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THE USE OF PROPICONAZOL (TILT CGA 64250) FOR CONTROL OF PHYMATOTRICHUM OMNIVORUM IN PEACHES (PRUNUS PERSICA L. BATCH) AND GRAPES (VITIS VINIFERA)

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THE USE OF PROPICONAZOL (TILT CGA 64250) FOR CONTROL OF *PHYMATOTRICHUM OMNIVORUM* IN PEACHES (*PRUNUS PERSICA* L. BATCH) AND GRAPES (*VITIS VINIFERA*)

by

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STATEMENT BY AUTHOR

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APPROVAL BY THESIS DIRECTOR

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September 2, 1983
Date

DEDICATION

This study is dedicated to the best in my life without whom this thesis would not have been possible--my wife Rosa Amelia, and my children Marco Alejandro, Maira Azucena, and Mauricio Aaron.

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ABSTRACT

A study was made in two peach orchards and one vineyard in Caborca, Sonora, Mexico, in order to evaluate propiconazol (Tilt) for control of *Phymatotrichum* Root Rot. The sites were heavily infected with *Phymatotrichum omnivorum*, the causal fungus of the disease. Laboratory studies confirmed the presence of *Phymatotrichum omnivorum* in the experimental plots.

Three randomized complete block designs were arranged in the experimental areas with four treatments and four replications. The treatments were control, 25, 50, and 75 grams active ingredient per hectare of Tilt granular (2.5% a.i.) in peaches and control, and 1, 2, and 3 kgs active ingredient per hectare in grapes. The fungicide was incorporated in the soil and irrigated in. The treatments applied June 3-5, 1982 reduced vine mortality and increased shoot growth in both grape and peach.

INTRODUCTION

Deciduous fruit production occupies more than 45,000 hectares in Sonora, Mexico and Arizona, and has increased more than 25,000 hectares in the last ten years. Approximately ten percent of this area is infected with diseases which have reduced tree longevity and fruit production. Phymatotrichum Root Rot, which is the most serious disease attacking grapes, peaches, pecans, apples and annual crops as cotton has caused the greatest losses. Mulrean et al., in September, 1981, reported that total Arizona seed cotton yield for Pima and Upland cotton was reduced by 13% and 10% respectively by P. omnivorum infection. Phymatotrichum Root Rot in Arizona, New Mexico, Texas, Durango, Aguas Calientes, Coahuila, Zacatecas, Chihuahua, and Sonora, is the most severe disease in fruit trees (INIA-Diagnosis, 1981). (Streets and Bloss, 1973).

Many methods have been used to control Phymatotrichum Root Rot; however, these have not proven consistently successful. Recently research has shown that sterol inhibiting fungicides may be useful in controlling this disease. Hine et al., (1982) found, in cotton fields in Marana, Arizona, that foliar sprays of propiconazol at 0.5 lbs a.i./A. and side-dress applications of granular at 1.0 and 2.0 Lbs. a.i./A. produced significant reduction in percent disease and increased yield in Upland cotton (DPL-55).

The experiments described were an attempt to control *Phymatotrichum* Root Rot in peaches and grapes under field conditions with one of the sterol inhibiting fungicides (propiconazol).

LITERATURE REVIEW

Phymatotrichum omnivorum (Shear) Duggar is a soil-born plant pathogen, native to Northern Mexico and the Southwest United States. It attacks only dicotyledonous plants and persists indefinitely in the soil. *Phymatotrichum omnivorum* attacks a wide range of annual crops, and is one of the major diseases of cotton, alfalfa, and fruit and nut crops. *Phymatotrichum* Root Rot is more severe in fruit crops (Streets and Bloss, 1973). In 1981, a special diagnosis of the agricultural problems in Mexico revealed *P. omnivorum* to be the most important disease on fruit trees (INIA-Diagnosis 1981).

Brinkerhoff and Streets (1946) found pecan survived for one or more seasons before finally dying. It was difficult to detect the early symptoms because similar symptoms were also caused by other factors such as insufficient irrigation and nitrogen deficiency. King and Hope (1929), reported that no injury was observed in pistachio trees (*Pistacia atlantica*) although root rot strands were found on the roots. Although *Phymatotrichum* Root Rot generally occurs only in a portion of the orchard, the economic importance is reflected in lowered fruit quality and reduced yields (Streets and Bloss, 1973).

