



# **Assessment of Early Blight Disease Resistant Tomato F<sub>1</sub> Hybrid Arka Abhed in Karimnagar District of Telangana, India**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

Tomato is the major Solanaceous vegetable crop grown in Karimnagar District of Telangana. *Alternaria tomatophila* and *Alternaria solani* cause early blight disease and severe yield losses to the tomato growers in Karimnagar District. Early blight is the major problem in Karimnagar from June to September months causing severe crop losses to the tomato farmers. Usually farmers are spraying different fungicides based on Copper to control early blight disease for private hybrids. It controls 25-35% of the disease and increased cost of cultivation. Hence, early blight disease resistant hybrid Arka Abhed was tested against private hybrid in KVK, Karimnagar operational area.

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Data on disease incidence was collected at 15, 30, 60, 90,120 DAP in all the hybrids. The data revealed that Arka abhed recorded significantly very lower incidence of early blight disease than private hybrid during all crop growth stages. It recorded 1.5% early blight incidence whereas private hybrid recorded 32.4%. Reduced number of sprayings to control early blight disease were also significantly low i.e. two sprays were carried out whereas in private hybrid seven sprays were done during in rainy period. According to yield Arka Abhed recorded 68.3t/ha whereas it was 58.6t/ha in private hybrid. The peduncle in green in colour for long days and taste also same for all the days in storage period for 8-12 days in Arka Abhed. Average fruit weight is 86 gr to 112 grams were recorded.

**Keywords:** *Early blight in tomato; arka abhed; disease resistant tomato.*

## 1. INTRODUCTION

One of the most well-liked and extensively consumed vegetable crops worldwide is the tomato (*Solanum lycopersicum* L.), and a high-quality yield is a necessary need for its commercial success worldwide. Fourth most grown crop worldwide is the tomato [1-4]. In terms of acreage and production, India comes in second place globally, right after China. With an annual yield of 20.51 million tonnes and a productivity of 21.13 t/ha, tomatoes are produced on 0.81 million hectares in India [5]. Carotenoids, especially the unsaturated alkylic component lycopene, which lowers the risk of cancer and heart disease, are abundant in it. Tomato fruits are thus in great demand all year round. Due to severe selection and inbreeding during domestication and development, cultivated tomatoes have a limited genetic diversity, making them more vulnerable to disease outbreaks throughout the growing season [6,7,8].

One of the most terrible tomato diseases, early blight can cause up to 78% yield and loss of yield [9] Early blight on foliage, collar rot on seedlings' basal stem, stem lesions on adult plants, and tomato fruit rot are all indications of *Alternaria solani* infection [10-12]. The symptoms of early blight manifest on the plant's aerial parts, including the leaves, stem, and fruits. Brown, spherical spots that may develop up to half an inch in diameter are seen on leaves [13-15]. After sporulation, larger patches with concentric rings emerge, which develops characteristic bull eye-shaped patches or "target board" symptoms due to sporulation pattern [16-19]. The *Alternaria* blight has been managed with a variety of fungicides; nevertheless, fungicide treatment is neither ecologically nor economically viable. According to Kemmitt et al. [20], fungicides are first sprayed 1-2 days after transplanting and thereafter need to be routinely administered at

intervals of 7-10 days for successful control [21,22]. This increases the expense of production and pollutes the environment. The most cost-effective and long-lasting method of controlling early blight is the development of resistant cultivars. Due to its devastating nature, early blight draws a lot of attention. The tomato plant (*Solanum lycopersicum* L. [23], [syn. *L. esculentum* Mill.] is especially susceptible to this disease, which in extreme circumstances can result in total defoliation, in areas with high humidity, heavy rainfall, and relatively high temperatures between 24 and 29 degree Celsius. In semi-arid areas with regular, long-lasting nighttime dews, epidemics can also happen [24].

Therefore, the goal of the current study was to pinpoint tomato resistance sources against early blight disease. University, which would offer a more extensive genetic base to support the emergence of resistant cultivars.

## 2. MATERIALS AND METHODS

The present study was carried out by the Krishi Vigyan Kendra during *Kharif* season from 2021 to 2023 at the farmers' fields of different villages of the Karimnagar district of Telangana. In total 323 Ha of tomato fields of Karimnagar District. Selected farmers based on crops growing in the village and conducted training programmes to the famers.A group of cooperative farmers were identified based on their participation and feedback received during the preliminary survey and interactive FPO meetings

The seeds of Arka Abhed bought from IIHR, Bengaluru. We had grown nursery in KVK Jammikunta, the seedlings were transplanted during the 1<sup>st</sup> week of July in the years 2020-21, 2021-22, and 2022-23, right into the fields of Karimnagar farmers. For this on-farm trial, Arka

**Table 1. Disease rating scale [25]**

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

Abhed and the hybrid PHS-448 check hybrid were transplanted at same days. The seedlings used in the transplantation were between 33 days old and were spaced at 75 x 45 cm intervals. During the land preparation process, 6 tonnes per hectare (t/ha) of Vermi compost was incorporated into the soil. Further more, a combination of NPK fertilizers, The nutrient requirement for hybrids is 200:250:250 kg of NPK per ha. 75 % of P (187.5 kg P which comes to 1172 kg of superphosphate) is applied as basal. The remaining quantity of 200:62.5:250 kg of NPK per ha applied through fertigation. Every day irrigation had given for one hour. Along with this, water soluble fertilizers have to be given.

This dose was split and given once in 3 days for the entire crop period through fertigation as detailed below.

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.

