified organic farms (willer, 2011)

Among various spice seeds crop cultivated in India, the cumin is important for both internal consumption and exports.The crop is generally grown as rabi crop in cool and dry climateCumin is grown extensively in Rajasthan, Fujarat,and Uttar Pradesh.Rajasthan and Gujarat together accounts for more than 90 percent of total area under cumin grown in india.Cumin is cultivated in India in 5,14,000 ha. with annual production of 79,000tonnes(Anonymous 2012) The aromatic flavor in the cumin seed is due to presence of volatile oil.It is chief ingredient in mixed spices and curry powders used for flavouring different beverages (Chattopadhyay and Maiti 1990) *Alternaria* blight caused by *Alternaria burncii*(Uppal et al,1938) *Alternaria* blight ,*Powdery mildew* and *Wilt* diseases cause severe yield losses in cumin and have been identified as major production constraints. Wilt of cumin is a important soil borne disease while *Alternaria* blight and *Powdery mildew* are important foliar diseases that affect the crop. The diseases causes serious yield losses under favourable weather conditions which may as highas 83 percent under congenial weather condition (Patel and Desai1971)

Alternaria blight, Powdery mildew and *wilt* disease are most important diseases of cumin in India. Till now, the diseases are managed mostly through the use of pesticides. The indiscriminate use of pesticides causes environmental and ecological hazards. Botanical pesticides have received attention of the growers because these are considered as less toxic and environmentally safe. The anti microbial property of some plant extracts under in vitro and in vivo have been reported(Mehta and Mehta2005;Kumar et al 2006) We investigated on the effect of plant extracts Neem oil, Azedirachtin against *Alternaria burncii*, *Erysiphe poligony* and *fusarium oxysporum* in field condition Chemical management of all three diseases is un economical and environmentally hazardous. Therefore, there is a need to look for non hazardous and eco friendly control measures for plant diseases management. In this context an investigation was planned to evaluate the efficacy of organic module against *Alternaria burncii Erysiphe polygony and Fusariun oxysporum* pathogens causing *Alternaria blight , Powdery mildew and wilt* diseases in cumin respectively.

MATERIAL AND METHOD

The efficacy of six different modules were tested against *Alternaria blight,Powdery mildew* & and *wilt* diseases in cumin at Dryland Farming Research

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Station Arjia, Bhilwara during 2009-10,2010-11&2011-12. Cumin variety RZ-19 was sown in Randomized Block Design with three replications.The unit plot size was 5.0x4.2m and Cumin seed were sown in second fortnight of November during all three years. Prior to sowing cumin seeds were treated with *Trichoderma harzeanum @8g/kg seed* . In control plot seeds were sown without any treatment. Treatment details are as follows:

Treatments

T_1 - Seed treatment with TH @ 8 g/kg seed + foliar spray with NSKE @ 5% (two spray at 45 & 60 DAS + milk whey spray @ 100 ml/l at 75 and 90 DAS

T_2 - Seed treatment with TH @ 8 g/kg seed +foliar spray with NSKE @ 5% three spray at 45-60 + at 60-75 & at 90-100 DAS

T_3 - Seed treatment with TH @ 8 g/kg seed + foliar spray with NSKE @ 5% spray at 45-60 DAS + @ 2% garlic extract spray followed by vermiwash spray (5%) at 60-75 & 90-100 DAS

T_4 - Seed treatment with TH @ 8 g/kg seed + *Azadirachtin* @ 2 ml/lit three spray at 45-60 + 60-75 and at 90-100 DAS

T_5 - Seed treatment with TH @ 8 g/kg seed + foliar spray with spray of BD 501 at 45-60 DAS + foliar spray with *Azadirachtin* @ 2 ml/lit at 60-75 + and at 90-100 DAS

T_6 - Control

Note : TH = *Trichoderma harzanium*

NSKE = Neem seed kernel extract

DAS = Days after sowing

Preparation and application of the treatments

Cumin field was given. Farm Yard Mannure @2 ton/ha. prior to sowing crop. Sowing was done using seed treatment with *Trichoderma harzeanum* @ 8g/Kg seed of cumin. Beside a pre sowing irrigation, crop was given four irrigations. For organic amendment in soil Neem cake @ 200 Kg/ha. was given at the time of field preparation, as a cultural practice summer ploughing was also done after the harvesting of previous crop in summer.

