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Bio-efficacy and phytotoxicity study of fungicide fluopyram 200 + tebuconazole 200 – 400sc against powdery mildew and postharvest diseases of mango

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Abstract
Yield of mango can be drastically reduced due to infection of powdery mildew and postharvest fruit rots diseases. These two diseases are widespread causing heavy loss in mango. Considering the endemic nature of disease under Konkan conditions the present investigation was carried out at Regional Fruit Research Station, Vengurle by using new molecule Fluopyram 200 +Tebuconazole 200 – 400 SC fungicide. In the present study two fungicides with different concentrations were tested against powdery mildew and Postharvest rot in field conditions. Among the different concentrations of fungicide tested Fluopyram 200 +Tebuconazole 200 – 400 SC at 750 ml/ha concentration were found to be significantly superior over control with incidence of powdery mildew (25.10%) and postharvest disease incidence (15.00%) as compared to rest of the treatments.

Keywords: Bio-efficacy, phytotoxicity, postharvest rot fluopyram 200 + tebuconazole

1. Introduction
Mango is an important fruit crop in tropical and subtropical countries of the world. It is grown in almost all parts of our country except temperate region and its production in India is a landmark because of maximum area. Konkan is the major and famous Alphonso mango producing belt on the west coast of Maharashtra, where it occupies an area of 0.185 million ha in four districts *viz*, Thane, Raigad, Ratnagiri and Sindhudurg. The productivity of mango in Konkan is about 1.7 tonnes per ha. Konkan region accounts for about 12 per cent of the total area under mango in the whole country out of which almost 95 per cent area is covered by most popular cultivar 'Alphonso' which is locally known as 'Hapus' with a major export share to the tune of over 35 per cent. But, this crop is found affected by large number of pests and diseases. Among the different diseases; powdery mildew caused by *Oidium mangiferae* and post-harvest rots *viz*, anthracnose, stem end rot and black rot caused by *Collectotrichum gloeosporioides*, *Rhizoctonia solani and Aspergillus niger* respectively are of great economic importance, which causes loss in, ripening, transit as well as transport and ultimately reduce the mango production. The probable losses can be minimized with optimum inputs. In this view, the research work was undertaken at Regional Fruit Research Station, Vengurle with new molecule Fluopyram 200 +Tebuconazole 200 – 400 SC against powdery mildew and post-harvest diseases in mango cultivar Alphonso during the period of 2014-15.

Materials and Methods
The experiment was conducted at Regional Fruit Research Station, Vengurle by employing Randomized Block Design with seven treatments and three replications for bio-efficacy against the powdery mildew and post-harvest diseases in mango. For phytotoxicity another trial was conducted with higher concentrations of fungicides.

A) **Bio-efficacy of powdery mildew**
During the season 2014-15, the Alphonso trees having flowering flush were selected, tagged and sprayed twice at 10 days interval with the respective concentrations of Fluopyram 200 + Tebuconazole 200 – 400 SC fungicide as per the given protocol. The incidence of powdery mildew was recorded on panicles by using 0-5 scale

0 = No incidence 1 = 1-20 % incidence
2 = 21-40 % incidence 3 = 41-60 % incidence
4 = 61-80 % incidence 5 = 81-100 % incidence
(As per AICRP Mango Proceeding)

The Per cent Disease Incidence (PDI) was calculated by using the following formula.

$$PDI = \frac{\text{Sum of all numerical rating} \times 100}{\text{No. of panicles observed} \times \text{Maximum rating}}$$

Treatment wise fruit yield in Kg. per plant was recorded at the time of harvesting.

B) **Bio-efficacy of post-harvest rots**

The Alphonso plants having fruits were selected and sprayed with respective fungicides at 30 and 20 Days before Harvest (DBH). The matured fruits were harvested 20 days after the second spray and were brought in the ripening house and were kept for ripening in boxes. The observations on post-harvest diseases *viz.* anthracnose, stem end rot and soft rot were recorded on 5th, 10th and 15th days after harvest. The per cent fruit rot was calculated by following formula

