INTERNATIONAL JOURNAL OF PLANT PROTECTION
VOLUME 13 | ISSUE 1 | APRIL, 2020 | 76-80

● ISSN-0974-2670 | Visit us : *www.researchjournal.co.in*

IJPP

RESEARCH PAPER

DOI : 10.15740/HAS/IJPP/13.1/76-80

Assessment of technological gap and performance of integrated diseases management approach for wilt in cumin

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ARITCLE INFO

Received : 06.02.2020
Revised : 07.03.2020
Accepted : 20.03.2020

KEY WORDS :
Antagonistic, wilt disease, *Fusarium oxysporum*, technological interventions, *Trichoderma harzianum*

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ABSTRACT

The experiment was carried out to assessment of technological gap and performance of integrated diseases management (IDM) approach as a resistant variety, chemical seed dressing, soil and seed treatment as a bio-agents for antagonistic fungi on growth of cumin *Fusarium oxysporum* f. sp. cumini pathogens under field conditions. This experiment was conducted on farmer trials (OFT) villages like Bhusi, Patelo Ki Dhani and Baldo Ki Dhani in Pali distract four year (2014 to 2017). This area is major growing cumin cultivation and here major problem face farmer every year cumin wilt disease due to reduction of yields. During this experiment disease incidence of wilt was observed to be lowest (Disease Incidences 5.00%) when resistant variety GC-4, seed dressing Carbendazim @ 2.0g/ kg with *Trichoderma harzianum* @ 6g/ kg seed + application of 100 kg FYM enriched with *T. harzianum* @ 3.0 kg/ha for soil treatment before 15 days of sowing cumin. Maximum disease incidence (24.00%) was observed when traditional farmers practice (no seed treatment). The adoption of recommended improved crop production technology and plant protection measures was poor. The OFT was effective in changing attitude, skill and knowledge of IDM approach and yield increased upto 28.64 per cent more over the traditional farmers practices. Results indicates that IDM approach increased net income by Rs. 20,593/-ha over farmers practices.

How to view point the article : Balai, Laxman Prasad, Singh, Dheeraj and Meena, M.L. (2020). Assessment of technological gap and performance of integrated diseases management approach for wilt in cumin. *Internat. J. Plant Protec.*, **13**(1) : 76-80, **DOI : 10.15740/HAS/IJPP/13.1/76-80,**

INTRODUCTION

Cumin is a major spice growing crops in western Rajasthan especially in Pali, Jodhpur, Barmer, Jalor and Ajmer distract. It has become indispensable in every Indian home and, it is used as spices in whole of the country. It is cultivated as an irrigated crop during winter season. In India,the total area under cumin is around 0.76 million ha with the production of 0.49 million tones with an average productivity of 640 Kg ha^{-1}, which is the highest in the world during 2016-17 (DASD, 2017). Pali, situated in the arid fringes of Rajasthan, represented by sandy loam to loamy silt soil with temperature range from 2 to 48°C and receives about 420 mm rainfall annually. The major cumin diseases was observed on farmer field in cumin growing district of Pali like wilt, blight and powdery mildew in moderate to severe form. Other diseases like phyllody and plant parasite orobanche were the new emerging problem in cumin. Wilt is an important disease of cumin with incidence upto 25.7 per cent but may be 60 per cent in some sever incidence cases. Losses in yield up to 25 per cent have been reported from North Gujarat and upto 60 per cent in Rajasthan. The disease was first reported from Ajmer district of Rajasthan by Gaur (1949). The fungus was identified as *Fusarium oxysporum* f. sp. cumini by Patel *et al.* (1957). Most of researches were undertaken in Rajasthan and Gujarat as the crop is concentrated in these states. The disease occurs at all stages of crop height but germination time and harvest stage most occur. The symptoms are plant leaves droop down. The roots exhibit browning of vascular region, when split open, when the wilting takes place at flowering proper flowering and fruiting do not occur. The diseased plants are produce in small, thin, shrivelled seeds. The pathogen is internally seed borne as well as soil borne associated with diseased plant debris. The intensity of the fungus is occurring more in top soils. The density of the pathogen is increases under continuous rising planting of cumin in the same field. The pathogen is survives in soil as hyphae and chlamydospore. The chlamydospores are heat tolerant. Under moist condition the lethal temperature range is 60-62°C and under dry conditions, it is 62-65°C.

