ingly, *T. pallidus* was found in most plots intended for colonization, even though some of these were many miles from previously known areas of establishment. Furthermore, moderate to heavy parasitization was recorded from aphids collected at a number of these places. This indicates that the wasp is now spreading explosively over all of the major walnut growing areas of northern and central California, and rapidly assuming major status as a natural enemy of the walnut aphid.

Iranian strain

All of this recent development is believed to involve the Iranian strain of *T. pallidus*, since it has occurred in areas where parasite numbers had previously been low or the wasp had been nonexistent. It is impossible to confirm this through morphological study because no known structural differences occur between the two strains. However, biological study has revealed that the two strains do not interbreed, and so it will be possible to determine the identity of field collected material through mating tests with laboratory stocks of the two strains.

The Iranian strain of *T. pallidus* has the potential to effect wide-scale control of the walnut aphid in California. Its performance at Lafayette shows that under optimum conditions it can reduce the aphid population to a very low level and maintain it there. Native hyperparasites have not seriously hindered its activities. It appears to be fully adapted to the climatic conditions of California's interior valleys. On the other hand, cultural practices, and especially the adverse effects of insecticides applied for control of pests such as codling moth and walnut huskfly, may seriously hinder the wasp. This latter situation will be closely studied and efforts will be made to effect full integration of chemical control with *T. pallidus* and the natural enemies of the several other walnut pests.

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Effects of foliar sprays for FROST PROTECTION WITH YOUNG CITRUS

R. M. BURNS

A NUMBER OF new chemical sprays were tested for frost protection of young citrus during the winter of 1969–70. Fifteen commercial compounds were sprayed on container-grown grapefruit nursery trees and young lemon trees in the field. Most of the compounds were antitranspirants (film-forming, stomata closing, and reflecting types). Growth inhibitors used were maleic hydrazide (MH), potassium salt of 6-hydroxy-3-(2H)-pyridacinone (KMH), and ethyl hydrogen 1-prophylphosphonate (NIA-10637). Freezing the grapefruit nursery trees in a cold chamber resulted in no significant differences in the amount of cold protection given by any of the sprays. Temperatures in the field where the young lemon trial was located never reached freezing, but there were significant differences in growth response to the different sprays.

Two different chemical treatments with growth regulators for frost protection show a tree in good to fair condition after freezing temperatures (photo above) and one in poor condition with very little new growth (photo below).

Many chemicals

Many chemicals have been tested in an attempt to induce cold tolerance or frost protection in citrus and other agricultural crops. In some trials, a few degrees of increased frost tolerance have

IN TESTS
TREES

Young grapefruit nursery trees prior to freezing in the cold chamber at University of California, Riverside. Plants had been sprayed with growth regulators three weeks before and anti-transpirants two weeks before, to determine frost protection possibilities.

been obtained. In general, the results have been variable, or at best, not commercially acceptable. Since the cost of conventional protection is increasing, it would be beneficial to develop a chemical that would provide the necessary protection. This chemical would have to be non-toxic, easily applied, and relatively long-lasting.

MH foliar sprays

Ten years ago Florida researchers found that MH foliar sprays provided some frost protection by inhibiting new growth and inducing dormancy in young citrus trees. However, the variability in tree response limited commercial acceptance of the sprays. Similar results were obtained in California. Subsequently a number of new compounds were introduced that stimulated more interest, and many were included in these trials.

KMH, the potassium salt of MH, and NIA-10637, a new experimental growth inhibitor produced by Niagara, have reduced top regrowth of lemon trees. Two of the 12 antitranspirants that were tested (see table) have given ornamentals some cold protection.

Fifteen compounds

During the winter of 1969–70, fifteen compounds were sprayed on both container-grown grapefruit nursery trees and young lemon trees in the field. Twelve of the compounds were antitranspirants and three were growth inhibitors (see table).

There were five single tree replicates in the grapefruit test. The growth inhibitors (treatments 1, 2, and 3) were sprayed December 16, 1969. The antitranspirants (treatments 4 through 15) were applied one week later. Three weeks after the first spray, all 80 trees were placed in a cold chamber. Data from the recording thermograph showed the following temperatures: below 32°F for 7 hours; below 25°F for 2.5 hours; and below 22°F for one hour. The lowest temperature was 20°F.

First evaluation

When the first evaluation was made 48 hours after freezing, there was more foliage damage to the check trees than to the treated trees. However, subsequent evaluations over a period of seven months showed no treatment was significantly better than the checks.

In the field test, the same compounds and concentrations (see table) were sprayed February 14, 1970 on 8-month-old Frost Lisbon lemon trees southwest of Santa Paula. The coldest night was April 22, 1970, when a minimum thermometer in the plot registered 30°F. There was no measurable frost damage. However, there was significant growth inhibition from the growth inhibitors (treatments 1 through 3) six months after treatment.

Although these tests with many chemicals sprayed on different varieties of young citrus failed to provide the hoped-for cold protection, there is reason to believe that a suitable chemical will be found. More tests with different compounds, concentrations, penetrating agents, etc. are planned for the near future.

R. M. Burns is Farm Advisor, Ventura County. *Nursery trees were provided by the Sespe Land and Water Company in Fillmore, California. Field trial trees were provided by J. R. West, Santa Paula, California. Statistical analysis was by R. A. Brendler, Farm Advisor, Ventura County.*

SPRAY TREATMENTS FOR GRAPEFRUIT NURSERY TREES AND YOUNG LEMONS IN THE FIELD IN CALIFORNIA, 1969–70

1. Slo Gro (MH)	2000 ppm	9. Needle Fast	1:4 Pt.*
2. KMH	1000 ppm	10. Vapor Gard	1:2 Pt.*
3. NIA 10637	2500 ppm	11. TIBA	30 ml/gal*
4. Wilt Pruf	1:4 Pt. H_2O*	12. Frost Guard	1½ lb/gal
5. RD9	1:5 Pt.*	13. Foli Gard	1:4*
6. All Safe	1:2 Pt.*	14. Folicote	1:5*
7. Clear Spray	1:2 Pt.*	15. Key Kote	1:20*
8. Spruce Seal	1:40 Pt.*	16. Check	No Spray

* 1 ml X-77/gal added to those with no formulated spreader