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INFLUENCE OF CANOPY MANAGEMENT PRACTICES TO REDUCE THE SEVERITY OF ANTHRACNOSE DISEASE OF GRAPES

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ABSTRACT

Anthracnose caused by *Elsinoe ampelina*(de Bary) shear is one of the important foliar diseases of grapes (*vitis vinefera* L.) in India. Gupta *et al*. (1981) recorded 50% yield losses in grapes due to infection of anthracnose disease in all aerial parts including inflorescence and berries. In West Bengal susceptible cultivars *i.e.* Pusa Seedless is usually infected due to its dense canopy and light berry cluster in every cropping season. The field experiment was conducted during 2011 and 2012 to manage the Anthracnose disease through integration of canopy management practices with fungicidal spray for minimizing the yield losses and also to detect the influence of lateral shoots on fruit yield. A susceptible cultivar *i.e.* Pusa Seedless was selected in a 6 years old vineyard at Birbhum, West Bengal. Under canopy management practices, treatments consisted of leaf removal, shoot removal and control. Leaf removal showed significant reduction in disease incidence (13.5%) and severity (1.9%) than control. Similarly shoot removal not only showed significant increase in lateral shoot development but also reduced the incidence (20.85%) and severity (8.9%). Yield components *i.e.* berry weight (g), number of berries/cluster, cluster weight (g) and fruit yield (Kg/vine) showed significant increase due to canopy management. The berry weight was significantly enhanced due to leaf removal (97.5 g) and shoot removal (96.0 g). Canopy exposure also increased the cluster weight (215.4 g and 226.0 g) as a result of leaf removal and shoot removal respectively. Total fruit yield was also enhanced in leaf removal (7.9 Kg/vine) and shoot removal (8.25 Kg/vine) over control (5.5 Kg/vine).The canopy management practices also increased the lateral leaf area (%) resulting better fruit yield. Even, when canopy exposure practices was combined with fungicidal spray as an integrated approach, significant results were obtained as compared to the sole use of canopy exposure practices. Hence, it may be stated that, integrated use of canopy management practices with fungicidal spray reduces the anthracnose disease as well as increases the fruit yield.

INTRODUCTION

Grape cultivation in one of the most remunerative farming enterprises in India. Grape (*Vitis vinifera* L.) is grown under a variety of soil and weather condition in different agro climatic zones namely, subtropical, hot tropical and mild tropical regions in India (Shikhamani, 2012). The cultivated area under grape increased from 79.5, 000 ha (2008-09) to 111.4, 000 ha (2010-11). On the other hand, the total production of grape decreased from 1878.3, 000 MT (2008-09) to 1234.9, 000 MT (2010-11). Similarly, productivity also declined from 23.6 t/ha (2008-09) to 11.1 t/ha (2010-11) (Statistical year Book, 2012). The important reasons behind the downfall of production and productivity may be due to lack of adoption of canopy management technology and outbreak of pest and diseases. Gupta *et al*. (1981) recorded 50% yield losses due to severe infestation of anthracnose disease in aerial plant parts including inflorescence and berries. The anthracnose of grape nowadays has become one of the major

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Constraints in West Bengal. The susceptible cultivar Pusa Seedless having dense canopy and light berry cluster is frequently infested by the pathogen *i.e. Elsinoe ampeline* (de Bary) shear causing anthracnose of grape. The anthracnose became severe during spring and summer seasons with mild rain in almost all the grape growing areas of India (Jamadar, 2007). Epidemiological conditions *i.e.* temperature (25-26ºC), relative humidity (68%), rainfall (2mm/day) and leaf wetness period of 3 hours are essential for successful development of Anthracnose disease of grape (Nargund *et al*.,- 2007). Canopy management includes a range of techniques which can be applied to vineyard to alter the position or amount of leaves, shoot and fruit in space and so as to achieve some desired canopy microclimate for reduction of disease pressure (Smart, 1985). According to Smart et al (1990) sparse and open canopy maximizes exposure of foliage to sunlight, facilitates air movement, reduces humidity and inhibits fungal infections, permits greater pesticide penetration resulting good quality yield. Gubler and Marois (1987) reported that, integration of fungicide application with canopy management gave adequate protection against *Botrytis cinerea* during severe disease pressure. The grape growers usually do not follow scientific approaches of canopy manipulation techniques but apply excessive chemicals to control the disease. As a result, environmental pollution takes place with lower quality fruit yield. Therefore, the objective of this present study was to reduce the injudicious use of chemicals through adoption of canopy management practices along with fungicidal application for effective management of anthracnose disease as well as increase of fruit yield.

