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Bioefficacy and phytotoxicity of fluxapyroxad 250 g/l + pyraclostrobin 250 g/l 500 SC (Merivon 500 SC) against powdery mildew disease of cucumber

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Abstract
A field experiment was conducted to evaluate the efficacy of Merivon 500 SC (Fluxapyroxad 250 g/L + Pyraclostrobin 250 g/L 500 SC) against powdery mildew of cucumber during 2015, at Konana thale village of Ranebennur taluk. It was found that Fluapyoxad 250 g/L + Pyraclostrobin 250 g/L 500 SC @ 0.005 per cent and 0.006 per cent is highly effective in reducing the powdery mildew disease in cucumber. Further the phytotoxicity was not observed in the chemical Fluxapyroxad 250 g/L + Pyraclostrobin 250 g/L 500 SC to the treated plots of cucumber even at high doses (0.1%) and also exhibiting an appreciable increase in cucumber yield.

Keywords: Merivon 500 SC, cucumber, powdery mildew, fluxapyroxad and pyraclostrobin

Introduction
Cucumber (*Cucumis sativus* L.), a popular fresh market vegetable prepared for salads and is cultivated throughout India. The total area under cucumber cultivation in India is reported around 0.071 lakh ha and its production is 0.12 million tonnes with an average productivity of 16.92 tonnes (Anon, 2015-16). The major constraint to cucumber production in India is powdery mildew and caused by *Erysiphe cichoracearum* and *Sphaerotheca fuliginea*, respectively. A powdery mildew infection acts as a sink for plant photosynthates causing reductions in plant growth, premature foliage loss, and consequently a reduction in yield. The yield loss is proportional to the severity of the disease and the length of time that plants have been infected (Mossler and Nesheim 2005) [10]. For instance, in cucumber there is a negative linear relationship between disease severity and yield (Dik and Albajes, 1999) [3]. Powdery mildew and downy mildew together causes up to 50-70 per cent a loss Sitterly, (1972) [14]; Awad, (2000) [1]. If these diseases are not controlled in a timely manner, symptoms can be severe enough to cause extensive premature defoliation of older leaves and wipe out the crop. Therefore, protective spray schedules require frequent application of fungicides as the disease cycle is completed in 3-7 days and several quick cycles cause widespread infection within a short period. Furthermore, the successive use of systemic fungicides such as fenarimol, triadimefon and bupirimate to control these diseases has led to the development of tolerant strains (Gupta and Shyam, 1996) [7]. Frequent sprays of copper containing fungicides (Bordeaux mixture and copper oxychloride) and certain other groups of fungicides are required to check the diseases, which increase the cost of cultivation besides posing residue problem. Hence, newer fungicides are needed for powdery mildew disease management in cucumber. Merivon 500 SC (Fluxapyroxad 250 g/L + Pyraclostrobin 250 g/L 500 SC) is one among them, which have fluxapyroxad active ingredient and it is a succinate dehydrogenase inhibitor and an-other new active ingredient pyraclostrobin, which inhibits the mitochondrial respiration in fungi. The above two fungicides combined together and labeled as Merivon for use in stone and pome fruits against common leaf spot, powdery mildew and anthracnose (Schilder, 2015) [11]. Hence, an investigation was initiated to study the bioefficacy and phytotoxicity of Fluxapyroxad 250 g/l + Pyraclostrobin 250 g/l 500 SC (Merivon 500 SC) along with different standard fungicides against powdery mildew disease of cucumber.

Material and Methods
Source of fungicides:
BASF India Ltd., NMHO-II, Thane- Belapur Road, Turbhe, Navi Mumbai-400705

Bioefficacy of Fluxapyroxad + Pyraclostrobin 500 SC

A field experiment was conducted with cucumber cv. gypsy during June, 2015 in the farmer's holding at, Konana thale village of Ranebennur taluk Haveri district, Karnataka to study the bioefficacy of Fluxapyroxad + Pyraclostrobin 500 SC against powdery mildew disease. The experiment was laid out in randomized block design with three replications with the spacing 1.0 × 0.5 m. Regular agronomic practices were followed according to the University of Agricultural Sciences, Dharwad crop production guide. The treatments of the experiment were T_1- Fluxapyroxad + Pyraclostrobin 500 SC @ 75 g a.i./ha, T_2 - Fluxapyroxad + Pyraclostrobin 500 SC @ 100 g a.i./ha, T_3- Fluxapyroxad + Pyraclostrobin 500 SC @ 125 g a.i./ha, T_4 - Fluxapyroxad + Pyraclostrobin 500 SC @ 150 g a.i./ha, T_5 - Pyraclostrobin 20% WG @ 100 g a.i./ha and T_6 - Fluxapyroxad 300 g/L SC @ 62.5 g a.i./ha, T_7 - Benomyl 50% WP @ 100 g a.i./ ha and Control - untreated.

