EVALUATION OF PROQUINAZID 20% EC ON POWDERY MILDEW OF CHILLI CAUSED BY *LEVEILLULA TAURICA*

C. RUTH¹, K. SUBRAMANYAM² & K. GOPAL³

^{1,3}Department of Plant Pathology, Dr. YSR Horticultural University, College of Horticulture,
Anantharajupeta, YSR District, Andhra Pradesh, India

²Department of Plant Pathology, Dr. YSR Horticultural University, Horticultural Research Station, Mahanandi,
YSR District, Andhra Pradesh, India

ABSTRACT

Chilli (*Capsicum annum* L.) is an important cash crop among the spices. Field trials were conducted, to determine the evaluation of Proquinazid 20%, against powdery mildew disease of Chilli, in two seasons. Experimental findings indicate that, three foliar sprays with Proquinazid 20% was found most effective treatment, against powdery mildew which exhibited lowest disease severity (PDI, 5.05) and maximum yield (19.80q/ha), as compared to other fungicides viz. Dinocap 48%, Azoxystrobin 23%. It is evident from the present investigation that, Proquinazid 20 % EC was found effective against powdery mildew disease of Chilli @ 40 g.a.i/ha dose, with maximum fruit yield. No phytotoxic symptoms were noticed at any of the dose tested (30, 40, 50, 80 and 160 g.a.i/ha) at 1, 3, 5, 7 & 10 days, after spraying.

KEYWORDS: Powdery Mildew, Proquinazid & Chilli

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INTRODUCTION

Chili (*Capsicum annum* L.), also known as 'red pepper' is traditionally used as vegetables, spices, condiments, sauces and pickles, and has value added in pharmaceuticals, cosmetics and beverages. India is a major producer, exporter and consumer of chillies in the world. Chilli is a very remunerative spice crop of the Indian subcontinent (Sharma *et al.*, 2002), and occupies an area of about 0.81 million ha (Suthin Raj and Christopher, 2009), which accounts for 25% of the world production (Chandra Nayaka *et al.*, 2009). It is primarily grown in Andhra Pradesh, Karnataka, Tamil Nadu and Maharashtra. Some of the popular varieties are Sannam-4, Indian wrinkled chillies, Wonder hot, Bird's eye chilli, Kashmiri chilli, Byadagi chilli and Warangal Chappatta. Chilli suffers from many diseases caused by fungi, bacteria, viruses, nematodes and other abiotic stresses. Among the fungal diseases, powdery mildew is caused by *Leveillula taurica* (Lev.) Arn., is a major constraint in chilli production in India, causing heavy yield loss ranging from 14 to 20%. (Mathur *et al.*, 1972; Sivaprakasam *et al.*, 1976; Gohokar and Peshney, 1981).

MATERIALS AND METHODS

A field experiment was conducted at Horticultural Research Station, Mahanandi, Kurnool, (A. P.) to study the efficacy of fungicide Proquinazid 20 % EC, against Powdery mildew in Chilli cv. RKHS-105 during late kharif season 2014-2015 and 2015-16. The plot size is 5x5M with spacing of 60x45cm, and the soil type is

clay loamy soil. According to the meteorological data, it recorded more rainfall in the month of November, during 2014-15 and in October and November, during the 2015-16 (Table-3, 7). The experiment was laid out in Randomized Block Design (RBD), with three replications and the crop was raised by standard agronomic practices. The test fungicide, Proquinazid 20 % EC, was evaluated at 5 doses 30, 40, 50, 80 and 160 g.a.i/ha, along with standards and untreated check against target diseases.

The crop was raised as per the recommended package of practices, except plant protection measures. The first treatment spray was done, soon after the onset of the disease and subsequent three sprays were taken up, at an interval of 10 days. 500 liter spray volume was used per hectare. Observations were recorded on ten plants, on disease severity in each treatment, before first spray and after 10 days of each spray, as per the standard method. Finally, the chilli fruits yield per plot was recorded and converted into quintals/ha, and data was analyzed statistically.

