10. Alternatively, two to three foliar sprays of *Verticillium lecanii* /*Beauveria bassiana* (2x108 cfu/mL/g) @ 5 g/L at 15 days interval in the rainy season (July-August) can be given.

AFTER FRUIT PRUNING

Steps No. 1-8 to be followed after foundation pruning should be repeated in October-November also. Step No. 7 has to be followed with preharvest interval of 60 days for imidacloprid.

9. Monitoring and destroying the mealybug colonies as and when seen on the trunk, stem, etc. from November to February.

10. Foliar spray of the following chemicals (Table 1) depending on the incidence of the mealybugs is recommended to keep the mealybug population under check.

Table 1. List of insecticides recommended to control mealybugs

Insecticide	Dose	Pre Harvest Interval
Buprofezin 25 SC	1.25 mL/L	40 days
Methomyl 40 SP	1 g/L	61 days
Dichlorvos 76 EC	2 mL/L	15 days
Azadirachtin 1%	2 mL/L	3 days
Chlorpyriphos 20 EC	2 mL/L	40 days

11. Releasing the Australian ladybird beetle (*Cryptolaemus montrouzieri*) @ 5000/ha. during mid December - first fortnight of January.

12. One or two applications of dichlorvos 76% EC (2 mL/L) from mid February to the first week of March, if necessary, depending upon the incidence of mealybugs and time of harvesting.

13. One jet spray of water can be given on the bunches if the mealybugs are still present just prior to harvest to dislodge the mealybugs.

MEALYBUG MANAGEMENT IN NURSERY

Planting material is the major source of mealybug infestation. Therefore mealybug management in the nursery is very important to prevent further spread in the main field. The above steps No. 7 and 8 or 9 can be followed to control the mealybugs in the nursery.

DO'S

1. Follow the mealybug control practices in time.
2. Control the ants associated with the mealybugs.
3. Follow the waiting period of 2-3 weeks after the last spray to release the ladybird beetle.
4. Allow 2 months for the ladybird beetle to clear the mealybugs.
5. Apply safer pesticides like dichlorvos, chlorpyriphos, fish oil rosin soap, azadirachtin, buprofezin, etc. during the activity of ladybird beetle.

DONT'S

1. Taking control measures in the advanced /late stage of berry development.
2. Application of harmful insecticides prior to and during the release of the Australian ladybird beetle.
3. Allowing the ants in the vicinity of the grape gardens.
4. Allowing the weeds and alternate host plants harbouring mealybugs in and around vineyards.

Extension Folder No. 11

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MANAGEMENT OF MEALYBUGS ON GRAPES

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In recent years, mealybugs have become an increasing threat to grapevine in peninsular India causing heavy loss in the field.

DAMAGE

Nymphs and adult mealybugs suck the sap from the trunk (Fig. 1), cordons, buds, spurs, aerial roots, leaves, shoots, nodes, flower panicles and bunches. Infestation of the growing point especially with the pink mealybug results in malformation of leaves and shoot tips (Fig. 2). Honeydew excreted by mealybug nymphs and adults, support the growth of sooty mould on leaves, shoots and bunches. Sooty and sticky bunches harbouring mealybugs and

Fig. 1. Mealybugs under bark

Fig. 2.Mealybug affected shoots

their white cottony wax masses are unfit for marketing as table grapes. Raisins cannot be prepared from such infested bunches. The pest attack weakens the grownup vines. In case of severe mealybug infestation young vines often die. The grape mealybug causes losses up to 100 per cent in severe cases in the vineyard.

MEALYBUG SPECIES

Among the mealybug species infesting grapes in India, the pink mealybug *Maconellicoccus hirsutus* and the citrus mealybug *Planoco-ccus citri* are found causing severe loss in many grape growing areas of Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu.

