



Report on research trial

On

To evaluate bio-efficacy and phytotoxicity of ProPhite (potassium salt of active phosphorus) against downy mildew of grapes after fruit pruning.

(October 2017 – March 2018)

Sponsored By

Isha Agro India

Pune

Conducted By



ICAR - National Research Centre for Grapes, Pune

PROJECT REPORT

Project Title : To evaluate bio-efficacy and phytotoxicity of ProPhite (potassium salt of active phosphorus) against downy mildew of grapes after fruit pruning.

Objectives : To test the bio-efficacy and phytotoxicity of ProPhite (potassium salt of active phosphorus) against downy mildew of grapes after fruit pruning

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Bio-efficacy and phytotoxicity of ProPhite (potassium salt of active phosphorus) against downy mildew of grapes after fruit pruning

1. Introduction

In major grape growing areas in Maharashtra, Andhra Pradesh and Karnataka regions adjoining Maharashtra, 'two pruning - one yield' system of grape cultivation is followed wherein foundation pruning is done during April and forward pruning is done during October. In most grape growing areas mentioned above, normal time of forward pruning is around 15th of October, but it can range from first week of July to last week of November. From disease management point of view forward pruning taken before 15th of October has greater risk of downy mildew, as there are more chances of rains and temperature is warmer. After forward pruning, about 8-10 days are needed for sprouting of buds. Thereafter on an average every 2-3 days interval new leaf is developed. At fifth leaf there will be a bunch, which takes about 25 to 35 days from forward pruning to develop to flowering stage and by 40 to 50 days fruits set in. First 50 to 55 days after pruning, risk of damages due to downy mildew infection on bunches is very high. Rains and heavy dew during this period helps development of downy mildew on bunches. Leaf wetness for continuous period of three hours after sunrise is favorable for new infection. If such conditions prevail during first 55 days of pruning sprays of fungicides are needed at shorter intervals for effective control of downy mildew. Berries develop to 10 to 12 mm size within first 70-75 days of forward pruning and thereafter the risk of downy mildew gradually reduces. Normally, 5 to 6 sprays of fungicides are required during first 55 days of pruning for effective management of downy mildew. This number of sprays may be increased to 9 in the event of rains, while it can be reduced to 3-4 when wet weather is absent after forward pruning. Present study was conducted after forward pruning at Tasgaon, Sangli district of Maharashtra.


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2. Material and methods

2.1. Bio-efficacy of ProPhite (potassium salt of active phosphorus) against downy mildew disease in grapes.

The experiment was conducted in a vineyards located at Tasgaon, Sangli during October, 2017 to March, 2018. The experiment was laid out in RBD with four replications and measuring a plot size of 269.09 sq. ft. with a spacing of 10 ft. x 6 ft. Variety used was Sonaka, grown in Black cotton soil and was on extended Y trellises.

Isha Agro India, Pune, supplied test product ProPhite and fungicide Potassium phosphite 50% (Fosponic). Standard check fungicide, cymoxanil + mancozeb was purchased from local market. Sprays of these fungicides were given whenever the weather conditions were favorable for development of disease. Weather data for period of experimentation is given in Annexure 1. Based on the favorable weather conditions six sprays at Sangli were given between 9th October 2017 and 11th November 2017 for downy mildew management. From 18th November 2017 up to 18th Jan 2018 only ProPhite @ 4 g/L water was sprayed at 10 days interval in T2, T3 and T4 treatment and Potassium phosphite 50% @ 3 g/L water was sprayed at 10 days interval in T5, T6 and T7 treatment up to harvest. Water volume used for spray was calculated based on requirement of 1000 L/ha at full canopy sprayer used for spray. Knapsack sprayer was used for spray.

Details of treatments are given in Table 1 (a). Dates of fruit pruning, harvesting and fungicide sprays at the location are mentioned in Table 1 (b).



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Table 1(a). List of treatments for field trials

Sr. no.	Treatment details	Dose/ha
		Formulation (ml or g)
1.	Cymoxanil 8% + mancozeb 64% (Curzate)	2.0
2.	ProPhite	4.0
3.	ProPhite followed by Curzate (4 applications) followed by successive applications of ProPhite	4.0 + 2.0
4.	ProPhite followed by Curzate (2 applications) followed by successive applications of ProPhite	4.0 + 2.0
5.	Potassium phosphite 50% (Fosphonic)	3.0
6.	Potassium phosphite (Fosphonic) followed by Curzate (4 applications)	3.0 + 2.0
7.	Potassium phosphite (Fosphonic) followed by Curzate (2 applications)	3.0 + 2.0
8.	control	-

