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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(5): 3190-3192

www.thepharmajournal.com
Received: 05-02-2023
Accepted: 15-03-2023

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Impact of on farm trial on integrated pest management practices in chilli (*Capsicum annuum* L.) in Krishna district of Andhra Pradesh

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Abstract
Chilli (*Capsicum annuum* L.) is an important commercial crop in India. Though India is the highest in production, consuming and export of chilli, the productivity of the crop is decreasing day by day mainly due to incidence of sucking pests (transmit viral diseases) and fruit borers. Chilli thrips, mites, aphids, *Spodoptera* and *Helicoverpa* are the major pests responsible for considerable yield loss. IPM and non-IPM (famer's practice) practices were evaluated in ten different villages of Krishna district at 15 locations under KVK, Ghantasala for sustainable management of these pests. Experimental findings revealed that the IPM practices proved superior in managing the insect pests and recorded higher fruit yields and quality than non IPM practices (*i.e.,* use of only chemicals/pesticides) with reduced cost of cultivation in IPM plots when compared to non IPM practices. The benefit cost ratio was found to be 1.99, 1.99 and 1.79 in IPM treated plots when compared to 1.54, 1.49 and 1.40 in check plots during 2017-18, 2018-19 and 2019-20, respectively.

Keywords: IPM, Non IPM, Chilli, thrips, mites, *Spodoptera* and *Helicoverpa*

Introduction

Chilli (*Capsicum annuum* L.) is one of the major vegetable and spice crop belongs to the family Solanaceae and is one of the versatile spices as well as vegetables grown for the value of its fruits in India. India has rich diversity of chilli varieties with different quality parameters. Besides traditional use of chilli as a vegetable, spice, condiment, sauce and as pickles it is also being used in pharmaceuticals, cosmetics and beverages (Tiwari *et al.*, 2005) [1]. India is a major producer and the largest consumer, exporter of chilli in the world with a production of 4417 MT from an area of 418 thousand hectares (Department of Agriculture and Farmers Welfare, 2021) [5]. Though India is the largest chilli producer, a number of limiting factors have been identified for its low productivity. A major bottle neck in the production of chilli is the pest complex with more than 293 insects and mite species debilitating the crop in the field as well as in storage (Tiwari *et al*., 2005) [1]. The major insect pests that attack chilli are aphids (*Myzus persicae* and *Aphis gossypii*), thrips (*Scirtothrips dorsalis*) and mites (*Polyphagotarsonemus latus*). Chilli virus vectors, majorly white fly and thrips are causing leaf curl, crinkling, reduction in growth and flowering and then finally impact on yield. In addition to sucking pests, pod borers also cause maximum damage to the crop both during vegetative and fruit formation stages. The crop loss by three major pests were 30-50% by thrips (*S. dorsalis*), 30-70% by mites (*P. latus*) and 30-40% by fruit borers *Helicoverpa armigera* and *Spodoptera litura* (Mallapur *et al.*, 2003) [2]. These pests cause serious damage to the crop by direct feeding on the plant. The farmers always give priority in protecting such a high value crop from any type of damage caused by insects-pests. The indiscriminate use of pesticides without proper diagnosis results in pest resurgence, phytotoxicity, infertility/low fruit setting due to killing of pollinators and presence of high amount of pesticide residue on harvested fruits along with destruction of earthworms. However, there is a potential to manage these pests and to increase the production of chilli by adopting improved production practices and recommended plant protection measures at right time. Adoption of integrated pest management practices with non-pesticidal practices has proved to have beneficial effect on improving the natural enemy population, which in turn keep the pest population in check.

In view of the above, an attempt was made to evaluate and popularize on the use of Integrated Pest Management practices in farmer's field for sustainable production of crop with minimum loss.