The observations of chilli severity of powdery mildew were recorded, using 0-9 disease rating scale as mentioned below:

Table 1: Rating Scale for Assessment of Powdery Mildew Disease (Jenkins-Wehner, 1983)

Grade	Description of the Symptoms
0	No symptoms of powdery mildew disease (PMD) on leaf
1	Less than 1% leaf area showing PMD symptoms
3	1 -10% of leaf area showing PMD colonies
5	11 – 25% area of leaf showing PMD colonies
7	26 – 50% area of leaf showing PMD and development of colonies on petiole and pedicel of fruit
9	Above 50% area of leaf affected and yellowing and drying of leaves; Powdery growth of the fungus covers the petiole, pedicel.

The percent disease index of Powdery mildew of Chilli was calculated using the following formula:

$$\text{Percent Disease Index} = \frac{\text{Sum of the individual diseases grade} \times 100}{(\text{PDI}) \text{ Number of Branches or fruits observed} \times \text{Maximum Disease grade}}$$

Phytotoxicity Observations

Observations for phytotoxicity recorded in 1, 3, 5, 7 and 10 days, after 1st, 2nd and 3rd spray on stunting, necrosis, epinasty and hyponasty, and epinasty by using 0-10 scale, which indicates 0 – no phytotoxicity, 1 – 0 to10; 2-11to 20; 3 - 21to 30; 4 – 31to 40; 5 – 41to 50

Treatments for Bio-Efficacy and phytotoxicity

Table 2

Sl. No.	Treatment	g. a.i/ha
T ₁	Proquinazid 20 % EC	30
T ₂	Proquinazid 20 % EC	40
T ₃	Proquinazid 20 % EC	50
T ₄	Dinocap 48% EC	108
T ₅	Azoxystrobin 23 %SC	125
T ₆	Proquinazid 20 % EC*	80
T ₇	Proquinazid 20 % EC*	160
T ₈	Untreated Control	-

Treatments 6 & 7 are meant only for recording Phyto-toxicity & no bio-efficacy observations were recorded from these two treatments

Data Analysis

The data on percent intensity of powdery mildew diseases, at pre treatment of each spray (Before spray, 10th day after 1st, 2nd and 3rd spray) was recorded. The data on incidence on 10 randomly selected chilli plants, from each replication were taken. The powdery mildew disease intensity was scored in 0-9 scale, during every fruit picking and infected leaves, respectively. The data on the percent severity of powdery mildew were analyzed, in the SPSS-16 software.

Results on Powdery Mildew (*Leveillula Taurica*) – First Season

The results of Efficacy of Proquinazid 20 % EC, against Chilli Powdery mildew disease, during first season are presented in the Table 1. During pre treatment, it is observed that, all the treatments were on par with each other & non significant. During first spray, among the treatments against Powdery mildew showed that, the treatment Proquinazid 20 % EC @ 50 g.a.i/ha, recorded least percent disease index of Powdery mildew (terminal PDI, 4.27), and it was followed by its lower dose @ 40 g.a.i/ha (terminal PDI, 5.05), which were on par and significant from rest of the treatments. Whereas, untreated control (terminal PDI, 15.85) recorded maximum powdery mildew incidence. Similar results were observed at second and third spray subsequently. The difference in the yield level between treated and untreated plots was very much significant. The highest fruit yield (20.49 q/ha) was recorded in the plot, treated with the Proquinazid 20 % EC @ 50 g.a.i/ha, followed by Proquinazid 20 % EC @ 40 g.a.i/ha, which recorded fruit yield of 19.80 q/ha, which were on par with each other. The lowest yield of 15.28 q/ha was recorded in untreated check (Table No.2).

Results on Powdery Mildew (*Leveillula Taurica*) – Second Season

The test fungicide Proquinazid 20 % EC and recommended fungicides viz., Azoxystrobin @ 125 g.a.i/ha and Dinocap @ 108 g.a.i/ha, were differed significantly with the control in reducing the percent disease index. Lowest mean percent disease index (12.95), was recorded with Proquinazid 20 % EC, when tested at 50 g.a.i/ha, followed by the same chemical at the concentration 40 g.a.i/ha (14.53), which were on par with each other and differed significantly with the recommended fungicides Dinocap (18.24), Azoxystrobin (21.53) and control (29.20). (Table 3).