Table 1 (b). Date of pruning, harvesting and sprays

Date of fruit pruning : 30/08/2017		
No. of spray	Dates of spray	Days after fruit pruning
1	09/10/2017	41
2	17/10/2017	49
3	24/10/2017	55
4	31/10/2017	62
5	06/11/2017	70
6	11/11/2017	75
ProPhite @ 4 g/L water was sprayed to treatments T2, T3 and T4 and Potassium Phosphite 50% @ 3 g/L water was sprayed to treatments T5, T6 and T7 @ 10 days interval up to till harvest		
7	21/11/2017	84
8	01/12/2017	94
9	11/12/2017	104
10	19/12/2017	112
11	30/12/2017	123
12	09/01/2018	133
Date of harvesting: 18/01/2018 (142 days)		

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2.1.1. Foliar infection

Downy mildew incidence on leaves was recorded visually adopting the 0-4 scale, where 0 means no disease present and 4 means more than 75 per cent leaf area infected. Rating scale on leaves has been shown in Fig 1. Percent disease index (PDI) was calculated by following formula:

$$\text{PDI} = \frac{\text{Sum of numerical ratings} \times 100}{\text{Number of leaves observed} \times \text{Maximum of rating scale}}$$

The ratings on ten leaves were recorded on randomly selected canes. Ten such canes per vine were observed, thus 100 disease observations were recorded per replicate. Four replications for each treatment were considered. Only actively growing downy mildew lesions were considered for recording ratings.

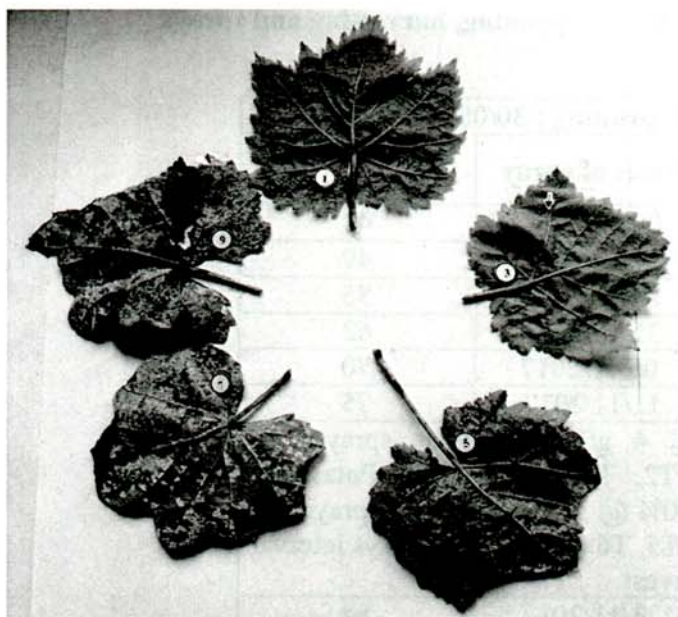


Fig.1 : Ratings of downy mildew in 0-4 scale on leaves


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2.2. Marketable yield

The marketable yield from the four replications of each of the treatments and the control was harvested and expressed as yield per vine (Kg).

2.3. Phytotoxicity

Phytotoxicity experiment was conducted at the research farm of ICAR-NRC for Grapes, Pune. Plants treated with sprays of different doses of ProPhite as mentioned in Table 1(c) were critically observed for presence of phytotoxic effects such as chlorosis, tip burning, necrosis on leaves and berries, epinasty and russetting on berries up to seven days after each spray. Observations were recorded at 1, 3, 5, 7 & 10 days after the spray in the form of visual ratings in 0-10 scale as detailed below:

Sr. no.	Treatment details	Dose/ha
		Formulation (ml or g)
1.	ProPhite (potassium salt of active phosphorus)	4.0
2.	ProPhite (potassium salt of active phosphorus)	8.0
3.	Control	-

Table 1(c). Treatment details for phytotoxicity observations

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

2.4 Statistical analysis

The PDI data was transformed by using arcsine transformation for leaves and analyzed statistically following Randomized Block Design (RBD) using Statistical Analysis System (SAS software 9.3). The yield data was analyzed without transformation. Means were compared using Least Significant Difference (LSD) Test.

