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DECIDUOUS FRUIT AND VEGETABLE PLANT PROTECTION PROBLEMS WITH PARTICULAR REFERENCE TO ENTOMOLOGICAL PESTS.

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ACKNOWLEDGEMENT.

This report covers the work of Dr. Angus J. Howitt, Entomologist, on a short term assignment to Uruguay under the USAID/Uruguay contract for a three month period, from October 1, 1973, to December 31, 1973.

I wish to express my appreciation to the members of the Las Brujas Experiment Station at Sayago for their help and hospitality. Particular thanks are due to Ing. Agr. Joaquín Carbonell for his invaluable assistance in field trips and help in his assessment of entomological problems of arthropods attacking deciduous fruits and vegetables.

INTRODUCTION.

One of the primary objectives of Contract AID/La-722 is to increase the export of non traditional exports, namely fruits and vegetables. While this report deals principally with arthropod pests of fruit and vegetables, the many complex problems in the production and export of quality fruit and vegetables are recognized. For example, of the varieties of apples grown in Uruguay none is better suited to the climate, particularly the mild winters, than Granny Smith. Its ability to yield large crops under the climatic conditions of Uruguay merits its greater commercial consideration by growers. Entomologists and plant pathologists consider it to present fewer production problems than Red Delicious. Unlike Red Delicious it is relatively free of apple scab. It harbors low populations of European red mite and it is less susceptible to attacks from the fruit tree borer, Praxithea dercurei.

There is a growing demand for Granny Smith apples in the northern hemisphere, particularly in North America and Europe. Since Granny Smith, for the present at least, is not grown extensively in the northern hemisphere the outlook for continuation and growth of these markets looks very promising. But overseas markets are not extensively utilized by the producers of Uruguay for a number of reasons. Their total present volume of apple production, which is approximately 1.5 million boxes, is too small to merit significant attention on any overseas market, even with quality fruit. A start has been made in making growers aware of the requirements necessary for a good yield of quality fruit. Basically the problems fall into the following categories: 1. Management -this includes pruning, pest management, varieties, etc., 2. Transport -this includes cold storage, shipping, quarantine, etc.

Lack of shipping with refrigeration facilities means that Uruguay must depend on land transport for the export of its apples. Brazil presents the most sizeable market for Uruguayan apples that can be reached by truck. In Brazil, although Golden Delicious is gaining favor, the present market demands red varieties, as do Uruguayan markets. Hence nearly 70% of Uruguay's apple production is devoted to growing Red Delicious 2/.

Because of an unfavorable climate, including too little winter cold, Uruguay produces an odd shaped Red Delicious that in general could not compete with Red Delicious grown in the Rio Negro Valley of Argentina, where climatic conditions are more favorable.

DECIDUOUS FRUIT OF URUGUAY.

A - Pome Fruits.

Apples - There are about 6,000 hectares[1] of apples yielding an average of about 25,000 tons[1]. About 60-70% of the apples grown are Red Delicious[1]. Other varieties grown include Granny Smith, Rome Beauty, King David and Jonathan used as pollinators. Cleopatra and Ben Davis varieties are also grown. There is the potential for increasing apple production by 40% or more. At present diseases and pests of pome fruits account for a loss of about 15%[2] of the fruit. Many saleable fruits lose value because of minor imperfections due to pests and diseases.

Pears - There are approximately 1300 hectares[1] of pears grown with an annual yield of about 4,500 tons[1]. Williams (Bartlett) is the most common variety. While the availability of suitable soil is the limiting factor there is a potential for increasing production by about 40%.

Quince - About 900 hectares[1] are planted to quince with an annual yield of about 6,000 tons[1]. Conditions are very favorable for the production of quince.

ARTHROPOD PESTS OF POME FRUITS.