Yield

Both the test fungicide Proquinazid 20 % EC and recommended fungicides viz., Azoxystrobin 125 g.a.i/ha and Dinocap 108 g.a.i/ha, were differed significantly, to control on pod yield. However, highest fruit yield (72.50 q/ha) was recorded with Proquinazid 20 % EC, when tested with 50 g. a. I/ha, followed by the same chemical at the concentration 40 g. a. I/ha (71.51 q/ha), which are at par with each other, and differ significantly with the recommended fungicides, Dinocap (69.13 q/ha), Azoxystrobin (68.91 q/ha) and control (67.19 q/ha). (Table 4).

Table 3

Phytotoxicity
No Phytotoxic symptoms like leaf surface injury, leaf tip injury, chlorosis, necrosis, epinasty and malformation were recorded with Proquinazid 20 % EC at the two concentrations tested viz., 80 and 160 g.a.i/ha (Table 5).

DISCUSSIONS

In the present study, least percent disease index of Powdery mildew (terminal PDI, 4.27) at @50 g.a.i/ ha, and it

was followed by its lower dose @ 40 g.a.i/ha (terminal PDI, 5.05), which were on par and significant from rest of the treatments in two seasons, and maximum yields of 20.49, 18.26 t/ ha were recorded with Proquinazid 20%EC @50 g.a.i/ha and Azoxystrobin at 125 g ai/ha, respectively. The results were in accordance with the following reports. Kalra *et al.* (2000) reported that, early planting coupled with the application of dinocap reduced the powdery mildew disease severity on the coriander. Sharma *et al.* (2002) reported that, hexaconazole (0.05%) sprays were found highly effective in reducing the severity of powdery mildew, followed by fenarimol and bitertanol, in controlling the powdery mildew of pea. Khunti *et al.* (2002) reported that, application of hexaconazole (0.05%) and penconazole (0.1%) were found effective in managing powdery mildew and *Cercospora* leaf spot of mung bean, caused by *Erysiphe polygoni* and *Cercospora canescens*. Fugro *et al.* (2004) reported that, carbendazim 80% WDG at 250g a.i./ha was most effective in managing powdery mildew of chilli. Reuveni (2003) reported that, azoxystrobin at 40 g 100 l-1 water gave 95.9% reduction over control of grapes downy mildew *P. viticola*, in field experiments. Azoxystrobin at 0.3g l-1, as pre-inoculation spray significantly reduced the lesion length (2.75 mm), compared with the water control (26.4 mm) caused by *D. bryoniae* (stem blight), of cucumber (Utkhede and Koch, 2004). These above chemicals belong to triazoles group. These fungicides interfere with the biosynthesis of fungal sterols, and inhibit ergosterol biosynthesis. Ergosterol is essential to the structure of cell wall and its absence causes irreparable damage, to the cell wall and the fungus dies. They will also interfere in conidia and haustoria formation. They change the sterol content and saturation of the polar fatty acids, leading to alterations in membrane fluidity and behavior of membrane bound enzymes (Nene and Thapliyal, 1993). Sendhil Vel (2003) recorded 43.06% increase in yield, over farmer practices in the first season, and 33.98% increase over farmer practices in the second season trial, by azoxystrobin (150 g a.i ha-1) treatment. Anand *et al.* (2009) reported maximum fruit yield of 10.54, and 10.35 tonnes ha-1 cucumber, at azoxystrobin (250 ml ha-1) for the first and second seasons, respectively.

CONCLUSIONS

It is evident from the present investigation that, Proquinazid 20 % EC was found effective against powdery mildew disease of chilli, at all the concentrations tested, which resulted in more fruit yield/ha. The chemical was also found to be non phytotoxic, to the chilli. Hence, the powdery mildew of chilli can be effectively managed, by giving three foliar sprays with Proquinazid 20 % EC @ 40 g.a.i/ha. The first spray should be initiated just after appearance of the disease and subsequent two sprays at 10 days interval.