Material and Methods

Chilli hybrid, VNR-145 is a very popular and widely cultivated hybrid in Krishna district of Andhra Pradesh. Though it is a high yielding hybrid, it is much susceptible to viral diseases. The experiments were conducted for three consecutive years from 2017-18, 2018-19 and 2019-2020 at ten different villages of Krishna district namely, Uttara chiruvolulanka, Mellamertilanka, Kosurivaaripalem, Nagaitippa, Nadakuduru, Bobbarlanka, Inapuru, Mopidevi, K Kothapalem and KVK, Ghantasala farm. The soil of the experimental plots was sandy loam to black in the texture with medium fertility status and deficient in boron and zinc micro nutrients. The experiment was laid out in completely randomized block design. The crop was raised in the nursery and 25 days old seedlings were transplanted in the experimental field at 60 cm x 60 cm spacing. Standard agronomic practices were followed to grow the crop. The IPM plots were maintained by following IPM practices *viz.*, deep summer ploughing, seed treatment with imidacloprid 8g/kg seed, erection of yellow (white fly) and blue (thrips) sticky traps for sucking pest management @ 20 each/acre, *Helicoverpa* and *Spodoptera* pheromone traps for monitoring and mass trapping @ 8 no./acre each, marigold as trap crop, removal of weeds on bunds and need based application of recommended dose of insecticides.

To study the number of viral infected plants and incidence of fruit borer damage, five plants were selected randomly from each plot and tagged. Observations were recorded at seven days interval starting from 14 days after transplanting (DAT) up to last harvesting of fruits and counted average percent infected of virus plants, *Spodoptera* and *Helicoverpa* plants per plot. First plucking of fruits was made at 65 DAT and successive plucking was done at an interval of 15 days. Fruit yield per plant was calculated from each harvesting and cumulated fruit yield per hectare from all harvestings of field. The plant biometric observations and the fruit yield parameters were recorded and computed to tons per hectare. The benefit - cost ratio (BC Ratio) of the treatments was calculated by estimating cost of cultivation and return from fruit yield after converting them to one hectare of land. The economics were calculated using the following formula:

1. Gross return = Yield x Market price
2. Net Returns = Gross Return - Total Cost of cultivation
3. B: C ratio = Gross Return / Total Cost

Results and Discussion

In the treated plots as well in the non-treated farmers' fields, thrips incidence was noticed to be high compared all other pests causing damage to the crop. The thrips lacerates the epidermis and suck the sap and the infested leaves develop crinkles and curl upwards. The white minute, streaky spots were commonly noticed on infested leaves. Buds become brittle and drop down. At early stage, infestation leads to stunted growth and flower production with arrested fruit set. The adults and nymphs of mites generally suck sap from leaves, petioles and tender twigs. As a result, the margin of the young leaves curled downwards in an inverted boat shaped manner. However, the older leaves and petioles were found elongated. In severely infested plant, leaves and terminal twigs become hardened, twisted and thickened. Infested plants have very small sized leaves. In such a plant most fruits become cracked and deformed. Besides, flower and fruit shedding were observed rarely. The experimental results of the present study revealed that the plant biometric parameters of yield and yield attributing traits were recorded highest in IPM plots than non IPM plots i.e., the plant (*viz.*, plant height, plant spread, number of branches) and fruit parameters (*viz.*, fruit length, fruit diameter, fruit weight, number of fruits per plant and total green fruit yield per plant) were significantly higher in case of IPM plots of chilli than in non IPM plots (Table-1). From Table-2 it was clear that the average fruit yield for three consecutive years was highest in IPM (27.58 t/ha., 27.75 t/ha. and 25.00 t/ha.) than non IPM plots (23.75 t/ha., 23.25 t/ha. and 22.00 t/ha.). The average percent increase in yield over three consecutive years was observes as 16.43% in IPM plots than in control. Apart from this, from Table-2, it was clear that the gross returns and net returns were observed highest in IPM plots than non IPM plots and the cost of cultivation was observed highest in non IPM fields than in IPM plots because of dependency on chemical sprays only with increased number of sprays and indiscriminate use of pesticides to control pest population. The benefit cost ratio was observed as 1.99, 1.99 and 1.79 in IPM plots and 1.54, 1.49 and 1.40 in check plots during 2017-18, 2018-19 and 2019-20, respectively. The findings are in collaboration with the earlier works of Akshata *et al.*, 2018 [3]. The over-all observations revealed that the farmers got better fruit yield and quality in practicing IPM practices rather than spraying only chemical insecticides in indiscriminate way for pest control. Moreover, it also increased the cost of cultivation in non IPM plots by spraying pesticides making it less remunerative.