MATERIALS AND METHODS

The field trials were conducted during 2011 and 2012 cropping seasons in a vineyard of 6 yrs old established in Birbhum, West Bengal. The susceptible cultivar used for the trial was Pusa seedless. Vines on this site were moderately vigor, trained in/trellis, planted on a spacing of 3m x 3m designed with RBD having four replicates. Number of plants/ treatment was 5 and row to row orientation was in north-south direction. There were shoot removal, leaf removal and control treatment.

Shoot removal

Shoots were removed during 4th week of January during every cropping season to facilitate the bud break in the spring. Besides, pruning of nonfruiting shoots was done at the base of the spurs or cane. Weaker primary shoots and secondary shoots grown from a count bud were also removed early in the season. Suckers arising from the base of the trunk were removed to avoid the crowding of canopy. Shoot thinning was done to maintain canopy width 30-40 cm and 10-15 nodes/shoot. 3 inches spacing between shoots was rigidly maintained. Shoot thinning was also done after bud break and before shoots attained more than 18 to 24 inches long. Lateral shoot development was encouraged in this moderately vigor vine to compensate the total leaf area.

Leaf removal

It was done at pre bloom, bloom, fruit set, pea size and bunch close stage simply by hand pulling resulting window of exposed cluster. Leaves located opposite one node above and one node below each flower cluster was removed at bloom stage.

Fungicidal use

For combined application of fungicide and canopy management practices, the copper fungicide *i.e.,* Blitox 50WP was used. Sprayed and unsprayed plots were separately maintained for all the treatments.

Disease scoring methods

Grape leaves and shoots having typical symptoms of anthracnose collected from the grape vineyard. The severity of anthracnose of grape was recorded by following 0-9 scale of visual rating (Mayee and Datar, 1986) Percent disease intensity reaction was classified as 0 = no disease or immune, 1 = 1 to 5% infection, 3 = 6-10%.

Table 1: Effect of Canopy management on severity of Anthracnose disease and yield of Grapes.

Treatment(Year of trial)	Incidence (%)	Severity (% disease cluster)	Number of Berries/Cluster	Berry weight (g)	Cluster weight (g)	Yield (kg/vine)
Leaf removal(2011)	2.5	0.6	98	1.5	260.5	8.2
Leaf removal(2012)	24.5	3.2	95	1.3	220.3	7.6
Mean	13.5	1.9	97.5	1.4	215.4	7.9
Shoot removal(2011)	8.1	1.82	100	1.25	235.2	9.5
Shoot removal(2012)	30.6	16.0	92	1.40	218.0	7.0
Mean	20.85	8.91	96	1.32	226.0	8.25
Control(2011)	15.2	8.6	75	1.8	115.5	6.0
Control(2012)	40.2	25.4	60	1.7	102.7	5.0
Mean	27.7	17.0	67.5	0.75	109.5	5.5
C.D (p=0.05)	4.03	2.82	0.72	0.63	5.28	1.37

Table 2: Weather data during the progress of Anthracnose Disease on Grapes

Weather Parameters	Temperature (ºC)		Relative Humidity (%)	Rainfall (mm)	Sunshine (Hours/Day)	Wind Speed (Km/hr)	Disease Severity (%)
Months	Min.	Max.					
January	12	26	68	19	10	3	-
February	16	29	65	41	11	3	4.5
March	21	33	65	38	11	4	16.2
April	24	36	68	50	11	7	25.0
May	25	36	72	133	11	8	25.4

Table 3: Influence of canopy manipulation on canopy architecture

Treatment		Main leaf area/vine(m^2)	LateralLeafarea /vine(m^2)	Total leaf area /vine(m^2)	Lateral leafarea %of total	Leaf : Fruit Ratiocm^2/g fruit
Leaf Removal	No	3.8	2.2	6.0	33.0	14
	Yes	2.7	1.6	4.3	37.2	10
Shoot Removal	No	5.2	2.3	7.5	30.6	15
	Yes	2.5	1.6	4.1	39.0	11
Laterals	Absent	4.0	-	4.0	-	9
	Present	2.4	1.8	4.3	41.0	15
CD (P = 0.05)		0.46	0.25	0.60	-	0.82