The wide range of host plants for *Phymatotrichum* Root Rot were considered by Ezekiel et al., (1934). They determined the immune monocotyledonous plants were protected by the presence of some specific unknown, toxic material, not by lack of a particular nutrient. Streets and Bloss (1973) suggested that resistance in monocots was related to specific microflora. They found cotton was susceptible in both sterile and non-steril soil; however, corn was susceptible only in sterile soil.

Wheeler and Hine (1972) studied the growth of strands of Phymatotrichum on cotton and found strand formation occurred at 27 and 32 C, and 22 and 30 percent soil moisture. Lyda and Burnett (1971) found sclerotial formation occurred most rapid at temperatures of 15 to 35 C. Lyda (1978) stated that fungus survived best in alkaline soil with pH of more than 8.0, temperature from 15 to 35 C., and moisture close to 35 per cent. This organism occurred more frequently in poorly drained soils. Olsen et al., (1982) found sigificant differences in water-stress infected cotton plants. Alderman and Hine (1981) recovered viable strands from soil at depths of 15-60 cms; however, no viable strands were recovered at either 0-15 or 60-90 cms. Lyda and Burnett (1971) found less diseased cotton plants when sclerotia was uniformly distributed in soil with high densities (3125 to 15,625 sclerotia/kg.) than with low densities (125 to 625 sclerotia/kg.). They suggested that the energy reserve within each propagule could be a basis for germination.

Ezekiel et al., (1934) reported root rot was higher in soil with high pH. In laboratory experiments lowering soil pH with sulfur was very effective but concluded it was impracticable to acidify soils under field conditions. In 1982, Rush and Lyda reported anhydrous ammonia to be toxic to mycelium and sclerotia of P. Omnivorum; however, extremely high concentrations were required for control. Henis and Chet (1977) concluded that ammonia affected sclerotium germinability by increasing the pH value of the sclerotial environment to toxic levels.

In laboratory cultures, Sleeth (1968) obtained similar results to Ezekiel and Taubenhaus (1934) and reported that to be effective in controlling the fungus, the chemical should have a definite toxicity after penetrating the soil to considerable depths. In similar studies Nixon et al., (1976) found Phymatotrichum Root Rot could be controlled by application of 375 liters/ha. of Telone soil fumigant at a depth of 51 cms. Considering the economic possibility of high rates of applications, Herrera (1978) found that only high rates (146 and 187 liters/ha.) reached the fungus at 30 and 45 cms depth. Heilman et al., (1978) also found a good response at 187 liters/ha. of 1,3-dichloropropene. Lyda et al., (1967) found that the deep placement of the fumigant also provided weed control. An important characteristic for chemical control is its persistance and movement in the soil. In 1969, Hine et al., determined that benlate was taken up by roots in soil containing low concentrations of the chemical and that the chemical moved in the plant from foliage applications.

Recently, a group of new fungicides which inhibit ergosterol biosynthesis in fungi have been found. Their importance is found on the effect of sterol biosynthesis which was required for growth and reproduction by eucaryotic organisms. Certain fungi failed to initiate spore germination or initial cell growth (Siegal, 1981). Growth of Venturia inaqualis was inhibited by sterol inhibitors which provided a good alternative where benomyl and dodine resistance was a problem (Jones, 1981). Sterol inhibitors provided excellent results in the control of powdery mildew (Podosphaera leucotricha) (Szkolnik, 1981).

Hickey and Yoder, 1981 found most sterol-inhibitors gave good control on scab and rust.

The work reported herein was undertaken to determine if propiconazol (Tilt) could be used to control Phymatotrichum Root Rot of grapes and peaches under field conditions.

MATERIALS AND METHODS

Three experiments were conducted from June 1982, to March 1983 in the agricultural area of Caborca, Sonora, Mexico (30^{o} 37' north latitude and 112^{o} 06' west longitude). The peach orchards were to the north of Caborca city and the vineyard was on the southwest of the city (Figure 1).

The selection of the sites for the experiments was initially taken from the characteristic symptoms of P. omnivorum attack (circular areas of dead plants, and necrotic leaves remaining on the tree) (Streets and Bloss, 1973). After selecting the orchards, plants with symptoms were selected and sampled for the presence of the fungal structures (strands and cruciform structure) on the roots before the fungicide application were made. The selected plants were taken from the transition area around the dead plants (from dead plant to healthy plant). Dispersion of the fungus was considered to have occurred as the result of transmission from one tree to the next in a circular form (Figures 2, 3 and 4).

