The Pest Control Circular

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Recent negotiations between the quarantine officials of Japan and this country concerning the continuing interception in Japan of citrus fruit shipments infested with eggs of the Fuller Rose Beetle (FRB) vividly highlighted the seriousness of the problem that confronts the citrus growers and shippers of California and Arizona.

Foremost among the realities of the situation is the fact that the Japanese quarantine is definitely and undeniably a valid and highly demanding requirement:

Valid because our government quarantine officials clearly indicate that this plant protection restriction being imposed by the Japanese government is unchallengeable and that under reverse circumstances our government would be required to institute comparable safeguards.

Demanding because an exceptionally high degree of FRB control will henceforth be required at the orchard level in order for lemon shipments to qualify for export to Japan.

Orange and grapefruit shipments must also be free of FRB egg masses, but the fumigation with methyl bromide of lots found to be infested upon arrival in Japan results in less fruit damage to grapefruit and far less to oranges than is usually sustained by lemons.

Even though all preclearance inspections are presently limited to lemon shipments, the background of concern about FRB infestations also being found on oranges and grapefruit suggests the immediate and long-term advantages of implementing equally effective control programs in orchards producing these varieties for possible export to Japan.

New Agreement

Under the terms of the government-to-government agreement reached at the recently concluded negotiations, the government of Japan will provide quarantine inspectors for the next three-month period to conduct preclearance inspections of lemons at the harbor in the same manner as last year. Such assistance will definitely not be provided at any time beyond that. Fruit shipments found not to have viable eggs of the FRB will be qualified for export to Japan and will not be reinspected for egg masses upon arrival.

During this three-month period, equal numbers of Los Angeles County agricultural inspectors will work with the Japanese team of inspectors and will then continue the FRB preclearance inspections of lemons after the Japanese inspectors return to their country.

An update on the Fuller Rose Beetle situation

Specific control strategies are available for immediate implementation by growers

The author is Dr. G. E. Carman, professor emeritus, University of California/Riverside and consulting entomologist for Sunkist Growers, Inc.

The ongoing preclearances by the county inspectors working alone will be periodically checked on randomly selected lots by their trained quarantine inspectors in Japan. Thus, the acceptability of the phytosanitary certificates issued by our quarantine inspectors and officially required for the export of lemons to Japan will henceforth depend upon a final preclearance inspection at the harbor to determine that the fruit is free of FRB egg masses.

It will also be required that the shipper has certified on the application for preclearance inspection that the fruit came from orchards in which measures had been taken to control the FRB or in which this pest was not known to occur.

The Situation Last Year

In some measure the same requirements existed during much of the harvesting season last year, but extenuating circumstances left many growers and shippers in something of a quandary as to the full parameters of the problem and as to what they could do in a cost effective manner.

Understandably, having the FRB become a major problem in the exporting of citrus fruits to Japan came as a great surprise to an industry that had long categorized this insect species as a relatively minor pest that seldom justified the need for control measures.

Not so surprising was the fact that growers and shippers could not readily be given specific and fully detailed information concerning the biology, life history and control of this beetle that has the remarkable habit of laying its eggs frequently, or possibly preferentially, under the calyxes or buttons of citrus fruits.

Until last summer, only two studies had previously been undertaken and reported by entomologists at the Citrus Research Center of the University of California in Riverside.

The first, published as a University bulletin in 1950 by R. C. Dickson, primarily reported the emergence and presence of adult beetles in a citrus orchard in Fillmore and one in San Fernando during the summer and fall months of 1940, 41 and 42. The second, published in a technical journal in 1960 by H. S. Elmer, gave the results of greenhouse trials and a field test with chemical control treatments.

Unfortunately, many of the materials involved in those studies are no longer available for grower use. Limited studies conducted in other citrus producing areas, notably Florida and Australia, provided only limited guidance in relation to control approaches at the orchard level.

Thus, California growers were confronted last summer with a demanding need to initiate control programs that would quickly and substantially reduce the FRB population levels in their orchard properties, but could only be given tentative and incomplete guidance concerning the most effective procedures to use.

That so many growers did undertake

control programs under these circumstance through the use of foliar sprays or the combination of skirt pruning and the use of trunk barriers will predictably contribute to an earlier resolution of this export problem.

But, however great the degree of population reduction growers achieved through such efforts this past season, it is imperative that they continue with a FRB control program this coming season.

The Current Situation

With the time quickly approaching for the start of control measures this season on all citrus varieties, it is totally reassuring to now have available for grower use a number of control strategies for dealing with the FRB problem.

