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Assessment of Late Blight Resistant Tomato Hybrid Arka Abhed

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ABSTRACT: Tomato is the major vegetable crop grown in Chittoor District of Andhra Pradesh. Biotic stresses like late blight, early blight, *Tuta absoluta* causing severe yield losses to the farmers. Late blight is the major problem in tomato from September to January months causing severe yield losses to the farmers. Local private hybrids are susceptible to the disease and farmers used to spray fungicides for 5-6 times to control the disease which resulted in increased cost of cultivation and sometimes fungicides spray is of no use. Hence, late blight disease resistant hybrid Arka Abhed was tested against Arka Samrat and private hybrid in KVK operational area. Data on disease incidence was collected at 30, 60, 90 DAP in all the hybrids. The data revealed that Arka abhed recorded significantly lower incidence of late blight than other hybrids during all crop growth stages. It recorded 2.6% late blight incidence whereas Arka Samrat and private hybrid recorded 46.6% and 50% of disease incidence. Number of sprayings to control the disease were also significantly low *i.e.* one spray was carried out whereas in Arka Samrat and private hybrid five sprays were done. With respect to yield Arka Abhed recorded 63.85t/ha whereas it was 33.3t/ha and 39.7t/ha in private hybrid.

Keywords: Tomato, late blight disease, resistant hybrid, Arka Abhed.

INTRODUCTION

Tomato is native to South America and it is one of the major vegetable crop of India growing in an area of 0.8m.ha with a production of 22.33MT (Sadashiva *et al.*, 2017). Andhra Pradesh, Karnataka, Madhya Pradesh, Orissa, Gujarat and Bihar are the major tomato producing states and A.P has maximum share to the production followed by Karnataka. In Chittoor district of Andhra Pradesh, it is growing in 32,000ha especially in western part of the district. Higher market prices during scarcity period resulted in intensive cultivation throughout the year in the district. This resulted in severe incidence of insect pests and diseases. Local private hybrids are susceptible to pests and diseases resulting in high pesticide usage. At present more than 200 tomato diseases are known Worldwide (Akhtar *et al.*, 2010). Insect pests like *Tuta absoluta*; diseases like late blight, early blight, bacterial spot, bud necrosis disease are some of the problems causing yield losses to the farmers. Early and late blight diseases causing an incidence of 49-91% in conducive conditions (Azam and Shah, 2003). Especially late blight disease caused by *Phytophthora infestans* is a major problem during *rabi* resulting in huge yield losses.

Late blight appears on the leaves, stems, and fruits (Robin and Choen, 2004). On the leaves, symptoms appear as pale green, water-soaked spots, often begins at the leaf tip or edge. These lesions are often surrounded by a pale yellowish-green border that merges with healthy tissues. Under favourable conditions, lesions enlarge rapidly and turn dark brown to purplish-black, killing the leaves instantly. High humidity and leaf wetness, favors the growth of a cottony, white mould on the lower side at the edges of lesions. However, in dry weather, infected leaf tissues quickly dry and the white mould growth disappears. On stem, brown to black lesions which enlarge rapidly under moist conditions and the entire stem may be killed soon. (NICRA team of Tomato Pest Surveillance 2012). This is accompanied by the dispersion of airborne asexual sporangia during the growing season (Shattock, 2002).

Low temperature and high humidity prevailed from November to January favours late blight incidence (Saleem *et al.*, 2016). According to an estimate, 85-90% yield losses recorded in Chittoor District (Ravuri and Kumar, 2018). Farmers mainly rely upon fungicides to control the disease. They used to spray 5-6times to control late blight disease only. If market price of tomato is high, then number of sprayings will also increase. Even after repeated sprayings, the crop may not recover if favourable conditions for the disease prevails. Moller *et al.*, (2009) reported that the fungicides have become ineffective against resistant strains of late blight, because they were treated too frequently at 5-12 day intervals. In addition, fungicides have such adverse effects as environment pollution, and

they are not able to control late blight under some conditions that favor heavy disease pressure (Ko, 1994).

Host resistance comes into limelight under these circumstances which reduces the disease incidence thereby reduces cost of cultivation to the farmers. Mukalazi *et al.,* (2001) reported that host resistance is an important element in late blight management due to its long-term economic benefits for small-scale farmers and decreasing the likelihood of the development of fungicide resistance. In view of the above KVK, Kalikiri has assessed new multiple disease resistant hybrid Arka Abhed in farmers fields during the *Rabi*, 2020-21.