In order of preparation of two pesticides NSKE was prepared using 1.0 kg of Neem kernels. The kernels were dried and grounded in a grinding machine as course powder and added one lit. of water and kept it for overnight. Extracts was filtered through muslin cloth to get 100% stock solution of NSKE. 5ml of this solution adding in 100 ml of water will be treated as 5% NSKE solution. Milk whey also applied this way in which we used 100 ml milk whey added in 1 lit. water then it becomes 10% milk whey spray solution. All bio pesticides were exercised as per scheduled, at initiation of the disease on the standing crop at 10-15 days interval according to the treatments,while control plots were sprayed with plain water. The experiment was irrigated four times and other inter cultural operations were done when necessary. The crop was harvested offer 125-130 days. The data were recorded farm randomly selected 10 plants/Plot for disease severity of *Alternaria blight* & *Powdery mildew* of cuminstarted from just before first spray of bio pesticide. Cumin yield (q/ha-1) and disease scoring data were recorded on, whole plot basis and then diseases score data converted in to disease severity. (PDJ) The efficacy of bio pesticides were measured by scoring the disease (PDI) in the individual plot on the basis of a standard score scale (Anonymous 1994) Where O= Leaf and twigs free from in infection 1= 1-5% leaves are infected, 2=6-20% leaves are infected, 3 = 21-40% leaves & twigs are infected 4=41-70% leaves & twigs are infected. The disease data were converted in to percent disease index (PDI) suggested by Sharma (1984) & Rahman et al (1986) Data were analyzed following the statistical procedure followed by Gomez & Gomez (1983)

RESULT AND DISCUSSION

All the bio pesticides used in trial significantly reduced the severity of *Alternaria blight Powdery mildew* & wilt diseases in cumin .A significant variation among the bio pesticide treatment was observed. Data presented in Table No. 1,2 &3 revealed that treatment module comprising of seed treatment with Seed treatment with *Trochoderma herzeanum* @ 8 g/kg seed +foliar spray of *Azadirachtin* @ 2 ml/lit three spray at 45-60 + 60-75 and at 90-100 DAS was found significant superior over control and gave maximum seed yield of cumin5.76.q/ha., in comparison to control which gave only3.43 q/ha cumin seed yield with highest PDI 26.33% PDI of *Alternaria blight* 28.66.% *Powdery mildew* and 12.28..%*wilt* infected diseasesd plants respectively in organic cumin . This module effectively controlled disease and showed least PDI of *Alternaria blight* (12.49 %) 14.93 % *Powdery mildew* and 6.20%wilt infection..

Above results clearly indicated that among plant extracts Neem cake, NSKE Neem oil, Azerachtin, milk whey can be selected for further investigation with *T. harzeanumm* as they showed satisfactory controlled the *Alternaria blight & Powdery mildew* as well as *wilt* infection also. They all showed synergetic effect with each other it may be due to suitability of constituents present in bio pesticides & leaf extracts. Ravi Chander (1987) reported that growth of *Rhizoctonia solani* was completely inbihited with the leaf extract of subabul, but its efficacy was not tested against fungal antagonist by any worker earlier. Neem and Akven leaf extracts reduced the viability of sclerotia of *R.solani* (Laxman and Nair 1984) and mycelia growth considerably in vitro (Mani Bhusan Rao et al. 1988) It has suggested that treatment with biocontrol agents initiated in the plants a number of biochemical changes which can be considerd to be a part of plant defence responses(Sharma et al 2010) In Present finding

Neem seed kernel and neem based formulations were found inhibitory nature against pathogens involved in causing different diseases.