Research programs at the Citrus Research Center of the University of California at Riverside — first funded by the Citrus Research Board in May of last year — and additional research undertaken by other agencies and growers have developed much new information concerning the biology and control of this pest species, enabling Dr. Joe Morse, under whose direction the University's research program on FRB has been conducted, to prepare in consultation with others working on the problem updated and expanded control recommendations which are now being released for grower guidance until more definitive control measures can be specified.

For growers already embarked on a FRB control program, the follow-up use of these new control recommendations should result in such an incremental lowering of the population levels in their orchard properties that the current dimension of this export problem should be greatly minimized for them.

For growers initiating control efforts this coming season, the careful implementation of the recommended control procedures should effect significant reductions in population levels and provide the basis for increasingly effective follow-up treatments.

Three means of control are detailed in the University recommendations being released: namely, foliar applications, and the combinations of skirt pruning with trunk spraying or skirt pruning with trunk barriers, the latter approaches capitalizing on the inability of FRB adults to fly.

Foliar Applications

Field tests this past year have shown that the following treatments provide very effective control of FRB adults moving up into the trees to feed and lay eggs.

One of the field tests that contributed to the determination of what treatments could most suitably be recommended as foliar sprays for FRB was undertaken by Mr. H. S. Elmer, Entomology Specialist at the Lindcove Field Station, in cooperation with staff members of the Sunkist Research Department at Ontario. The results of this field test in a grapefruit orchard in Hemet that was heavily infested with FRB are reported by Mr. Elmer in the accompanying article.

The cogent features of the new University recommendations are shown here in the format of the entries proposed for inclusion in the *Treatment Guide for California Citrus Crops* which is currently being revised.

tory control would only be obtained if timing, type of application and other requirements coincided with the treatment recommendations separately indicated for the specific pest.

The timing of foliar applications is particularly important in that applications made at or shortly after the start of adult FRB emergence in June, July or early August can be made to the lower part of the tree only, usually limiting spray volumes to not more than 400 gallons per acre. Later timing of such treatments when beetles can be found in the upper parts of the tree require complete tree coverage ranging up to 2000 gallons per acre as a probable maximum.

Preferred timing for the coming season can be determined by contacting local Farm Advisors or University entomologists who will be monitoring adult beetle emergence traps placed in all production areas of Central and Southern California by the University. The earliest emergence would not normally occur until the beginning of July.

As will be seen in the results of the field test reported by Mr. Elmer, the Guthion and Sevin treatments provided a very high degree of control for a period of over three months. A second application later in the fall could be required if new feeding damage is ob-

Table 1 — Foliar applications for FRB.

Pesticide	Dosage	Varieties	Applicaton Time	Coverage	Other Pest Controlled
Guthion*, azinphos-methyl (minimum waiting period before picking — 30 days)					
Guthion 50% WP	0.75 lb/100 gal (max. 7.5 lb/acre of active ingredient)	ALL	Prior to beetles entering the tree (June-July)	TDC	(California red scale) (Orange worms) (Purple scale)
Sevin*, carbaryl (minimum waiting period before picking — 5 days)					
Sevin 80% S	1.2 lb/100 gal (max. 20 lb/acre of active ingredient)	ALL	Prior to beetles entering the tree (June-July)	TDC	(Black scale) (Brown soft scale) (California red scale) (Citricola scale) (Cottony cushion scale) (Orange worms) (Purple scale) (Yellow scale)
Kryocide, cryolite (minimum waiting period before picking — 1 day)					
Kryocide 96% WP	25-50 lb/acre	ALL	Prior to beetles entering the tree (June-July)	TDC	(Orange worms)

*Permit from County Agricultural Commissioner required for purchase and use.

It should be noted that other formulations of Guthion may be used, providing the same amount of active ingredient is applied. Also, all indications of other pests controlled are parenthesis-enclosed because satisfac-

served or when beetles drop onto a cloth sheet laid on the ground under branches being shaken. Supracide or methidathion also provided relatively good control in this field test but is not as yet being recommended by the University.

To the extent that the use of either Guthion or Sevin is considered undesirable for inclusion in an established pest management program, the compound cryolite which is strictly a stomach poison can be used to avoid adverse effects on parasites or predators. As used in the test herein reported, at the approximate rate of 24 pounds per acre, cryolite was considerably less effective than Guthion or Sevin so the higher dosages permitted on the label should probably be used for best results.