The percent virus and fruit borer infected plants were recorded highest in non IPM plots than in IPM plots (Table-3). The findings of present study revealed that there was an average of 29% of virus infected plants were observed in IPM plots, whereas, it was 62% in control. In case of fruit borer damage (both *Spodoptera* and *Helicoverpa*), it was observed that an average of 9% borer infected plants were recorded in IPM plots and 26% in non IPM plots. The result was in collaboration with the results of Gurava Reddy *et al.*, 2011 [4].

Table 1: Plant parameter observations recorded in IPM and non IPM plots

S. No.	Particular	2017-18	2018-19	2019-20	Mean	2017-18	2018-19	2019-20	Mean
		IPM				Non IPM			
1	Plant height (cm.)	66.31	79.31	68.31	71.31	60.93	73.93	62.93	65.93
2	Plant spread (cm)	64.32	77.32	66.32	69.32	59.21	61.71	5971	60.21
3	No. of branches	6.6	9.1	7.1	7.6	6.3	7.6	6.6	6.8
4	Fruit length (cm)	12.2	14.7	12.7	13.2	9.93	12.43	9.43	10.93
5	Fruit diameter (cm)branches	1.8	2.6	2.1	2.3	1.7	2.5	1.8	2.0
6	Fruit weight (g))	10.6	11.9	10.8	11.1	10.4	11.7	10.6	10.9
7	No. of fruits per plant	76.8	93.8	80.79	83.79	60.72	80.72	65.72	69.72
8	Green chilli yield per plant (kg.)	0.81	1.12	0.87	0.93	0.63	0.95	0.7	0.76
9	Green chilli yield t/ha.	24.8	29.1	26.13	26.78	20.6	26.13	22.25	23

Table 2: Effect of chilli IPM and Non IPM practices on benefit cost ratio

Years	Treatment	Variety	Yield (t/ha)	Percent increase in yield	Gross returns (Rs/ha)	Cost of cultivation (Rs/ha)	Net returns (Rs/ha)	BCR
2019-20	IPM	VNR-145	27.58	16.13	496440	249620	246820	1.99:1
	Check	VNR-145	23.75		427500	278250	149250	1.54:1
2018-19	IPM	VNR-145	27.75	19.35	499500	251550	247950	1.99:1
	Check	VNR-145	23.25		418500	281550	136950	1.49:1
2017-18	IPM	VNR-145	25.00	13.64	450000	250625	199375	1.79:1
	Check	VNR-145	22.00		396000	283125	112875	1.40:1
Over all	IPM	VNR-145	26.78	16.43	481980	250598	231382	1.92:1
	Check		23.00		414000	280975	133025	1.47:1

Table 3: Percent damage recorded in IPM and non IPM plots

S. No.	Particular	2017-18	2018-19	2019-20	Mean	2017-18	2018-19	2019-20	Mean
		IPM				Non IPM			
1	% virus infected plants	37	24	26	29	70	57	59	62
2	% fruit borers	10.6	8.1	8.5	9	31	18	23	26

Summary and conclusions

The overall data from three consecutive years reveals that there was an average of 29 per cent plants were virus affected and 9% were damaged due to fruit borers in non IPM plots. Whereas, it was 62% and 26% respectively in control. The average cost of cultivation for three years was reduced by Rs. 30,000/ha. approximately and percent yield was increased by16.43% in IPM plot than non IPM plot.

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