Factors responsible for development and spread of the disease:

Periodic surveys of different cumin field were conducted to find out the various factors involved in high incidence of the wilt and data on response of farmers to following factors were found associated with high disease incidence:

– Low plant population due to poor germination.

– Plant mortality due to severe wilt infestation.

– No use of fungicides and bio agents (Trichoderma) as per research seed and soil treatment: It was found that initially, none of the farmer goes for seed and /or soil treatment and on the appearance of the disease, they use fungicides indiscriminately.

– No remedy against wilt.

– Non awareness about role of seed and soil treatment.

– Poor soil management most of farmers are done no summer plough and weed management.

– Monoculture: In Pali district, farmers are mainly cultivating cumin field. Due to mono culturing of these crops, inoculums of soil bore diseases like wilt has increased tremendously. Once the inoculums establish itself in the field, it becomes very difficult to eradicate it.

– No use of resistant variety in this area (most farmer are used local seed).

In the absence of resistant varieties, farmers are compelled to grow the varieties which succumbto the disease very easily. Keeping in view the devastating magnitude of the disease, Krishi Vigyan Kendra (KVK) has designed an intervention on wilt management and the technology was disseminated to the farmersthrough conductance of OFT and front line demonstrations (FLD).

MATERIAL AND METHODS

Assessment and impact of integrated disease management (IDM) practices in cumin crop were carried out through On Farm Trials (OFT) were conducted at the farmers' fields at different locations of the villages like Bhusi, Patelo Ki Dhani and Baldo Ki Dhani in Pali distract for four years *i.e.* 2014-15, 2015-16, 2016-17and 2017-18 consecutively by ICAR-CAZRI, KVK, Pali to validate the efficacy of wilt disease management recommended technology was taken Centre Arid Zone Research Institute (CAZRI), Jodhpur and intervention this technology according location problem give below. For conducting the OFT, three innovative and receptive farmers were selected and area under each trial was 0.20 ha. The applicable management practices were use of cumin resistant variety GC-4 was sown in third week of November, soil treatment with CAZRI, Jodhpur product bio agent Marusena (*Trichoderma harzianum*). The OFTs farmers were facilitate by KVK scientists in performing field operation like FYM in enriched with Marusena for soil treatment, seed treatment with fungicides and bio agent, sowing, spraying, weeding, harvesting etc. during the course of training and visits. Keeping in view the above-mentioned factors, following treatments were given either alone or in combination and were compared with farmers' practice.

T_1 – Farmers' practice (*i.e.*, no seed and soil treatment + indiscriminate use of fungicides).

T_2 – Recommended technology (Seed treatment

Carbendazim@ 2.50 gm with Marusena @ 8.0 gm/kg seed).

T_3 – Refined technology (Seed treatment Carbendazim @ 2.0 g with Marusena @ 6 g/ kg seed + use of 100 kg FYM enriched with Marusena @ 3.0 kg/ ha for soil treatment before 15 day mixture sowing).

Training to the farmers was imparted with respect to envisaged technological intervention. Plot-wise data was recorded from recommended practice and farmer's plots. Percentage of disease incidence was also calculated on the same basis. Observations were recorded for per cent disease incidence using following formula:

$$\text{Per cent disease incidence} = \frac{\text{Number of seedling showing mortality}}{\text{Total number of seedling examined}} \times 100$$

Per cent reduction over control using following formula:

$$\text{Disease reduction (\%)} = \frac{\text{Disease incidences in control} - \text{Disease incidences in treatment}}{\text{Disease incidence in control}} \times 100$$

Information of yield and cost of cultivation was also recorded for economic evaluation in terms of net profit earned and the benefit cost ratio. Grain yield loss was calculated using following formula :

$$\text{Per cent yield loss} = \frac{\text{Yield in treatment} - \text{Yield in check}}{\text{Yield in treatment}} \times 100$$

The yield data were collected from both the demonstration and farmer's practice and workout to calculate the technology gap; extension gap and the technology index as given by Lal *et al.* (2013) below.