$A = Y (100)/X$

Where,

A= Per cent rot

X= Total number of fruits observed

Y= Total number of rotted fruits

Table 1: Treatment Details for Bio-efficacy

Tr. No.	Treatments	Dosage		Application time and method
		g a.i./ha	(ml or g) forml./ha	
T_1	Untreated (Control)	-	-	First spray immediately after the initial symptoms of disease was observed and subsequent spray at 10 days interval, Two more applications at 10 days interval. 1st spary was given at 30 days before harvesting and 2nd spray after 10 days by using foot sprayer. Water Volume on the basis of tree size.
T_2	Fluopyram 200 + Tebuconazole 200 – 400 SC	100+100	500	
T_3	Fluopyram 200 + Tebuconazole 200 - 400SC	125+125	625	
T_4	Fluopyram 200 + Tebuconazole 200 – 400 SC	150+150	750	
T_5	Fluopyram 500 SC	150	300	
T_6	Tebuconazole 25 EC	150	600	
T_7	Carbendazim 50 WP	250	500	

C) **Phytotoxicity**

To evaluate the phytotoxicity of Fluopyram 200 + Tebuconazole 200 - 400 SC, another trial was carried out during 2014-15 seasons. The Alphonso trees having flowering and vegetative flush were selected, tagged and sprayed once with Fluopyram 200 + Tebuconazole 200- 400 SC with three different concentrations *viz.* 0.075%, 0.15% and 0.3%. The phytotoxicity effect of Fluopyram 200 + Tebuconazole 200-400 SC if any on mango flowering flush/vegetative flush due to spraying of fungicide were regularly examined for injury of leaf tip, leaf surface, necrosis, chlorosis, wilting, epinasty and hyponasty. The observations were recorded at 1, 3, 5, 7 and 10 days after spraying in each treatment and the parameters on phytotoxicity were observed on the following scale.

Score	Phytotoxicity (%)
0	No phytotoxicity
1	1 – 10%
2	11-20%
3	21-30%
4	31-40%
5	41-50%
6	51-60%
7	61-70%
8	71-80%
9	81-90%
10	91-100%

Table 2: Treatment details (Phytotoxicity)

Tr. No.	Treatments	a.i. (g)	Formulation (ml/ha)	Application time and method
T_1	Fluopyram 200 + Tebuconazole 200 – 400 SC	150+150	750	One spray only coinciding with the onset of disease with foot sprayer. **Water volume:** on the basis of tree size.
T_2	Fluopyram 200 + Tebuconazole 200 – 400 SC	300+300	1500	
T_3	Fluopyram 200 + Tebuconazole 200 – 400 SC	600+600	3000	
T_4	Control	-	-	

Results and Discussion

A) **Bio-efficacy against powdery mildew**

Data regarding bio-efficacy of Fluopyram 200 +Tebuconazole 200 – 400 SC against Powdery mildew of mango presented in Table 2 revealed that all the fungicidal treatments recorded significantly less incidence over control. Further, the treatment T_3 i.e. Fluopyram 200 +Tebuconazole 200 – 400 SC @ 750 ml/ha with 18.00 per cent disease incidence was found statistically significant over rest of the treatments. It was followed by the treatment T_2 i.e Fluopyram 200 +Tebuconazole 200 – 400 SC@ 625 ml/ha to the tune of 19.33 per cent disease incidence and was found at par with (T_1). Further the treatments Tebuconazole 25 EC(T_5), Fluopyram 500 SC(T_4) and Carbendazim 50 WP(T_6), were at

par with each other and significantly effective for controlling the powdery mildew These results found closely in agreements with, Karande *et al.* (2016) [2]. And Chavan *et al.* (2009) [1]. Who reported that Hexaconazole 5EC @ 0.1% and 0.05% found effective in reduction of disease severity in mango powdery mildew. Sharma *et al.* (2012) [4]. Stated that the triazole group fungicides were found the most effective in reducing the disease incidence of powdery mildew in mango. Thind and his co-workers (2005) [7]. Found that fungicides *viz*, Penconazole, Triadimefon and Hexaconazole were found significantly better in controlling the powdery mildew of mango

B) **Bio-efficacy against Post-harvest diseases of mango**

Data regarding percent disease incidence of post-harvest rot in mango after 15 days of harvest are presented in Table.3 revealed that the treatment of Fluopyram 200 +Tebuconazole 200 – 400 SC @ 750 ml/ha (10.00%)was found significantly superior over rest of the treatments for controlling the post-harvest diseases incidence in mango. These were followed by Fluopyram 200 + Tebuconazole 200 – 400 SC (T_2), Tebuconazole 25 EC (T_6) and Carbendazim 50 WP (T_7) were equally effective in controlling post harvest diseases of mango. Similar results were also found by Swart *et al.* (2009) [6]. who stated that Fludioxonil can control post-harvest rot of mango. Sharma and his co-workers (1994) [5]. also stated that Tribendazole (0.1%) was the most effective fungicide for the control of *G. cingulata* causing Post-harvest rot of Mango. Rehana *et al.* (2014) [3]. who reported that Azoxystrobin and Tebuconazole+ Trifloxystrobin was found effective against post-harvest rot and stem end rot of mango.