Two sprays were performed with Merivon 500 SC at 54 days after sowing along with the standard checks at 10 days interval using a high volume knapsack sprayer with a spray volume of 500 L/ha. Powdery mildew incidence was recorded before treatment and 10 days after final spray. The intensity of powdery mildew disease was assessed using the score chart of 0 to 4 scale given by Gangopadhyay (1984) [5] as mentioned below. Further, the disease scale was converted into severity per cent disease index (PDI) with the following formula (Mckinney 1923) [9]. The weight of fruits from each plot during harvest was recorded and the average yield per treatment was calculated.

The intensity of powdery mildew disease was assessed using the score chart of 0 to 4 scale given

Numerical rating/ scale	Disease intensity
0	No powdery growth
1	Trace to 25% of leaf area having powdery growth
2	26-50% of leaf area having powdery growth
3	51-75% of leaf area having powdery growth
4	76-100% of leaf area having powdery growth

$$\text{PDI} = \frac{\text{Sum of all numerical disease rating}}{\text{Total no. of leaves observed} \times \text{maximum disease grade in scale}} \times 100$$

Further, to check for phytotoxicty the higher dose of 250 g a.i. /ha and lower dose 125 g a.i. / ha as shown (Table. 1) was used and observations on phytotoxicity were recorded based on 0-10 scale as mentioned below for leaf tips, surface injury, wilting, necrosis, epinasty and hyponasty. From each treatment, three plants were selected randomly and the total number of leaves and those showing phytotoxicty were counted from 1, 3, 5, 7 and 10 days after first spray. The data collected were converted in to percentage.

Table 1: Phytotoxicity treatment details:

Tr. No	Treatment details	Dosage per ha		
		Grams in a.i	Formulation (ml or g)	Water volume (L)
T_1	Fluxapyroxad + Pyraclostrobin 500 SC	125	250	500
T_2	Fluxapyroxad + Pyraclostrobin 500 SC	250	500	500
T_3	Control	-	-	-

Observations on phytotoxicity were recorded based on 0-10 scale

Scale	Per cent crop health affected
0	No phytotoxic effect
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

Results and Discussion

Efficacy of fungicide on per cent disease index (PDI)

The result presented in Table 2 revealed that, all the fungicidal treatments were found statistically significant and effective in reducing the disease index of powdery mildew in cucumber over control. Among the different treatments, pre-mix fungicide, Fluxapyroxad 250g/l + Pyraclostrobin 250g/l @ 0.6 ml/L (300 ml/ha) recorded significantly lower PDI of (14.30) and next best treatment was Fluxapyroxad 250g/l + Pyraclostrobin 250g/l @ 0.5 ml/L (250ml/ha) with 15.75 PDI followed by Fluxapyroxad 250g/l + Pyraclostrobin 250g/l @ 0.4 ml/ L (200 ml/ha) of 17.90 PDI Fluxapyroxad 300g/l SC @ 0.41 ml/L (209 ml/ L) with PDI of 18.28.

Pyraclostrobin 20% WG @ 1 g/L (500 g/ha) recorded 19.36 PDI while Benomyl 50% WP 0.4 g/L (200 g/ha) recorded 18.28 PDI. The maximum PDI (47.69) was recorded in untreated control treatment.

The PDI was found minimum in Fluxapyroxad 250g/l + Pyraclostrobin 250g/l @ 0.6 ml/l 0.5 ml/l (Table 2). This is mainly due to fluxapyroxad shows broad spectrum of activity and is announced to be a mixing partner for epoxiconazole and pyraclostrobin to be used in many crops including fruits, vegetables and cereals (Semar *et al.*, 2011; Walter, 2010) [12, 16]. The compound provides preventive, curative and long lasting efficacy and is expected to have significant sales potential and the market introduction in 2012. Though the traditional old chemical hexaconazole significantly reduced the disease incidence on leaves, fruits and inflorescence over control, new generation chemicals pyraclostrobin and fluxapyroxad were more efficient. Because pyraclostrobin belongs to the strobilurins group, is the leading systemic fungicide, found to exert their fungicidal action by blocking electron transport in the mitochondrial respiratory chain in fungi (Gerth *et al.*, 1980) [6].

Among the different treatments, Fluxapyroxad 250g/l +Pyraclostrobin 250g/l 500 SC @ 0.6 ml/l also recorded significantly lower per cent disease index of powdery mildew (14.30) than control (47.69). The pre-mixture fungicides were found highly effective in controlling the powdery mildew disease when compared to the individual fungicide spray separately (Table 2). Karaoglanidisa and Karadimosb (2006) [8] reported that efficacy of strobilurins increased when mixed with other broad spectrum or contact fungicides in controlling powdery mildew in field-grown sugar beet. They provided better control efficacy compared to single applications of traditional or strobilurin fungicides. As the concentration of pre-mix fungicide Fluxapyroxad 250g/l +Pyraclostrobin 250g/l 500 SC increased, the PDI was reduced. This might be due to the extent of inhibition of conidial germination.

