

INSECTS ON POTATO FOLIAGE WITH NOTES ON INSECT  
RESISTANT POTATO VARIETIES IN COLOMBIA

by

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## INTRODUCTION

The potato, Solanum tuberosum L., and other species of Solanum, are food natives to the Andes in South America, from which area the white potato was introduced into Europe about 1585. Years later it was brought to the United States, where it became an important farm crop.

In Colombia, potatoes are considered a daily basic food. They are grown in the high valleys and mountains, at altitudes over 8,000 feet, where the climatic factors, mainly temperature and precipitation, are favorable to the crop. In spite of the fact that in national production potatoes rank in fifth place commercially after coffee, sugarcane, corn and bananas, the importation of the tubers is still high (Estrada Ramos et al. 1959). This importation can be explained in part by the low yields obtained there. While in the United States the average potato yield is about 6.5 tons per acre, in Colombia it is only of about 2.1 tons per acre. This large difference in yields is the result of a great variety of factors, such as the growing of different species of Solanum, and differences in cultural practices including the control of diseases and insect pests.

The aims of this work were (1) to gain a better knowledge of the foliage insects found in potato fields in Colombia, and (2) to find sources of resistance in varieties of potatoes to the more important pests.

Agriculture is one of the most important industries in Colombia, but entomological work, due to the lack of personnel, has been mainly oriented towards the chemical control of the most serious insect pests. Very little is known about those insects that are not considered pests, but are commonly found in the fields.

After identification of the material collected on potato foliage, mostly by the personnel of the United States National Museum, the lack of taxonomic work in certain groups of insects was noted. Several undescribed genera, mostly of Diptera, and many undescribed species were found, constituting valuable material for further taxonomic studies. These studies, and others such as life histories of the insects and compilation of lists of the insect pests of the main crops are basic prerequisites to a well planned pest control program.

The control of insect pests can be accomplished in different ways. Cultural control for example, is based on the current cultural farm practices that help to check some of the insect pests. Included in these practices is the use of resistant varieties, which is based in the genetical transmission of certain plant characteristics that make it difficult for certain insect populations to increase on such plants. There are different methods of locating the sources of resistance to a certain pest, one of which is to work with plant material from or near the place of origin. Since Colombia is geographically located in or near the center or the origin of the potato, it is logical to think that a few of the cultivated varieties might carry some resistance to insect pests.

#### REVIEW OF THE LITERATURE

Both general and specific works, similar to this study, have been published. Painter (1955) studied the insects found on corn and teosinte in Guatemala. He collected about one hundred and eight species of insects, eighty-one on corn and twenty-seven on teosinte, of which about half were identified to species. In Peru, Wille (1954) compiled a list of the insects pest of the principal crops, and Yust and Ceballos (1955) made a

similar work in Ecuador, both include lists of potato insects. Also in Peru, Combe (1953) studied the potato insects found in the Valley of Rimac and Carabayllo.

In order to give complete information about the insects collected, a review of the literature was made and is given, for each one of the genera and species. This review was made having in mind the economic importance of the species. Since not all the insects were found reported as pest of potato, and some were found reported as pest of other crops, in some cases related to potato, it was considered important to record such information. While doing this review, it was noted that information on potato insects, besides those considered important pests, was scarce.

#### MATERIAL AND METHODS

##### Host

The insects discussed here were collected on Solanum andigenum Juz. and Buk., which includes the common varieties of potato grown for food in Colombia. The general appearance of this plant differs little from that of the Solanum tuberosum L. varieties, the species commonly grown in the United States and Europe. Some of the agronomic characteristics are different, but the main difference consists of the amount of water in the tubers. In general the varieties of S. andigenum have tubers with a higher specific gravity, which results from more dry matter and starches, giving a different flavor that is more acceptable to the Colombian consumer.

##### Collections

In order to have a more nation-wide coverage of the problem, the localities for the collections were chosen from among the most representative



potato producing centers across the country. The general method followed in making the collections was to sweep the plants. No special collections were made of soil insects and those that attack the tubers. Each one of the farms or fields visited was considered as a single collection, which was made up of several individual collections, the number of which varied with the size of the plantation.

The single collections were referred to by numbers and under each some general information was recorded. Included were variety grown, topography, type of planting, stage of the crop at the time of the collection, aspect of the field from the standpoint of weeds, and cultural practices currently used, the latter being mainly rotation and the application of insecticides and fungicides.

