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MANAGEMENT OF POWDERY MILDEW IN GRAPE

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Abstract

A field experiment was conducted for two years on grape variety Thomson seedless during 2008-09 and 2009-10 to evaluate the bio-efficacy of 8 fungicides and combination of fungicides with potassium bi-carbonate along with control against powdery mildew in grape and also analyzed the terminal fungicidal residues in grape produce. The results revealed that spraying of Fusilazole 40EC @0.125ml/l at 40 days after forward pruning followed by– Penconazole10EC @ 0.5ml/l + Potassium bicarbonate @ g/l at 60 days AFPR – Triademefon 25WP @ 1g/l at 70 days AFPR - Hexaconazole 5EC @ 1ml/l + Potassium bicarbonate @ 5g/l at 80 days AFPR – Myclobutanil 10WP @0.4g/l at 90 days AFPR – Azoxystrobin 23SC @ 0.5ml/l at 105 & 120 days AFPR (or) Fusilazole40 EC @0.125 ml/l at 40 days after forward pruning followed by Penconazole 10 EC @ 0.5 ml/l + Potassium bicarbonate @ 5 g/l at 60 days after forward pruning followed by Triademefon 25WP @1.0 g/l at 70 days after forward pruning followed by Hexaconazole 5 EC @ 1.0 ml/l + Potassium bicarbonate @ 5 g/l at 80 days after forward pruning followed by Myclobutanil 10WP @ 0.4 g/L at 90 days after forward pruning+ Pyraclostrobin 20%WG @0.5g/l at 105 & 120 days AFPR were found to be significantly on par with each other in reduction of PDI on leaves, berries and enhanced marketable yield per vine (Kg) over other six spray schedules and control. Studies on terminal fungicidal residues in grape produce revealed that all treatments were below MRL or below damage level (BDL).

Key words : Grape, powdery mildew, Fusilazole Penconazole, potassium bicarbonate, MRL (minimum residue level).

Introduction

Powdery mildew in grape is caused by *Uncinula necator*, which is the most wide spread and destructive diseases of grapevine. This is found in most of the grape-growing areas of the world, including tropics even though several fungicides are known to control this disease effectively (Kapoor, 1967). This disease is observed on all green parts of vine. Mildew colonies are usually found on either both lower surface of exposed leaves or both sides of well shaded leaves. Levels of photosynthesis and transpiration of infected leaves will be reduced. In the powdery mildew affected leaves due to reduction in the photosynthetic area, the chlorophyll content is reduced which leads to low activity of chloroplasts and low efficiency of carbon dioxide fixation (Dillion *et al*., 1992). Infected berries develop web like blemishes and eventually covered with powdery growth. Severely infected berries are scarred, disturbed and often split. Berries are susceptible to infection until sugar content reaches about 8% although established infection continue to produce spores until the berries contain 15% sugar (Delp, 1954). The maturity of severely infected bunches is retarded (Emmett *et al*., 1992). Grape berries are most susceptible to powdery mildew during the period from flowering to fruit set, and failure to control the disease during this period can result in serious crop loss.

Application of either wettable sulphur @ 3g/l followed by various combinations of penconazole (0.125 ml/l) azoxystobin (0.5 g/l) trifloxystrobin @ 0.15g/l) applied in 2 or 3 consecutive sprays around flowering was more effective in controlling powdery mildew and limiting the Strobilurins to 2 applications per season may be an appropriate disease management strategy to avoid the development of resistant strains of the fungus to strobulirins (Wicks and Hitch, 2002). Spraying of Azoxystrobin and Trifloxystrobin from Prebloom to three weeks post bloom stage were more effective in control of powdery mildew (Margal *et al*., 1998). Half dose of Potassium bicarbonate (5g/l) in combination with Hexaconazole (0.5ml/l) showed better control the powder mildew disease than Myclobutanil, Fusilazole and

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Peconazole without combination of Potassium bicarbonate. Potassium bicarbonate was also found compatible with Myclobutanil, Fusilazole and Penconazole and hence can be used in combination with these fungicides also to manage powdery mildew (Adsule *et al*., 2008). Hexaconazole 5EC @ 1ml/l found to be superior over other systemic and non-systemic fungicides used in control of powdery mildew disease (Narayana *et al*., 2005). Penconazole 10EC @ 1ml/l was most effective to control the powdery mildew disease up to 88.48% (Thind *et al*., 2010).

The availability of "Premix" or combination of fungicide formulations is a relatively recent trend in agriculture. The "Premix" types of products can provide better disease control, provide disease control security if there is field resistance to one of the two active ingredients, and help prevent resistance if there is not. The resistance risk of strobulirins is high while the risk of other important classes (DMI, quinolones, and benzophenones) is considered medium. The resistance risk of contact fungicides, narrow range petroleum oils, and potassium carbonate is low (Grove and Nelson, 2011).