The selected orchards, which had flood irrigation, were Loma Linda and Olmo (peaches) in the northern area and Vazquez (grapes) in the southwestern area. Loma Linda peaches were planted in March 1979 with a spacing of 6 x 6 meters (277 trees per hectare). The variety was Desert Gold. Olmo peaches were planted on March 1980 with a planting distance of 6 x 5 meters (333 trees per hectare). The variety was

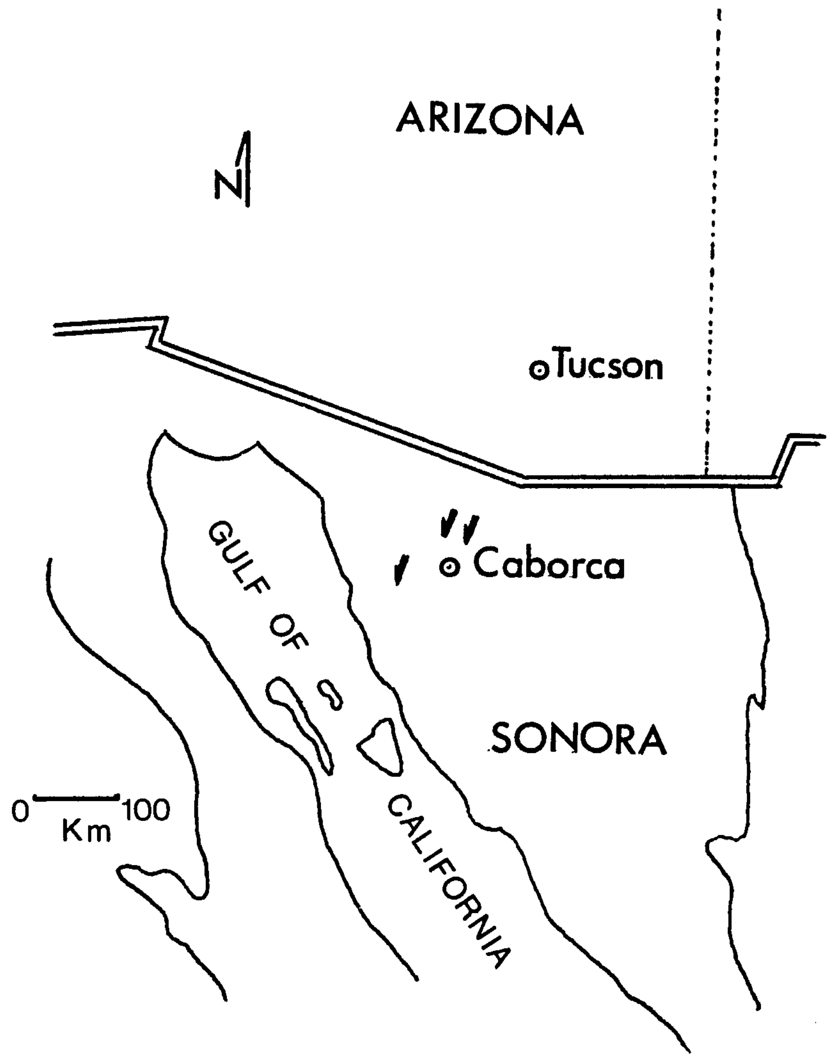
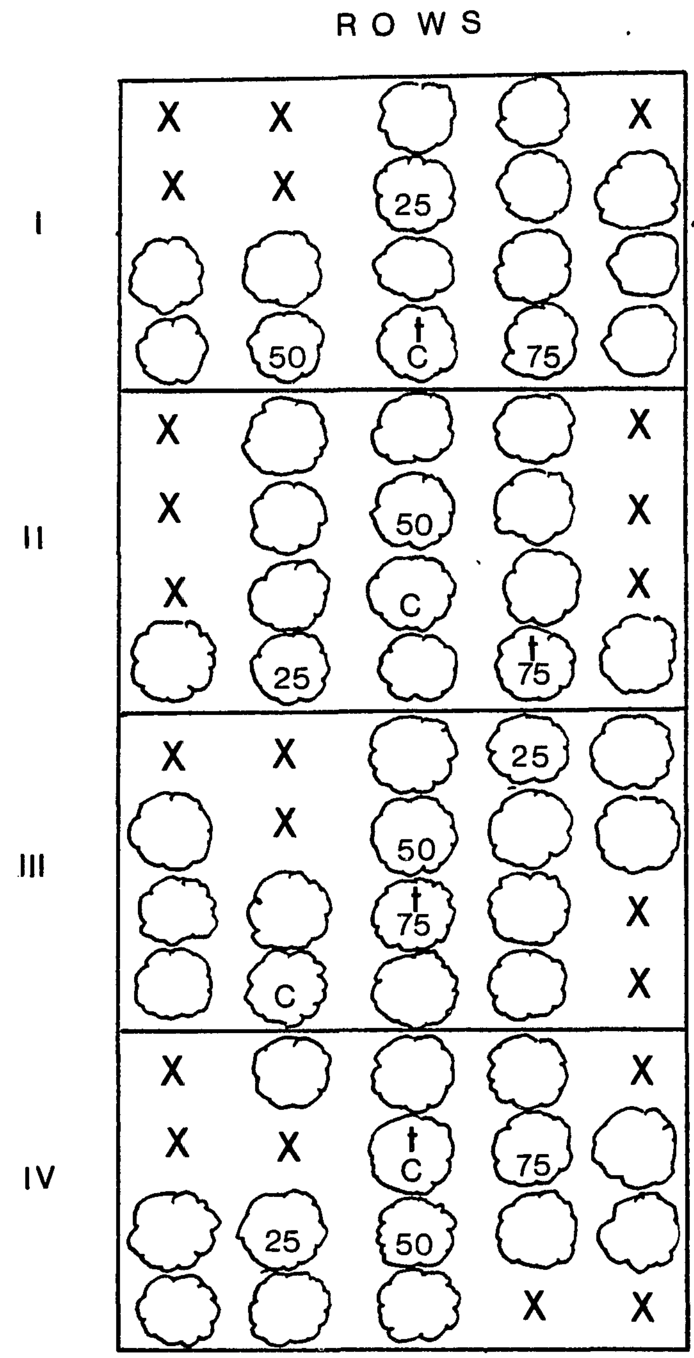
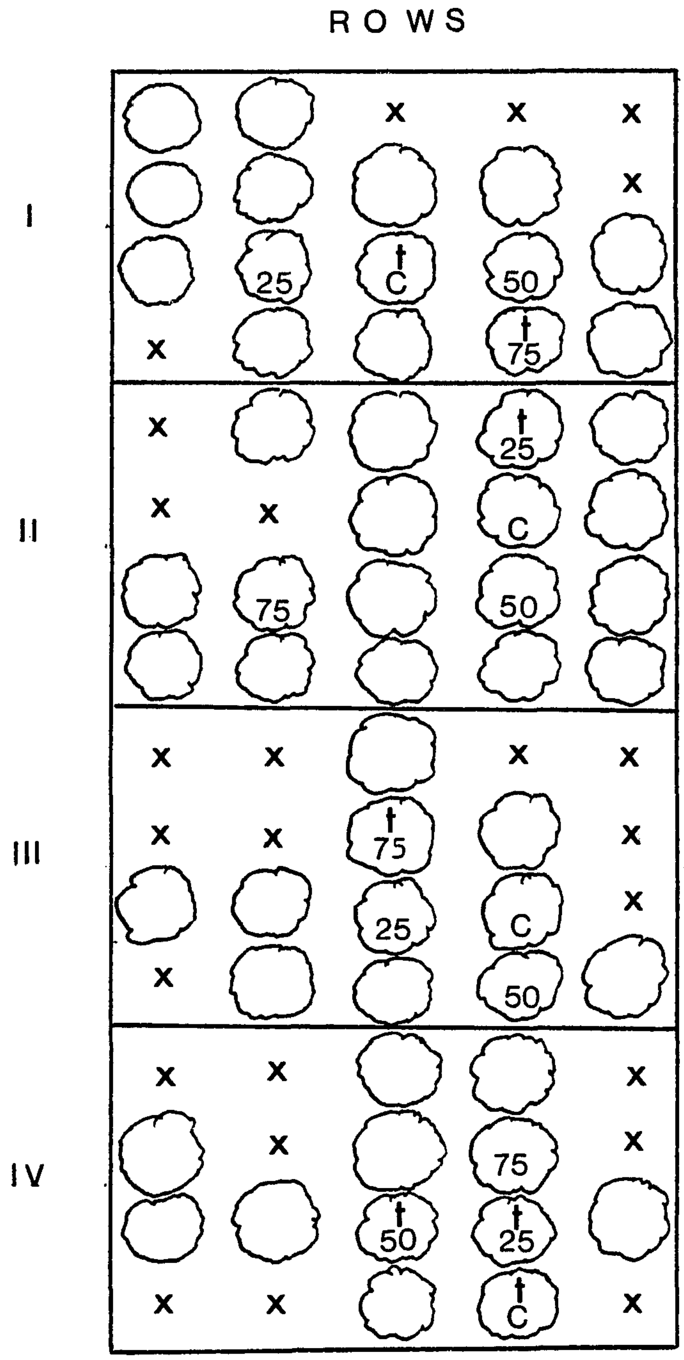


Figure 1. Locations of the study areas (arrows).