All the insects belonging to a single collection bear the number under which the collection was recorded. Each insect, except the aphids and thrips, was labeled, giving the locality name and altitude, date, collector, host, and in some cases a small letter was added to record the different genera and species within a particular family. After grouping all the single collections, the insects were sorted by orders and families. The identification of each insect was carried as far as possible before being sent to the specialists. Most of the specimens of the insects herein reported have been deposited in the entomological collection at the Centro Nacional de Investigaciones Agrícolas "Tibaitatá", Bogotá, Colombia, South America, and some in the United States National Museum or in the collections of the specialists who identified the material.

## Habitats

Since under the discussion of the species the only information relating to the collections themselves is the locality, date, and the number of specimens collected, it seems that a general description of the places where the collections were made will help one form a better idea of the habitate. In Table 1 are recorded the localities, altitudes, average maximal and minimal temperatures, average precipitation, and the numbers assigned to the single collections made in each locality. La Unión, Antioquia, which is not included in Table 1, is located near Sonsón, Antioquia, and the collections 3 and 9 were made there. Weather data was not available for this locality.

Table 1. Average annual maximum and minimum temperature, average annual precipitation, altitude and single collection numbers at five of the localities where the potato insect collections were made.\*

Locality	Temperature**: Max. Min.	Precipitation***:	Altitude in feet	Single collection number
Funza, Cundinamarca	22.8 1.9	62.6	8,365	1, 2, 22 and 23
Usme, Cundinamarca	16.4 2.8	105.2	10,235	21
Duitama, Boyaca	23.0 5.8	66.9	8,495	19 and 20
Pasto, Nariño	20.8 8.1	109.3	8,510	10 through 18
Sonsón, Antioquia	21.4 10.2	162.9	7,710	4 through 8

\* Based on data for three years, (Columbia, Min. de Agr. 1955).

\*\* In degrees Centigrade.

\*\*\* In millimeters.



Funza, Cundinamarca. This locality is in the "Sabana de Bogotá" in the eastern branch of the Colombian Andes, near Bogotá. Beside potatoe, other important crops of this area are wheat, barley and corn. It is also an important dairy cattle center.

Collection 1. October 12, 1955.

Variety: Tocana.  
 Field: under experimentation.  
 Topography: savanna.  
 Type of planting: rows.  
 Crop stage: half grown.  
 Field aspect: clean.  
 Rotation: cereals-potato.  
 Other treatments: application of weed killer, soil treatment with aldrin and fungicides.

Collection 2. Same data as above.

Collection 22. March 15, 1956.

Same as collection 1, except:

Crop stage: flowering.  
 Field aspect: potato plants with fungous diseases, mainly late blight.

Collection 23. Same as collection 22.

Usme, Cundinamarca. This locality is situated in the mountains near Bogotá and is mainly a potato growing region. The area called "the paramo" is so high that principally only grasses grow. Usme is near areas of this kind.

Collection 21. April 19, 1956.

Variety: Londree.  
 Field: under experimentation.  
 Topography: steep slope.  
 Type of planting: rows.  
 Crop stage: two thirds grown.  
 Field aspect: some weeds.  
 Rotation: pasture-potato.  
 Other treatments: one early application of 5% DDT dust and two of fungicides.

Duitama, Boyaca. This is an important agricultural section north of Bogota, in the eastern branch of the Colombian Andes and is a continuation of the "Sabana de Bogotá". This locality is an important fruit producing center. Other crops of the region are potatoes, wheat, barley, corn and lima beans. The topography is characterized, in general, by the presence of small valleys and low mountains.

Collection 19. April 12, 1956.

Variety: Tuquerreña.  
 Field: experimental plots.  
 Topography: gentle slope.  
 Type of planting: rows.  
 Crop stage: one third grown.  
 Field aspect: clean.  
 Rotation: cereals-potato.  
 Other treatments: none.

Collection 20. Same as collection 19, except:

Variety: Tocana.  
 Other treatments: sprayed with 25% heptachlor, emulsifiable,  
 2 pints per acre, and fungicide.

Pasto, Nariño. It is situated in an important agricultural section in the southern part of the country, near the frontier of Ecuador in a very mountainous and volcanic region. This locality is at the foot of the still active Galeras volcano. In general all temperate climate crops are grown, the most important being potatoes, wheat and barley.

Collection 10. December 7, 1955.

Variety: Jabonilla.  
 Field: commercial.  
 Topography: moderate slope; soil consists in part of volcanic ash.  
 Type of planting: in contour.  
 Crop stage: flowering.  
 Field aspect: clean.  
 Rotation: wheat-potato-corn-potato.  
 Other treatments: application of 5% DDT dust and fungicides.

Collection 11. December 9, 1955.

Same conditions as in collection 10.

Collections 12 to 16. Same as collection 11, except that the fields were under experimentation and each had a different variety.

Collection 17. December 9, 1955.

Conditions as in collection 10, except:

Variety: Pamba Morada.