1. Codling Moth (a) - Carcopsa pomonella L.

This is the most important problem in apple and pear production. The grower applies an average of 7 sprays during the season to control this pest. Technicians from the Centro de Investigaciones Agrícolas Dr. Alberto Boerger, Estación Experimental "Las Brujas" have devised an alarm system for alerting growers when to spray. This alarm system consists of placing several hundred pails of a fermenting mixture of yeast and molasses in orchards and counting the catches. In 1973 we introduced specific pheromone traps for codling moth. Pheromones are female sex hormones that are synthesized for different species of insects. These attractants are specific for the males of the species involved, thus only the males of the species involved are attracted and trapped. Rubber or plastic septums are impregnated with the pheromone then placed inside paperboard traps. The insides of the traps are coated with sticky adhesive that traps the males when they alight inside the traps. The pheromone traps are much more efficient than the bait pails. To date single pheromone traps placed alongside the 3 bait pails that are normally used for each station have caught more than 50 times more moths than the total caught by the olefactory traps.

While most chemicals control codling moth, it is essential that broad spectrum chemicals be employed so that other pests occurring at the same time, such as leafrollers and aphids can be controlled.

2. Leafroller - Argyrotaenia sphaleropa Meyrick

Up until around 1950 this was a minor problem. At present it ranks with codling moth in importance. Two or three flights of both codling moth and leafroller appear at about the same time each year. At present an alarm system employing bait pails similar to those used for codling moth are used for alerting growers to spray.

(a) The pests are listed numerically in their order of economic importance. 2/

3. European red mite - Panonychus ulmi (Koch)

Although European red mite was not officially recognized until 1950, it is generally believed that it existed in damaging numbers in Uruguay since 1950, coinciding with increased use of DDT to control codling moth. Previous to this time the small brown mite Bryobia rubrioculus (Scheuten) had been the major mite problem. The red spider mite Tetranychus telarius L. is a minor problem appearing on the foliage late in the season, particularly when conditions are dry. Many beneficial predators of these mites appear to be active.

4. Woolly Apple Aphid - Eriosoma lanigerum Hans.

Two forms exist, the aerial and the subterranean. While the aerial forms do little damage the subterranean woolly apple aphids are a serious problem. Northern Spy rootstocks are resistant to this pest; however, about 80% of the rootstalks in Uruguay are on rootstocks other than Northern Spy[2/].

5. San José scale - Aspidiotus perniciosus Comstock.

While this is not a serious pest at the present time it is a potentially serious threat. Dormant sprays of oil and DNOC compounds and parathion on foliage have been effective in controlling San José scale.

6. Fruit tree borer - Praxithea derourei Chabrill.

The larvae of this Cerambycidae causes much damage by entering the ends of branches and boring down through the length of the branch for considerable distance.

7. Green apple aphid - Aphis pomi De Geer.

This is not a serious problem. Natural control from Coccinellids Syrphid flies and micro hymenoptera help keep populations reduced below damaging numbers.

Other insects are found at times in apple, quince and pear orchards, but these appear at present to be secondary pests. These include the waxy scab, Ceroplastis grandis, which is sometimes a problem on quince. The basket bug, Oiketicus kirlyi Lands-Guild is at times a secondary problem on apples.

The bark beetle, Scolytus ruguosus can be a problem when the orchard is in a weakened condition. Thrips at times can be a problem on pears. An Eriophyid mite, Eriophyes pyri Pagens, also is a minor problem on pears.

8. Mediterranean fruit fly - Ceratitis capitata Wied

This pest is distributed all over Uruguay. Most of the damage occurs in fruit that ripens from February to May. This includes late peaches, pears, apples and quinces. In wet years soil moisture takes a heavy toll of pupae in the soil. In dry years there is a high survival of pupae and Mediterranean fruit fly can cause serious damage. In 1973 we introduced sticky traps baited with Trimedlure. These traps have proven very efficient in the alarm system.

9. Ants - The black ant, Acromyrmex lundi Muer. and the red ant Acromyrmex heyeri Forel.

A mound formed by dry vegetation characterizes nests of the red ant. The nests of the black ant are more difficult to locate since there are no mounds and only small holes at the surface indicate the presence of nests. Ants are a serious pest and can cause great damage to nurseries, young plantings and to mature orchards.

10. Pear Psylla - Psylla pyricola Forst.

This is a minor problem on pears and is not present in the majority of pear orchards. This is surprising since pear psylla is the major insect problem of the pear growing regions in North America.