Similarly *T. harzeanum* is known to produce certain volatile and non volatile compounds which adversely affect the growth of pathogens (Dennis and Webster,1971)*T. Harzeanum* has been recognized as astrong mycoparasite against soil borne plant pathogens such as *R.solani, Sclerotium rolfsii*,and *Fusarium oxysporum (*Papavizas, 1985; Chet, 1987).

Economics

The study also indicate that initially organic farming attributed lower productivity and yield losses but there was an over all improvement in soil quality parameters indicating better soil health.It is economically feasible to practice organic farming when the farmers are able to get premium price for their produce and with the reduced cost of cultivation by not depending upon the purchased off farm inputs. On an average of three years productivity of cumin yield was found lower by 15-20 % in comparison to conventional farming. However due to availability of premium price (20-40%) for organic cumin the average net profit was 35-40% higher in organic farming compared to the conventional farming.

The economics of organic cumin cultivation over a period of three years indicated that there is a reduction in cost of cultivation and increased gross and net returns compared to conventional cumin cultivation at research station.Three year's pooled analysis data on disease management and yield attributes are depicted in Table no 1. revealed that application of organic treatments viz. Seed treatment with *Trichoderma herzeanum* @ 8 g/kg seed + *Azadirachtin* @ 2 ml/lit three spray at 45-60 + 60-75 and at 90-100 DAS found significant superior over control plot during cropping period.

The best treatment gave highest net return of Rs 28,013.33over control while Maximum B:C ratio of 1:23.95 was also recorded under best treatment in organic cumin cultivation during 2009-10,2010-11&2011-12.

Table 1. Effect of different modules of disease management of *Alternaria blight* in organic cumin

Treat-ment	PDI (%) of *A. blight*			
	2009-10	2010-11	2011-12	mean
T_1 - Seed treatment with TH @ 8 g/kg seed + foliar spray with NSKE @ 5% (two spray at 45 & 60 DAS + milk whey spray @ 100 ml/l at 75 and 90 DAS	21.08 (27.35)	25.70 (30.46)	16.50 (23.96)	21.09 (27.25)
T_2 - Seed treatment with TH @ 8 g/kg seed +foliar spray with NSKE @ 5% three spray at 45-60 + at 60-75 & at 90-100 DAS	17.85 (24.99)	22.80 (28.52)	14.45 (22.33)	18.36 (25.61)
T_3 - Seed treatment with TH @ 8 g/kg seed + foliar spray with NSKE @ 5% spray at 45-60 DAS + @ 2% garlic extract spray followed by vermiwash spray (5%) at 60-75 & 90-100 DAS	23.87 (29.27)	27.75 (31.78)	20.33 (26.79)	23.98 (29.28)
T_4 - Seed treatment with TH @ 8 g/kg seed + *Azadirachtin* @ 2 ml/lit three spray at 45-60 + 60-75 and at 90-100 DAS	11.86 (20.13)	15.26 (22.98)	10.36 (18.78)	12.49 (20.63)
T_5 - Seed treatment with TH @ 8 g/kg seed + foliar spray with spray of BD 501 at 45-60 DAS + foliar spray with *Azadirachtin* @ 2 ml/lit at 60-75 + and at 90-100 DAS	15.75 (23.38)	20.26 (26.78)	12.70 (20.87)	16.23 (23.67)
T_6 - Control	25.19 (30.10)	30.31 (33.40)	23.49 (28.98)	26.33 (30.82)
SEm±	1.16	1.40	0.26	
CD(0.05)	3.50	4.21	0.78	

Table 2. Effect of different modules of disease management of *Powdery mildew* in organic cumin