C) **Phytotoxicity**

The data presented in Table 4 revealed that the fungicide Fluopyrum 200 + Tebuconazole 200-400 SC had no any phytotoxic effect on mango at the tested concentrations. The flowering and vegetative flushes were healthy at the different growth stages after the spraying. Therefore, the treatments were found safe to mango at the above referred concentration i.e. 0.75 to 3g. Hence, it is concluded that Fluopyram 200+Tebuconazole 200-400SC is a safe to use on mango up to the dose of 0.3 per cent concentration

Summary and Conlusion

Among the different concentrations of fungicide tested against powdery mildew and post-harvest rot under field conditions at RFRS, Vengurle; Fluopyram 200 +Tebuconazole 200 – 400 SC @ 750 ml/ha was found to be the most promising and efficient fungicide and has potential activity in controlling the disease incidence of powdery mildew and post-harvest rot of mango

Table 3: Bio-efficacy of Fluopyram 200+ Tebuconazole 200-400 SC against powdery mildew disease of mango

Tr. No.	Treatments	Dosage (for ml/ha)	Percent Disease Index
T_1	Fluopyram 200 + Tebuconazole 200-400SC	500	24.33 (29.54)
T_2	Fluopyram 200 + Tebuconazole 200-400SC	625	19.33 (26.07)
T_3	Fluupyram 200 + Tebuconazole 200-400SC	750	18.00 (25.10)
T_4	Fluopyram 500SC	300	22.66 (28.42)
T_5	Tebuconazole 25EC	600	20.66 (27.04)
T_6	Carbendazim 50WP	500	22.00 (27.97)
T_7	Control	-	52.00 (46.15)
	SE ±		**0.714**
	CD at 5%		**2.202**

*Figures in parenthesis indicate Arc sin transformation

Table 4: Bio-efficacy of post-harvest fruit rot of mango

Tr. No.	Treatments	Dosage (for ml/ha)	Percent Rot		
			5th DAH	10th DAH	15th DAH
T_1	Fluopyram 200 + Tebuconazole 200-400SC	500	0.00 (0.00*)	0.00 (0.00)	0.00 (0.00)
T_2	Fluopyram 200 + Tebuconazole 200-400SC	625	0.00 (0.00)	3.33 (6.15)	6.66 (8.85)
T_3	Fluopyram 200 + Tebuconazole 200-400SC	750	0.00 (0.00)	10.00 (15.00)	10.00 (15.00)
T_4	Fluopyram 500SC	300	0.00 (0.00)	10.00 (15.00)	16.66 (23.36)
T_5	Tebuconazole 25EC	600	0.00 (0.00)	10.00 (18.44)	13.33 (21.15)
T_6	Carbendazim 50WP	500	0.00 (0.00)	13.33 (21.15)	13.33 (21.15)
T_7	Control	-	3.33 (6.14)	30.00 (33.00)	43.33 (45.00)
	SE ±		2.313	5.179	5.368
	CD at 5%		**7.128**	**15.961**	**16.343**

*Figures in parenthesis indicate Arc sin transformation

Table 5: Phytotoxic effect of fluopyram 200+ Tebuconazole 200-400 SC in mango cultivar Alphonso

Tr. No.	Treatments	Dosage (for ml/ha)	Phytotoxicity (0%)																									
			Epinasty					Hyponasty					Necrosis					Wilting					Chlorosis					
			1	3	5	7	10	1	3	5	7	10	1	3	5	7	10	1	3	5	7	10	1	3	5	7	10	
T_1	Fluopyram 200 + Tebuconazole 200-400SC	750	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	
T_2	Fluopyram 200 + Tebuconazole 200	1500	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	
T_3	Fluopyram 200 + Tebuconazole 200	3000	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	
T_4	Untreated Control	-	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	

Black rot **Stem-end-rot**

Anthracnose

Powdery Mildew in Mango

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