B. - Stone Fruits.

Peaches - There are some 6,000 hectares[1/] of peaches that give an annual yield of approximately 25,000[1/] tons. Suitable soil is the limiting factor although there is a potential for about 100% increase for this crop.

Prunes and plums - There are about 1,100 hectares[1/] of prunes that give an annual yield of 5,200 tons[1/]. Although brown rot is a limiting factor for some varieties, these crops have no major insect pests and are considered relatively easy crops to raise.

ARTHROPOD PESTS OF STONE FRUITS.

1. Oriental fruit moth - Grapholita molesta Busk.

The oriental fruit moth is a major pest of peaches, as well as quinces. There are approximately 6 generations a year. Oriental fruit moth attacks only the fruit of quince, but in peaches both fruit and twigs are attacked. Young quince are sprayed in September and early October and again in February and March when they are under intense attacks from oriental fruit moth. On peaches oriental fruit moth damages about 7%[2] of the twigs in autumn but less than 1% in the spring. Early peaches are harvested in early December. Growers do not spray early varieties for oriental fruit moth. Sprays are applied for the main peach crop that is harvested in late December and January. Late varieties of peaches such as Elberta that are harvested in February must be sprayed. An alarm system, similar to codling moth, is used by technicians at the Las Brujas Experiment Station to alert growers for the need to spray. In 1973 we introduced specific pheromone traps for oriental fruit moth. To date these traps have proven to be decidedly more efficient in detecting oriental fruit moths than the olefactory traps. At present about 7%[2] of the crop is lost each year because of damage from the oriental fruit moth.

2. Green peach aphid - Myzus persicae Suly.

This is the most serious aphid pest. To date it has shown slight resistance to organic phosphates so that it can be readily controlled. Other aphids that can be problems some years are the plum tree aphid, Anuraphis helichrisi Kalt, peach tree black aphid, Anuraphis persicae Niger and the peach tree aphid, Anuraphis schwartzi Born. Aphids are generally secondary problems although some years they do injure the leaves. As a rule they are a local rather than a general problem.

RECOMMENDATIONS FOR POME AND STONE FRUITS.

Pome Fruits.

1. Pheromone traps for monitoring codling moth and oriental fruit moth should replace the olefactory bait traps immediately. Insect monitoring systems employing pheromones and insect traps are now being used by many growers in the United States as an important aid in achieving less costly and more effective control of destructive pests. The systems are used to detect the emergence and flights of adult insects. This information can help growers more accurately time spray applications for greatest effectiveness. By increasing the effectiveness of the sprays the number of applications may be reduced. The reduction of sprays can also have beneficial effects on pest predator populations. Using insect monitoring systems growers can often make further savings in application costs by concentrating sprays only on clearly infested areas, thus eliminating spraying where pests are non-existent or in extremely low populations.

Initial contacts have been made with Zoecon Corporation,(a) a major supplier of pheromones and its traps. Supplies should be obtained through the Ministry of Agriculture to minimize cost and delay.

2. All available leafroller pheromones should be evaluated as sex attractants for Argyrotaenia sphaleropa. These pheromones can be supplied by Zoecon Corporation. If the available pheromones are not effective attractants, arrangements should be made to make large collections of pupae of A. sphaleropa so that a specific pheromone for this pest can be synthesized. Zoecon Corp. has indicated a willingness to synthesize this pheromone if supplies of pupae are made available to them.

(a) Zoecon Corporation, 975 California Ave., Palo Alto, Calif. 94304, U. S. A.

3. Bait traps containing trimedlure should be employed in the alarm system. Commercial supplies are available. Although these traps are no longer available through Minnesota Mining and Manufacturing Co., it is expected that Zoecon Corp. will supply these traps. The Ministry of Agriculture should be responsible for importing these traps in order to save time and money.

4. More bait materials should be made available for ant control. Although heptachlor is extremely effective against all species of ants it is generally not available in Uruguay. We made a request to Velsicol Chemical Corp.(a), the basic manufacturer of chlordane and heptachlor to make their products available in Uruguay. Since we received a favorable response this should be followed up particularly since Velsicol Chemical Corp. indicated they were interested in making heptachlor baits.

