Plant Archives Vol. 17 No. 2, 2017 pp. 1415-1418 *ISSN 0972-5210*

PRODUCTIVITY ENHANCEMENT IN TOMATO THROUGH INTEGRATED CROP MANAGEMENT IN SAGAR DISTRICT OF MADHYA PRADESH, INDIA

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Abstract

The technology demonstrations were conducted at farmer's field with farmers participatory mode during *kharif* seasons of 2013 to 2016 with medium fertility status soils in Sagar district of Madhya Pradesh (India) for popularization of improved production technology of tomato. Seed sowing of varieties NP 5005, Dhanwan and Himshikhar in different years was done in raised bed nursery with a seed rate of 0.4 kg ha-1 than planted in the fields. FYM, neem cake and SSP and murate of Potash was applied as basal and soluble fertilizers were given through drip-fertigation to fulfill the nutrient requirement of the crop. IPM Practices was followed as seedling treatment with *Trichoderma viride* and PSB culture, one row of marigold after 16 rows of tomato, installation of pheromone trap (20/ha), Yellow sticky trap (50 No. / ha), Blue sticky trap (50 No./ha.) were installed. General spray of Carbendazim + Mancozeb @ 2.5 g/lit of water was done in vegetative stage to check the foliar diseases. Soil application of fipronil (15 kg/ha) and Spray of NPV 250 LE /ha at flowering stage followed by Profenophos 50 EC at fruiting stage for management of insect- pest. Seedling mortality reduced by 72 per cent in the nursery and incidence of wilt disease reduced by 69.5 per cent and yield of tomato was found 39.5 per cent more in technology demonstration (275 q/ha) as compared to farmers practice (197 q/ha) during the years. The additional cost Rs. 6700 per ha increased the average net return of Rs. 46100 per ha and incremental benefit cost ratio 7.88 shows higher profitability and economic viability of the technology demonstration.

Key words : Technology Demonstration, frontline demonstration, tomato.

Introduction

Tomato (*Lycopersicon esculantum*) is an important vegetable crop of Indian subcontinent, rich in vitamin A, C, potassium, minerals, antioxidants and fibres. In tomato crop grown on an area of 4.58 million hectares with a production of 74.62 million tonnes. India, it is grown in 0.90 mha area with 17.8 mt production and 19 t/ha productivity (Anonymous, 2014). Tomato is largely grown as winter crop in the irrigated patches of Madhya Pradesh with perennial streams as source of water. In general, summer and rainy seasons are the lean periods for tomato production. In order to avoid such oversupply and spoilage, emphasis is directly needed on off-season tomato cultivation. So that its availability is regulated throughout the year; besides the farmers could fetch premium prices.

Poor crop management, imbalanced use of fertilizers, indiscriminate use of pesticides are major constraint, which leads to poor harvest. The traditional cultivars of tomato are poor performer in off-season due to problems of rotting and wilting owing to heavy rain. Thus, there is tremendous opportunity for increasing the productivity of tomato by adopting improved production technologies. The intensive cultivation without proper crop rotation, poor crop management has led to increase in pest and disease incidence causing 50-60 per cent yield loss. Fruit borer, leaf miner, white fly are the important pests and Cercospora leaf spot, early blight, leaf curl disease major problem in tomato cultivation. There is potential to increase production of vegetables by using improving production practices and proper plant protection measures at right time. Adoption of integrated crop management practices at proper time resulted better production as well as management of insect pest and diseases. Technology demonstration is the most effective way to show how a thing works, how to do the work, principles involved in

an operation and to show the end results of the technology/ methodology adopted. The present studies were conducted at 70 farmer's field with farmers participatory approach from 2013-14 and 2016-17 in Sagar districts on use of improved varieties (NP 5005, Dhanwan, Himshikhar), drip-fertigation and IPM Practices by Krishi Vigyan Kendra, Sagar.

Materials and Methods

The present study was conducted during *kharif* seasons from 2013-2016 with medium fertility status soils in Sagar district of Madhya Pradesh for popularization of improve production technology of tomato. To find out the constraints in tomato production, Participatory Rural Appraisal (PRA) technique was used. Preferential ranking technique was utilized to identify the constraints faced by the respondent farmers in tomato production. Farmers were asked to perceive the extent of damage or yield loss (%) due to various biotic constraints in chilli production. Based on higher order problems identified, technology demonstrations were planned and conducted at the farmers' 70 field. Each demonstration was conducted on an area of 0.40 ha and the same area adjacent to the demonstration plot was kept as farmer's practices as suggested by Das *et al*. (1998).