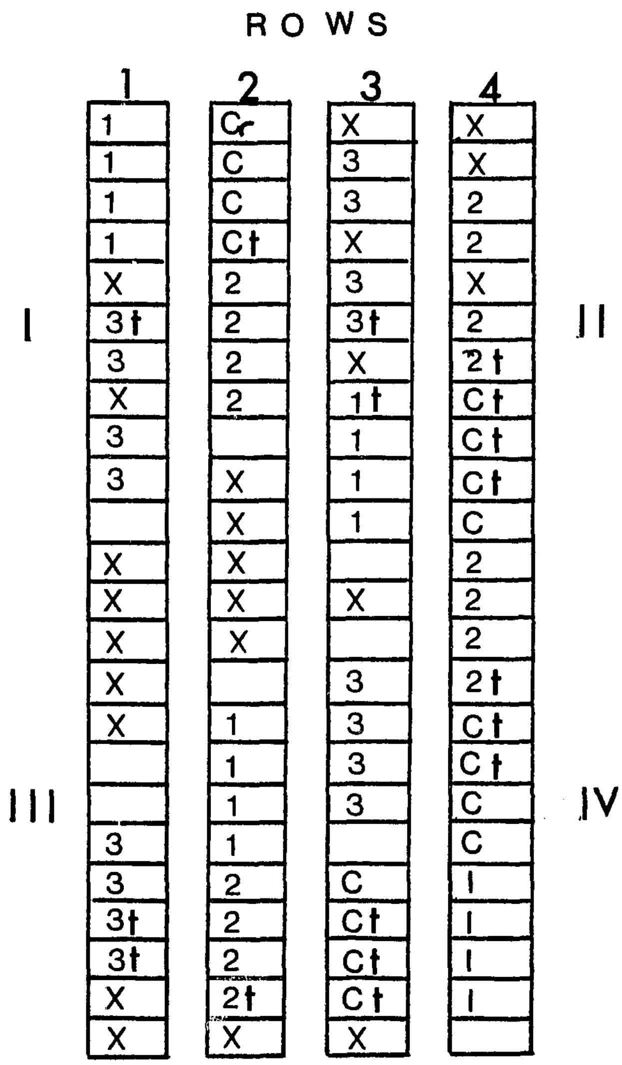
C Control
25, 50, and 75 gr/ha
X Killed trees before application
† Killed trees after application

Figure 2. Layout of treatments, replications, rows and plots: Loma Linda, peaches; cultivar: Desert Gold.



C Control
25,50, and 75 gr/ha
x Killed trees before application
† Killed trees after application

Figure 3. Layout of treatments, replications, rows and plots: Olmo, peaches; cultivar: Desert Gold.



C control
1,2, and 3 kg/ha
X killed trees before application
t killed trees after application

Figure 4. Layout of treatments, replications, rows, and plots: Vazquez, grapes; variety: Thompson Seedless.

Desert Gold. Vazquez grapes were planted on March 1980 with a spacing of 2 x 4 meters (1,250 plants per hectare). The variety was Thompson Seedless.

A randomized complete block design was used in each experiment with four treatments and four replications (blocks). In the peach orchards a single tree was used for each plot. The vineyard had four vines per plot. Plants and trees were marked on the trunk with paint (orange, blue, green, and white) for identification.

Tilt (CGA-64250) which is an experimental fungicide, has excellent activity at low use rates; also, Tilt is a systemic fungicide which is offered in a granular formulation (Technical Release Agricultural Division/Ciba Geigy). The applications were made around the plants at 50 cms from the trunk and incorporated into the top 10 cms of soil. Immediately after application, the fields were flood irrigated to activate the fungicide. In the peach orchards the amounts were 25, 50, and 75 grams of active ingredient of Propiconazol per hectare and in the vineyard 1, 2, and 3 kgs of active ingredient of propiconazol per hectare.