5. There are a number of phytoseid mites that appear to be beneficial in controlling phytophagon mites. These beneficial mites should be identified. Once identified, work must be initiated to determine the beneficial or detrimental effects of fungicides, specific miticides and broad spectrum insecticides have on these predators.

6. Life history studies on the biology of the woolly apple aphid should be initiated. Research with chemicals to control this pest should be initiated. Alternate hosts, if any, should be determined.

7. Very little is known about the biology of the fruit tree borer, Praxithea derouret. Studies on the bionomics of this pest should be initiated as soon as possible. Residual chemicals, particularly cyclodiene compounds such as dieldrin should be evaluated for its control.

8. An experimental orchard to be used only for plant protection research should be established at the Las Brujas Experiment Station. This orchard should not be expected to yield fruit for sale, thus allowing a high population of pests and a high inoculum of diseases to be built up. Since it will require several years before this orchard grows sufficiently for use, a grower's orchard should be leased for plant protection research in the interim. Fruit would not be harvested commercially, but the grower would be compensated on the basis of his normal profit for the acreage leased.

(a) Velsicol Chemical Corp., Ohio St., Chicago, Illinois, U.S.A.

9. Many major manufacturers of chemicals are not represented in Uruguay, possibly because the potential for sales is limited. Hence a large number of valuable chemicals are not available to growers. Most major basic manufacturers are located in the Northern Hemisphere and all are interested in locations in the Southern Hemisphere for evaluating their products. It is suggested that Uruguay became a major evaluation center in the Southern Hemisphere for new agricultural chemical products. This should result in the following benefits:

   a) Experimental products from chemical companies, once registered for use, should be available to Uruguayan growers;

   b) Grant-in-aids for field testing experimental products would help finance research on other experimental station projects and would provide money for purchase of equipment, usable on all such projects;

   c) Other countries, including Brazil, Chile and Argentina would look to Uruguay for guidance in using new compounds. This would encourage an exchange of visits, meetings and a general exchange of ideas with these countries. Uruguay would be a major beneficiary.

10. Plant Protection is seriously under-staffed with entomologists. The present two entomologists, although they do an outstanding job, cannot cope with the multitude of entomological problems. It is suggested that 2 entomologists be engaged in vegetable work. One would be involved in control work, the other in biological and ecological studies of insects attacking vegetables. It is suggested that the same number of entomologists be employed for the same purpose to conduct work on pests attacking fruit. In addition one entomologist should be responsible for the alarm system which would be considerably enlarged. Finally, an entomologist should be concerned with taxonomic work. He would be responsible for collections, preparing material and making preliminary identifications.

11. Some USAID funds should be used for sending Uruguayan Plant Protection personnel to the United States for graduate work in Entomology and Plant Pathology. Ultimately, these Uruguayans must train other Uruguayans. USAID personnel in Uruguay lack the facilities to fully train Uruguayan counterparts. There is no substitute for the disciplined, basic training and learning that a good graduate school affords.

12. A short or long-term Agricultural Engineer is needed to study spray application problems and make recommendations to update the present outdated spray equipment. Uruguayan weather presents a special problem in that nearly constant winds blow in the Spring which is the most important time for spraying. There is a complete lack of modern sprayers and parts. Most of the present equipment used is inadequate. Because growth of trees is limited and would be classified as semi-dwarf it would appear that growers would benefit from concentrate sprayers. The Agricultural Engineer would determine the requirements needed in a concentrate sprayer.

VEGETABLES OF URUGUAY.

Potatoes - There are two crops harvested in a year, a Spring and a Summer crop. The two main varieties are Kennebec and Red Pontiac. In 1970-71 there were 23,900 hectares[2] of potatoes planted in the Spring and Summer crop that yielded 150,355 tons of potatoes. The average yield of potatoes per hectare was 4.65 tons. The average consumption of potatoes per month in Uruguay is 10,000 tons.

Tomatoes - This is an important crop in both the Salto and Montevideo areas. There are some 3,029 hectares[2] of tomatoes that yield an average of 9,985 kgs. per hectare.