The package of improved production technologies included variety NP 5005, Dhanwan and Himshikhar, to fulfill the fertilizer requirement (100:80:60 NPK/ha) 50 qtl FYM, 100 kg Neem G (Neem formulation) and 150 kg SPS were applied as basal dose, Enrich Azotobactor, PSB and *Trichoderma viride* were also applied in the soil. Seeds were treated with *Trichoderma viride* @ 10 g kg^{-1} seed for prevention of seed-borne diseases and inoculated with azotobactor and PSB @ 10 g kg^{-1} seed for increasing the availability of nitrogen and phosphorus to crop roots. Seed sowing was done in raised bed nursery than planted in the fields. 25-30 days old disease free seedling of Tomato planted in the month of July on raised bed. IPM Practices was followed as seedling treatment with *Trichoderma viride* and PSB culture, one row of marigold after 16 rows of tomato, installation of pheromone trap (20/ha), Yellow sticky trap (50 No. / ha), Blue sticky trap (50 No./ha.) and were installed for monitoring and management of pod borer and sucking pest. General spray of Carbendazim + Mancozeb @ 2.5 g/lit of water was done in vegetative stage to check the foliar diseases. Soil application of fipronil (15 kg/ha) and Spray of NPV 250 LE/ha at flowering stage followed by Profenophos 50 EC at fruiting stage for management of insect- pest. In the second plot, the same variety was planted with basal dose of DAP 50 kg/ha than top dressing of urea, spray of insecticides and fungicides at pest and disease appearance and maintained as farmers practice. Frequent field visit were conducted in tomato growing areas of the district.

The data on wilt disease, infestation of sucking pest and fruit borer were recorded from vegetative to crop harvest stage, number of fruits/plant, yield were recorded. The cost of cultivation, gross monetary return and benefit cost (B:C) ratio were calculated based on current market price. In addition to this, data on farmer practices were also collected from the equal area. The benefit cost (B:C) ratio was calculated based on gross return. The following formulae were used to calculate the parameters as suggested by Tomar *et al*. (2009):

1. Increase in grain yield = Grain yield from Demo plot – Grain yield FP plot / Grain yield demo plot × 100.

2. Net Return = Gross Return – Cost of cultivation

3. Benefit / Cost Ratio = Net Return / Cost of Cultivation × 100.

Results and Discusson

Insect pest and disease incidence

Seed treatment with *Trichoderma viride* @ 10 gm/lit of water reduced damping off by 72 per cent in the nursery of tomato. The average incidence of wilt disease in the demonstration plot were 11.5 and 3.5 per cent as against farmers practice, which reduced by 69.5 per cent during the years. This may be due to precautionary use of *Trichoderma viride* with FYM as basal application. Bhat *et.al*. (2016) reported that *T. viride* was effectively managing *Fusarium* wilt of chilli and incidence of 15.4 and 6.2% was recorded in *T. viride* treatment as against 31.4 and 15.4%, respectively in untreated control. Singh (2007) also reported moderate effect of *T. viride* and *T. harzianum* against chilli wilt at Himachal Pradesh.

Adoption of IPM practices reduced the population of fruit borer of tomato by 66 per cent with 39.5 per cent increase in yield of tomato. Srinivasan *et al*., 1994 suggested the technology using the African marigold as a trap crop, one row of marigold is followed by 14-16 rows of tomato and two sprays of insecticide are made. Krishna Moorthy *et al*. (1993), Mohan *et al*. (1996) reported that 4-6 sprays of Helicoverpa armigera nuclear polyhedrosis virus (Ha NPV) at an interval of 4-6 days, starting from the flowering stage were successful in controlling the fruit borer in tomato.

Yield and yield attributes

The proper application of nutrients and management of crop enhances the productivity of tomato under

technology demonstration plots. The average number of fruits was increased in technology demonstration as 23 to 29.5 per plant in comparison to farmers practice. Yield of tomato was found 39.5 per cent more in technology demonstration (275 q/ha) as compared to farmers practice (197 q/ha). Balance fertilizer (NPK 20:50:20 kg/ha) application with biofertilizer increased the yield of vegetables as well as given higher monetary returns as reported by Khan *et al*. (1996).