Materials and Methods

This experiment was conducted on grape on variety Thompson seedless during 2008-09 & 2009-10 at Grape Research Station, Rajendranagar with 8 fungicidal treatments and control under Randomized Block Design with 3 replications and the experiment was conducted on variety Thompson seedless after forward pruning during October 2008 to March 2009 and October 2009 to March 2010 and the age of crop is 10th and 11th year, respectively.

The treatments were imposed as per details of spray schedules given below:

Treatments adopted	**8+1**
T_1	Fusilazole40 EC @0.125 ml/l at 40 days after forward pruning followed by Penconazole 10 EC @ 0.5 ml/l + Potassium bicarbonate @ 5 g/ l at 60 days after forward pruning followed by Triademefon 25WP @1.0 g/l at 70 days after forward pruning followed by Hexaconazole 5 EC @ 1.0 ml/l + Potassium bicarbonate @ 5 g/ l at 80 days after forward pruning followed by Myclobutanil 10WP @ 0.4 g/L at 90 days after forward pruning.
T_2	T_1 + Azoxystrobin 23SC @ 0.5 ml/l at 105 days after forward pruning.
T_3	T_1 + T_2 + Azoxystrobin 23SC @ 0.5 ml/l at 120 days after forward pruning.
T_4	T_1 + Pyraclostrobin 20% WG @0.5 g/l at 105 days after forward pruning.
T_5	T_1 + T_4 + Pyraclostrobin 20% WG @ 0.5 g/l at 120 days after forward pruning.
T_6	T_1 + Wettable sulphur 80WDG @ 3.15 g/l at 105 days after forward pruning.
T_7	T_1 + T_6 + Wettable sulphur 80WDG @ 3.15 g/l at 120 days after forward pruning.
T_8	T_1 + Water spray at 105 days and 120 days after forward pruning.
T_9	No spray

Observations recorded

Observations were recorded 10 days after last spray by randomly selecting 30 leaves and bunches per replication adopting 0-4 scale and where

0	no diseases present
1	15-25% leaf area and berries infected
2	26%-50% leaf area and berries infested
3	51%-75% leaf area and berries infected
4	more than 75% leaf area and berries infected

(Horsfall and Heuberger, 1942). Per Cent Index (PDI) is calculated by following formulae (MicKinney, 1923).

$$PDI = \frac{\text{Sun of numerical ratings}}{\text{Number of leaves/bunches observed} \times \text{Maximum rating}} \times 100$$

A. Marketable yield recorded separately after removal of infected berries at the time of harvest.

B. Residue analysis was conducted at Residue lab, NRCG, Pune for residue analysis.

Results and Discussion

Experiment details indicated that all treatments were found significantly superior over control for PDI on leaves, berries and enhanced marketable yield/vine. Among the treatments Fusilazole40 EC @0.125 ml/l at 40 days after forward pruning followed by Penconazole 10 EC @ 0.5 ml/l + Potassium bicarbonate @ 5 g/l at 60 days after forward pruning followed by Triademefon 25WP @1.0 g/l at 70 days after forward pruning followed by Hexaconazole 5 EC @ 1.0 ml/l + Potassium bicarbonate @ 5 g/l at 80 days after forward pruning followed by Myclobutanil 10WP @ 0.4 g/L at 90 days after forward pruning followed by Azoxystrobin 23SC @ 0.5 ml/l at 105 days and 120 days after forward pruning. T_3 and

Table 1 : Management of powdery mildew in grapes during 2008-09 & 2009-10 at GRS, Rajendranagar, Hyderabad.

