



Development of IPM Technology for Cumin and its Evaluation in Farmer Participatory Mode

M.M. Sundria^{1*}, H.R. Bishnoi¹, B.S. Rathore¹ and Abhishek Rajpurohit²

¹ Agricultural Research Station (AU, Jodhpur), Mandor, Jodhpur 342 304, India

² Lachoo Memorial College of Science and Technology, Jodhpur 342 001, India

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Abstracts: Field studies were conducted from 2006-07 to 2008-09 on development of organic plant protection modules along with IPM module in cumin (*Cuminum cyminum* L.) at Agricultural Research Station, Mandor, Jodhpur, and the same module were later validated during 2008-09 through farmer participatory mode at two locations of Shergath tehsil of Jodhpur district and two locations one each in Siwana and Shiv tehsils of Barmer district in arid zone of western Rajasthan. It was found that only IPM module comprising of soil treatment with *Trichoderma viride* (2.5 kg ha⁻¹) + seed treatment with *Trichoderma viride* (6 g kg⁻¹) + 1st spray of mancozeb (0.2%) at 30 DAS, 2nd spray of mancozeb (0.2%), acephate 75 SP (750 g ha⁻¹) and wettable sulphur (0.2%) at 50-60 DAS and 3rd spray as repeat 2nd spray after 10-15 days of 2nd spray, reduced the per cent incidence of major diseases such as wilt, blight and powdery mildew from 7.63, 27.10 and 27.37 in unprotected treatment to 5.03, 10.47 and 14.70, respectively in IPM module. The aphid population reduced from 12.78 aphids per umbel in unprotected control to 1.27 aphids per umbel in IPM module. IPM technology was found economically viable as indicated by net return (Rs. 6844) and incremental cost benefit (ICB) ratio (1:3.78). Though, organic plant protection modules were effective in comparison to unprotected control but all the organic plant protection modules gave negative return and ICB ratio. Organic module comprised of soil treatment with neem cake (1.0 t ha⁻¹) + seed treatment with *Trichoderma viride* (6 g kg⁻¹ seed) + three sprays of (cow urine @ 10% + neem seed kernal extract (NSKE) @ 2.5% + garlic extract @ 2% in equal ratio) was effective to manage wilt, blight and powdery mildew. Organic module comprising of soil treatment with tumba cake (1.5 t ha⁻¹) + seed treatment with *Trichoderma viride* (6 g kg⁻¹) + 1st spray of (cow urine @ 10%), 2nd spray of (cow urine @ 10% + Azadirachtin @ 0.03%) and 3rd spray (Karanj oil + Goshalla Keet Niyanttrak @ 30 ml L⁻¹) was most effective in controlling aphids in cumin as compared to unprotected control.

Key words: Cumin, aphids, organic modules, IPM.

Cumin (*Cuminum cyminum* L.) is most important seed spices crops of India. Cumin due to its high profitability and export potential has been well adopted in arid and semi-arid regions of Rajasthan and Gujarat. Western Rajasthan has great potentiality for cumin cultivation owing to suitability of this region to meet specific climatic requirement like dry and moderate cool weather and cloudless atmosphere during seed filling period in conjunction with well drained light textured soils (Choudhary *et al.*, 2013; Sharma *et al.*, 2013). The diseases viz., wilt (*Fusarium oxysporium* sp. *cumini*), blight (*Alternaria burnsii*), powdery mildew (*Erysiphe polygoni* D.C.) and aphids (*Myzus persicae* Sulz., *Hyadaphis coriandri* Das, *Aphis gossypii* Glov.) are major constraints leading to low productivity

of cumin. They may cause 10-90% losses to cumin crop.