	PDI (%) of *A. blight*			
	2009-10	2010-11	2011-12	mean
T_1 - Seed treatment with TH @ 8 g/kg seed + foliar spray with NSKE @ 5% (two spray at 45 & 60 DAS + milk whey spray @ 100 ml/l at 75 and 90 DAS	21.08 (27.35)	25.70 (30.46)	16.50 (23.96)	21.09 (27.25)
T_2 - Seed treatment with TH @ 8 g/kg seed +foliar spray with NSKE @ 5% three spray at 45-60 + at 60-75 & at 90-100 DAS	17.85 (24.99)	22.80 (28.52)	14.45 (22.33)	18.36 (25.61)
T_3 - Seed treatment with TH @ 8 g/kg seed + foliar spray with NSKE @ 5% spray at 45-60 DAS + @ 2% garlic extract spray followed by vermiwash spray (5%) at 60-75 & 90-100 DAS	23.87 (29.27)	27.75 (31.78)	20.33 (26.79)	23.98 (29.28)
T_4 - Seed treatment with TH @ 8 g/kg seed + *Azadirachtin* @ 2 ml/lit three spray at 45-60 + 60-75 and at 90-100 DAS	11.86 (20.13)	15.26 (22.98)	10.36 (18.78)	12.49 (20.63)
T_5 - Seed treatment with TH @ 8 g/kg seed + foliar spray with spray of BD 501 at 45-60 DAS + foliar spray with *Azadirachtin* @ 2 ml/lit at 60-75 + and at 90-100 DAS	15.75 (23.38)	20.26 (26.78)	12.70 (20.87)	16.23 (23.67)
T_6 - Control	25.19	30.31 33.40	23.49 (28.98)	26.33 (30.82)

• (Figures in Parentheses are transformed values)

Table 3. Effect of different modules of disease management of *wilt disease* in organic cumin

Treatment	PDI (%) of powdery mildew			
	2009-10	2010-11	2011-12	Mean
T_1 - Seed treatment with TH @ 8 g/kg seed + foliar spray with NSKE @ 5% (two spray at 45 & 60 DAS + milk whey spray @ 100 ml/l at 75 and 90 DAS	25.30 (30.32)	25.30 (30.32)	25.30 (30.32)	25.30 (30.32)
T_2 - Seed treatment with TH @ 8 g/kg seed +foliar spray with NSKE @ 5% three spray at 45-60 + at 60-75 & at 90-100 DAS	23.75 (29.17)	23.75 (29.17)	23.75 (29.17)	23.75 (29.17)
T_3 - Seed treatment with TH @ 8 g/kg seed + foliar spray with NSKE @ 5% spray at 45-60 DAS + @ 2% garlic extract spray followed by vermiwash spray (5%) at 60-75 & 90-100 DAS	28.74 (32.43)	28.74 (32.43)	28.74 (32.43)	28.74 (32.43)
T_4 - Seed treatment with TH @ 8 g/kg seed + *Azadirachtin* @ 2 ml/lit three spray at 45-60 + 60-75 and at 90-100 DAS	15.87 (23.46)	15.87 (23.46)	15.87 (23.46)	15.87 (23.46)
T_5 - Seed treatment with TH @ 8 g/kg seed + foliar spray with spray of BD 501 at 45-60 DAS + foliar spray with *Azadirachtin* @ 2 ml/lit at 60-75 + and at 90-100 DAS	21.37 (27.53)	21.37 (27.53)	21.37 (27.53)	21.37 (27.53)
T_6 - Control	32.15 (34.54)	32.15 (34.54)	32.15 (34.54)	32.15 (34.54)
SEm+	1.40	1.40	1.40	1.40
CD(0.05)	4.25	4.25	4.25	4.25

(Figures in Parentheses are transformed values)

Table 4. Effect of different disease management modules on yield and economics of organic cumin