Data was taken monthly, and consisted of leaf samples for determining coloration, which was measured from 0 to 10 (yellow to green, respectively). The number of killed trees and vines and shoot length were taken in September 1982 and March 1983, respectively.

Analysis of variance was conducted for all treatments for which data were available at sample dates (Shoot length). A combined Analysis of Variance (ANOVA) for the three experiments was used and the Duncan test was used to determine significant difference between treatments.

RESULTS AND DISCUSSION

The fungicide was applied in June 3-5, 1982. The temperature fluctuated between 40 to 45 C and moisture in the soil was high. The fungicide was incorporated at a depth of 10 cms in a band 50 cms from the trunk and irrigated in. The first selection of the sites was basically done on visually apparent symptoms. After that, laboratory information to check on cruciform structures of the fungus confirmed the presence in the experimental locations of the test organism.

In the greening response (Figure 5), the Loma Linda peaches exhibited greater differences than either the Olmo peaches and/or Vazquez grapes. During July and August, the treatments of 50 and 75 grams/Ha. in Loma Linda reflected a high level of green foliage. In comparison with the Olmo peaches at 50 and 75 grams/Ha. had large color fluctuations between July and August. The vineyard exhibited a continual decrease in green color from June until September; however, some color loss is expected because of the natural aging of leaves during autumn with color ranging from green to brown. Another possibility for the difference in peach response is the geographical location, because Loma Linda is situated more to the north.

In the Loma Linda and Olmo plots, no statistical differences were observed in the percent of tree mortality between treatments (Tables 1 and 2); however, in the vineyard 3 kgs rate was significantly better than the control and 1 and 2 kgs rates. The 1 and 2 kgs. rates