Cumin being high value crop, indiscriminate use of pesticides against pests and diseases may result in development of resistance against pesticides, reduce population of friendly predators and enhance residual hazard in seed and soil. Considering these ill effects, available natural resources, global marketing demand for quality produce there is need to develop organic cultivation and IPM technologies for cumin. In the present study neem based formulation, animal products, bio-agents and chemicals were used together to evolve an IPM module and organic production technologies which were tested in replicated manner at Agriculture Research Station and later validated through farmers' participatory

*E-mail: manu2015@rediffmail.com

Table 1. Details of different treatments imposed on cumin (RZ 19)

Treatments details	
T ₁	Soil treatment with tumba cake (1.5 t ha ⁻¹) + seed treatment with <i>Trichoderma viride</i> (6 g kg ⁻¹ seed) + Three sprays of (cow urine -10% + NSKE - 2.5% + garlic extract - 2%) equal ratio
T ₂	Soil treatment with neem cake (1.0 t ha ⁻¹) + seed treatment with <i>Trichoderma viride</i> (6 g kg ⁻¹ seed) + Three sprays of (cow urine -10% + NSKE - 2.5% + Garlic Extract -2%) equal ratio
T ₃	Soil treatment with <i>Trichoderma viride</i> (2.5 kg ha ⁻¹ with FYM) + 1 st spray of cow urine (10%), 2 nd spray of Azadirachtin (0.03%) and 3 rd spray of Garlic extract (2%)
T ₄	Soil treatment with <i>T. viride</i> (2.5 kg ha ⁻¹ with FYM) + 1 st spray of Garlic (2%), 2 nd spray of Goshalla Keet Niyanttrak (30 ml L ⁻¹) and 3 rd spray Azadirachtin (0.03%)
T ₅	Soil treatment with Tumba cake (1.5 t ha ⁻¹) + seed treatment with <i>Trichoderma viride</i> (6 g kg ⁻¹) + 1 st spray of cow urine (10%), 2 nd spray of (cow urine -10% + Azadirachtin -0.03%) and 3 rd spray (Karanj oil + Goshalla Keet Niyanttrak 30 ml L ⁻¹)
T ₆	Chemical control - soil treatment with <i>Trichoderma viride</i> (2.5 kg ha ⁻¹) + seed treatment with <i>Trichoderma viride</i> (6 g kg ⁻¹) + 1 st spray mancozeb (0.2%) 30 DAS, 2 nd spray mancozeb (0.2%), acephate 75 SP (750 g ha ⁻¹) and wettable sulphur (0.2%) 50-60 DAS and 3 rd spray, repeat 2 nd spray after 10-15 days of 2 nd spray, if needed.
T ₇	Control (untreated)

mode at village level for another one year so as to develop and disseminate eco-friendly management technique for pest and diseases of cumin.

Materials and Methods

The experiments were conducted during rabi seasons of 2006-07, 2007-08 and 2008-09 at Agricultural Research Station, Mandor, Jodhpur to find out suitable IPM module. A set of seven treatments as detailed in Table 1 including neem seed kernal extract (NSKE), *Azadirachta indica* Juss; clove extract of Garlic, *Allium sativum* L., oil of karanj, *Pongamia pinnata* (L.) Pierre, azadirachtin 0.03% EC, cow urine, *goshalla keet niyantrak* and mancozeb M-45, Acephate 75% SP, wettable sulphur 80% WDP and bio-agent i.e. *Trichoderma viride*, were imposed in four replications in an experiment laid in randomized block design.

The seeds of a susceptible cultivar of cumin (RZ 19) were treated with *T. viride* powder @ 6 g kg⁻¹ seed, by taking seeds in polythene bags and dusting seed dresser followed by thorough shaking for 10-15 min. Seeds were then kept for 24 h under normal laboratory conditions. Seeds were sown in plot in 10 rows of 4 m in length, with a row spacing of 30 cm. Soil application of *T. viride* was done @ 2.5 kg of commercial formulation along with FYM. The commercial formulation of the bio-agents were thoroughly mixed with 50 kg of well decomposed farmyard manure (FYM) @ 2.5 kg ha⁻¹ before 15 days of sowing and applied at the time of sowing in furrow. Soil application of neem cake @ 1.0 tha⁻¹ and tumba cake @ 1.5 t ha⁻¹ were done

