LIMB BREAKAGE IN CITRUS

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In recent years heavy damage has been caused in some orchards of Citrus sinensis and C. aurantifolia in the districts of North Arcot and Cuddappah by the breakage of large branches (limbs) bearing heavy crops of fruits at the junction of the branch and the stem. This usually occurs in the months of October to December and is aggravated by the prevalence of strong winds. The breakage of such large limbs results in the reduction of the cropping capacity of the trees. Sometimes large portions of the bark and wood of the main stem on one side are torn away when the limbs break. These wounds allow the entry of wound parasites like Diplodia natalensis and Ganoderma lucidum which cause further damage and destruction. The trees become unthrifty with several branches exhibiting die-back symptoms. In course of time they have to be grubbed out rather than be allowed to remain in the orchard.

In most of the cases the breakages are evident in the lower branches. Sometimes secondary branches may give way at the forks. The broken ends when examined reveal white mycelial plates extending into varying lengths in the woody region which is also soft and rotten. When these portions become exposed to humid conditions a whitish soft velvety growth envelopes the exposed surfaces. But fructifications were not evident in any of the affected plants at the time of inspection in the month of February. Further observations could not be made as the affected branches were removed and destroyed.

Damage to the main stem and limbs of Citrus trees is known to be caused by G. lucidum and D. natalensis in this tract. But these two fungi do not give rise to the peculiar mycelial growths on the exposed surface. Infection initiated by Diplodia can be easily spotted by the pycnidial development on the bark of the affected branches. G. lucidum forms the sporophores on the stem and the mycelial development of this species on the tissues is quite different in appearance. Heart rot of wood of Citrus is reported to be initiated in other countries by Diplodia (similar to D. natalensis) and later followed by Polystictus versicolor and Stereum sp. producing a soft powdery condition of the wood after a year or two. Schizophyllum commune has also been known to become established on dead wood and slowly advance.
into sound wood (Fawcett, 1936). The peculiar development of the velvety growth in the specimens examined suggested that a different fungus may be involved. Therefore typical affected portions were removed from the branches and the fungus was isolated from them.

The isolation was made by transferring bits of the affected tissues removed aseptically from inside the wood on to oatmeal agar. In all the dishes, the resulting fungal growths were identical producing radiating dense white mycelial development. From these, pure cultures were obtained by transferring single hyphal tips. The isolates grew luxuriantly on oatmeal agar. A white, slightly woolly growth occurred on the agar medium and several strands grew up the sides of the dishes. Even after four weeks there was no evidence of sporulation.

In order to induce sporulation the isolates were inoculated on plant tissues. Four-inch pieces of orange stem, coconut petiole and coconut roots were kept resting on 20 c.c. of oat agar in Erlenmeyer flasks and then sterilised. After sterilisation small bits of the pure culture of the fungus were placed on the tissues. Profuse mycelial growth formed on the orange stem while on the coconut tissues the growth was more or less stringy. On orange stem the growth was dense and woolly. It was white to begin with but slowly changed into cream and then buff. At the upper end thickened buff coloured formations were evident. The margin of the growth on the sides of the flasks was also thickened and deeper coloured. Irregular pores were observed in the thickened portions, but no spores were formed. The hyphae were mostly thin-walled. Near the thickened edges clamp connections were noticed in some of the hyphae. On the coconut petiole and roots several whitish incipient sporophores with horizontal pilei were formed one below the other. But here again there was no sporulation.

Pure cultures of the fungus grown on coconut roots were forwarded to Dr. Wiltshire, Director of the Commonwealth Mycological Institute, England, for favour of identifying the fungus. He writes to say that it was referred by him to Dr. W. R. R. Findlay, who has reported that the fungus agrees with *Trametes cervina* (Schw.) Bres. He has however added that he could not find spores either in the original material or in the cultures he grew from them and that therefore he could not confirm the identity of the species with certainty. This genus of the pathogen has not been recorded on this host from India. This fungus has however been recorded on *C. sinensis* from South Africa (Doidge, 1950).