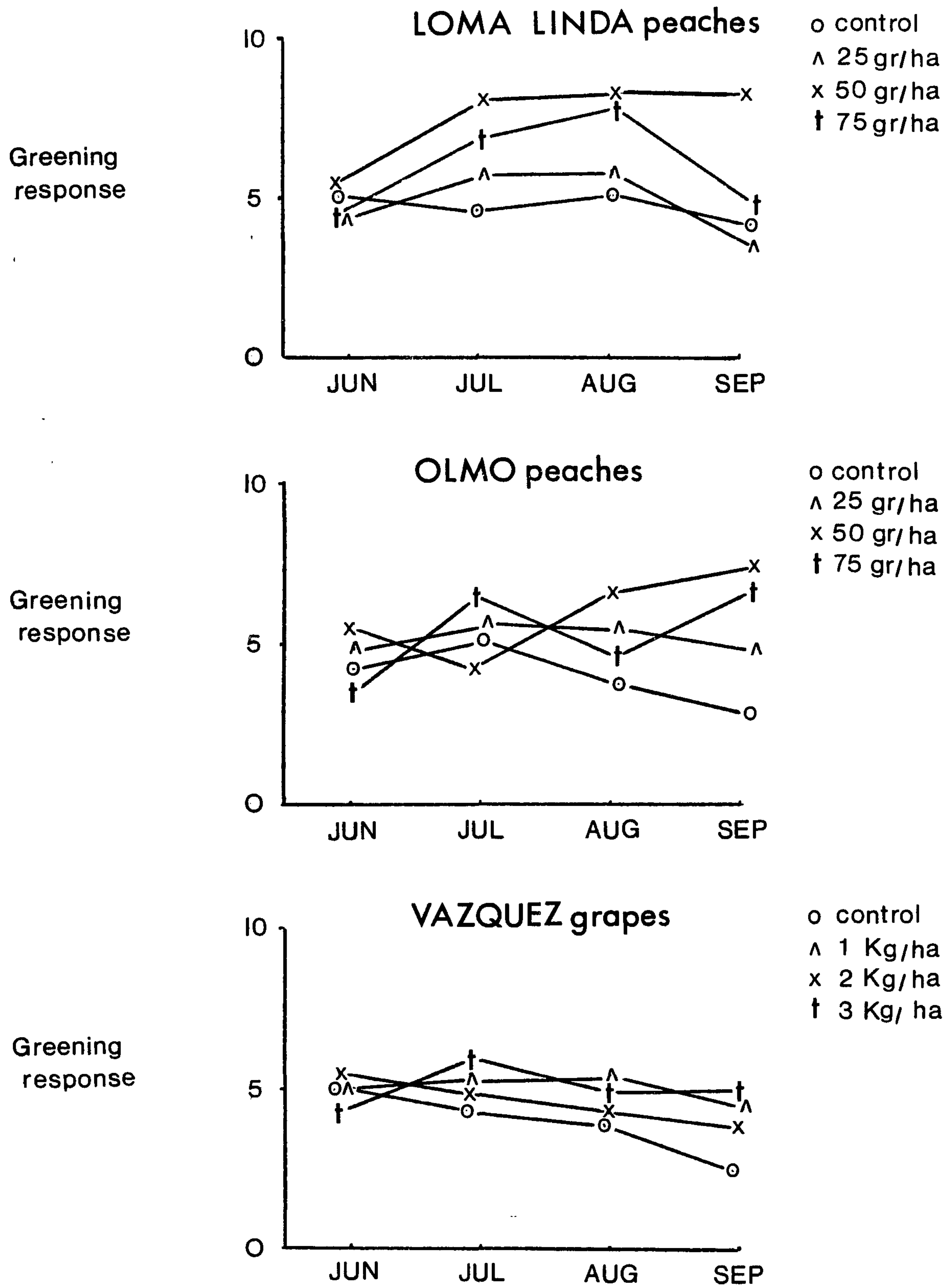


Figure 5. Greening response after fungicide application. -- The greening response was taken from 10 leaf samples of each plot in a range from 0 dark-yellow to 10 dark-green.

Table 1. Effect of Propiconazol on tree mortality and shoot length in peaches applied at Loma Linda Ranch in Caborca, Sonora, Mexico.

Treatments gms/Ha.	Number of treated trees	% tree mortality	Shoot length
25	4	0a^{y}	29.7b^{y}
50	4	0a	34.1ab
75	4	50a	39.9a
0	4	50a	27.0b

y = Duncan's multiple range test.

Table 2. Effect of Propiconazol on tree mortality and shoot length in peaches applied at Olmo Ranch in Caborca, Sonora, Mexico.

Treatments gms/Ha.	Number of treated trèes	% tree mortality	Shoot length
25	4	50a^{y}	32.9c^{y}
50	4	50a	40.2b
75	4	25a	54.7a
0	4	50a	30.6c

y = Duncan's multiple range test.

while not significantly different from one another were significantly better than control (Table 3).

In shoot length analysis, at Olmo peaches, 75 grams rate was signficantly better than 50 and 25 rates and control; also, 50 grams was signficantly better than 25 grams and control while not significantly different from one another (Table 2). The results observed from the grapes at Vazquez show similar levels of significance with the peaches at Loma Linda. Two and three kgs rates at Vazquez and 50 and 75 grams rates at Loma Linda were not significantly different; however, they were better than 25 grams rate, 1 kg rate, and control.

Table 3. Effect of Propiconazol on vine mortality and shoot length in grapes applied at Vazquez Ranch in Caborca, Sonora, Mexico.

Treatments kgs/Ha.	Number of treated vines	% vines mortality	Shoot length
1	16	6.75 c^y	16.5b^y
2	16	18.75 b^y	19.5ab
3	16	25.00 b^y	26.8a
0	16	56.25 a^y	9.1 b

y = Duncan's multiple range test.

SUMMARY AND CONCLUSIONS

Diseases in the Northern Sonoran agricultural area have increased in the last ten years. It was provoked by a big fruit material movement; in this form, the biggest economic effect in the agricultural area of Sonora has been the reduction in yield and number of trees due to _P. omnivorum_.

The major objective of this study was to evaluate Tilt which inhibits the ergosterol biosynthesis in _P. omnivorum_. Tilt belongs to a new group of sterol inhibiting fungicides which has come into recent prominence.

During the course of the experiments, an influence of the fungicide application in the trees was observed. Significant differences were found in percent of vine mortality in the vineyard; in Olmo peaches, significant differences were observed between the 75 g rate and the 25 and 50 g rates and control. A good greening response was reflected in the next two months after the applications were made. Fifty and 75 grams and two and three kilograms rates per hectare had a significant difference on Loma Linda peaches and the vineyard. In Olmo peaches 75 grams per hectare was the best treatment.

The orchards and the vineyard were located in different areas which may have had an influence on the data which reflected better response to the fungicide in the northern location.

Tilt worked in the three experiments at low rates for controlling the disease. It is suggested that a study of the timing of the fungicide applications would be the next logical step.