Treatment	Percent infection of wilt(%) (30 DAS)			
	2009-10	2010-11	2011-12	Mean
T_1 - Seed treatment with TH @ 8 g/kg seed + foliar spray with NSKE @ 5% (two spray at 45 & 60 DAS + milk whey spray @ 100 ml/l at 75 and 90 DAS	8.00 (16.43)	8.00 (16.43)	8.00 (16.43)	8.00 (16.43)
T_2 - Seed treatment with TH @ 8 g/kg seed +foliar spray with NSKE @ 5% three spray at 45-60 + at 60-75 & at 90-100 DAS	5.6 (13.69)	5.6 (13.69)	5.6 (13.69)	5.6 (13.69)
T_3 - Seed treatment with TH @ 8 g/kg seed + foliar spray with NSKE @ 5% spray at 45-60 DAS + @ 2% garlic extract spray followed by vermiwash spray (5%) at 60-75 & 90-100 DAS	6.0 (14.18)	6.0 (14.18)	6.0 (14.18)	6.0 (14.18)
T_4 - Seed treatment with TH @ 8 g/kg seed + *Azadirachtin* @ 2 ml/lit three spray at 45-60 + 60-75 and at 90-100 DAS	5.12 (13.05)	5.12 (13.05)	5.12 (13.05)	5.12 (13.05)
T_5 - Seed treatment with TH @ 8 g/kg seed + foliar spray with spray of BD 501 at 45-60 DAS + foliar spray with *Azadirachtin* @ 2 ml/lit at 60-75 + and at 90-100 DAS	7.90 (16.32)	7.90 (16.32)	7.90 (16.32)	7.90 (16.32)
T_6 - Control	10.19 (18.62)	10.19 (18.62)	10.19 (18.62)	10.19 (18.62)
SEm+	0.90	0.90	0.90	0.90
CD(0.05)	2.75	2.75	2.75	2.75

Treatment	Seed yield (q/ha)				% increase in seed yield over control				Net returns over control (Rs. / ha)			
	2009-10	2010-11	2011-12	mean	2009-10	2010-11	2011-12	mean	2009-10	2010-11	2011-12	mean
T_1 - Seed treatment with TH @ 8 g/kg seed + foliar spray with NSKE @ 5% (two spray at 45 & 60 DAS + milk whey spray @ 100 ml/l at 75 and 90 DAS	3.61	2.28	6.28	4.06	9.72	18.13	23.86	17.24	3255	4550	15125	7643.33
T_2 - Seed treatment with TH @ 8 g/kg seed +foliar spray with NSKE @ 5% three spray at 45-60 + at 60-75 & at 90-100 DAS	3.84	2.69	6.71	4.41	16.41	38.86	32.35	29.21	5670	9750	20500	11973.33
T_3 - Seed treatment with TH @ 8 g/kg seed + foliar spray with NSKE @ 5% spray at 45-60 DAS + @ 2% garlic extract spray followed by vermiwash spray (5%) at 60-75 & 90-100 DAS	3.89	2.74	6.85	4.49	18.23	41.97	35.11	32.18	6195	10530	22250	12991.66
T_4 - Seed treatment with TH @ 8	5.24	3.78	8.25	5.76	59.2	95.3	62.7	72.4	2037	2392	39750	28013.

g/kg seed + *Azadirachtin* @ 2 ml/lit three spray at 45-60 + 60-75 and at 90-100 DAS					7	3	2	4	0	0		33
T_5 - Seed treatment with TH @ 8 g/kg seed + foliar spray with spray of BD 501 at 45-60 DAS + foliar spray with *Azadirachtin* @ 2 ml/lit at 60-75 + and at 90-100 DAS	4.11	3.46	7.64	5.07	24.29	79.27	50.69	51.41	8505	19890	32125	20173.33
T_6 - Control	3.30	1.93	5.07	3.43	-	-	-	-	-	-	-	-
SEm±	0.21	0.11	0.33									
CD(0.05)	0.64	0.33	0.99									

Net return from control Rs. 63375/- ha.

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