Skirt Pruning with Trunk Applications of Chemicals

Increasing interest in skirt pruning as a cultural practice coupled with the flightlessness of FRB adults suggested possibilities of controlling this pest species by preventing its movement up the trunks of trees.

Trunk applications of Guthion and Sevin demonstrated sufficient promise as control treatments in test plots to justify provisional recommendations by the University. The essential specifications for such sprays are as shown below:

Table 2 — Trunk applications for FRB.

Pesticide	Dosage	Varieties	Application Time	Coverage
Guthion*, azinphos-methyl				
Guthion 50% WP	1.5 lb/gal (maximum 7.5 lb/acre of active ingredient)	ALL	Prior to beetles entering the tree (June-July)	Trunk painting or spraying — one foot wide band
Sevin*, carbaryl				
Sevin 80% S	2.5 lb/gal (maximum 20 lb/acre of active ingredient)	ALL	Prior to beetles entering the tree (June-July)	Trunk painting or spraying — one foot wide band

*Permit from County Agricultural Commissioner required for purchase and use.

The indications are that such applications may effectively deter the upward movement of FRB adults for three to six months, but efficacy in any situation will depend on the concentration of pesticide used and post-application exposures of the deposits to sprinkler irrigations or rainfall, sunlight, dust or other environmental factors.

Material costs at the indicated maximum rates are high, and field tests will be undertaken this coming season to determine the minimum effective dosage rates for these or other materials.

Skirt Pruning with Trunk Barriers

The only trunk barrier being recommended by the University consists of a 4-8 inch wrap of a polyester material onto which a 2-4 inch band of a sticky compound can be applied. The most satisfactory banding material tested to date is 4.5 oz. Needlepunch, and the most persistent sticky substance appears to be Stickem Special Tropical Extra. Such materials are obtainable from Fruit Growers Supply and other supply outlets.

While the banding can readily be wrapped around the trunk with enough overlay to provide for girth expansion and easily secured with a large paper clip, care must be taken to stuff additional polyester or equally suitable materials into any openings between the banding and the trunk caused by irregular trunk growth, fluting, mechanical injuries, etc. so as to force the beetles endeavoring to climb into the trees to encounter the sticky barrier.

The easier approach of *applying any sticky compound directly to the trunk bark is strongly recommended against* as other investigators have reported that repeated applications over a number of seasons have invariably tended to cause serious bark injury or even trunk girdling. Only long term tests without any bark deterioration could demonstrate the full safety of such applications with any material.

With the use of trunk applications or trunk barriers on skirt-pruned trees, treatment provisions should be in place prior to the first adult beetle emergence. Present indications are that the work should be completed before July 15 for the most secure results.

When such trunk barriers are effectively in place and properly maintained along with the lack of any tree contact with the ground other than the trunk, prevention of leaf feeding and egg laying on fruits by FRB could approach the 100 percent level in a citrus orchard. This coupled with the observations of Dr. Morse and his coworkers that newly emerged FRB adults must have access to food within 1-2 weeks to survive suggests that such properties lacking ground cover, weeds or other vegetative growth would further limit, if not virtually eliminate, the FRB population in an orchard within a season.

A future control strategy is dependent upon the completion of tests at the Citrus Research Center which will make it possible to predict the time required for FRB eggs to hatch under prevailing temperature and humidity conditions. With such day-degree information available, a foliar application that would provide very effective beetle control could be applied sufficiently in advance of a schedule picking to insure that all eggs present on the harvested fruit would be hatched. This control approach would be somewhat less attractive for use on lemon crops with more than one scheduled picking during the seasonal presence of the FRB adults.

The important consideration for all growers who have established FRB populations in their orchard properties and who have the expectation that their fruit may be included in export shipments to Japan is to initiate control programs or follow-up on the measures taken last season with the type of treatments or procedures now being recommended by the University as outlined above.

Effectively utilized these control measures will greatly reduce the extent of the following years population levels and since it is reported that each generation requires a full year for development, the sequential use of such control treatments should provide the opportunity to again reduce this species to the status of a minor pest.

Efficacy of citrus registered pesticides on FRB control

The author is H. S. Elmer, specialist in entomology, UC/Riverside, working at Lindcove Field Station, Tulare County, CA.

While Fuller Rose Beetle (FRB) is generally only an innocuous pest in California citrus groves, these beetles have become a major concern to the citrus industry's export market — this following Japan's exclusion quarantine of any citrus found having FRB egg masses on the fruit rind.