MATERIALS AND METHODS

Krishi Vigyan Kendra, Kalikiri conducted On Farm Trial (OFT) on tomato hybrid 'Arka Abhed' during *rabi* 2020-21 at 6 locations in KVK adopted villages with the following treatments.

T1: Arka Abhed
T2: Arka Samrat
T3: Private hybrid

Tomato hybrids Arka Abhed and Arka Samrat were released from IIHR, Bangalore. Saho is the popular private hybrid grown in the district and it was taken as check in all the locations.

Arka Abhed characters: It is a multiple disease resistant hybrid *i.e* resistant to late blight, early blight, leaf curl virus and bacterial wilt with a crop duration of 140-145days and yield potential of 70-75t/ha. It is suitable for cultivation during *Kharif*, *Rabi* and Summer.

Arka Samrat characters: It is a triple disease resistant hybrid having resistance to early blight, bacterial wilt and leaf curl virus diseases. It has got yield potential of 80-85t/ha with 140-150days crop duration.

Seed was purchased from IIHR, Bangalore and seedlings were raised in KVK nursery and distributed to farmers. Crop was planted during the last week of October, 2020 and trellising system was followed in all the locations. In Arka Abhed, crop continued upto last week of March, 2021 whereas Arka Samrat and private hybrid crop was completed by last week of February, 2021.

Data on late blight incidence was collected from vegetative stage to fruiting stage in all the locations *i.e.* at 30, 60 and 90DAP. Late blight incidence was recorded in an area of 3×3m per spot. Mean severity percent was calculated based on limits depending upon visual symptoms given in the following Table.

Disease rating scale (Henfling 1987).

Mean severity (%)	Limits (%)	Symptoms
0	0	No symptoms
2.5	Tr < 5	Up to 10 lesions per plant
10	5 -15	Lesions easily seen at closer distance. Maximum foliage area affected up to 20 leaflets.
25	15 - 35	About 25 % of foliage is covered with lesions
50	35 - < 65	Lower leaves are dead. About half the foliage area is destroyed
75	65 - < 85	About 75 % leaf area destroyed; field appears neither brown nor green
90	85 - < 95	Only top leaves are green. Many stems have large lesions
97.5	95 - < 100	All plants in a spot are brown-colored. A few top leaves still have some green areas. Most stems have lesions
100	100	All leaves and stems dead

Economic aspects like cost of cultivation, yield, gross returns, net returns and B:C ratio were calculated based on respective formulae in all the locations.

Statistical analysis: Data collected on late blight incidence was analyzed using appropriate statistical tools viz., mean, standard deviation, RBD and repeated measures ANOVA for comparison among three treatments during different stages and two way ANOVA for yield.

RESULTS AND DISCUSSION

A. Late blight incidence

Data on late blight incidence was collected from vegetative stage to fruiting stage in all the three treatments in all the locations. There is significant difference among tomato hybrid Arka Abhed and other two hybrids with respect to late blight incidence during all growth stages.

During vegetative stage of the crop, late blight incidence was not observed in tomato hybrid Arka Abhed whereas in Arka Samrat and private hybrid, half of the foliage *i.e.* lower leaves are dried due to late blight disease. During flowering stage, 5.5% of late blight incidence was observed in Arka Abhed whereas in Arka Samrat and private hybrid 60% and 65% late blight incidence was observed. During this stage about 75% of leaf area was blighted in both the susceptible hybrids. During fruiting stage 30% and 35% of late blight incidence was observed in Arka Samrat and private hybrid respectively whereas in Arka Abhed 2.5% of late blight incidence was observed. This might be attributed to high disease pressure and favorable environmental conditions for spread of the disease.

Table 1: Mean severity percentage of late blight incidence among three hybrids during different stages.