Topography: gentle slope; soil without much volcanic ash.

Crop stage: two thirds grown.

Collection 18. Same as collection 17, except:

Varieties: Pamba Blanca and Guata.

Sonsón, Antioquia. This area is located in the central branch of the Colombian Andes, near Medellín, the principal consumer center. The general topography is a gentle to moderate slope with some small valleys. It is an important corn production center. Other crops of importance in the region are potatoes, beans and several other garden crops.

Collection 4. November 16, 1955.

Variety: Argentina.

Field: commercial.

Topography: gentle slope.

Type of planting: contour.

Crop stage: ripe fruits and vines starting to dry.

Field aspect: with many weeds.

Rotation: corn-leguminous-potato.

Other treatments: applications of fertilizer and fungicides; also soil treatment with sldrin and four sprays with DDT.

Collection 5. Same as the preceding except:

Crop stage: ripe fruits.

Field aspect: clean.

Rotation: corn-potato.

Collection 6. Same as collection 4.

Collection 7. November 17, 1955.

Conditions like those in collection 4, except:

Topography: moderate slope.

Crop stage: flowering

Field aspect: clean.

Rotation: corn-potato.

Other treatments: applications of DDT and fungicides.

Collection 8. Same as the preceding except:

Crop stage: beginning fruit formation.

La Unión, Antioquia. This area is situated near the preceding locality; the same general description would apply here, with the exception that the soil is of heavy clay.

Collection 3. November 16, 1955.

Variety: Argentina.

Field: commercial.

Topography: moderate slope.

Type of planting: in contour.

Crop stage: ripe fruits, some dried vines.

Field aspect: clean.

Rotation: corn-potato.

Other treatments: one application DDT dust.

Collection 9. November 17, 1955.

Conditions same as in the preceding except:

Crop stage: flowering.

#### SPECIES OF INSECTS COLLECTED ON POTATO

Most of the identification of the specimens was done by specialists of the staff of the Entomology Research Branch, Agricultural Research Service, United States Department of Agriculture. A list of the identifiers follows, and they will hereafter be cited by their initials only: Albuquerque, D. de O.; Burks, B. D.; Cartwright, O. L.; Chapin, E. A.; Foote, R. H.; Kramer, J. P.; Krombein, K. V.; Muesebeck, C. F. W.; O'Neil, K.; Ruppel, R. F.; Russell, L. M.; Sabrosky, C. W.; Sailer, R. I.; Smith, R. C.; Spangler, P. J.; Spilman, T. J.; Stone, A.; Vogt, G. B.; Walkley, L. M.; Weld, L. H.; and Wirth, W. W.

To be consistent in the treatment of the material, the different genera and species were arranged alphabetically under the families, which

were arranged phylogenetically under the different orders. For each species the identifier's initials follow the names, then the number of specimens collected, the localities, and the dates are given. After this, general references on the genus are cited, followed by those concerning potato pests, and those concerning pests of other crops. The majority of the scientific names used in this paper are stated as found in the paper cited.

A total of about 2,950 specimens were collected, representing near 208 species. Of these, 32.2 per cent were identified to species, which is lower than the one obtained by Painter (1955) in insects collected on corn and teosinte in Guatemala; 59.7 per cent to genera, and the remaining 8.1 per cent to higher categories.

#### Thysanoptera

##### THRIPIDAE

##### Frankliniella sp. (Det: K. O'N.)

Several specimens, mostly females, were collected at Pasto, Dec. 9, 1955.

Species of this genus have been recorded in the literature attacking a great variety of plants that are not taxonomically related. Munro (1954) and Yuet and Ceballos (1955) reported F. tuberosi (Moult.) causing damage potato leaves in Bolivia and Ecuador. F. occidentalis Perg. has been recorded on cotton causing stunting of the plants (Smith 1942), damaging cotton seedlings in New Mexico (Eyer and Medler 1941) and infesting onion umbels and flowers, causing a type of injury similar to that of the Thrips tabaci Lind. (Elmore 1949). The species, F. tritici (Fitch), was recorded in Canada damaging fruit trees (Boyce 1955) and in Texas on cotton seedlings



(Hightower and Martin 1956).

Other species have been reported on wheat (Nuorteva and Kanervo 1952), lima beans (Wilcox and Howland 1954), and corn and teosinte (Painter 1955).

From Brazil and Argentina, several species have been reported as vectors of virus diseases of tomato, tobacco and citrus (Sauer 1946; Reiniger 1942; and Fawcett 1940).

### Homoptera

#### CICADELLIDAE

"Species near genus Bahita" (Det: J. P. K.)

Only one specimen collected at La Unión, Nov. 16, 1955.

Agallia sp. (Det: J. P. K.)