Treatments	Powdery mildew PDI & Marketable Yield/vine (Kg) 2008-09			Powdery mildew PDI & Marketable Yield/vine (Kg) 09-10			Pooled analysis of 2008-09 & 2009-10		
	Leaves	Bunches	Marketable yield/vine (Kg)	Leaves	Bunches	Marketable yield/vine (Kg)	Leaves	Bunches	Marketable yield/vine (Kg)
T_1	14.99f(22.76)	03.61c(10.94)	9.835c	21.66f(27.72)	6.66e(14.82)	9.570	18.33(25.24)	05.13c(12.93)	09.70c
T_2	07.77c(16.16)	02.22b(8.53)	10.67b	9.44b(17.87)	2.49b(9.00)	11.09b	8.60(17.02)	02.35b(8.77)	10.86b
T_3	**04.99a(12.79)**	**01.38a(6.67)**	**11.55a**	**6.66a(14.88)**	**1.66a(7.24)**	**11.99a**	**05.83(13.85)**	**01.52a(7.04)**	**11.77a**
T_4	08.33c(16.77)	02.49b(9.00)	10.52b	10.55b(18.90)	3.33b(10.45)	11.06b	09.43(17.83)	02.91b(9.73)	10.79b
T_5	**05.55a(13.59)**	**01.66a(7.40)**	**11.09a**	**7.22a(15.43)**	**1.94a**(7.96)	**11.73a**	**06.38(14.51)**	**01.80a(7.68)**	**11.41a**
T_6	8.88d(17.32)	2.77b(9.57)	10.32b	16.66d(24.08)	4.72c(12.51)	10.10b	12.77(20.70)	03.74b(11.05)	10.20b
T_7	6.11b(14.27)	1.94a(7.98)	10.89a	12.77c(20.93)	3.88c(11.33)	10.46a	09.43(17.60)	2.91b(9.66)	10.57b
T_8	12.77e(20.93)	3.33c(10.51)	10.01b	19.99e(26.55)	5.83d(13.95)	9.76c	16.38(23.74)	04.58c(12.57)	09.92c
T_9	58.88g(50.12)	24.72d(30.03)	6.87d	66.11g(54.38)	26.66f(31.22)	6.58d	62.49(52.25)	25.85d(30.55)	06.82d
	1.28	**0.88**	**0.74**	**2.78**	**1.75**	**0.47**	**1.74**	**1.35**	**0.46**
	3.6	**10.4**	**4.17**	**6.6**	**11.6**	**3.64**	**4.05**	**9.37**	**3.87**

(Figures in parenthesis are transformed values).

Fusilazole 40 EC @ 0.125 ml/l at 40 days after forward pruning followed by Penconazole 10 EC @ 0.5 ml/l + Potassium bicarbonate @ 5 g/l at 60 days after forward pruning followed by Triademefon 25WP @ 1.0 g/l at 70 days after forward pruning followed by Hexaconazole 5 EC @ 1.0 ml/l + Potassium bicarbonate @ 5 g/l at 80 days after forward pruning followed by Myclobutanil 10WP @ 0.4 g/L at 90 days after forward pruning followed by Pyraclostrobin 20% WG @0.5 g/l at 105 days and 120 days after forward pruning (T5) were on par with each other in reduction of PDI on leaves and berries and enhanced marketable yield/vine in Kg during both the years (table 1).

The results were in conformity with Adsule *et al.* (2008), who reported that half dose of potassium bi-carbonate (5g/L) in combination with hexaconazole (0.5ml/L) showed better control of the powdery mildew disease than myclobutanil, fusilazole and penconazole without combination of potassium bi-carbonate. Potassium bi-carbonate was also found effective with myclobutanil, fusilazole and penconazole and hence can be used in combination with these fungicides also to manage powdery mildew in grape. The results were inconformity with (Wicks and Hitch, 2002), who reported that limiting the Strobilurins to two applications per season may be an appropriate disease management strategy. Resistance risk is very low.

Accordingly in the present findings strobulrins only one or two sprays twice in a season and contact fungicide only two times in a season are included in the experiment in this trial. Similar observations revealed by Grove and Nelson (2011) revealed that the resistance risk of Strobulirins is high while the risk of other important classes (DMI, Quinolones, and Benzophenones) is considered medium and resistance risk of contact fungicides, narrow range petroleum oils and potassium carbonate is low.

The grape produce from all the treatments were free from terminal fungicides residues used for the study. In view of human health the above mentioned treatment schedules for the management of powdery mildew disease in grape were recommended for the management of powdery mildew disease in grape as the produce of grape below MRL and BDL (table 2).

Table 2 : Terminal residues of the fungicides for the management of powdery mildew during 105 days before harvest.

Residue in mg/kg						
Treat	**Azoxystrobin**	**Pyraclostrobin**	**Fusilazole**	**Penconazole**	**Hexaconazole**	**Myclobutanil**
MRL	2.0	1.0	0.05	0.2	0.1	1.0
T_1	—	—	BDL	BDL	BDL	BDL
T_2	0.061-0.233	—	BDL	BDL	BDL	BDL
T_3	0.090-0.145	—	BDL	BDL	BDL	BDL
T_4	—	0.083-0.113	BDL	BDL	BDL	BDL
T_5	—	0.063-0.114	BDL	BDL	BDL	BDL
T_6	—	—	BDL	BDL	BDL	BDL
T_7	—	—	BDL	BDL	BDL	BDL
T_8	—	—	BDL	BDL	BDL	BDL

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