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A report of Fungicide resistance in Alternaria leaf blight pathogen in tomato crop grown in Nandurbar district of Western Maharashtra

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Abstract
Ten farmers field of two talukas of Nandurbar district of Western Maharashtra viz., Nandurbar and Shahada were surveyed for Alternaria leaf blight disease of tomato crop. For the management of Alternaria leaf blight disease of tomato, farmers in these area uses fungicide Dithane-M-45, Bavistin, Ridomil, Blitox and Captaf. However, Alternaria leaf blight pathogen had developed resistance to the fungicides Dithane-M-45, Bavistin and Captaf; but it was still susceptible to Blitox and Ridomil. The Captaf resistant isolates had dull white colour coloured mycelial growth. At the bottom line, in Nandurbar district, the farmers may use Ridomil and Blitox for the control of Alternaria leaf blight pathogen.

Keywords: early blight, tomato (*Lycopersicon esculantum* L.), *Alternaria solani*, *A. alternata*, fungicide resistance

Introduction
Tomato (*Lycopersicon esculantum* L.) is one of the major vegetable crops grown in Western Maharashtra and is affected severely with Alternaria leaf blight disease. These Alternaria leaf blight of tomato is caused by the fungus *Alternaria solani* and *A. alternata* (Leiminger and Hausladen, 2012, 2013; Ellis and Martin, 1882; Jones and Grout, 1897) [11, 12, 2, 8]. The *A. solani* isolates show high virulence while *A. alternata* isolates show low or no symptoms after inoculation. The *A. alternata* are secondary invader which lives saprophytic on lesions and is therefore often isolated from leaf spots (Gerd *et al*., 2014) [14]. The Primary methods for control of early blight of tomato includes prevention of wetness on the leaf surface for long period, cultural scouting, sanitation, and development of the host plant resistance with the application of fungicides (Namanda *et al*., 2004; Kirk *et al*., 2005 and Kumar and Srivastava, 2013) [15, 9, 10]. Cultivation of resistant varieties is the ultimate control of this disease. Although there has been other several practices like cultivation of resistant varieties (Christ, 1991; Herriot *et al*., 1986 and Holley *et al*., 1983) [1, 5, 6], the disease is still primarily managed by use of foliar fungicides. However frequent application of these fungicides over a period of time has led to the development of fungicidal resistance in Alternaria resulting in emergence of fungicidal resistant strains (Holm *et al*., 2003; Tymon and Johnson, 2014; Fairchild *et al.* 2013) [7, 17, 3]. Though farmers follow different spraying schedules of fungicides to control the disease the incidence of the disease has observed to increase in recent years, inspite of large number of sprays. The development of fungicidal resistance in the pathogen may be the probable reason for the increase in disease incidence and severity of the disease in Nandurbar district of Western Maharashtra.

Material and Methods
Disease samples showing typical symptoms of Alternaria leaf spot of tomato were collected from two talukas of Nandurbar district *viz.*, Nandurbar and Shahada from the tomato fields where fungicidal spray of different fungicides was done. The samples were collected randomly from 10 farmer's field from each district and the collected samples were preserved in paper bags for further isolation.

Isolation of fungicide resistant Alternaria from disease samples
The Alternaria pathogen was pathogen was isolated from the disease leaf samples collected from different locations of Nandurbar District. The disease leaf samples were subjected for the isolation of Alternaria pathogen. The Alternaria fungi was isolated on the medium containing

respective fungicides and its concentration as were used in spray schedule by the respective farmer, as listed in Table 1; using poison food technique (Nene and Thapliyal, 2000) [16]. The plates were incubated at 30°C and the observations of fungal growth colonies were taken after 7th days. The Alternaria isolates, appearing on the respective poison food plants were regarded as fungicidal resistance isolates which were then maintained on PDA slants of respective fungicide at given concentration.