Table 2: Bioefficacy of Fluxapyroxad 250g/l +Pyraclostrobin 250g/l 500 SC against powdery mildew of cucumber and its yield

SL. No.	Treatments	Formulation (ml or g/ha)	PDI (Before treatment)	PDI (After final treatment)	Yield (q/ha)
1	Fluxapyroxad 250 g/L + Pyraclostrobin 250 g/L 500 SC	150	24.36 (30.53)*	18.59 (25.53)	15.27
2	Fluxapyroxad 250 g/L+ Pyraclostrobin 250 g/L 500 SC	200	25.89 (30.80)	17.90 (25.01)	16.97
3	Fluxapyroxad 250 g/L +Pyraclostrobin 250 g/L SC	250	26.23 (32.43)	15.75 (23.37)	17.74
4	Fluxapyroxad 250 g/L +Pyraclostrobin 250 g/L 500 SC	300	24.43 (31.67)	14.30 (22.20)	18.98
5	Pyraclostrobin 20% WG	500	25.82 (32.31)	19.36 (26.09)	13.31
6	Fluxapyroxad 300 g/L SC	209	25.10 (33.63)	18.28 (25.30)	13.27
7	Benomyl 50% WP	200	25.72 (30.59)	18.89 (25.75)	17.20
8	Control	-	28.92 (34.22)	47.69 (43.66)	10.31
S.E.m ±			0.60	0.62	0.53
C. D. at 5%			1.81	1.87	1.62

*Figures in parenthesis are arc sin transformed values

Influence of fungicide on yield

The productivity of cucumber was recorded maximum (18.98 q/ha) and (17.74 q/ha) in Fluxapyroxad 250g/l +Pyraclostrobin 250g/l 500 SC at 0.6 ml/l and 0.5 ml/l concentration respectively as shown in Table 2. The yield was significantly low in untreated control (10.31 q/ha). All fungicides significantly increased the yield as compared to untreated control. It has both excellent preventative and curative activity through the inhibition of fungi at several stages of the fungal lifecycle including spore germination, germ tube growth, appresoria formation and mycelial growth (Strathmann *et al.*, 2011) [15]. Overall, Fluxapyroxad 250g/l + Pyraclostrobin 250g/l 500 SC @ 0.6 ml/l was found to be the best treatment for controlling powdery mildew disease in cucumber.

Table 3: Evaluation of phytotoxicity of Fluxapyroxad 250g/l + Pyraclostrobin 250g/l 500 SC Observation on Chlorosis, Necrosis, Wilting, Scorching, Hyponasty and Epinasty

Day of observation after each spray	Treatments	Phytotoxicity symptoms				
		Chlorosis	Necrosis	Wilting	Scorching	Hyponasty and Epinasty
1	X	0*	0	0	0	0
	2X	0	0	0	0	0
	Untreated control	0	0	0	0	0
3	X	0	0	0	0	0
	2X	0	0	0	0	0
	Untreated control	0	0	0	0	0
5	X	0	0	0	0	0
	2X	0	0	0	0	0
	Untreated control	0	0	0	0	0
7	X	0	0	0	0	0
	2X	0	0	0	0	0
	Untreated control	0	0	0	0	0
10	X	0	0	0	0	0
	2X	0	0	0	0	0
	Untreated control	0	0	0	0	0
15	X	0	0	0	0	0
	2X	0	0	0	0	0
	Untreated control	0	0	0	0	0

X- Fluxapyroxad 250 g/l + Pyraclostrobin 250 g/l 500 SC @ 250 ml/ ha (0.5 ml/l)
2X- Fluxapyroxad 250 g/l + Pyraclostrobin 250 g/l 500 SC @ 500 ml/ha (0.6 ml/l)
0*- No phytotoxicity

Phytotoxicity

The result of phytotoxicty studies of Fluxapyroxad 250g/l +Pyraclostrobin 250g/l 500 SC is presented in Table 3. The observations on the leaf tip, surface injury, wilting, vein clearing, necrosis, epinasty, hyponasty and fruit injury were the parameters used to record phytotoxicity during the cropping period but there were no visual symptoms of phytotoxicty noticed on cucumber crop by Fluxapyroxad 250g/l + Pyraclostrobin 250g/l 500 SC treatment even at 1ml/l concentration. Strathmann *et al.*, (2011) [15], demonstrated fluxapyroxad is highly active on several major plant pathogens from the Ascomycete, Basidiomycete, Deuteromycete and Zygomycete classes of fungi. It was found to be effective for use on a wide variety of crops, including cereals, corn, soybean, fruiting vegetables, tuberous and corm vegetables, pome fruits and stone fruits with excellent crop safety.