Technology gap = Potential yield-demonstration yield

Extension gap = Demonstration yield -farmer's yield

$$\text{Technology index} = \frac{\text{Potential yield} - \text{Demonstration yield}}{\text{Potential yield}} \times 100$$

RESULTS AND DISCUSSION

The Average per cent disease incidences, yield performance and economics of three 'OFT' of farmers' practices, refined technology andrecommended technology were assessed. Seedling mortality as seed borne disease estimation data is presented (Table 1). Farmer practices fields were recorded disease incidences average 18 per cent all four years, whereas refine technology minimum disease incidences was recorded. The perusal of the data (Table 2) revealed that there was a remarkable decrease in disease incidence where treatment was done as compared to the untreated one. During 2014-15, it was found that 12.0 per cent disease incidence and 50.0 per cent disease control was achieved in T_2 (recommended technology) and T_3 treatment (refined technology) with 5.0 per cent disease incidences and 79.17 per cent disease control. The crop yield was found 620 kg/ha in T_3 and 560 kg/ha in T_2 as compared to farmer's practice (FP) 475 kg/ha. There was a net return of Rs. 59,854 and Rs. 52,054 rupees /ha and a B:C ratio of 2.52 and 2.38 was achieved in T_3 and T_2 treatments, respectively as compared to only Rs. 39,756

Table 1 : Seedling mortality as seed borne disease estimation for wilt in cumin

Treatments	Per cent disease incidences			
	2014-15	2015-16	2016-17	2017-18
T_1 – (Farmer practice)	18.0	18.2	18.5	19.2
T_2 – Recommended technology	8.0	7.7	7.4	7.2
T_3 – Refined technology	3.0	2.6	2.4	2.1

* Average of three replications
# Based on seedling showing mortality

Table 2 : Assessment of technological gap and performance of integrated disease management approach for wilt in cumin

Treatments	Per cent disease incidences				Production (kg/ha)				Net Return (Rs. / ha)				B: C Ratio			
	2014-15	2015-16	2016-17	2017-18	2014-15	2015-16	2016-17	2017-18	2014-15	2015-16	2016-17	2017-18	2014-15	2015-16	2016-17	2017-18
T_1-Farmer practice	24.0	25.5	26.0	26.2	475	505	495	515	39756	48604	47634	52405	2.09	2.30	2.33	2.39
T_2- Recommended technology	12.0	11.7	11.3	10.9	560	585	590	600	52054	60904	62864	65020	2.38	2.58	2.58	2.63
T_3-Refined technology	5.0	5.2	4.7	4.4	620	628	650	668	59854	66414	71504	74415	2.52	2.64	2.71	2.75

rupees/ha net return anda B:C ratio of 2.09 in FP. Similar trend were observed during 2015-16 and 2016-17 also. During 2015-16, 11.7 and 5.2 per cent disease incidences and 54.12 and 79.60 per cent disease control was achieved in T_2 and T_3 treatments, respectively as compared 25.5 per cent disease incidences and 505 kg /ha yield were found in farmer's practice and a B:C ratio of 2.58 and 2.64 was observed ascompared to 2.30 in FP. Similarly, 11.0 and 4.5 per cent disease incidences and 57.69 and 82.69 per cent disease control was achieved in T_2 and T_3 treatments, respectively as compared 26.0 per cent disease incidences and 495 kg /ha yield were found in FP and a B : C ratio of 2.58 and 2.71 was observed as compared to 2.23 in FP in recorded 2016-17.