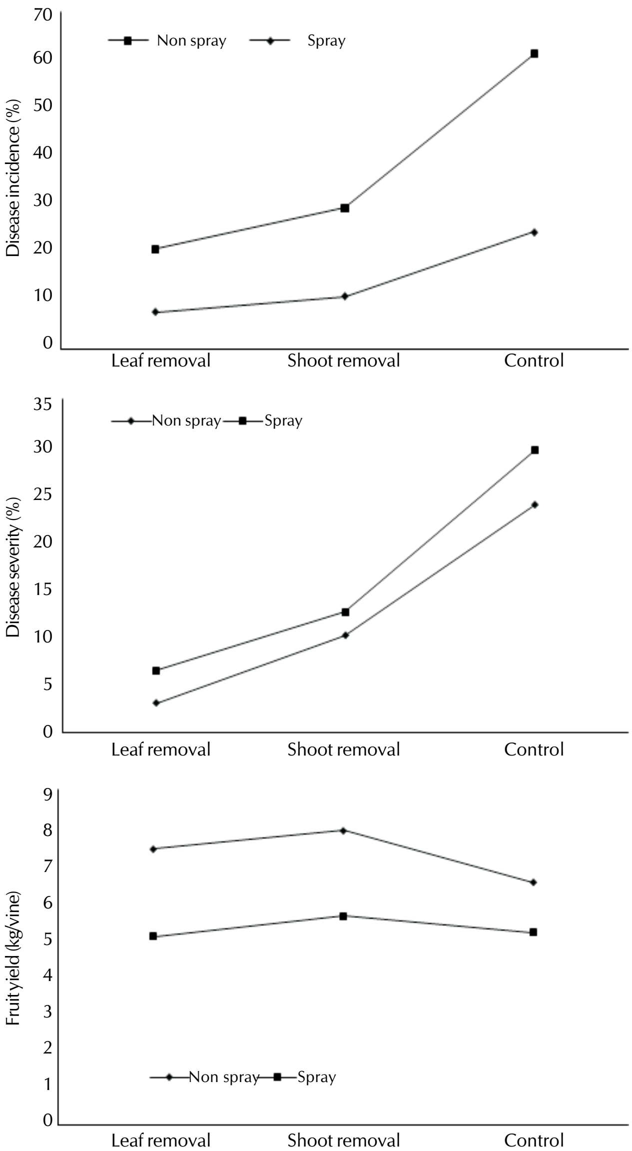

Figure 1: Influence of canopy management practices and fungicides application on disease development and yield of grapes

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Infection, 5 = 11-25% infection, 7 = 26-50% infection, 9 = >50% infection. Percent disease index (PDI) was calculated by using following formula of Jindal and Bhavani Shankar (2002)

$$\text{Percent Disease Index} = \frac{\text{Sum of individial ratings}}{\text{No. of leaves examind X Maximum disease sclale}} \text{ X } 100$$

Weather data [daily max and min. temperature (°C), max and min RH (%) and rainfall (mm)] were collected from the weather station situated at Birbhum, West Bengal. Under disease profile study, incidence (%) and severity (%) were recorded. Number of berries/cluster, Berry weight (g), cluster weight (g) and fruit yield (kg/vine) were recorded in terms of yield. Under canopy architecture study, the data on main leaf area (m^2/vine), lateral leaf area (m^2/vine), lateral leaf area (%), total leaf area (m^2/vine) and leaf: fruit ratio (cm^2/g fruit) were also recorded at active vegetative growth stage. Statistical analysis was done according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Results from the Table 1 clearly reveal that during adoption of canopy management practices incidence and severity of anthracnose disease was remarkably reduced over control. The reduction of disease due to leaf removal (2.5%) and shoot removal (8.1%) was significantly noticed than control (15.2%) during 2011. The suppression of disease due to leaf removal (24.5%) and shoot removal (30.6%) was also observed during 2012 as compared to control (40.2%). On the other hand, reduction of disease severity was also significantly recorded due to leaf removal (0.6%) and shoot removal (1.82%) over control (8.6%) during 2011. Again during 2012, the decrease of disease severity due to leaf removal (3.2%) and shoot removal (16.0%) was significantly noticed over control (25.4%).Under yield component study, number of berries was significantly increased due to leaf removal (95 to 98) and shoot removal (92 to 100) over control (67.5). Berry weight on the other hand was significantly increased due to leaf removal (1.4g) and shoot removal (1.32g) than control (0.75g). Similarly, the cluster weight showed significant increase in leaf removal (215.4 g) and shoot removal (226.0g) over control (109.5g). Finally, the fruit yield was significantly increased in leaf removal (7.9kg/vine) and shoot removal (8.25 kg/vine) as compared to control (5.5 kg/vine). The present results have also similarity with previous workers. English *et al.* (1993) also noticed that leaf and shoot removal gave increased fruit yield and reduced disease.

