Project No. 7

Weather-Pest-disease- relations in Grape:

Powdery mildew, Downy Mildew and Anthracnose

Background:

Farmers take up pruning of grapes, starting from mid September to late November. Observations on the incidence of powdery mildew, downy mildew and anthracnose diseases of grapes variety Thompson seedless were made on farmers' fields of neighboring villages, at 15 days after pruning for three years 1997, 1998 and 1999. It is also known that, the crop faces different diseases if sown on different dates. Looking to the climatology of Bijapur, the pruning periods were categorized as: Early pruned cases: Mid-September to October-end, and late pruned: Mid-October to November-end. The early pruning is during the rainy period and the late pruning is after cessation of rainfall. The analysis was accordingly performed.

Objectives:

1. Association of weather variables with powdery mildew, downy mildew and anthracnose incidence in grape
2. Development of weather based forecast models for these diseases in grape

Results:

1999

Correlation analysis between powdery mildew disease incidence at 15 days after pruning and antecedent weather is presented in Table 7.1. The associations hold good for the indicated pruning periods, and within the given limits of the variables.

Table 7.1 Correlation analysis between powdery mildew and meteorological variable

Parameter	Lead time in weeks	Correlation coefficient	Sensitive pruning period(s)	Limits of weather variable
Rainfall	4	0.64	All	0-110.1mm
		0.90	N1 TO N2	
Mean temperature	1	0.66	O2 to N2	22.9-26.7 C
Afternoon R.H.	1	0.74	S2 to O2	43-61 %
		0.82	S2 to O1	
RH range	1	-0.83	S2 to O2	24-36 %
		-0.87	S2 to O1	

Where S2= Second Fortnight of September

O1=First fortnight of October O2= Second Fortnight of October

N1=First fortnight of November N2= Second Fortnight of November

Powdery mildew:

- The powdery mildew disease is affected by both hygric and thermal factors variously at different lead times. Afternoon relative humidity and relative humidity range at one week lead time were seen to be the important variables for early pruned crop, while rainfall at four weeks lead time and mean temperature are important for delayed pruned crop,

Downy mildew:

- Maximum temperature and mean temperature influenced the downy mildew disease incidence in late pruned vines at two and three weeks' lead time.
- Minimum temperature.
- In early pruned cases the Temperature range influenced the disease positively at one week lead time and negarively at four weeks lead time, whereas minimum temperature at all lead times up to one month.
- Higher values of morning humidity, mean humidity and relative humidity range reduced the disease incidence.

Anthracnose:

- The meteorological variables showed significant influence on anthracnose disease, particularly when the pruning is performed between second fortnight of September and second fortnight of October.

2000

Based on the correlation results of 1999, multiple regression models were developed for forecast of the various diseases of grape.

The models are presented in Table 7.2. One model for early pruned, two for late pruned conditions, and one for all pruning situations were developed for powdery mildew disease. On the other hand, two models each for early pruned conditions, and one each for late and all pruning conditions were developed for downy mildew and anthracnose diseases. The models developed considering all pruning conditions have poor R^2 values, thereby **vindicating the proposals of this Scientist** that forecast models should be developed separately for various pruning conditions in view of the diverse prevailing and antecedent meteorological situations.

Table 7.2 Multiple regression models for forecast of grape diseases

Disease	Pruning time	Model developed	R^2
Powdery Mildew	S2-O2	DI= 64.85 – 1.83 RHR(1)	0.70
	N1-N2	DI= 4.36 + 0.33 RF(4)	0.80
	N1-N2	DI= - 186.7 + 6.41 TX(2) + 0.30 RF(4)	0.97
	S2-N2	DI= 2.48 + 0.21 RF(4)	0.43
Downy Mildew	S2-O2	DI= 74.26 – 1.51 RHR(4)	0.57
	S2-O2	DI= 32.15 + 3.82 TR(2) – 1.25 RHR(4)	0.67
	N1-N2	DI= - 325.6 + 11.25 TX(3)	0.76
	S2-N2	DI= - 213.6 + 10.89 TN(3)	0.67
Anthracnose	S2-O2	DI= 299.5 -12.91 TN(5)	0.82
	S2-O2	DI= 188.4 – 9.98 TN(5) + 1.53 RHR(3)	0.91
	N1-N2	DI= - 142.6 + 7380 TN(5)	0.65
	S2-N2	DI= -48.43 + 2.32 RHR(3)	0.34

Where

DI= Disease incidence	S2= Second Fortnight of September
O1=First fortnight of October	O2= Second Fortnight of October
N1=First fortnight of November	N2= Second Fortnight of November
RF= Rainfall (mm)	TX= Maximum temperature (C)
TN = Minimum temperature (C)	TR= Temperature range (C)
RHR= Relative humidity range (%)	S2-O2= Early pruned conditions
N1-N2= Late pruned conditions	S2-N2= All pruning contions

Numerals in the parentheses indicate lead time in weeks

The paper presented on these aspects at the first National Seminar on Agrometeorology, at Gujarat Agricultural University Anand was acclaimed for its logical development and was awarded the Best Paper in the Pest and Disease Session.

2003

Testing of the models developed for grape diseases

The above models were tested during the year 2003. For grape vines to be pruned in October second week, and for disease incidence levels in October-end; The forecast of anthracnose is made around September 25 using minimum temperature of Week No. 38, while in case of powdery mildew the forecast is made at the end of second week of October, using the maximum temperature of Week No. 41 and rainfall of Week No. 39. The forecast based on real time weather data is given to the Plant pathologist of the Agromet Advisory team, who gave appropriate input to the agro advisory. The forecast and the actual data are presented in Table 7.3.

Table 7.3 Comparison of the Forecast and Actual Percent disease incidence at October-end during 2003

Disease	Forecast (%)	Actual (Post facto independent information from pathologist) (%)
Powdery mildew	29-32	45-50
Anthracnose	10-15	2-5

Though exact economic impact cannot be indicated, the forecasts could provide qualitative assessment like low and high. Keeping in view the above encouraging results, the AICRP on Agrometeorology awarded a full fledged research program on Weather – pest and disease relations in Grape from the year 20004, which has been taken up at the Horticultural Research Station, Bijapur.