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ASSESSMENT OF ARKA ACTINO PLUS IN TOMATO IN DHARMAPURI DISTRICT, TAMILNADU, INDIA, THROUGH FARMERS PARTICIPATORY APPROACH

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Abstract

Tomato is a major vegetable crop of Dharmapuri district grown in an area of about 4000 hectares. The major problems faced by the tomato growers is establishment of seedlings in main field due to damping off, incidence of wilt, incidence of sucking pest and pinworm affecting the growth and yield of the crop. Yield loss goes even upto50 percent due to wilt incidence. ArkaActino plus, released by IIHR, Bengaluru is a microbial consortia recommended for the better nutrient uptake and imparting wilt tolerance in Tomato. On farm trial were conducted to compare the performance of ArkaActino plus in Tomato in Dharmapuri district in 10 farmers' field during *Kharif* 2016. M_1 - Farmers' practice with no application of biofertilizers or biocontrol agents; M_2 - FYM 25 t/ha; Basal Application : P – 210 kg/ha; Azospirillum & Phosphobacteria 2 kg/ha, *P. fluorescens*+ *T. viride*@ 2.5 kg/ ha ; Top dressing N:P: K - 200 : 62.5 : 250 kg/ha and M_3 - FYM 25 t/ha;Basal Application : P – 210 kg/ha: ArkaActino plus 15 kg/ha. he results of the trials showed that the yield was higher in M_3 (47.32 t/ha) than the other two technology options. The quality of the fruits was good in the M_3 which was recorded by the first grade fruits (85.33 percent) which was comparatively lesser in the M_3 (76.67 percent) and M_3 (83.33 percent). The incidence of wilt is high in the farmers practice M_1 without any prophylactic measure (13.66 percent) than M_2 (12.0 percent) and M_3 (5.33 percent). The gross returns was higher in the M_2 and M_{23} (Rs. 3,93,120/ha and 4,04,480 /ha respectively) than the farmer's practice (Rs. 3,72,000 /ha). Hence the benefit cost ratio was higher in the M_1 and M_2 (4.72 and 4.81 respectively) than the farmer's practice (4.38).

***Keywords*:** Tomato, On farm trials, ArkaActino plus, *Pseudomonas fluorescence,* Gross cost, BCR.

Introduction

Tomato is one of the prime vegetables occupying the daily diet of major population worldwide in various forms. Its nutritional importance with more fiber (1.2 g/100 g) and is a good source of vitamin A, C, B2, folate. It contains a variety of carotenoids including lycopene and beta-carotene. Tomatoes are also rich in potassium (290 mg/100g) (Hedges and Lister, 2005). All these nutrient contentsmakes it hold this importance. Also in the farmers' point of view, Tomato is a highly remunerative crop yielding good returns. It needs mention that it is a risky crop too which is well exhibited by the scenes of exorbitant prices when it reaches consumers' hands or left untouched in mandies or unplucked in fields due to almost zero cost.

With all these pros and cons tomato occupies about 8.08 lakh ha in India with an annual production of 196.9 lakh metric tonnes. Tamilnadu in turn is an important state occupying a share of 8.40 lakh tones and 38780 ha in area and production (Horticulture Statistics, 2017). In Dharmapuri district Tomato is grown in an area of about 7557 hectares with an annual production of 26450 metric tones (DDH, Dharmaprui, 2016-17). The productivity of Dharmapuri district is comparatively high (35.0 MT/ha) where as the state and national productivity (21.6 and 24.4 MT/ha respectively). The key reason was that more than 60 % of area under tomato is under drip and fertigation. Since tomato harvest can be extended upto eight months under drip and fertigation, farmers can able to meet manage the price fluctuation. Hence tomato is a preferable choice of the vegetable farmers in Dharmapuri district.

The production scenario of tomato in district level has considerable potential if the major problems faced by the tomato growers in establishment of seedlings in main field due to damping off, incidence of wilt affecting the growth and yield of the crop and the yield and quality reduction due to tomato leaf curl virus. Yield loss goes even upto 30 percent due to wilt incidence (KVK Dharmapuri Action Plan 2015-16). Also the improper nutrient management practices reduces the productivity at field level though potential is comparatively high. This also reduces the profit that is realized by the farmers.

Farmers participatory approach is an important means to assess the suitability of agricultural technologies for their adoption under real farming conditions. On farm trials can be used to measure the technology performance under representative faremres' conditions and management (Subhash Chandra, 2004). Though number of production problems hinder the potential productivity of tomato under Dharmapuri conditions the nutrient management and wilt incidence played a major role which were repeatedly observed during our participatory rural appraisals, trainings and field visits. With this background, on farm trials were conducted to assess the nutrient management modules for Tomato in farmers' field.

