5. Hodgson, R. W. 1967. Horticultural varieties of citrus. p. 431-591. *In* W. Reuther, H. J. Webber and L. D. Batchelor (eds.), The citrus industry, University of California Press, Berkeley. Vol. 1.
6. Klotz, L. J. and W. S. Stewart. 1948. Observations on the effect of 2,4-D on fruit-stem die-back in citrus. California Citrog. 33:425.
7. Krezdorn, A. H. 1960. The influence of girdling on the fruiting of 'Orlando' tangelos and navel oranges. Proc. Fla. State Hort. Soc. 73:49-52.
8. ———. 1965. Fruit setting problems in citrus. Proc. Carib. Reg. Amer. Soc. Hort. Sci. 9:85-92.
9. ———. 1969. The use of growth regulators to improve fruit set in citrus. Proc. First Int. Citrus Symp. 3:1113-1119.
10. ——— and M. Cohen. 1962. The influence of chemical fruit set sprays on yield and quality of citrus. Proc. Fla. State Hort. Soc. 75:53-60.
11. Lange, J. H. de and A. P. Vincent. 1972. Evaluation of different cultivars as cross-pollinators for the Washington Navel sweet orange. Agroplantae 4:49-56.
12. Lima, J. E. O. and F. S. Davies. 1981. Fruit morphology, anatomy and late season drop of navel oranges. HortScience 16(3):420 (abst.)
13. ———, ———, and A. H. Krezdorn. 1980. Factors associated with excessive fruit drop of navel orange. J. Amer. Soc. Hort. Sci. 105(6):902-906.
14. Southwick, S. M. 1980. Fruit abscission studies in navel oranges, *Citrus sinensis* (L.) Osbeck M.S. thesis, University of Florida, Gainesville.
15. Webber, H. J. 1930. Influence of pollination in set of fruits in citrus. Calif. Citrog. 15:304, 322-323.

Proc. Fla. State Hort. Soc. 94:14-15. 1981.

SLOW RELEASE PESTICIDE INSIDE TREE WRAPS FOR YOUNG TREE TRUNK PROTECTION FROM INSECT DAMAGE

STANTON L. REESE AND RAND L. REESE
Reese Citrus Insulators, Inc.,
P.O. Box 2352, Lakeland, Florida 33803

Abstract. **The practive of applying an insecticide to tree trunks when banking or wrapping has been less than satisfactory due to rapid loss of effectiveness of the pesticide from decomposition and dispersion by water. The slow release of Diazinon[1] vapors through the walls of packets formed from 5 mil thick, low density polyethylene film placed in semi-rigid tree wraps, has been found to produce a vapor concentration sufficient to repel or kill the insects that frequently damage the trunks of citrus trees, and to be effective over a relatively long period of time. The results of field tests are presented.**

It is common practice in many regions of the world and over most of the Florida citrus belt to insulate young citrus trees to protect them from loss due to cold (1, 2, 3). The material used to cover the tree trunks for this purpose almost invariably invites ants and other insects to take up residence in the protected area. Some of these insects such as ants, may chew on the bark near the base of the tree. Once a wound is created, the young tree is highly susceptible to *phytophthora parasitica* (foot rot). To protect the trunk from insect damage, insecticides are usually applied. Unfortunately, most insecticides either decompose upon exposure to moisture and soil or they are dispersed by water, or both, and lose their effectiveness in a period of time measured in days, or, at most, weeks. To add to the problem, few, if any, insecticides now enjoy regulatory approval for this use. This report presents the results of research into the use of insecticide vapors as a means of providing effective long term protection from insects.

Materials and Methods

For a vapor to be effective in insect control, it must be confined such that a concentration which is lethal or which is at least repellant to the insects in question is achieved within the confined area. A semi-rigid, insulating wrap with a central chamber surrounding the tree trunk was reported on previously (4). This wrap afforded the possibility of achieving a micro environment of insecticide vapors just as it produced a micro climate inside the central chamber by means of its heat releasing solution liners. This wrap is produced from expanded polystyrene (Styrofoam®), a closed cell material, the volume of its central chamber measuring about thirty cubic inches.

A number of insecticides were screened to find one that was effective against the insects to be controlled, had sufficient vapor pressure at grove temperatures to produce an effective vapor concentration and was environmentally acceptable. Diazinon appeared to meet these requirements being effective against a wide variety of insects including ants, roaches, crickets and wasps. It has a rather low vapor pressure at ordinary temperatures being only 1.8×10^{-7} atmospheres at 68°F and 1.4×10^{-6} atmospheres at 104°F. Others were also low. Chlordane for example, has a vapor pressure of 3×10^{-4} atmospheres at 68°F and 1.2×10^{-3} atmospheres at 104°W. Diazinon has been found to be safe in a number of applications, both residential and agricultural, giving it an advantage in this respect.

The insecticide was encased in packets of plastic film in all tests. There are a number of plastic film materials that are relatively impervious to liquid penetration, which is important here if hydrolytic loss of the insecticide is to be minimized, but which do transmit vapors. A wide selection of vapor transmission rates are available with ethylene vinyl acetate at the high end followed by low density polyethylene. Mixtures of these two may also be used. Lower transmission rates can be had by using a higher density polyethylene. The vapor concentration may also be varied by changing the thickness of the film to be used, and also by changing the surface area of the packet containing the insecticide. Low density polyethylene was selected for this study the film thickness used being five mils. The total surface area of each insecticide packet was about sixteen square inches, approximately half of this surface being open for unrestricted vapor transmission.

Initially, wraps with an insecticide packet in either one or both halves were tested singly on trees where insects were found or directly on ant nests. Since the point of entry by insects into the wrap is generally near the bottom it was reasoned that this should be the zone of highest insecticide vapor concentration. To accomplish this, the insecticide packets were placed near the bottom of the wrap in all tests.