before sowing as per treatments. Foliar spray of mancozeb M-45 @ 0.2% and acephate 75 SP @ 0.037% and wettable sulphur 80 WDP @ 0.025%, Cow urine @ 10%, karanj oil and goshalla keet niyantrak @ 30 ml L⁻¹ (equal ratio), kernel extract of neem @ 2.5%, clove extract of garlic @ 2.0%, azadirachtin @ 0.03% were done as per treatment schedule. In this regard, the extract of neem kernel and clove was prepared by method described by Rathroe (2009). The pesticides and plant extracts were applied as per treatment. Total three foliar sprays were given at 15 days intervals since 30 days of seed germination. Plots without any foliar spray served as control. Per cent disease intensity was recorded 15 days after the last spray on 15 random plants from each plot using 0-5 scale. Per cent disease index (PDI) was calculated by using formula given by Mc Kinney (1923). Aphid population was recorded before spray and three and seven days after second and third sprays. Average yield (kg ha⁻¹) of seed was also estimated. Incremental cost benefit ratio (ICBR) of treatment with respect to yield was also calculated as per procedure. The treatments which effectively inhibited the diseases and insect pest intensity in trials were tested further for their efficacy against wilt, blight, powdery mildew and aphid infestation in next season for validation at adaptive trial centre (ATC) and at farmers' fields.

Results and Discussion

Three years pooled data indicated that the treatment comprising of soil treatment with *Trichoderma viride* (2.5 kg ha⁻¹) + seed treatment

Table 2. Effect of different organic module including botanicals and bio-agents against diseases and aphids in cumin (Pooled data of 2006-07, 2007-08 and 2008-09)

Treatments	Mean aphids population**/plant*						Per cent disease incidence***			Seed yield (kg ha ⁻¹)	Net return (Rs.)	ICBR
	Second spray			Third spray			Wilt	Blight	P. mildew			
	Pre treat.	3 DAT#	7 DAT	10 DAT	3 DAT	7 DAT						
T ₁	11.73 (3.47)	6.00 (2.53)	5.57 (2.45)	6.37 (2.60)	4.47 (2.20)	3.45 (1.97)	6.07 (14.16)	14.73 (21.23)	18.00 (24.37)	206	(-) 1781	0.79
T ₂	12.25 (3.55)	6.03 (2.54)	5.67 (2.47)	6.62 (2.65)	4.62 (2.25)	3.62 (2.02)	5.77 (13.74)	14.40 (20.93)	17.27 (23.78)	216	(-) 281	0.97
T ₃	12.13 (3.53)	4.90 (2.31)	4.42 (2.21)	5.43 (2.42)	4.70 (2.26)	4.28 (2.17)	6.40 (14.56)	16.60 (22.94)	18.50 (24.76)	161	(-) 900	0.60
T ₄	12.15 (3.53)	5.40 (2.41)	4.92 (2.31)	6.13 (2.56)	3.62 (2.01)	3.18 (1.91)	7.30 (15.62)	18.27 (24.34)	21.00 (23.32)	167	125	1.06
T ₅	12.30 (3.55)	4.02 (2.12)	3.87 (2.07)	5.20 (2.36)	3.75 (2.04)	3.25 (1.92)	6.50 (14.68)	16.67 (22.94)	20.20 (26.10)	185	(-) 3111	0.53
T ₆	11.98 (3.49)	2.23 (1.64)	1.70 (1.47)	2.40 (1.68)	1.45 (1.38)	1.27 (1.31)	5.03 (12.68)	10.47 (16.81)	14.70 (21.42)	246	6844	3.78
T ₇	11.78 (3.48)	13.65 (3.74)	14.95 (3.92)	15.68 (4.01)	13.97 (3.79)	12.78 (3.63)	7.63 (15.91)	27.10 (30.20)	27.37 (30.74)	151	-	-
CD at 5%	NS	0.40	0.40	0.43	0.39	0.38	0.90	3.27	3.33	49.12	-	-
CV %	-	11.10	10.85	11.03	11.70	12.13	7.43	12.73	12.83	17.33	-	-

* Mean of five plants; ** Figures in parenthesis are $\sqrt{X+0.5}$; *** Figures in parenthesis are ARCSIN; # Days after treatment (DAT).

with *Trichoderma viride* (6 g kg⁻¹) + 1st spray mancozeb (0.2%) 30 DAS, 2nd spray mancozeb (0.2%) + acephate 75 SP (750 g ha⁻¹) + wettable sulphur (0.2%) 50-60 DAS and 3rd spray (repeat 2nd spray after 10-15 days of 2nd spray) showed significantly lower wilt (5.03%), blight (10.47%), powdery mildew (14.70%) and aphid infestation (1.27 umbel⁻¹) among all the treatments and also recorded significantly higher seed yield (246 kg ha⁻¹) than control (Table 2).