Table 1: Fungicidal spray applied by the farmers in the tomato field at Satara District of Western Maharashtra

Sl. No.	Trade name	Active Ingredient (s)	Concentration
1.	Dithane-M-45	Mancozeb	0.2 %
2.	Bavistin	Carbendazim	0.2 %
3.	Ridomil	Ipirodione	0.2 %
4.	Blitox	Copper oxy chloride (COC)	0.2 %
5.	Captaf	Captan	0.2 %

Result and Discussion

The disease samples infected with Alternaria leaf blight pathogen of tomato crop was collected from two talukas of Nandurbar district viz., Nandurbar and Shahada. The infection of the pathogen was assessed for the fungicide resistance in Nandurbar district and is presented in Table 2, Fig 1. In Nandurbar taluka the fungicide Dithane-M-45, Bavistin, Blitox, Ridomil and Captaf were used by the farmers. The assessment of the fungicide resistance showed that the Alternaria leaf blight pathogen had developed resistance to the fungicides Dithane-M-45, Bavistin and Captaf. However it was still susceptible to Blitox and Ridomil. In Shahada taluka the fungicide Dithane-M-45, Bavistin and Captaf were used by the farmers. The assessment of the fungicide resistance showed that the Alternaria leaf blight pathogen had developed resistance to the fungicide Bavistin. However it was still susceptible to Dithane-M-45 and Bavistin. Other researchers like Mrunalini *et al.*, (2015) [15] and Murugan *et al.*, 2016 [14] has also reported the development of carbendazim resistance in *Alternaria spp.* Murugan *et al.*, (2016) [16] reported that, there were no distinguished variation of the isolates observed on the colour parameters based on culture colour and conidial dimensions (conidial length and breadth, and beak length). Although, a wide variation was observed in the length of conidia and beak, no significant difference was observed in conidial breadth. However, in our findings the fungal resistant isolate produced deeper colour of mycelia growth. The Bavistin resistant isolates had White grey to Dark grey coloured mycelial growth. The Captaf resistant isolates had dull white colour coloured mycelial growth. The Dithane-M-45 resistant isolates had pinkish colour coloured mycelial growth. At the bottom line, in Nandurbar district, the farmers may use Ridomil and Blitox for the control of Alternaria leaf blight pathogen.

Table 2: Development of fungicide resistance in *Alternaria* leaf blight pathogen in tomato crop fields in Nandurbar district

Sr. No.	Village, Tal.	Sprays applied by farmer (@ 0.2 %)	Isolation and growth of *Alternaria* on respective fungicide containing PDA	Diameter of fungal growth (cm) on fungicide containing media (at 7 days)	Diameter (cm) of fungal growth on PDA media without fungicide (at 7 days)	Colony morphology (colom of fungal isolate)
1.	Tokartalav, Tal. Nandurbar	Dithane-M-45	X	-	2.5	
		Bavistin	√	3.0	2.1	White grey colour
		Redomil	X	-	3.2	
2.	Maliwada, Tal. Shahada	Dithane-M-45	X	-	3.2	
		Captaf	X	-	1.5	
		Bavistin	√	3.5	1.1	White grey colour
3.	Karankeda, Tal. Nandurbar	Blitox	X	-	2.5	
		Bavistin	√	4.5	5.1	Dark grey colour
4.	Chadawelpada, Tal. Nandurbar	Dithane-M-45	X	-	4.0	
		Bavistin	√	4.3	5.5	Grey colour
5.	Maliwada, Tal. Nandurbar	Dithane-M-45	X	-	3.0	
		Captaf	√	1.4	4.7	Dull white colour
6.	Satarpada, Tal. Nandurbar	Dithane-M-45	√	2.0	3.1	Pinkish colour
		Blitox	X	-	1.5	
7.	Nibali, Tal. Nandurbar	Bavistin	√	4.9	4.4	Dark grey colour
		Dithane-M-45	X	-	2.5	
		Blitox	X	-	3.5	
8.	Thanepada, Tal. Nandurbar	Dithane-M-45	X	--	2.5	
		Blitox	X	-	2.8	
9.	Pandarpada, Tal. Nandurbar	Dithane-M-45	X	-	1.9	
		Captaf	X	-	2.8	
10.	Gopalpada, Tal. Nandurbar	Dithane-M-45	X	-	3.1	
		Bavistin	√	4.3	1.6	Grey colour

Fig 1: Poison food plates showing fungicidal resistance

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