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Evaluation of technological gap and performance of low yield of tomato due to fruit borer

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ABSTRACT

The experiment was carried out to evaluation of technological gap and performance of integrated pest management (IPM) come upto as a resistant variety, tap crop as marigold line, bio pesticides as Ha NPV, chemical spray as sucking pest Dimethoate at before flowering time and borer managemant as Acephate fruiting time of tomato fruit borer, *Helicoverpa armigera* pest under field condition. This experiment was conducted on farmer trials (OFT) at different villages likewise Hemawas, Sandeyo Ki Dhani and Baldo Ki Dhani in Pali district (Rajasthan) during period of three year (2015 to 2017). During this experiment pest infestation of fruit borer was observed to be lowest (Pest infestation 12.0%) when, resistant variety Heemsohna, tap crop use African marigold, tomato line ratio 2:14, Ha NPV 250 LE @ 0.4 ml/lit of water at 30 DAP and 45 DAP Dimethoate 0.5 ml/lit at before flowering time and Acephate 0.5 g/lit at 45 fruiting time. Maximum infestation pest damage (44.00%) was observed when traditional farmers practice (FP). The adoption of recommended improved tomato production technology and plant protection measures was poor. The main objective of the OFT was to conduct extent of technological gap between recommended and actually adopted tomato technologies by the tomato growers from Pali district. It is suggest organising result OFT and field visits for minimizing technological gap by agriculture department. The OFT was effective in changing attitude, skill and knowledge of IPM approach and tomato fruit yield increased upto 57.52 per cent more over the traditional FP. Results indicates that IPM approach increased net income by Rs. 1,74,781/-ha over FP.

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INTRODUCTION

The tomato (*Solanum lycopersicum*) is one of the board majority grown vegetable in the world. In India, tomato is the second most important vegetable crop, next to potato. In India during 2017-18, it was cultivated in

10.4 million-hectares area with a production of 197.6 million tonnes. In Rajasthan, its area and production were 16.32 lakh hectares and 1.67 million tonnes, respectively (Anonymous, 2018). Known for tomato is specit nuttrient value and multiple uses. Among many factor responsible for low yield of tomato, insect pest and disease are major one that had been reported to attack tomato at all stage of crop growh in the Pali dristrict in Rajasthan. However, among insect pests the damage caused by fruit borer *Helicoverpa armigera* surpass the loss caused by all other insect pest together range from 20-50 per cent. Fruit borer can damage 90 per cent of fruit and reduce yield by 30-40 per cent (Selvanarayanan, 2000) and loss was 31.53 per cent on winter sown tomato crop (Singh *et al.*, 2017). Pali district (Rajasthan) tomato are comercial vegetable crop the farmers have a tendency to indiscrinatery use insecticides to managemant this destractive pest.

Factor responsible for decelopment and spread of the infestation/reason low yield of tomato:

– Severe infestation of tomato fruit borer
– Lack of sucking pest awerness
– Lack of knowledge of IPM
– Lack of money for inputs
– Use of local varieties
– No seed treatment
– Inproper plant protection appliation.

Tomato is considere as most profitable vegetable crop in Sandeyo Ki Dhani, Baldo Ki Dhani and Hemawas village of adjacent Pali district (Rajasthan) in recent years. The tomato produce is obtainable in cities more or less all the year round. Introduction of high yielding varieties and other technologies in tomato is a significant landmark in the agricultural development. Agriculture is an applied science, in new practices, seed, plant protection and machinery are coming to limelight; however, there is drop of time and a hagu gap in research outcome and extent of adoption by the farmers. It is beyond that, location specfic needbased, appropriate, timely and balanced application of the critical inputs may be the positive reply to increase the crop production in common and particularly production of vegetable crops. The effort is made for transfer of scientific information to potential users as quickly as possible. Nevertheless, there exist a gap between the scientific information evolved and its utilization by ultimate users. In the absence of resistant varieties, farmers are compelled to grow the varieties, which give way to the pest very easily. Keeping in view the demoralizing amount of the pest attack in tomato, ICAR- Central Arid Zone Research Institute, Krishi Vigyan Kendra, Pali has designed an intervention on borer management and the recommended technology was disseminat to the tomato grower through conduct of OFT.