In order to find out whether the isolate is capable of causing damage to *Citrus*, inoculations were carried out on the stem and branches of young
plants of *C. sinensis* and *C. aurantium*. In one series the culture of the fungus was placed over the bark in crotches and covered by tying alkathene sheets. In another series the bark was cut and raised as is done while budding, with sterilised scalpel and the culture placed between the bark and the wood and then tied with alkathene sheets. Controls were kept wherein similar treatments were given except for the addition of fungal cultures. Even after four months there was no evidence of infection in the first series of inoculated plants. But in the second series extensive development of thick white mycelial mats over and under the bark was visible in all the inoculated plants. The wood was discoloured. The tissues had been penetrated and plenty of gum formation was evident. Callus had not formed. In the controls callus had formed in the wounded series and the wound had healed up. There was neither discoloration nor gum formation. It was established that the fungus could infect *Citrus* stem through wounds only. The infection progressed readily involving more and more of the tissues but there was actually no breakage of the limbs. Nor was this expected as the plants were small and not in bearing and consequently there was no extra weight acting at the ends of the branches. Die back symptoms were exhibited by the infected branches in six months. However the responsibility of the fungus in causing damage to the stem and thus weakening the tissues was proved. In the orchards in the tract mentioned above *Arbela tetraonis* was found to be infesting *Citrus* heavily. The insects were eating away the bark extensively and boring into the bark especially at the crotches. These wounds would be very helpful in the fungus gaining entry into the tissues of the host.

The initiation of the infection at the crotches and the prevalence of insect infestation in the tract suggested that protection of the crotches with a fungicide after destroying the insect might prove useful in preventing the damage. To assess the usefulness of this method trials were laid out in a private garden. In one set of trees the galleries formed by the insects were carefully scraped and a mixture of petrol and naphthalene injected into the bores made by the insects (Ramakrishna Iyer, 1940). After this operation Bordeaux mixture (10·10: 50) was painted over the bark at the crotches and extending up to one foot on the stem and the limb. Another set of trees was left as control without any treatment. The application of Bordeaux mixture was repeated after six months. At the end of one year twenty per cent. of the control trees exhibited breakage of one or more limbs while there was no incidence of limb breakage in the treated trees.

The protective action of this treatment was evident only when it was carried out before the fungus had invaded the tissues. Moreover the
application of the fungicide had to be repeated. The adoption of these measures after infection had progressed was of little value. It is recommended that frequent inspection of the orchard be made to detect the incidence of insect infestation and the adoption of timely control measures. Whenever limb breakage has occurred the wounded surface on the stem is to be planed smooth after removing the discoloured wood. The exposed surface is to be painted with twenty-five per cent. creosote oil or Bordeaux paste (Uppal and Kamat, 1936). Over this a coating of zinc white or any other waterproof coating may be given to prevent ingress of rainwater.

I am indebted to Dr. Wiltshire for the help in the identification of the fungus. I am thankful to Sri. P. Govinda Rao, Lecturer in Mycology, Agricultural College, Bapatla, for help in the conduct of the trials, and for supplying the photographs of the trees showing the disease symptoms.

SUMMARY

In several orchards in the districts of North Arcot and Cuddappah limb breakage of oranges and limes has been prevalent in recent years causing damage to the trees in full bearing. This occurs in the months of October to December and is aggravated by strong winds. *Trametes cervina* is associated with this. This fungus is able to infect the bark and wood through wounds. Eradication of the insects infesting the crotches and painting the bark with Bordeaux mixture are recommended as preventive measures.

REFERENCES


EXPLANATION OF PLATES

**PLATE XIII**. (1) Broken limb in *C. sinensis*. (2) Broken limb in *C. aurantifolia*. (3) Cultures of the fungus on coconut petiole, coconut roots and *Citrus* stem (the two right side flasks).

**PLATE XIV**. (1) and (2) Inoculated fork and stem of *C. sinensis* and *C. aurantium* respectively. (3) Control. Note the formation of callus over the wound.