A number of informative articles on this problem have been published in the *Citrograph* (see April, May, June and July 1986 issues) and in past issues of the *Sunkist Pest Control Circular* (see No. 544, April, 1986 and 545, June 1986); that information will not be further discussed in this article.

Early in 1986 a decision was made to go ahead with field trials using available citrus registered pesticides to determine if one or more would be effective in eliminating or at least reducing populations of FRB. This information could aid the citrus industry in getting a jump on FRB control while other researchers continued to study more time-consuming basic strategies that could eventually lead to a more permanent solution.

Five pesticides were selected for this study. Lorsban, Supracide, and Sevin are extensively used in citrus for the control of California red scale and, therefore, would give growers a twofold pesticide if FRB control were adequate. The other two test materials, cryolite and Guthion, are the only remaining materials still registered for use on citrus from a long list of chemicals tested for the control of FRB in the 1950's. (Malathion was also in that 1950's study but was excluded because of certain biological reasons.)

A grove in the Ivanhoe area of Tulare County and one in the Hemet area of Riverside County were used for spray plots in 1986. Populations of FRB in the Ivanhoe grove never reached a high enough density to give any conclusive results so only the results from the Washburn grove tests, near Hemet, are presented here.

The Washburn grove had a very high density population of FRB on grapefruit trees in early summer. Plots were thorough-distribution-coverage sprayed on August 26, 1986, using hand guns at a rate of 350-400 gallons per acre.

In addition to the sprayed plots, two ground treated plots using Lorsban 15% granules were broadcast completely under the tree canopy and just around the tree trunk. Ground applications were included with the intent of killing soil emerging adults before they climbed up the tree trunk; these trees had been pruned so that no foliage was in contact with the ground.

Efficacy evaluations were made by making a 2 minute per tree timed observation of live FRB within the canopy of the tree. Eight trees per plot were monitored in this manner at varying intervals up to 105 days after treatment. The results are given in the table.

The most significance should be on the live FRB averages at 27 days and later. Neither of the cryolite dosages nor any of the Lorsban plots gave the reduction in the FRB populations as did the other pesticides while the lower dosage rates of Supracide and Guthion were less effective than the higher dosages of each. Adding the acid buffer to the Sevin did not improve the performance. The 1.0 pound Sevin plot reduced the FRB populations to the same level as found in the 2.0 pound plot, with or without the buffer.

This data should be used only as an indicator or what might supplement other FRB control recommendations. Multiple applications using alternating pesticides might be necessary for a short term eradication of this beetle within particular grove.

(These tests were designed and applied under the direction of Dr. Glenn E. Carman, Professor and Entomologist Emeritus, University of California-Riverside; counts were made by H.S. Elmer, Specialist in Entomology, UC-Riverside working out of the Lindcove Field Station, Tulare County, CA.)

Table 3 — Evaluation of five pesticides of various rates for the control of FRB and compared to an untreated check. Washburn grapefruit grove — Hemet, Riverside County, CA 1986.

Treatments		Counts—Avg. no. live FRB per 2 minute search per tree			
Materials	Amount per 100 gals. or per tree	9-9-86 (14 days)	9-22-86 (27 days)	10-20-86 (55 days)	12-9-86 (105 days)
Cryolite 96 WP	3.0 lb	0.0	5.8	7.9	2.2
Cryolite 96 WP	6.0 lb	6.1	1.9	5.8	0.6
Guthion 50 WP	0.5 lb	0.0	1.4	1.0	0.0
Guthion 50 WP	1.0 lb	0.0	0.2	0.2	0.0
Lorsban 4 EC	0.75 pt	3.5	9.5	11.9	1.0
Lorsban 4 EC	1.5 pt	6.0	1.5	4.1	0.5
Lorsban 15 G	½ lb/tree*	6.0	31.2	28.8	3.9
Lorsban 15 G	½ lb/tree**	11.9	21.4	27.8	3.0
Sevin 80 SP	1.0 lb	0.0	0.0	0.9	0.0
Sevin 80 SP + acid buffer	1.0 lb + 2.5 oz	0.0	0.1	0.6	0.0
Sevin 80 SP	2.0 lb	0.0	0.0	0.6	0.0
Sevin 80 SP + acid buffer	2.0 lb + 5.0 oz	0.0	0.0	0.1	0.0
Supracide 2 EC	1.0 pt	2.5	3.0	1.6	0.1
Supracide 2 EC	2.0 pt	0.5	0.0	0.1	0.0
Untreated	-----	17.1	22.3	24.5	5.8

* Broadcast over entire area under tree
**Broadcast around base of tree

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