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3. Results

3.1. Bio-efficacy of ProPhite (potassium salt of active phosphorus) against downy mildew

First disease observation in experiment plot was recorded on 31st October, 2017 in untreated control (Table 2). By this time 62 days have passed after fruit pruning and three preventive sprays were already given by this time. All the treatments were observed to be significantly superior over untreated control in minimizing PDI of downy mildew on leaves. Last three observations recorded between 6th November, 2017 and 18th November, 2017 indicated that downy mildew was significantly higher in untreated control than all fungicide treatments in the experiment. The treatment ProPhite @ 4g/L followed by Curzate (4 applications) @ 2g/L followed by successive applications of ProPhite @ 4.0 g /L water (T3) recorded lowest PDI (19.16) of downy mildew on leaves on 18/11/17, which was significantly less over rest of the treatments except that it was on par with the treatment ProPhite@ 4g/L followed by Curzate (2 applications) @ 2g/L followed by successive applications of ProPhite @ 4.0 g /L water (T4) PDI (20.65). ProPhite @ 4g/L (T2) has also shown promising control of the disease as PDI in this case on last observation was on par with standard check cymoxanil + mancozeb (Curzate) (T1) @ 2 g/L and significantly lower PDI than that in case of potassium phosphite 50% (Fosphonic) @ 3 g/L water. The untreated control treatment recorded maximum PDI (33.84) on leaves on 18/11/17.

ProPhite @ 4g/L followed by Curzate (4 applications) @ 2g/L followed by successive applications of ProPhite @ 4.0 g /L water (T3) were also significantly better than cymoxanil + mancozeb (Curzate) (T1) and potassium phosphite 50% (Fosphonic) (T5) in the last observation recorded on 18/11/17. Terminal residue of phosphonic acid was 5.98 mg/kg observed at Tasgaon, Sangli location.

Infection of downy mildew did not develop on bunches during the period of experimentation.


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Table 2. Bio-efficacy of ProPhite (potassium salt of active phosphorus) in management of downy mildew

Treatment		Dose/ha	PDI of downy mildew (%) on leaves				% Disease control over control
		Formulation (ml)	31/10/17	06/11/17	11/11/17	18/11/17	
T ₁	Cymoxanil 8%+ mancozeb 64%(Curzate)	2.0	0 (0.00)	9.19 (17.60)	12.75 (20.91)	15.56 (23.22)	31.38
T ₂	ProPhite	4.0	0 (0.00)	8.63 (17.06)	10.31 (18.72)	13.93 (21.91)	38.20
T ₃	ProPhite followed by Curzate (4 applications) followed by successive applications of ProPhite	4.0 + 2.0	0 (0.00)	5.69 (13.78)	7.96 (16.32)	10.87 (19.16)	43.38
T ₄	ProPhite followed by Curzate (2 applications) followed by successive applications of ProPhite	4.0 + 2.0	0 (0.00)	6.81 (15.10)	9.43 (17.86)	12.50 (20.65)	38.98
T ₅	Potassium Phosphite (Fosphonic)	3.0	0 (0.00)	10.94 (19.30)	15.69 (23.32)	17.93 (25.00)	26.12
T ₆	Potassium Phosphite (Fosphonic) followed by Curzate (4 applications)	3.0 + 2.0	0 (0.00)	9.06 (17.48)	11.50 (19.80)	14.25 (22.13)	34.60
T ₇	Potassium Phosphite (Fosphonic) followed by Curzate (2 applications)	3.0 + 2.0	0 (0.00)	9.50 (17.93)	12.00 (20.24)	15.12 (22.87)	32.42
T ₈	Control	-	2.19 (8.23)	16.69 (24.07)	21.94 (27.88)	31.06 (33.84)	-
CD (<i>p</i> = 0.05)		-	1.40	1.69	1.87	2.37	

*= Figures in parenthesis indicate arcsine transformed averages

3.2 Effect on marketable yield

Harvestable yield of grapes in all the fungicide treatment ranged between 10.83 to 14.92 kg/vine. Control recorded a yield of 9.09 kg/vine (Table 3). Among the treatments, Only T₃ (14.92 Kg/vine) and T₄ (13.13 Kg/vine) recorded significantly higher yield over untreated control (Table 3).