This IPM module also offered high net return of Rs. 6844 and cost benefit ratio of 1: 3.78. However, maximum disease intensity

(7.63, 27.10, 37.37%, wilt, blight, powdery mildew) and 12.78 aphid umbel⁻¹ along with lowest seed yield (151 kg ha⁻¹) were recorded in untreated plots. Organic modules comprising of soil treatment with neem cake (1.0 t ha⁻¹) + seed treatment with *Trichoderma viride* (6 g kg⁻¹ seed) + Three sprays of (Cow urine @ 10% + NSKE @ 2.5% + Garlic Extract @ 2%) equal ratio proved to be most effective among all other combinations of botanicals against diseases and aphids and it ranked next best in descending order of effectiveness after pesticide treatment. Similar results and trend was also recorded at adaptive trial centre

Table 3. Management of cumin diseases and aphids at adaptive trial centre (ATC) and farmers' fields through botanicals and bio-agents

Treatments	Per cent mortality (wilt)	Mean aphid population per umbel	Seed yield (kg ha ⁻¹)	
			ATC	CF*
Soil treatment with neem cake (1.0 t ha ⁻¹) + seed treatment with <i>Trichoderma viride</i> (6 g kg ⁻¹ seed) + Three sprays of (cow urine -10% + NSKE - 2.5% + garlic extract -2% in equal ratio)	5.6	5.4	93.3	185
Soil treatment with <i>T. viride</i> (2.5 kg ha ⁻¹ with FYM) + 1 st spray of garlic (2%), 2 nd spray of <i>Goshalla keet niyantrak</i> (30 ml L ⁻¹) and 3 rd spray Azadirachtin (0.03%)	4.7	3.5	97.3	225
Control	11.2	15.2	79.3	150

Data of rabi 2008-09; * Mean data of 4 fields.

and farmers field (Table 3). Sundria (2008) earlier reported that non chemical treatment comprising with cow urine (10%) + garlic clove extract (2.0%) + neem seed kernel extract (5%) was found effective in reducing aphid population from 9.80 to 2.53 aphids umbel⁻¹ whereas the plot treated with acephate 75% SP @ 750 g ha⁻¹ proved effective to manage aphid population (0.86 aphids umbel⁻¹) as compared to other pesticides.

Antifungal activity has been reported in extract of several plant species by various workers also. The inhibitory effect of the botanicals on the fungal growth might be attributed to the presence of some antifungal ingredients. Fungicidal properties in leaves of neem and garlic have been reported. De Groot (1972) reported that antifungal activity of neem leaf extract may be attributed to the presence of azadirachtin and monoterpenes. Hence, it is concluded that to manage wilt, blight, powdery mildew and aphids, seed treatment with *Trichoderma viride* (6 g kg⁻¹) + soil treatment with *Trichoderma viride* (2.5 kg ha⁻¹) + 1st spray mancozeb (0%) 30 DAS, 2nd spray mancozeb (0.2%) + acephate 75 SP (750 g ha⁻¹) + wettable sulphur (0.2%) 50-60 DAS and 3rd spray, repeat 2nd spray after 10-15 days of 2nd spray may be done. Further, non chemical treatment combination i.e. soil treatment with neem cake (1.0 t ha⁻¹) + seed treatment with *Trichoderma viride* (6 g kg⁻¹ seed) + three sprays of (Cow urine @ 10% + NSKE @ 2.5% + garlic extract @ 2% in equal ratio) was also found effective but ranked next to the best based on chemicals (fungicides and insecticides).

Thus, the integrated effect of different types of plant material and effective chemicals may

be explored further to develop an eco-friendly strategy for the combined management of diseases and aphids of cumin. All the treatments except integrated approach of chemicals and bio-agents, gave negative return. On the basis of experimental results it is concluded that complete organic modules have capabilities to manage pest and diseases of cumin but they are not economically profitable.

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