The weather data (Table 2) shows that during January and February months immediately after pruning the weather was not so conducive for disease development. Since March, gradually the temp (°C), relative humidity (%) and rainfall (mm) became favorable for progress of the disease. It was significantly noticed that in later part of growing period due to prevalence of favorable temp (25-26°C), RH (68% and above) and rainfall (2 mm/day) there was rapid progress of the disease. The similar observation was also recorded earlier by Nargund *et al.,* 2007.

Fig. 1 reveals that, combined application of canopy management practices and fungicide use had greater impact on disease suppression as well as yield increase than sole use of canopy management practices. The results reveal that disease incidence (%) was significantly reduced in sprayed plots of leaf removal (7.8%) and shoot removal (11.05%) over control (24.4%). The unsprayed plots showed higher level of disease incidence in case

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Of all the treatments. Disease severity (%) significantly declined in sprayed plots of leaf removal (3.1%) and shoot removal (10.2%) than control (23.9%). The unsprayed plots exhibited higher level of disease severity in all the treatments. The fruit yield (kg/vine) became significantly enhanced in sprayed plot of leaf removal (7.4 kg/vine) and shoot removal (7.9 kg/vine) than control (6.5 kg/vine). The unsprayed plots showed significantly lower fruit yield in all the tested treatments. The present finding has also made conformity with earlier workers. Gubler and Marois (1987) also found that, fungicides alone did not provide adequate protection against *B cinerea* during severe disease pressure. Travis (1987) also observed that improved spray penetration became possible due to selective leaf and shoots removal resulting disease control and increased fruit yield. Hence, in the present study, integration of cultural practices *i.e.,* leaf removal and shoot removal with the fungicide use resulted significant disease suppression.

Results from Table 3 clearly shows that manipulation of canopy has direct influence on canopy architecture in case of grape crop resulting greater effect on main leaf area (m^2), lateral leaf area (%) and leaf : fruit ratio (cm^2/g of fruit).The significant responses were recorded in all the tested treatments of leaf removal, shoot removal and laterals. In the initial stage, due to adoption of canopy manipulation techniques, the main leaf area (m^2) became significantly reduced in leaf removal (2.7m^2) and shoot removal (2.5m^2). As a result, the lateral leaf area also became significantly reduced in leaf removal (1.6m^2) and shoot removal (1.6m^2). Therefore, the total leaf area was significantly reduced in leaf removal (4.3m^2) and shoot removal (4.1m^2) over control resulting considerable increase of lateral leaf area (%) in case of leaf removal (37.2%) and shoot removal (39.0%) over control. Though due to absence of laterals, there was significant increase in main leaf area (4.0m^2) as well as total leaf area (4.0m^2) but, reduction in leaf: fruit ratio (9.0 cm^2/ g of fruit) was also noticed. Due to presence of laterals, main leaf area (2.4m^2) was reduced but total leaf area (4.3 m^2) was significantly increased due to simultaneous development of lateral leaf area (1.8m^2) resulting increased lateral leaf area (%) *i.e.* 41.0 % and leaf: fruit ratio (15 cm^2/g of fruit). The present observations has also made conformity with earlier workers. Condolfi *et al*. (1990) observed that, canopies composed of lateral leaves generated fruit with soluble solids and skin anthocyanin content as compared to non control. He also reported that, leaves being youngest in the lateral shoot of the canopy could play a vital role in metabolic processes during ripening. Candolfi *et al.,* 1994 also reported that, in the very beginning, alteration of canopy architecture resulted sizable reduction in total leaf area in case of leaf and shoot removal in moderate vigor vineyard. The presence of lateral shoot produced more young leaves, resulting more lateral leaf area contributing sugar and starch accumulation towards fruit ripening and qualitative fruit yield. Therefore, lower leaf: fruit ratio in leaf removal (10 cm^2/g) and shoot removal (11cm^2/g) treatment might result good quality fruit yield. Hence, it may be concluded from this present study that, canopy exposure through selective leaf and shoot removal may be combined with fungicidal spray to reduce the disease pressure due to Anthracnose and also to increase the fruit yield. In moderately vigor vineyard of any susceptible grape cultivar, lateral shoot growth may be encouraged for obtaining more lateral leaf area resulting quantitative and qualitative fruit yield.

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