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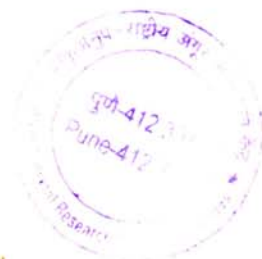


Table 3. Harvestable yield of ProPhite (potassium salt of active phosphorus)

Treatments		Dose/ha	Yield/vine (kg)
		Formulation (ml or g/L)	
T ₁	Cymoxanil + mancozeb (Curzate)	2.0	11.68
T ₂	ProPhite (potassium salt of active phosphorus)	4.0	12.83
T ₃	ProPhite followed by Curzate (4 applications) followed by successive applications of ProPhite	4.0 + 2.0	14.92
T ₄	ProPhite followed by Curzate (2 applications) followed by successive applications of ProPhite	4.0 + 2.0	13.13
T ₅	Potassium phosphite (Fosphonic)	3.0	10.83
T ₆	Potassium phosphite (Fosphonic) followed by Curzate (4 applications)	3.0 + 2.0	12.13
T ₇	Potassium phosphite (Fosphonic) followed by Curzate (2 applications)	3.0 + 2.0	11.57
T ₈	Control	-	9.09
CD ($p = 0.05$)		-	3.96

3.3. Observations on phytotoxicity

No phytotoxicity symptoms were developed on leaves up to 10 days of spray in any treatment (Table 4), indicating that ProPhite (potassium salt of active phosphorus) is not phytotoxic to grapes up to the dose of 8.0 g/L water.


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Table 4. Evaluation of the phytotoxicity of ProPhite (potassium salt of active phosphorus) on vines during Grape Season, 2017-18

Tr. no	Treatments	Dose (g/ha)	Phyto-toxicity scale at different observation days on leaves																	
			Leaf chlorosis						Tip burning						Necrosis					
			0	1	3	5	7	10	0	1	3	5	7	10	0	1	3	5	7	10
T ₁	ProPhite	4.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T ₂	ProPhite	8.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T ₃	Control	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Tr. no.	Treatments	Dose (g/ha)	Phyto-toxicity scale at different observation days on leaves																	
			Vein clearing						Epinasty						Hyponasty					
			0	1	3	5	7	10	0	1	3	5	7	10	0	1	3	5	7	10
T ₁	ProPhite	4.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T ₂	ProPhite	8.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T ₃	Control	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Tr. no.	Treatments	Dose (g/ha)	Phyto-toxicity scale at different observation days on bunches											
			Necrosis						Russeting					
			0	1	3	5	7	10	0	1	3	5	7	10
T ₁	ProPhite	4.0	0	0	0	0	0	0	0	0	0	0	0	0
T ₂	ProPhite	8.0	0	0	0	0	0	0	0	0	0	0	0	0
T ₃	Control	-	0	0	0	0	0	0	0	0	0	0	0	0

Note : Observations were recorded at 1, 3, 5, 7 & 10 days after the spray of ProPhite (potassium salt of active phosphorus)

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5. Conclusion

- ProPhite @ 4 g/L followed by Curzate (4 applications) @ 2 g/L followed by successive applications of ProPhite @ 4 g/L water (T₃) and ProPhite @ 4 g/L followed by Curzate (2 applications) @ 2 g/L followed by successive applications of ProPhite @ 4.0 g /L water (T₄) as foliar spray showed effective control of downy mildew on leaves over untreated control and check fungicide treatments, and also showed increase in yield over control.
- ProPhite upto dose 8.0 g or ml/L water did not show any phytotoxicity symptoms on leaves and bunches.

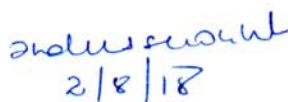


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Annexure – I

Weather Data- September 2017 to January 2018

Location: Tasgaon, Sangli

Standard Meteorological Week No.	Air Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
	Max.	Min	Max	Min	
36	30.07	21.00	98.00	49.00	6.00
37	31.84	23.07	97.00	49.00	8.35
38	27.77	21.12	97.00	64.00	7.47
39	32.08	20.27	97.00	41.00	6.33
40	32.93	22.43	98.00	35.00	6.77
41	30.73	21.84	97.00	51.00	7.48
42	31.94	20.08	97.00	25.00	4.18
43	31.78	20.46	97.00	27.00	0.82
44	30.40	18.68	69.00	24.00	0.00
45	31.54	18.57	78.00	27.00	0.00
46	30.28	16.67	74.00	20.00	0.00
47	31.11	19.54	78.00	32.00	1.15
48	31.06	18.03	62.00	21.00	0.00
49	29.85	18.18	96.00	32.00	0.00
50	30.50	17.95	86.00	29.00	0.00
51	30.29	13.56	75.00	15.00	0.00
52	30.85	13.46	54.00	16.00	0.00
1	29.77	13.75	64.00	21.00	0.00
2	30.85	14.48	68.00	23.00	0.00
3	32.98	17.03	52.00	21.00	0.00
4	30.39	14.24	84.00	12.00	0.00

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