However, the Fungicide Resistance Action Committee has developed resistance management recommendations for pathogens of different crops in order to reduce the risk for resistance development to this class of fungicides (FRAC, 2013) [4]. These recommendations include preventative usage, mixture with partner fungicides active against the current pathogen population, alternation in the mode of action of products used in a spray program, and limitations in the total number of applications per season or per crop (Sierotzki and Scalliet, 2013) [13]. Findings of our field studies suggest that Fluxapyroxad 250g/l + Pyraclostrobin 250g/l 500 SC is effective in reducing powdery mildew in cucumber at 0.6 ml/l concentrations. No phytotoxic symptoms were recorded after spraying on the plants even at higher dose (1ml/l). The application of Fluxapyroxad 250g/l + Pyraclostrobin 250g/l 500 SC has significantly decreased the powdery mildew disease and at the same time it increased the productivity in cucumber. Fluxapyroxad 250g/l + Pyraclostrobin 250g/l 500 SC at the standard dose (0.6ml/l concentration) tested was found effective and superior to other fungicides evaluated together.

References

1. Anonymous. Handbook of horticulture statistics, GOI, Ministry of agriculture. Department of agricultural sciences and co-operation. New Delhi 2015-16, 14-16.
2. Awad NGH. Reaction of some cucurbits against physiological and histopathological changes. Arab Univ. J Agric Sci 2000;8:829-851.
3. Dik A, Albajes R. Principles of epidemiology, population biology, damage relationships and integrated control of diseases and pests. In Albajes. R., Gullino, L., Lenteren, J., Elad, Y., *ed*, Integrated pest and disease management in greenhouse crops. Kluwer Academic Publishers, Dordrecht, The Netherlands 1999, 9-81.
4. FRAC. (Fungicide Resistance Action Committee) 2013. URL http://www.frac.info/
5. Gangopadhyay S. Powdery mildews of cucurbits, peas, capsicum, beets and crucifers and lettuce. Adv. Veg. Sci 1984, 123.
6. Gerth K, Irschik H, Reichenbach H, Trowitzsch W. Myxothiazol, an antibiotic from *Myxococcus fulvus* (Myxobacterales) - Cultivation, isolation, physicochemical and biological properties. J Antibiot 1980;33:1474-1479.
7. Gupta SK, Shyam KR. Antisporulant activity of some fungicides against *Pseudoperonospora cubensis* on cucumber. Indian J Mycol Plant Pathol 1996;26(3):293-295.
8. Karaoglanidisa GS, Karadimosb DA. Efficacy of strobilurins and mixtures with DMI fungicides in controlling powdery mildew in field-grown sugar beet. Crop Prot 2006;25 977-983.
9. Mckinney HH. A new system of grading of plant diseases. J Agric Res 1923;26:195-218.
10. Mossler MA, Nesheim ON. Florida Crop/Pest Management Profile: Squash. Electronic Data Information Source of UF/IFAS Extension (*EDIS*). CIR 1265. February, 3, 2005. http://edis.ifas.ufl.edu/ 2005.
11. Schilder A. Merivon, a new fungicide option for disease control in strawberries. Michigan State University Extension Bulletin 2015. http://tinyurl.com/ y8fxgv3m.
12. Semar M, Strobel D, Strathmann S, Groeger U. Xemium: The BASF fungicide innovation. In: Modern Fungicides and Antifungal Compounds VI, Dehne, H.W., Deising, H. B., Gisi, U., Kuck, K. H., Russell, P. E and Lyr, H., (Eds). DPG-Verlag, Braunschweig, Germany 2011, 63-68.
13. Sierotzki H, Scalliet G. A review of current knowledge of resistance aspects for the next-generation succinate dehydrogenase inhibitor fungicides. Phytopathol 2013;103(9):880-887.
14. Sitterly WR. Powdery Mildews of Cucurbits. In: The Powdery Mildews, Spencer, D. M., ed. Academic Press Inc. Ltd., New York 1972, 359-379.
15. Strathmann S, Walker S, Barnes J. Fluxapyroxad: A new broad-spectrum fungicide. Phytopathol 2011;101(6):172.
16. Walter H. New Fungicides and New Modes of Action. In: Modern Fungicides and Antifungal Compounds VI, Dehne, H.W., Deising, H. B., Gisi, U., Kuck, K. H., Russell, P. E and Lyr, H., (Eds). Friedrichroda, Germany 2010, 47-54.