Materials and Methods

The on farm trials were conducted in five farmers' field of village Achrahalli in Pennagaram block of Dharmaprui district during *Kharif* 2016. The field was brought to fine tilth and the basal application of fertilizers and other inoculam are applied as per the different treatment modules. Protray seedlings of F1 Tomato hybrid is planted in spacing of 90 x 60 cm spacing. The cultural practices were from field preparation to plant protection measures were uniform in the three technology options except for the treatment modules. Necessary top dressing, weeding, irrigation and plant protection was carried out.

ArkaActino plus, released by IIHR, Bengaluru is a microbial consortia recommended for the better nutrient uptake and imparting wilt tolerance in Tomato. It can be

applied through seed treatment, soil application and seedling drenching (IIHR Annual report, 2014-15). Arka Vegetable Special is the micronutrient formulation recommended for all vegetable crops at different doses. It contains most of the secondary nutrients such as Calcium, Magnesium, Sulphur and Potassium. (www.iihr.res.in)

The nutrient applicationmodules under assessment are as follows:

M_1	Farmers' practice FYM 25 t/ha Basal Application N: P – 90: 250 kg/ha Top dressing N:K - kg/ha
M_2	FYM 25 t/ha Basal Application : P – 210 kg/ha; Azospirillum & Phosphobacteria 2 kg/ha, *P. fluorescens*+ *T. viride*@ 2.5 kg/ ha Top dressing N:P: K - 200 : 62.5 : 250 kg/ha
M_3	FYM 25 t/ha Basal Application : P – 210 kg/ha: ArkaActino plus 15 kg/ha Top dressing N:P:K - 200 : 62.5 : 250 kg/ha Foliar application of Arka Vegetable Special thrice @ 0.5 % during 30,50,70 DAP

On-farm trials planned mainly by researcher or jointly by both but executed entirely by farmers (Subhash Chandra, 2004). Hence selection of farmers is very important in conduct of the on farm trials. The farmers were selected based on the interest of farmers ready to adapt the technology who were regularly and actively in contact with KVK in that particular cluster. The selected farmers are given a prelude of the technology and the technologies to be followed in a group discussion. Then demonstration of the application of Arkaactino plus including the other nutrient management modules was demonstrated. The adaption of other management practices to be adapted was ensured by frequent visits by the KVK scientists.

According to Subhash Chandra (2004) the experimental design may become irregulardue to the farmers' choice of varieties to test on their fields, or due to other constraints arising from the fact that trials are located on farmers' fields during the conduct of on farm trials. Based on this approach in farmers' participatory research each farmers plot was considered a replication. In each farmers' field the one acre was divided into three and the three nutrient application modules were implemented. Twenty plants were randomly selected to record the yield and growth parameters with three replications in each location. Plant height during 60 and 90 DAP, no of branches on 90 DAP, average fruit weight, percentage of first grade fruits, yield per plant, yield per hectare, wilt incidence and leaf curl virus disease incidence are the observations recorded. In case of leaf curl virus incidence plants with symptoms in more than 30 % of the foliage is considered as infected and expressed in percentage. The data was analyzed with online statistical analysis software WASP 2.0 of ICAR - CCARI, Goa. The economic analyses of the varieties were calculated to find out the benefit cost ratio of the respective technology options.

Results and Discussion

The results of the on farm trials showed that the technology modules are significantly different in terms of yield parameters. The plant height was significantly higher in module 2(83.28 cm) and module 3 (97.86) than the farmers' practice (74.42) during the early stage *ie*. 60 DAP. Similar trend was observed during 90 DAP (Table 1). The number branches was higher in module 3 (7.32) followed by module 2 (6.66) and farmers' practice (6.33). There was no significant difference between module 2 and farmers' practice. The fruit yield per plant was significantly higher in module 3 (2.57 kg) followed by module 2 (2.46 kg). the lowest single plant yield was recorded in farmers' practice.

All the yield attributing characters are higher in the module 3 which includes ArkaActino Plus and Arka Vegetable Special. It is a novel Acinobacterial consortium developed for horticultural crops. It is a carrier based product containing three *Streptomyces spp.* which has the ability to solubilize insoluble P and Z, produce phytohormones and a variety of enzymes involved in organic matter recycling (IIHR Annual report2014-15). Arka Vegetable Special reported to enhance the fruit appearance, keeping quality and taste. Though the improvement in yield attributing characteristics *viz.* number of branches, fruit yield per plant, average fruit yield and hence yield per hectare may not be directly attributed to ArkaActino Plus and Arka Vegetable special, their contribution towards yield improvement cannot be eliminated.