MATERIAL AND METHODS

Evaluation and impact of integrated pest management (IPM) practices in tomato crop were carried out through OFT were conducted at the tomato grower fields at different locations of the villages likewise Hemawas, Sandiyo Ki Dhani and Baldo Ki Dhani in Pali district for three years *i.e.* 2015-16, 2016-17 and 2017-18 consecutively. It was conducted at ICAR-CAZRI, KVK, Pali to validate the efficacy of fruit borer management recommended technology was taken Indian Institute of Vegetable Research, (IIVR), Varanasi (U.P.) 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. Each plot size was 3.6×2.0 m^2. The applicable management practices were use of tomato resistant variety *i.e.,* Heemsohna sown in third week of November for prepaird nursery at KVK, Pali modal nursery under supervision of horticulture and plant protection scientists. After attending thirty days, old nursery plants or attained a height of 15 cm with 8-10 leaves were uprooted and transplant at progressive farmer fields keeping row-to-row 60 cm and plant to plant distance 40 cm. The OFTs farmers were facilitate by KVK scientists in performing field operation likewise FYM, fertilizer, prepaird bed for transplanting, irrigation, spraying, weeding, harvesting and marketing of tomato etc. during the expeirmant of farmers were training and visits as per requirment. Keeping in view the above-mentioned factors, following treatments were given either alone or in combination and were compared with FP.

T_1 Farmers' practice.

T_2 Recommended technology (African marigold line, Dimethoate 1.0 ml /lit at before flowering time and Acephate 1.0 g/lit at 45 fruiting time).

T_3 Refined technology (African marigold line, Dimethoate 0.5 ml/lit at before flowering time and Acephate 0.5 g/lit at 45 fruiting time +Ha NPV

(*Helicoverpa armigera* nuclear polyhedrosis virus) 250 LE @ 0.4 ml/lit of water at 30 DAP and 45 DAP).

Training to the farmers was imparted with respect to envisaged technological intervention. Plot-wise data was recorded from recommended practice and farmer's plots. To know the avoidable losses due to *H. armigera,* ten plants were selected from each replication in both recommanded tehnology and farmer technology set of plots and observation pertaining to various per cent infestation pest damage weights of fruits and insect pest management index was calculated expressed as suggested by Ghosh *et al.* (2013).

Insect pest management index (IPMI): IYIC÷ PCIP where, IYIC = Per cent yield over insect check plot, PCIP = Per cent control of the insect pest

Per cent fruit damage was worked out by the following formula:

$$\text{Per cent fruit infestation} = \frac{\text{Number of damaged fruits}}{\text{Total number of tomato fruits}} \times 100$$

Per cent fruit weight loss was worked out by the following formula:

$$\text{Per cent fruit weight loss} = \frac{\text{Weight of damaged fruits}}{\text{Total weight of tomato fruits}} \times 100$$

The damage by fruit borer was judged on the basis of per cent fruit infestation for estimating resistance and susceptibility of different tomato varieties to tomato fruit borer as per the method given by Kashyap and Verma (1987). Field visits during OFT plots and farmers practice plot (control plot) and finally extension gap, technology gap and technology index were calculated as given as formula suggested by Samui *et al.* (2000) and Dayanand and Mehta (2012) as given below.

$$\text{Per cent increase in yield} = \frac{\text{Demonstration yield - Farmers practice yield}}{\text{Farmers practice yield}} \times 100$$

Technology gap = Potential yield -Demonstration yield

Extension gap = Demonstration yield - Yield under existing practice

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

RESULTS AND DISCUSSION

The average per cent infestation pest damage, yield performance and economics of OFT of farmers' practices, refined technology and recommended technology were assessed. The perusal of the data (Table 1) revealed that there was a remarkable decrease in infestation pest damage where treatment was done as compared to the untreated one. During 2015-16, it was found that 26.0 per cent infestation pest damage and 40.90 per cent pest control was achieved in T_2 (recommended technology) and T_3 treatment (refined technology) with 14.0 per cent infestation pest damage and 68.18 per cent infestation pest damage control. The tomato yield was found 280 q/ha in T_3 and 243 q/ha in T_2 as compared to FP 186 q/ha. There was a net return

Table 1: Evaluation of technological gap and performance of integrated pest management come upto for fruit borer in tomato

Technology assessed	Per cent of infestation pest damage			Production per unit in quntal / ha			Net return (Profit) in Rs. / unit			BC ratio		
	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18
T_1 (Farmer practice)	44	40	36	186	209	218	77520	103971	121900	2.47	2.96	3.32
T_2 African marigold line, Dimethoate 1ml /lit at before flowering time and Acephate 1 g/lit at 45 fruiting time	26	24	22	243	249	255	114400	130900	148087	3.05	3.34	3.64
T_3 African marigold line, Dimethoate 0.5 ml/lit at before flowering time and Acephate 0.5 g/lit at 45 fruiting time +Ha NPV 250 LE @ 0.4 ml/lit of water at 30 DAP and 45 DAP	14	12	13	280	286	293	137200	155611	174781	3.33	3.64	3.95