Table 4: Effect of Proquinazid 20 % EC on Powdery Mildew Incidence on Chilli – 2014-15

Sl. No.	Treatment	g. a.i/ha	Percent Disease Index (PDI) [10 days after each Spray]			
			Pre-Treatment	I st Spray	II nd Spray	III rd Spray
T ₁	Proquinazid 20 % EC	30	6.48 (14.65)*	7.24 (15.56)	11.56 (19.87)	14.82 (22.64)
T ₂	Proquinazid 20 % EC	40	7.28 (15.56)	5.05 (12.92)	9.28 (17.66)	12.56 (20.70)
T ₃	Proquinazid 20 % EC	50	5.87 (13.94)	4.27 (11.83)	8.56 (16.95)	10.98 (19.28)
T ₄	Dinocap 48% EC	108	6.46 (14.65)	11.76 (20.00)	14.58 (22.38)	17.28 (24.50)
T ₅	Azoxystrobin 23 %SC	125	8.56 (16.95)	9.55 (17.95)	12.54 (20.70)	15.54 (23.19)
T ₆	Untreated Control	-	8.55 (16.95)	15.85 (23.42)	21.56 (27.63)	27.23 (31.44)

Table 4: Contd.,						
	SEm ($\pm$)		1.05	0.68	0.71	0.60
	CD at 5%		N.S	2.05	2.15	1.82
	CV		13.64	12.60	11.48	14.20

*Figures in parenthesis are angular transformed value

Table 5: Effect of Proquinazid 20 % EC on the Yield of Chilli – 2014-15

Sl. No.	Treatment	g. a.i/ha	Chilli Yield (q/ha)
T ₁	Proquinazid 20 % EC	30	17.45
T ₂	Proquinazid 20 % EC	40	19.80
T ₃	Proquinazid 20 % EC	50	20.49
T ₄	Dinocap 48% EC	108	17.05
T ₅	Azoxystrobin 23 %SC	125	18.26
T ₆	Untreated Control	-	15.28
	SEm ($\pm$)	-	0.27
	CD at 5%	-	0.80
	CV	-	12.72

Table 6: Effect of Proquinazid 20 % EC on Powdery Mildew Incidence on Chilli – 2015-16

Sl. No	Treatment	g.a.i/ha	Percent Disease Index (PDI) [10 days after Each Spray]				
			Pre-Treatment	I st Spray	II nd Spray	III rd Spray	Mean
T ₁	Proquinazid 20 % EC	30	8.45 (16.87)	9.21 (17.63)	12.53 (20.69)	14.25 (23.74)	12.66 (20.73)
T ₂	Proquinazid 20 % EC	40	9.25 (17.64)	7.02 (15.35)	11.25 (19.57)	14.53 (22.39)	10.94 (19.13)
T ₃	Proquinazid 20 % EC	50	7.84 (16.22)	6.24 (14.45)	10.53 (18.89)	12.95 (21.08)	9.91 (18.16)
T ₄	Univ. Standered (Dinocap)	108	10.75 (19.06)	12.25 (20.45)	15.25 (22.95)	18.24 (25.24)	15.24 (22.91)
T ₅	Univ. Standered (Azoxystrobin)	125	9.52 (17.91)	13.42 (21.47)	17.55 (24.75)	21.53 (27.63)	17.50 (24.63)
T ₆	Untreated Control	–	10.52 (18.89)	17.82 (24.96)	23.53 (29.01)	29.20 (32.70)	23.51 (28.90)
	SEm		0.97	0.67	0.17	0.40	0.57
	CD 5%		NS	2.07	0.51	1.23	1.79
	CV		17.91	10.28	1.89	3.73	6.57

* Figures in parenthesis are angular transformed values

Table 7: Effect of Proquinazid 20 % EC on the Yield of Chilli (2015-16)

Sl. No.	Treatment	g.a.i/ha	Pod Yield (q/ha)
T ₁	Proquinazid 20 % EC	30	69.36
T ₂	Proquinazid 20 % EC	40	71.51
T ₃	Proquinazid 20 % EC	50	72.50
T ₄	Univ. Standered (Dinocap)	108	69.13
T ₅	Univ. Standered (Azoxystrobin)	125	68.91
T ₆	Untreated Control	–	67.19
	SEM		0.41
	CD 5%		0.92
	CV		0.73

Table 8: Phytotoxicity of Proquinazid 20 % EC on Chilli

S. No	Treatments	Concentrations tested (g.a.i/ha)	1 DAS						3 DAS						5 DAS						7 DAS						10 DAS					
			A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
1	Proquinazid 20 % EC	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2	Proquinazid 20 % EC	120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

A- Leaf Surface Injury B- Leaf Tip Injury C- Chlorosis D- Necrosis

E- Epinasty F-Malformation DAS: Days after spray

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