Data (Table 3) revealed that an extension gap of 123-155 kg ha^{-1} was found between demonstrated technology and FP and on average basis the extension gap was 78.0 kg ha^{-1}. The lowest extension gap (57 kg ha^{-1}) was in the year 2015-16. Such gap might be attributed to adoption of improved technology especially high yielding varieties sown with the help of seed cum fertilizer drill with balanced nutrition and appropriate plant protection measures in demonstrations, which resulted in higher grain yield than the traditional FP under on-farmer condition. The new technology will eventually motivate the farmer to adopt the promising technology with use of proper management practices for increasing the profitability. These results are in agreement with the findings of Lal *et al.* (2013) and Singh *et al.* (2011) that there is a wide technology gap among the years. It was highest (255 kg ha^{-1}) in the year 2017-18 while lowest (207 kg ha^{-1}) in the year 2014-15. The average technology gap was (233.5 kg ha^{-1}). The difference in technology gap in different fields is due to better performance of recommended varieties with recommended practices and more feasibility of recommended technologies during the course of study with the other factors like monitoring by farmers, soil type and fertility status of the fields. Similarly, the technology index for the years in the study was in relevance with technology gap. Higher technology index reflected the inadequate proven technology for transferring to farmers and insufficient extension services for transfer of technology. The technology index shows the feasibility of the evolved technology at the FP. In this study overall 26.69 per cent technology index was recorded, which varied from 23.66 per cent (2017-18) to 29.14 per cent (2014-15).

Assessed over FP (these are no seed treatment fungicides as well as bio agents and soil treatment, no crop rotation therefore, soil borne pathogen year after buildup population and ultimately pathogen reduction crop yield). This study indicate that the soil by adding FYM and *T. harzianum* were found effective in reducing wilt incidence and increasing the yield in cumin. Similar findings were reported by Mishra *et al.* (2007 and 2012) in onion and cauliflower. Outcome of the 'OFT' organized clearly brings out that the dissemination of assessed technology is feasible, economically viable and environmentally safe for containing wilt in cumin. The assessment could convince on account of it sobvious advantages and effective management of wilt in cumin. These innovative practices showed solving the farmers' problem, decision-making and ability to modify their farming practices. 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*. Many root pathogens have been successfully controlled by ploughing organic materials in the soil (Ghaffar, 1993). Chatta and Verma (2010) reported that the soil application of seed treatment with *T. harzianum*@ 8 g kg^{-1} seed is effective for organic pest and disease management in cumin. On the basis of out come from OFT, assessment of management practices and FLD were organized and their

Table 3 : Yield and gap analysis of on farm trials in cumin

Year	Area (ha)	Potential yield (kg/ha)	Demonstration yield (kg/ha)	Farmer yield (kg/ha)	Yield increase over FP (%)	Ext Gap (kg/ha)	Tech Gap (kg/ha)	Tech index (%)
2014-15	0.6	875	620	475	30.53	145	255	29.14
2015-16	0.6	875	628	505	24.36	123	247	28.23
2016-17	0.6	875	650	495	31.31	155	225	25.71
2017-18	0.6	875	668	515	29.10	153	207	23.66
Over All Average	0.6	875	641.5	497.5	28.94	144	233.5	26.69

yield performance and economics of recommended technology and FP were analyzed and presented in Table 1, 2 and 3. Thus, favorable cost benefitratio and higher net returns proved the economic viability of the recommended technology and convinced the farmers on the utility of technology provided at real farming situation.

Conclusion:

This approach is environmentally safe and farmers friendly. It is promises higher yield and at the same time minimizes threat to the environment. In IDM approach, development and adaptation of disease resistant/ tolerant high yielding crop variety plays a pivotal role. Under the situation when farmer is fails to execute the disease management practices in time, there always remains a risk of crop being damaged by diseases. Moreover, IDM which is a well established technology to reduce the disease pressure on a crop not only reduced cost of cultivation by curtailment in expenditure onpesticide purchase and labour, but also increases farm income through improvement in crop yield.

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