of Rs. 1,37,200 and Rs. 1,14,400 rupees /ha and a B:C ratio of 3.33 and 3.05 was achieved in T_3 and T_2 treatments, respectively as compared to only 77,520 Rs./ ha net return and a B:C ratio of 2.47 in FP. Similar trend were observed during 2016-17 and 2017-18 also. During 2016-17, 24.0 and 12.0 per cent infestation pest damage and 36.36 and 63.63 per cent infestation pest damage control was achieved in T_2 and T_3 treatments, respectively as compared 40.0 per cent infestation pest damage and 209 q/ha yield were found in FP and a B:C ratio of 3.34 and 3.64 was observed ascompared to 2.96 in FP. Similarly, 22.0 and 13.0 per cent infestation pest damage and 38.89 and 63.89 per cent infestation pest damage control was achieved in T_2 and T_3 treatments, respectively as compared 36.0 per cent infestation pest damage and 218 q/ha yield were found in FP. There was a net return of Rs. 174781 and 148087 Rs./ha and B: C ratio of 3.64 and 3.95 was observed as compared to 3.32 in FP in recorded 2017-18. Similar reports were found Srinivasan *et al.* (1994); Kumar *et al.* (1999); Shalini and Gowda (2016) and Sinhg *et al.* (2017) technology using the African marigold as a trap crop tomato in yield and reduction yield. Moorthy *et al.* (1993) and Mohan *et al.* (1996) reported that sprays of Ha NPV starting from the flowering stage were successful in controlling the fruit borer in tomato.

Data Table 2 revealed that an extension gap of 286.33-204.33 q/kg ha^{-1} was found between demonstrated technology and FP and on average basis the extension gap was 82.0 q/ ha^{-1}. The lowest extension gap (75 q/ ha^{-1}) was in the year 2017-18. Such gap might be attributed to adoption of improved technology especially high yielding varieties sown with the help of appropriate plant protection measures in OFT, which resulted in higher tomato fruit 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 Shalini and Gowda (2016) and Singh (2017) in tomato that there is a wide technology gap among the years. It was highest (170 q/ha^{-1}) in the year 2015-16 while lowest (157q/ha^{-1}) in the year 2017-18. The average technology gap was (163.67 q/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 investigation with the other factors likewise 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 36.22 per cent technology index was recorded, which varied from 34.89 per cent (2017-18) to 37.78 per cent (2014-15). Similar findings were found with Shalini and Gowda (2016) and Singh (2017) in tomato crop.

Evaluated over FP (these are lack of sucking pest, root knot nematodes, lack of knowledge of IPM, lack of money for inputs, use of local varieties, no seed treatment, severe infestation of fruit borer and improper plant protection reduction tomato yield). This study indicates that the marigold line and Ha NPV were found effective in reducing fruit borer infestation and increasing the yield in tomato Mishra *et al.* (2019) reported similar findings in tomato. Out come of the OFT organized clearly brings outthat the dissemination of assessed technology is feasible, economically viable and environmentally safe for containing fruit borer in tomato. The evaluation could convince because of it sobvious advantages and effective management of fruit borer in tomato. These innovative practices showed solving the farmers' problem, decision-making and ability to modify their farming practices. On the basis of out come from OFT were organized and

Table 2 : Analysis of ext, tech, gap with yield on farm trials in tomato crop

Year	Area (ha)	Potential yield (q/ha)	Demonstration yield (q/ha)	Farmer yield (q/ha)	Yield increase over FP (%)	Ext gap (q/ha)	Tech gap (q/ha)	Tech index (%)
2015-16	0.6	450	280	186	50.53	94	170	37.78
2016-17	0.6	450	286	209	36.84	77	164	36.44
2017-18	0.6	450	293	218	34.34	75	157	34.89
Average	0.6	450	286.33	204.33	40.57	82	163.67	36.22

their yield performance and economics of recommended technology and FP were analyzed and presented in Table 1 and 2. Thus, favourable cost benefit ratio 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. Scientific method of tomato cultivation can reduce the technology gap to a considerable extent, thus leading to increased productivity of tomato in district, which in term will improve the economic condition of the tomato growers. Moreover, extension agencies in the district need to provide proper technical support to the farmers through different educational and extension methods to reduce the extension gap for better tomato production in the western Rajasthan.

Conclusion:

This approach is environmentally safe, farmer's friendly and extra income with marigold cultivation. It is also root knot disease managemant and other insect and pest managemant. It is promises higher tomato yield and at the same time minimizes threat to the environment. In IPM approach, development and adaptation of pest resistant/ tolerant high yielding tomato variety plays a pivotal role. Under the situation when farmer is fails to execute the pest management practices in time, there always remains a risk of crop being damaged by pest. IPM is a well-established technology to reduce the insect pressure on a crop not only reduced cost of cultivation by restriction in expenditure on pesticide purchase and labour, but also increases farm income through improvement in tomato crop yield.

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