Onions - Onions have great potential as an export crop. Onions are grown in the Salto and Montevideo areas. The Salto region has the greatest potential for onion production. At present there are 2,205 hectares planted to onions with an average yield of 7,2[illegible] kgs. per hectare.[2]

Peppers - Although the acreage is small peppers are a high value crop and of great economic importance. There are 610 hectares of peppers with an average yield of 5,497 kgs. per hectare.[2]

Squash - Both squash and small squash are important crops. There are 6,730 hectares[2] of squash with an average yield of 3,968 kgs. per hectare. Small squash is grown as an early season crop in the Salto area. There are some 621 hectares[2] of small squash with an average yield of 6,170 kgs. per hectare.

There are a number of other vegetable crops that are grown in Uruguay. The table lists the latest figures available for the number of hectares grown of each crop and the yield in kgs. per hectare.

Crop	Nº of hectares[2]	Av. yield kg/hect.[2]
Strawberries	215	3,032
Mellon	564	4,915
Lettuce	992	3,197
Swiss Chard	426	6,147
Spinach	289	2,062
Cabbage	148	6,787
Cauliflower	157	6,247
Dry beans	4,364	627
Sweet potatoes	14,195	5,591
Peas	757	2,011
Carrots	1,791	6,841
Sweet Corn	1,508	1,589
Watermellon	996	8,535

ARTHROPOD PESTS OF VEGETABLES.

Potatoes - Aphids are the most important pests and are commonly considered a major vector of viruses[2]. Thrips occur on potatoes and are another important virus vector.[2] Cutworms feed and cut the foliage off the small potatoes. The black cutworm, Agrotis ipsilon (Hufnagel) is the major cutworm pest with the larvae feeding on the foliage in the Spring and Summer, but not in the Fall or Winter. Other cutworms of the genus Peridroma, Laphyma and Heliothis cause a similar type of injury to potatoes. Three species of flea beetles of the genus Epitrix, Diabrotica and Systena are important pests of potatoes. Leafhoppers of the genus Empoasco are present on potatoes and may be vectors of viruses. Two homopterous pests of the genus Phenacoccus injure the tubers of potatoes and Pseudococcus citri attacks the tubers of Red Pontiac.

The most important of the larvae pests of tubers, especially bad when newly plowed sod is planted to potatoes, include Cycocephala signaticollis and Diloboderus abderus. Blister beetles attack potatoes. Important pests are Epicauta adpersa, E. atomaria, E. griseo-nigra and E. lactifera. Blister beetles are a more serious problem when grasshoppers are abundant, since the larvae feed on the eggs of grasshoppers while the adults feed on the potato foliage. The potato tuber moth, Gnorimoschema operculella is a minor problem since parasites that attack the larvae keep it under control. The larvae of an Arctiidae moth, Mallocephala deserticola feed on the foliage of potatoes but is not considered a serious problem. Ants, Acromyrmex hoyeri and A. lundi can do serious damage by feeding on the foliage.

Species of Pentatomidae, Edessa meditabunda, E. rufomarginata, and nezara viridula can be serious problems in some years. Both adults and nymphs of these feed on the foliage.

Tomatoes - Aphids are the major problem and probably a major cause of spread of viruses. Crickets of the genus Gryllus is an underground pest that cuts the roots of the tomatoes. It is more a problem on sandy soil.

The carmine spider mite, Tetranychus telarius at times, particularly in the Autumn can be a problem on solanaceous plants including potatoes, peppers and tomatoes.

Cutworms, particularly Agrotis ipsilon can cause damage to young plants.

The corn earworm, Heliothis yea some years can be a serious problem by feeding on the young fruit of tomato.

Onions - Thrips are the major pest of onions, and probably the only serious insect pest of this crop. Hylemyia antigua, the major problem of onions in North America is not present.

Peppers - Aphids are the most srious problem and probably the major vector of viruses. Other insect pests of peppers that may act as vectors are Diabrotica sp., thrips and a blister beetle, Epicauta adspersa.