BIOLOGY

The adult female mealybugs are pinkish (*M. hirsutus*) or yellowish white (*P. citri*) and sparsely covered with white wax. Each female mealybug deposits 350-500 eggs in a loose cottony terminal ovisac during a week's time. These eggs are orange in colour (*M. hirsutus*) (Fig. 3) or yellowish white (*P. citri*). They hatch in about 5 days. The first instar nymphs are also called as crawlers, which are mobile. They settle on the plants, start sucking the sap and form the colonies. Crawlers are orange in colour (*M. hirsutus*) or yellowish white (*P. citri*). The male and female mealybugs are similar in early stages. The female passes through three nymphal instars while male passes through four nymphal instars. The total nymphal period is 19 days for male and 21 days for female. The male nymph forms a cottony cocoon in which the pupal stage is found mainly in the winter season. The adult male

Fig. 3. Eggs of pink mealybug

Fig. 4. Adult female pink mealybug

has a pair of wings and a pair of halteres. All the stages of the female mealybug are similar (Fig. 4). Males are very rare and female mealybugs are commonly found causing the damage in the field. Mealybug completes the life cycle in about 30 days. Without mating, they are known to reproduce partheno-genetically throughout the year.

SEASONAL DEVELOPMENT

The mealybug occurs on the grapevine throughout the year (Fig. 5). After the harvesting, the mealybug population is confined to vegetative parts. The grapevine is pruned usually in April-May (Foundation pruning). Grape mealybugs remain on the leaves, stem and trunk from April to September. The mealybug population is usually low from June to September. After the fruit

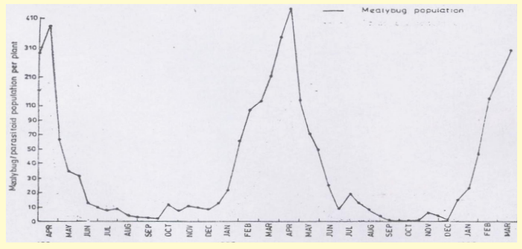

Fig. 5. Seasonal incidence of grape mealybug

pruning also, the mealybugs remained low on the trunk, cordons and stem up to the first fortnight of December.

The mealybug population starts increasing from mid December onwards. During January, they migrate from the trunk, cordons and shoots to developing berries. It attains peak population before harvesting of bunches during March-April. Early pruned crop usually escapes from the mealybug attack as compared to late pruned crop. Heavy sporadic rains and cool temperatures of less than 20°C results in temporary reduction in the mealybug population. The pest population buildup coincides with high temperature of 30-40°C, low humidity (less than 40%) and berry development. The population was low in winter and rainy seasons, and higher in summer months.

MANAGEMENT

Prevention is better than cure. This principle is highly applicable in the management of grape mealybug. Mealybugs are hard to kill pests on several crop plants. They form colonies in protected areas like cracks and crevices. All the stages of the mealybugs are covered with waxy coating and therefore it is difficult to control the mealybugs with conventional insecticides. Cultural, mechanical, biological and chemical methods of control have to be adapted throughout the year to contain the mealybug population thus preventing the loss caused by the mealybugs.

1. Collection and destruction of the mealybug - infested bunches at the time of harvesting in March-April.
2. Collection and destruction of all the pruned material from mealybug infested gardens in April/May.
3. Removal of loose bark and destruction of the debarked material in April/May.
4. Removal of weeds and alternate host plants harbouring the mealybugs in and around the vineyards throughout the year.
5. Locating the ant colonies and destroying them with drenching of chlorpyriphos 20 EC @ 2.5 mL/L or apply malathion 5% dust @ 10 kg/ac in April-May, since the ants are associated with the buildup of mealybug population.
6. Swabbing/washing of trunk and cordons with 2 mL of dichlorvos 76 EC + 2 g of fish oil rosin soap in a litre of water in April-May.
7. Soil drenching with imidacloprid 200 SL @ 1.50 mL/L/plant in the basins around the trunk or through drip irrigation @ 400 mL/ ac in April-May.
8. Foliar spray with methomyl @ 1g/L after 30 days of soil drenching.
9. Releasing the Australian ladybird beetle (*Cryptolaemus montrouzi-eri*) @ 5000/ha. in August-September to clear the mealybug population present on the plants (Fig. 6).

Fig.6. Ladybird beetle feeding on the mealybugs