In Tomato, yield increase of 8.7 % had been reported ((IIHR Annual report 2014-15). ArkaActino Plus has been reported to enhance the yield attributing characters in Turmeric (Reddy and Parama, 2018). Panneerselvam *et al.*2018 has reported that ArkaActino Plus increased yield in Rice. Results of our on farm trials were in correlation with the above results. The highest yield was recorded by the module 3 which includes ArkaActino Plus (47.32 t/ha). This was significantly different from the module 2 (45.56 t/ha) and farmers' practice (40.66 t/ha). Yield increase in Brinjal by the application of Arka Vegetable special was reports by IIHR, Bengaluru (www.iihr.res.in). Foliar application of the micronutrients have positive influence on the yield attributes such as plant height, number of branches, fruit yield per plant, fruit weight and fruit volume according to the reports of Saravaiya *et al.* (2014). Similar reports support the positive correlation of foliar application of micronutrients (Trejo Tellez *et al.*, 2007; Manoj Kumar *et al.,* Singh *et al.*, 2018).

The reason for the improvement in yield by the application of ArkaActino Plus was that a nutrient rich environment was created by the microbial consortium in the rhizosphere due to enhanced mineralization. Nutrient uptake of plant was enhanced and hence yield increase to a tune of 13 – 14 % in different vegetables by soil application of ArkaActino Plus had been reported (Ganeshamurthy *et al.,* 2015). Chauhan *et al.* (2015) has reported that direct effect of PGPR consortia on growth of crop plants was by promotion of plant growth promoting metabolites and facilitating uptake of essential nutrients. Enhanced soil enzymes involved in the nutrient cycle may be the reason behind the contribution of ArkaActino Plus for the increased yield in module 3.

The market price is determined by the appearance of fruits. Hence the percentage of bigger sized and good colored fruits was very important. The average fruit weight was highest in module 3 (53.17 g) followed by module 2 (48.97 kg). The average fruit weight was significantly less in the farmers practice (44.42 g). The quality of the fruits as

indicated by average fruit weight and the percentage of first grade fruits. The quality and color of fruits based on visual appearance was highest in module 3 (85.33) followed by module 2 (83.33 %). The quality of the fruits was comparatively less in farmers' practice which was represented by the less number of first grade fruits (76.67 %). Improvement in quality of fruits in terms of fruit color and keeping quality by foliar application of nutrients were reported by Sivaiah (2012) and Verma *et al.* (2018).

The results of the on farm trials show that there was reduction in incidence of wilt and leaf curl viral incidence in the module 2 and module 3 than the farmers' practice (Table 2). The incidence of viral curl virus disease was significantly less in module 3 during 60 and 90 DAP (0.73 and 5.33 %) than module 2 (8.99 and 12.00 %) and farmers' practice (9.99 and 13.66 %). Wilt incidence was significantly lesser in module 3 during 30 and 60 DAP (8.00 and 13.33 %) than module 2 (13.33 and 22.67 %) and farmers' practice (18.67 and 25.34 %). The overall improvement in the nutrient uptake and hence the plant health mechanism may be the reasons behind the reduction the incidence of diseases. Similar results were reported in tomato, pepper and pomegranate (IIHR annual report, 2014 – 15). Chauhan *et al.* (2015) had opined that PGPR lessen or prevent the deleterious effect of phytopathogenic organisms by the production of antibiotics, siderophores, hydrogen cyanide (HCN), *etc*. Actinobacteria reduces the growth of soil dwelling plant pathogenic bacteria and colonization of plant surfaces also reduces the disease incidence (Selvakumar *et al.,* 2014). Similar results of reduction of dieases incidence by actinobacteria and activity of actinobactria on plant pathogens had been reported (Pannerselvam *et al.,* 2015)

According to Subhash Chandra (2004), on farm trials measure technology performance under representative farmers' conditions and management. Technologies will perform differently according to where and which farmer is using them. Hence the on farm trials which include the farmers' participation will emphasis on the economic returns of the technologies adaption.The results of the current on farm trial showed that the technology module 3 recorded highest gross returns (Rs. 4,00,480) and net returns (Rs. 3,16,280) (Table 3). This was followed by module 2 in terms of economic returns (Rs. 3,93,120 and Rs. 3,08,920 gross and net returns respectively). The difference between the cost of cultivation was recorded among the different modules. Increased cost of cultivation in the farmers' practice was attributed to the increased plant protection cost. Over all evaluation of the technology modules in terms of Benefit cost ratio shows that technology module 3 with application of FYM 25 t/ha, basal Application : P – 210 kg/ha; ArkaActino plus 15 kg/ha;Top dressing N:P:K - 200 : 62.5 : 250 kg/ha and foliar application of Arka Vegetable Special thrice @ 0.5 % during 30,50,70 DAP Top dressing N:P: K - 200 : 62.5 : 250 kg/ha improved the productivity of Tomato.