Squash - The squash beetle, Solanophila paenulata is at times a serious problem on squash. Both larvae and adults feed on the foliage. The larvae of two species of pickleworm, Diaphania hyalinata and D. nitidalis also feed on the foliage and fruit. An aphid Aphis gossypi at times occurs in outbreak numbers.

Beans - The major pest of beans is a cutworm, Agrotis ipsilon. Two species of cutworm, Peridroma margaritosa and Laphgma frugiperda feed on the foliage of beans. The seed corn maggot, Hylemyia cilicrura is a seed pest. A leafminer, Epinotia aporema at times causes damage to the fruit. Aphids at times build up to damaging numbers. Diabrotica sp. are present.

Lettuce - Aphids are the only pest of any consequence on lettuce.

Swiss chard, spinach, watermellon, peas, sweet potatoes and carrots have no major insect problems.

Cauliflower and Cabbage - Aphids are the major problem of cruciferous crops including cabbage and cauliflower. The diamondback moth, Plutella maculipennis at times can be a problem. The larvae of two species of Pieridae of the genus Pieris and Tatochila feed on the foliage of cabbage and cauliflower.

Sweet Corn - The fall armyworm, Laphygma frugiperda, cutworms, Agrotis ypsilon and the corn earworm Heliothi zea are lepidopterous pests that can cause serious damage on corn. When corn is planted into newly cultivated land, white grubs can be a problem. These species include Cyclocephala modesta, C. signaticollis and Dyscinetus gagates.

Strawberries - Strawberry aphids are the major pest problem of strawberries. On heavy soil slugs can cause considerable damage. The white-fringed beetle, Eraphognathus leucoloma at times builds up to damaging numbers.

RECOMMENDATIONS FOR VEGETABLES.

1. More research in biology and control of vectors of viruses in solanaceous crops, particularly aphids, is urgently needed. Since improved chemical control is needed, this will require evaluation of new pesticides, particularly some of the outstanding aphicides such as Pirimor and Orthene.

2. New techniques for seeding and treating should be tested. Seeding may have advantages over transplants for crops such as peppers, onions, and tomatoes. Whether these crops be seeded or transplanted, furrow treatments using granular systemic pesticides at the time of planting should be proven.

3. Special equipment is required for vegetable research. This equipment should include a V-belt planter and pesticide applicator, available from the Allan Machine Co. (a) The Improved Test Plot and Garden Cone Seeder would be particularly useful for seeding and furrow treatments. This equipment, that was designed particularly for experimental work is available from Craftsman Machine Co. (b)

4. Research work on vegetable pests must be initiated in the Salto area. This region has great potential for vegetables, particularly early season vegetables. Ground for vegetable research should be made available at the Salto Citrus Experimental Station. A man, thoroughly trained by vegetable technicians at Las Brujas Experiment Station should be stationed in the Salto area. Technicians from Las Brujas could set up the experimental plots and make regular visits to Salto. The possibilities for free or reduced rates for passage and transport of equipment and personnel on the Government owned airline operating from Montevideo to Salto should be investigated.

(a) Allan Machine Co., Ames, Iowa 50010, U. S. A.
(b) Craftsman Machine Co., 201 Princess St., Winnipeg, 2, Manitoba, CANADA.

5. The alarm system for growers in the Montevideo area must be expanded and should be initiated in the Salto area. Present control practices on vegetables are currently poor resulting in great losses and downgrading of vegetables. Corn, for example, is seldom sprayed, so that much of the sweet corn marketed has insect damage. Pheromones, when available, should be employed in the alarm system.

6. Because of its small size and limited number of agricultural technicians, Uruguay is somewhat isolated from major research being conducted in other countries. To keep Uruguayan technicians fully informed on new ideas and techniques in vegetable and fruit research it is essential that Uruguayan technicians be able to travel to other countries, particularly countries in North and South America, where research work is being conducted on common problems.

7. If the possibilities of raising virus-free seed potatoes are investigated then research employing seed treatment of potato prices with systemics should be initiated. Research work, in addition to seed treatment, should include furrow, band, and foliar applications using systemic materials including arthene, Temik, and Thimet.

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