Chapter 6

Conclusion and recommendations

Conclusion of the research work

The anthracnose causing fungal pathogen was isolate from major grape growing regions of India. On the bases of cultural, morphological and molecular these isolated pathogen was identified as *Colletotrichum gloeosporioides*. There appears to be a shift in the etiology of the grape anthracnose pathogen from *Elsinoe ampelina* to *Colletotrichum gloeosporioides*.

Find the extent of resistance to carbendazim in natural field isolates of *C. gloeosporioides*. Taking a large population study the sensitivity of *C. gloeosporioides* isolates to different group of fungicides belonging to QoI and DMI which may provide insights for better disease management, in vineyards where carbendazim resistance is seen.

Fungicides with different modes of action which would reduce the selection pressure for buildup of carbendazim resistant of the pathogen. This study brings out the importance of integrated disease management using fungicides of different modes of action.

Furthermore, use of fungicides with wide spectrum of activity in vineyards will help to minimize anthracnose specific sprays. The sensitivity evaluation of *C. gloeosporioides* to five groups of fungicides based on the dose response curves showed variable sensitivities to the different groups, especially to carbendazim, a fungicide used frequently in vineyards, indicating presence of carbendazim resistant isolates.

As we could not locate even a single vineyard with no previous history of carbendazim use, we have classified resistance with respect to the values reported in literature.

SCAR marker developed from RAPD primer can be used to unambiguously identify carbendazim highly resistant isolates of *C. gloeosporioides*. Also, these SCAR primers proved useful in discriminating carbendazim highly resistant *C. gloeosporioides* from other *C. gloeosporioides*.

The SCAR developed was used for the detection of carbendazim resistant *C. gloeosporioides* from naturally and artificially infected leaf samples of grapes. Results
can be obtained within 24 hrs, when compared with up to several days for conventional methods. The specific assays reported in this work for identification of carbendazim resistant *C. gloeosporioides* provides a simple and efficient tool for early, rapid, sensitive and accurate detection.

Three potential biocontrol strains of *Bacillus amyloliquefaciens* TS-31, TS-45 and TS-46 were used for management of carbendazim resistant *C. gloeosporioides* isolates.

These Three potential biocontrol strains TS-31, TS-45 and TS-46 showed good adaptation to environmental conditions and antagonistic effects against *C. gloeosporioides* isolates were characterized and identified as potential biocontrol agents for the control of anthracnose disease of grapevines.

These all three potential biocontrol strains TS-31, TS-45 and TS-46 exhibited the good control at the concentration $1 \times 10^6$ CFU/ml. But at the concentration $1 \times 10^4$ CFU/ml the only strain TS-45 showed better control as compared to the other strains and TS-45 also exhibited good establishment on the leaf and stem of the grapevine. So only TS-45 strain is utilized for controlling the antracnose disease in grape field.

Detached leaf bioassay, field trial, detached berry assay and fungicide sensitivity experiments indicated that the possible effectiveness of these strains in integrated disease management (IDM).
Recommendations of the research work

1. The all antracnose causing isolates recognized as *Colletotrichum gloeosporiodes*. Study on species complex of *C. gloeosporiodes* by using the different primers which are very specific to the different genes.

2. Find out the mutation in beta tubulin gene of carbendazim resistant isolates. For this study produce the own primers for beta tubulin gene from the known sequence of the *C. gloeosporiodes* or utilize the identified primers for beta tubulin gene and developed the sequence of the beta tubulin gene of resistant, moderately and sensitive isolates of the *C. gloeosporiodes*.

3. The sequences of carbendazim resistant and sensitive isolates of *C. gloeosporiodes* are deposited on the NCBI site for used as the reference sequence.

4. Take field trial on large scale for providing there capability and effectiveness of the three promising isolates of bacteria. For large scale study use only TS-45 instead of two strains TS-31 and TS-46. Utilize only one bacterial strain is TS-45 because this strain showed good control in $1 \times 10^4$ CFU/ml concentrations than the other two strains.

5. In this present research work the researcher is only focused on the grape anthracnose so biocontrol property of bacteria was only checked for anthracnose disease.

6. Check activity of these three promising bacteria against downy and powdery mildew disease because these two diseases is also very important in grapes and these three important main diseases are occur at same conditions.

7. The potential biocontrol strain TS-45 showed good results at the concentration $10^4$ CFU/ml and this bacteria is also showed good development at high temperature and pH. This strain TS-45 exhibited the most compatibility with the all different types of the fungicides.

8. The bacterial strain TS-45 showed the excellent results on the large scale field trials against the anthracnose disease and as well as exhibited the good control for also downy and powdery mildew syndrome so get formulate this TS-45 strain.

9. And also think for the making a patent of TS-45 strain.