Table 1 : Yield attributes and yield of Tomato under different nutrient modules

Technology options	Plant Height (60 DAP) cm	Plant Height (90 DAP) cm	No of Branches	Fruit yield Plant (kg)	Average Fruit weight (g)	First grade fruits (%)	Yield (t/ha)
M_1	72.42	113.24	6.33	2.18	44.42	76.67 (61.13)	40.66
M_2	83.28	124.82	6.66	2.46	48.97	83.33 (65.96)	45.56
M_3	97.86	137.62	7.32	2.57	53.17	85.33 (67.67)	47.32
Mean	84.52	125.23	6.77	2.40	48.85	81.78	44.51
SEd	3.78	3.58	0.21	0.02	1.65	1.61	0.48
CD (0.05)	8.72	8.26	0.50	0.06	3.82	3.72	1.11

*Values in parenthesesare arcsine transformed values

Table 2: Incidence of wilt and leaf curl viral diseases under different nutrient modules

Technology options	Wilt incidence		Leaf curl virus disease	
	30 DAP (PDI)	60 DAP (PDI)	60 DAP (PDI)	90 DAP (PDI)
M_1	18.67 (25.54)	25.34 (30.18)	9.99 (16.67)	13.66 (21.41)
M_2	13.33 (21.41)	22.67 (28.38)	8.99 (10.07)	12.00 (25.48)
M_3	8.00 (16.26)	13.33 (23.48)	0.73 (7.19)	5.33 (14.19)
Mean	13.33	20.45	6.57	10.33
SEd	1.34	1.55	1.32	1.38
CD (0.05)	2.93	3.39	2.91	4.29

*Values in parentheses are arcsine transformed values

Table 3 : Economics of the Dolichos bean varieties under on farm trial

Technology options	Gross cost (Rs.)	Gross returns (Rs.)	Net returns (Rs.)	BCR
M_1	85,760	3,72,000	2,86,240	4.38
M_2	84,200	3,93,120	3,08,920	4.72
M_3	84,200	4,00,480	3,16,280	4.81

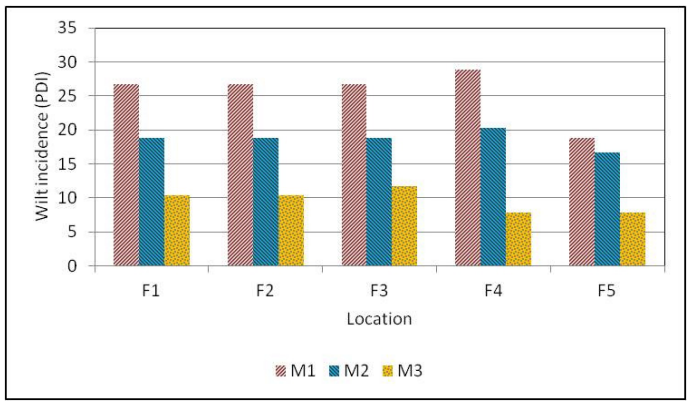

Fig. 1 : Incidence of wilt in the different nutrient modules at various locations (30 DAP)

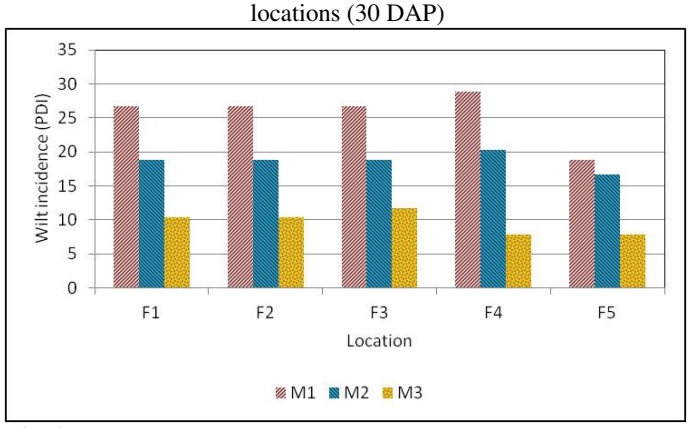

Fig. 2 : Incidence of wilt in the different nutrient modules at various locations (60 DAP)

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