A combination life and effectiveness test was initiated in November of 1980 involving 1200 Hamlin orange trees on Swingle citrumelo root stock planted in October of 1980. One group of trees were fitted with wraps as described

[1]Diazinon is the registered trademark of the CIBA-GEIGY CORP. for 0,0-diethyl-0-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate.

above with an insecticide packet in each half. Another group had only one insecticide packet per tree and a third group had none.

Results and Discussion

Results from the early tests demonstrated that insect populations around the tree trunks were drastically reduced when one or more insecticide packets of the configuration described above were present within the wrap. Diazinon was seen to be somewhat more effective than Chlordane in eliminating insects at the vapor concentrations produced.

The results to date in the continuing long term test are presented in Table 1. It can be seen that wraps with two packets of insecticide are very effective in controlling ants within the wrap even after eleven months of exposure. Only 1.5% of these wraps were found to contain live ants. Even a single packet per wrap was found to have a significant effect in ant control with live ants found on 12% of the trees compared to 61% with live ants where no insecticide had been applied. Dead ants were found at the bottom of the wrap on 54% of the trees with two packets and on 28% of the trees with one insecticide packet. As expected no dead ants were found in the wraps in the group of trees without insecticide. Therefore the concentration of Diazinon vapor inside the central chamber of the wrap is lethal to ants depending upon its concentration, and that concentration is proportional to the surface area of the insecticide packets contained. Further, on all trees with wraps containing insecticide the number of ants seen was always very few, and none had nests at the base of the tree.

Future Work

In view of the number of uncontrollable variables in this application of insecticide, we believe that field tests such as those described here are the most meaningful way of determining the effective life of insecticide packets such as those described here are the most meaningful way inside tree wraps. The ongoing test discussed above may take several years to dissipate the insecticide if calculated vapor transmission rates apply in practice.

In order to enlarge our data base another combined life-effectiveness test involving nine hundred trees is now in place. In this test, the surface area of the packets has been increased 50% and the quantity of insecticide per packet has been doubled.

Table 1. Long term ant control with Diazinon vapor inside a semi-rigid tree wrap.

Surface area for vapor release in square inches	Diazinon per wrap in grams	Number with live ants in percent 6 months	11 months	Number with dead ants in percent 6 months	11 months
32	4	13	1.5	90	54
16	2	18	12	71	28
0	0	47	61	0	0

Literature Cited

1. Jackson, L. K., and J. W. Sauls. 1977. Banking young citrus trees for cold protection. Citrus and Veg. Mag., November. pp. 8, 28-30.
2. Reese, R. L. 1969. Soil banks or fiberglass wraps for young citrus trees. The Citrus Industry. January. pp. 17, 19, 20.
3. Turrell, F. M. 1973. The science and technology of frost protection. pp. 338-446. In W. Reuther, (ed.) Vol. 3, The Citrus Industry. Univ. of California.
4. Yelenosky, G., and S. Reese. 1979. Self heating tree wraps in freeze protection. Proc. Fla. State Hort. Soc. 92:25-27.

Proc. Fla. State Hort. Soc. 94:15-18. 1981.

PROGRESS OF CITRUS CANKER ON SOME SPECIES AND COMBINATIONS IN ARGENTINA[1]

E. Danos, R. Bonazzola
Junta Provincial de la Citricultura, San Luis 1039, 3200 Concordia, Entre Rios, Argentina

R. D. Berger, R. E. Stall
University of Florida, IFAS, Plant Pathology Dept., Gainesville, FL 32611

J. W. Miller
Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Gainesville, Florida 32602

Abstract. **Citrus canker, caused by** Xanthomonas campestris **pv.** citri **(Hasse) Dowson strain "A", is spreading within citrus groves in Corrientes and in Entre Rios provinces, Argentina. Progress of disease was determined by recording incidence of disease on trees of several citrus species, varieties, and combinations. The proportions of diseased trees (y) plotted vs. time were asymmetrical sigmoidal curves. Thus, the Gompertz transformation was used to linearize the curves and to obtain estimates of epidemic rate (k). In a Corrientes citrus grove, disease incidence was followed on three citrus types on Trifoliate rootstock for 13 months. The infection rates (k) per month for incidence of citrus canker were 0.18 for Navel orange, 0.1 for Satsuma, and 0.06 for 'Comun' mandarin. At a rate of 0.18 per month (as for Navel orange) the proportion of diseased trees increased from 0.1% to 58% in 13 months. In an Entre Rios citrus grove, progress of disease incidence on trees was calculated for 22 months. The average infection rates (k) of canker per month were higher (k=0.13 and 0.24) among trees of 'Valencia Late' on Rough Lemon rootstock than among trees of 'Valencia Late' on Trifoliate rootstock (k=0.04 and 0.12) after low and high percentages of diseased trees were eradicated, respectively. For 'Ellendale' on Trifoliate the average infection rate (k) was 0.04 per month. Thus, the spread of citrus canker was affected by scion types, rootstocks, and percentage of previously eradicated trees.**

[1]The authors wish to thank Ing. Agr. D. R. Hogg (Argentina), Sr. M. Mancioni (Argentina), Mr. C. P. Seymour, and Dr. E. P. Du Charme for valuable support of this work.

The rate of spread of citrus canker, caused by *Xanthomonas campestris* pv. *citri* (Hasse) Dowson *(X.c.c.)* strain "A", in groves has not been determined quantitatively. The eradication campaigns have precluded much gathering of information on spread. After citrus canker was introduced into a new geopraphical area, its spread was reported as "rapid" (4,5). The rate of spread of canker in a citrus