LITERATURE CITED

Alderman, S. C. and R. B. Hine. 1981. Vertical distribution in soil of and induction of disease by strands of *Phymatotrichum omnivorum*. Phytopathology 72:409-412.

Brinkerhoff, L. A., and R. B. Streets. 1946. Pathogenicity and Pathological histology of *Phymatotrichum omnivorum* in a woody perennial. The pecan. University of Arizona Tech. Bull. No. 111. Tucson.

Ezekiel, W. N., J. J. Taubenhaus, and J. F. Fudge. 1934. Nutritional requirements of the root rot fungus *Phymatotrichum omnivorum*. Plant Physiology 9:187-216.

Heilman, M. D., P. R. Nixon, R. V. Cantu, and R. E. Smithey. 1978. Use of soil-applied liquid fumigant for Phymatotrichum root rot control in cotton. Plant Disease Reporter 62:609-612.

Henis, Y., and I. Chet. 1977. Mode of action of ammonia on *Sclerotium rolfsii*. Phytopathology 57:425-427.

Herrera, Perez T. 1978. Soil Fumigation: Effects on *Phymatotrichum omnivorum* (Schear) Duggar and on cotton root rot. Ph.D. diss., Univ. of Arizona, Tucson, 371 p.

Hickey, K. D., and Yoder, K. S. 1981. Field Performance of sterol-inhibiting fungicides against powdery mildew in the Mid-Atlantic apple growing region. Plant Disease 65:1002-1006.

Hine, R. B., D. L. Johnson, and C. J. Wenger. 1969. The persistency of two benzimidazole fungicides in soil and their fungistatic activity against *Phymatotrichum omnivorum*. Phytopathology 59:798-801.

Hine, R. B., R. S. Whitson, and S. D. Lyda. 1983. Control of Texas Root Rot of Cotton with Propiconazol in Arizona. Phytopathology 73:959.

Jones, A. L. 1981. Fungicide resistance: Past experience with benomyl and dodine and future concerns with sterol inhibitors. Plant Disease 65:990-992.

King, C. J. and C. Hope. 1932. Distribution of the cotton root rot fungus in soil and in plant tissues in relation to control by disinfectants. J. Agric. Res. 45:725-740.

Lyda, S. D., and E. Burnett. 1971. Influence of temperature on Phymatotrichum sclerotial formation and disease development. Phytopathology 61:728-730.

Lyda, S. D. 1978. Ecology of Phymatotrichum omnivorum. Annual Review Phytopathology. 16:193-209.

Lyda, S. D., G. D. Robinson, and H. W. Lembright. 1967. Soil fumigation control of Phymatotrichum root rot in Nevada. Plant Dis. Rep. 51:331-333.

Mulrean, E. N., J. Mueller, R. B. Hine and P. von Bretzel. 1983. Estimating Cotton Crop Loss by Phymatotrichum omnivorum. Cotton. A College of Agriculture Report series P-59. The University of Arizona.

Nixon, P. R., M. D. Heilman, and R. D. Smithey. 1976. Cotton root rot control plant growth and yield response with liquid soil fumigants. down to Earth 32(3):1-5.

Olsen, M. W., I. J. Misaghi, D. Goldstein, and R. B. Hine. 1982. Water relations in cotton plants infected with Phymatotrichum. Phytopathology 72:213-216.

Rush, C. M., and S. D. Lyda. 1982. Effects of anhydrous ammonia on mycelium and sclerotia of Phymatotrichum omnivorum. Phytopathology 72:1085-1089.

Secretaria de Agricultura y Recursos Hidraulicos, Instituto Nacional de Investigaciones Agricolas. 1981. Diagnostico de Investigacion. Mexico.

Siegel, M. R. 1981. Sterol-inhibiting fungicides: Effect on sterol biosynthesis and sites of action. Plant Disease 65:986-989.

Sleeth, B. 1968. Comparative fungicidal effectiveness of chemicals on Phymatotrichum omnivorum in laboratory cultures. Plant Disease Reporter 52:232-234.

Streets, R. B., and H. E. Bloss. 1973. Phymatotrichum root rot. Monograph No. 8. The American Phytopathological Society, St. Paul, 38 p.

Szkolnik, M. 1981. Physical modes of action of sterol-inhibiting fungicides against apple diseases. Plant Disease 65:981-985.

Wheeler, J. E. and R. B. Hine. 1972. Influence of temperature and moisture on survival and growth of strands of _Phymatotrichum omnivorum_. Phytopathology 62:828-832.