Crop stage	Treatment	Mean	Standard Deviation	F-value	p-value
Vegetative stage (30DAP)	Arka Abhed [a]	0.000	0.000	29.82**	0.000
	Arka Samrat [b]	50.000	0.000		
	Private hybrid [b]	50.00	0.000		
Flowering stage (60DAP)	Arka Abhed [a]	5.5	4.1	38.61**	0.000
	Arka Samrat [b]	60.0	13.69		
	Private hybrid [b]	65.0	13.69		
Fruiting stage (90DAP)	Arka Abhed [a]	2.5	0.000	12.250*	0.04
	Arka Samrat [b]	30.0	11.18		
	Private hybrid [b]	35.0	13.6		
Total	Arka Abhed [a]	2.6	1.36	32.50*	0.03
	Arka Samrat [b]	46.6	8.29		
	Private hybrid [b]	50.0	9.09		

**significant at 1% level; *significant at 5% level

Pooled analysis using RM ANOVA revealed that there was significant difference among hybrids during different crop growth stages with respect to late blight incidence. Tomato hybrid Arka Abhed outperformed remaining hybrids and on an average 2.6% late blight damage was recorded during entire crop growth period whereas in Arka Samrat and Private hybrid 46.6% and 50.0% was recorded. Panthee and Gardner (2010) reported low incidence of late blight in resistant cultivar 'Mountain merit' than susceptible cultivars. Park *et al* (2014) reported two late blight disease resistant hybrids superior over local hybrids with good fruit quality. DMRT test revealed that there was no significant difference between tomato hybrids Arka Samrat and private hybrid with respect to late blight incidence during all stages and they are very much susceptible to the disease. Hardham *et al.*, (2007) during reported that the primary line of induced defense in tomato plants against *P. infestans* is resistance against penetration at the leaf surface. This is a highly effective defense strategy rapidly mobilized by host plants to attempted penetrations. Chen and Halterman (2011) reported that multiple defense mechanisms seem to be involved in late blight resistance and alteration of metabolic pathways may be one of the most important disease defense responses.

Table 2: Incidence of late blight among three hybrids at different stages using RM ANOVA.

Source	F-value	p-value
Stages	30.659**	0.000
Stages * treatments	6.25**	0.001
Treatments	82.51**	0.000

**Significant at 1% level

B. Plant protection measures

During entire crop growth period, five sprayings were carried out by farmers to control late blight disease in Arka Samrat and Private hybrid whereas in Arka Abhed one spray was done during flowering stage to control the disease. Cost of cultivation was increased by Rs.25000/-per hectare towards plant protection measures for controlling the late blight in other two hybrids which was a burden to the farmers in perishable crop like tomato where prices are highly fluctuating.

Table 3: Average yield of tomato during the season.

Treatments	Mean	Standard deviation	F-value	p-value
Arka Abhed [a]	63.85	2.26	199.40**	0.000
Arka Samrat [b]	33.3	2.55		
Private hybrid [b]	39.7	3.17		

**Significant at 1% level

Tomato hybrid Arka Abhed recorded highest yield i.e. 63.02t/ha over other hybrids. Arka Samrat recorded 33t/ha and whereas private hybrid recorded 34.15t/ha fruit yield. In Arka Abhed first picking was started two weeks earlier than other hybrids *i.e.* during 2nd week of January, 2021 and continued upto March with 14-16 pickings in all the locations whereas in other hybrids 8-9 pickings were done and crop was completed early by February, 2021 resulting in lower yields than Arka Abhed. Sunitha *et al.*, (2020) reported higher yield of Arka Abhed than Arka Samrat and local hybrid.

Arka Abhed recorded less cost of cultivation *i.e.* 2,07,500/- per hectare with very limited plant protection measures whereas Arka Samrat and private hybrid recorded Rs.2,31,250/- and 2,35,000/- per hectare respectively. B.C ratio of 3.07 was recorded in Arka Abhed whereas it was 1.44 and 1.68 in Arka Samrat and private hybrid respectively (Table 4).

Table 4: Economics of three hybrids.

Treatments	Yield (t/ha)	Cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B:C ratio
Arka Abhed	63.85	2,07,500	6,38,500	4,31,000	3.07
Arka Samrat	33.3	2,31,250	3,33,000	1,01,750	1.44
Private hybrid	39.7	2,35,000	3,97,000	1,62,000	1.68

*Average Tomato price Rs.10/- per kg

However, the only drawback in Arka Abhed was fruit weight is comparatively high during first two pickings than local hybrid *i.e.* majority of fruits weighs upto 190-200g each whereas it was 90-100g in private hybrid. Because of this, there was reduced market price was received during first two pickings.

CONCLUSION AND FUTURE SCOPRE

Overall, Arka Abhed performed very well in farmers fields with good fruit quality, longer crop duration, high yield and maintained good late blight resistance under field conditions which are highly conducive to late blight development. If the problem of over size is rectified, the hybrid has very good scope to reach farming community.

Conflict of Interest. None.

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