Plant protection measures were implemented in both the check and trial plots to accurately observe the growth and yield parameters of the tomato hybrids. Tomato F1 hybrid Arka Abhed (H-397) is renowned for its resistance to multiple diseases, including tomato leaf curl disease (ToLCV), bacterial wilt (BW), early blight, and late blight. Arka Abhed tomato plants exhibit a semi-determinate growth habit and possess dark green foliage. The fruits of Arka Abhed are firm, oblate round, and of medium-

large size, typically weighing between 90-100 grams. Key characteristics of Arka Abhed include its resistance to late blight, early blight, leaf curl virus, and bacterial wilt, a crop duration of 140-145 days, and a remarkable yield potential of 70-75 tonnes per hectare. This hybrid is suitable for cultivation during the *Kharif, Rabi*, and summer seasons.

The fruits of Arka Abhed are characterized by their oblate to high round shape, large size (ranging from 90-97 grams), deep red coloration, and firm texture. On the other hand, PHS-448 is a private hybrid variety with plants that exhibit a growth pattern as semi-determinate. These plants feature robust foliage cover and vigor. The time to the first harvest for PHS-448 is typically 62-67 days. The fruits produced by this hybrid are flat and round, possessing green coloration with a very firm structure and a distinctly acidic taste. Their color matures to a deep red, and the average fruit weight falls within the range of 100-120 grams. Additionally, US-448 exhibits intermediate resistance to tomato leaf curl virus. The seeds for the tomato hybrids Arka Abhed was obtained from the Indian Institute of Horticulture Research (IIHR) in Bengaluru.

A field experiment was conducted across various locations in Thimapur, Mogilipalem villages within the Karimanagr during the *Rabi* season for three consecutive years: 2021-22, 2022-23 and 2023-24. The experiment utilized hybrids Arka Abhed and PHS-448 Hybrid as a reference or check hybrid. The experimental design followed a randomized block layout with five replications. Various traits, early blight symptoms, virus

infestation, including plant height, days to first flowering, days required for 50% flowering, days to the initial harvest, number of fruits per plant, average fruit weight (in grams), fruit yield per individual plant, yield per hectare, net returns per hectare, and the benefit-cost ratio, were meticulously recorded and subsequently subjected to statistical analysis using the methodology outlined by Panse and Sukhatme (1985).

### 3. RESULTS AND DISCUSSION

“Data on Early 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 private hybrid with respect to Early blight incidence during all growth stages. During vegetative stage of the crop, Early bight

incidence was observed very less in tomato hybrid Arka Abhed whereas in PHS448 and private hybrid, half of the foliage *i.e.* lower leaves are dried due to early blight disease. During flowering stage, 2-4 % of early blight incidence was observed in Arka Abhed in heavy rainy days only whereas private hybrid 35-45% early blight incidence was observed throughout the crop period. During this stage about 60-75% of leaf area was blighted in the susceptible Private hybrid. During fruiting stage 36-40 % of early blight incidence was observed in private hybrid respectively whereas in Arka Abhed 0 % (very minute observations) of early and late blight incidence was observed. This might be attributed to high disease resistance and favorable environmental conditions for spread of the disease. And late blight disease also observed in private and but it is very less in Arka abhed triple resistant hybrid” [26].

**Table 2. Demonstration and Check results given below**

Treatments	Yield (t/ha)	Cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B:C ratio
Arka Abhed	68.3	118900.00	409800.00	290900	1:2.4
Private hybrid	58.6	124300.00	351600.00	227300.00	1:1.8

**Table 3. Data on parameters**

S.No	Particulars	Arka abhed	Private hybrid PHS -448
1.	Seed rate /Ha	80gr	80gr
2.	Seed cost	2400.00	4800.00
3.	Land preparation	12000.00	9000.00
4	Cost of mulching +trellis+labour	56000.00	56000.00
5	Fertilizers and pesticides	26500.00	31200.00
6	Weeding labour charges	6000.00	9800.00
7	Fruit picking charges	16000.00	13500.00
8	Cost of cultivation	118900.00	124300.00
9	ToLCV, BW & EB	Very less	observed more
10.	Yield ( t / Ha )	68.3	58.6
11	Average Market rate /Kg	6	6
12	Gross returns	409800.00	351600.00
13	Net returns	290900.00	227300.00
14	C:B Ratio	1:2.4	1:1.8

**Table 4. Disease incidence particulars**

Sl.No	Particulars	Arka Abhed	Farmers Plot(Check)
1	Early blight symptoms	2% observed	35 %obserevd
2	Late blight symptoms	3% observed	40 %obserevd
3	Viral symptoms	Not observed	Not observed

**Table 5. Mean severity percentage of early blight among two hybrids during different stages**

Crop stage	Treatment	Different Percentages average
Vegetative stage (30DAP)	Arka Abhed <sup>a</sup>	0
	Private hybrid <sup>b</sup>	10
Flowering stage (60DAP)	Arka Abhed <sup>a</sup>	0
	Private hybrid <sup>b</sup>	35-40
Fruiting stage (90DAP)	Arka Abhed <sup>a</sup>	0.02
	Private hybrid <sup>b</sup>	40-65
Total	Arka Abhed <sup>a</sup>	0.03
	Private hybrid <sup>b</sup>	45

#### 4. CONCLUSION

Arka Abhed performed very well in farmers fields with good fruit quality, longer crop duration, high yield and observed disease resistance for early blight under Karimnagar field conditions which are highly conducive to early blight and late blight development in rainyseason in Karimnagar District. If farmers manage early blight disease in early stages from 10<sup>th</sup> day after transplanting and in flowering period, they will get good yields and good income.

#### DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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