Economic analysis

The economic viability of technology demonstrated over farmer's practices was calculated depending on prevailing prices of inputs and output costs (table 2). Different variables like seed, fertilizers (organic, inorganic and bio-fertilizer) and pesticides were considered as cash input for technology demonstrations as well as farmers practice. It was found that average cost of production of tomato under improved production technologies was 56225 per ha in all the years over farmers practice (local check) which was 49525 per ha. The improved production technology ad proper crop management in tomato given Rs. 154175 monitory returns in comparison to Rs. 108075 under farmers practice, subsequently B: C ratio increased from 3.19 to 3.78.

The average of additional cost Rs. 6700 per ha increased the average net return of Rs. 46100 per ha in the technology demonstration (table 3) was mainly due to more cost involved in organic manures for balanced fertilizer application which will be reduced in subsequent years. The additional cost of tomato cultivation in improved production technologies gave higher incremental benefit cost ratio 7.88 suggesting its higher profitability and economic viability of the demonstration. These results are in accordance with the findings of Byrappa *et al.* (2012). Similar results were also reported by Hiremath and Nagaraju (2009). The results from the current study clearly brought out the potential of improved production technologies for tomato cultivation in Madhya Pradesh, India.

Table 1 : Insect-pest and disease incidence, yield attributing Wilt, insect population, seed yield of tomato as affected by improved and local practices in farmer's fields.

Year	No. of demonst-rations	Wilt incidence (%)		Reduction per cent	Pod borer per plant		Reduction per cent	No. of fruit per plant		Yield (Kg/ha)		Increase in yield
		Demo	FP		Demo	FP		Demo	FP	Demo	FP	
2013-14	20	3	11	72.7	0.3	1.2	75	30.2	24.5	263	184	42.9
2014-15	20	5	12	58.3	0.4	1.0	60	31.4	23.4	282	215	31.1
2015-16	10	2	11	81.8	0.2	0.8	75	28.6	22.6	322	206	56.0
2016-17	10	4	12	66.6	0.3	0.9	66	29.5	21.8	233	183	35.3
Average	**3.5**	**11.5**	**69.5**	**0.3**	**0.9**	**66**	**29.5**	**23.0**	**275**	**197**	**39.5**	

Table 2 : Economics of tomato cultivation as affected by improved technology and local farmers practice.

Year	Cost of cultivation		Gross returns		Net returns		B:C ratio	
	Demo	Local FP	Demo	Local FP	IT	FP	IT	FP
2013-14	48000	45000	210400	147200	162400	102200	4.4	3.2
2014-15	52800	48200	210400	172000	157600	125800	3.9	3.5
2015-16	61300	56900	210400	164800	149100	117900	3.4	2.8
2016-17	62800	48000	210400	146400	147600	98400	3.4	3.0
Average	56225	49525	210400	157600	154175	108075	3.78	3.19

Table 3 : Economics of tomato cultivation in technology demonstration and farmer practices (Pooled data of four years).

Variables	Cost of cultivation Rs/ha)	Gross return (Rs/ha)	Average net return (Rs/ha)	Benefit-Cost ratio (Gross Return/Gross Cost)
Farmers practice	49525	157600	108075	3.19
Technology demonstration	56225	210400	154175	3.78
Additional in cost of cultivation	6700	52800	46100	7.88

Conclusion

The technology demonstrations on imprved cultivation of tomato revealed the additional cost of 6700 per ha given Rs. Additional net return of Rs. 46100 per hectare to the farmers. Farmers convinced with the technology and adopted biocontrol method for insect-pest. Therefore, FLD programme was effective in changing attribute, skill and knowledge of farmers towards improved technology of chilli cultivation. Based on the observation on various aspects, it may be inferred that improved cultivation with IPM practices for tomato was found to be superior over farmers practice. The demonstration could convince the farmers to use IPM technology on account of its obvious advantages and effective management of insect pest and diseases. These innovative practices would minimize farmer's problem, improve decision-making and innovativeness to modify their farming practices.

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