One female specimen collected at La Unión, Nov. 17, 1955.

Many of the species of this genus are considered of importance as vectors of diseases. The species, A. constricta Van D. and A. quadripunctata (Prov.) were found responsible for the transmission of the New Jersey variety of potato yellow dwarf virus on clover (Black 1944). It is considered important to point out that A. quadripunctata was the only specific leafhopper of white clover in northern New York (Wolcott 1950).

A. albidula Uhl. has been reported from Brazil as a common insect on cotton, potato, lettuce, pimento, sugar beet and tobacco, and it was found as vector of a virus disease of tomato (Sauer 1946; Bennett and Costa 1949).

The species A. sticticollis Stal., was reported from Argentina as vector of a kind of curly top of sugar beet (Fawcett 1927), and A. sanguinolenta Prov. as vector of potato yellow dwarf in the United States



(Black 1934).

A. lingula (Van D.) was reported from Ecuador as a potato pest (Yust and Ceballos 1955).

Balclutha sp. (Det. J. P. K.).

A total of three female specimens was collected at La Unión, Nov. 16, 1955; and Soneón, Nov. 16, 1955.

Caldwell and Martorell (1950a) reported two species from Puerto Rico, collected on grasses and at lights.

Cicadulina pastuae Pup. & Del. (Det: J. P. K.).

A total of eight specimens were collected: seven from Pasto, Dec. 9, 1955; and one from La Unión, Nov. 16, 1955.

This species was described from Colombia, and it seems that it may have caused the stunting of barley in southwestern Colombia and northern parts of Ecuador. Studies on this problem are being carried out now.

Caldwell and Martorell (1950a) reported the species C. tortilla from Puerto Rico, where it was found on grasses around the coastal plains and at high altitudes. They stated that most of the members of this genus are pests of corn, and that several species have been proven to be vectors of virus diseases.

From Tanganika the species, C. mbila Naude, C. zea China and C. storeyi China, were reported as responsible for the transmission of the streak disease and other virus diseases of corn (Storey 1937, 1939).

"Deltoccephalus" sp. (Det: J. P. K.).

A total of seven specimens were collected: one at Funza, Oct. 12, 1955; four at Usme, April 19, 1956; and two at Pasto, Dec. 7 and 9, 1955.

Three species of this genus were recorded in Puerto Rico. The commonest seemed to be D. flavicosta Stal., that was found on grasses and

weeds, mainly under Carica papaya trees. Some were collected sweeping on Manihot utilisima (Caldwell & Martorell 1950a).

D. affinis Gillete and Baker occurs throughout North America and has been recorded feeding on blue grass and other grasses, and also attacking oats and wheat (Essig 1958).

Empoasca sp. (Det: R. F. R.).

One female specimen was collected at Paeto, Dec. 9, 1955.

Species of this genus have a large range in distribution and hosts. They have been recorded on legumes, solanums, cucurbits, alfalfa, cotton, and other crops, constituting pests of many of them. About two hundred species are known from the nearctic region, of which at least fifteen are of economic importance. Seven species have been reared on potato in the United States, including E. abrupta DeL., E. bifurcata DeL., E. delongi Poos, E. filaments DeL., E. recurvata DeL., and E. solana DeL. (Painter 1951). About twenty-six species have been reported from Puerto Rico (Caldwell and Martorell 1950a).

An undescribed species of Empoasca was reported damaging the leaves of potato in Bolivia (Munro 1954). Several species of Empoasca were found building up large populations on potato fields in British Columbia during the late summer, particularly in large, well irrigated fields, but the damage was small (MacCarthy 1956). The species E. yusti, was recorded on potato in Brazil (Young 1956). E. mali was reported from Chile to be a serious pest of potato, producing a leaf burning like that due to the early blight disease, and reducing the yield as much as 50 per cent when not controlled (Mujica 1942). From India, E. punjabensis Pruthi was reported causing hopperburn on potato leaves (Vevai 1942); and in Spain, E. pteridie was frequently found on potato, in a study made on the relation

of the transmission of potato virus diseases by insects (Archimowitch 1952).

From Colombia, Ruppel and DeLong (1956) reported the new species E. ecinda Rup. and DeL., as a common insect on beans and corn, and E. antioquinae Rup. and DeL., which was recorded on *Crotalaria* and grasses. Empoasca bispinata Dav. and DeL. (Det: R. F. R.).

Five specimens were collected: one at Pasto, Dec. 9, 1955; two at Sonsón, Nov. 16, 1955; and two at La Unión, Nov. 16, 1955.

This species was described from Mexico, and has been recorded on peas, corn, and at lights in Colombia (Ruppel and DeLong 1956).

Empoasca fabae (Harr.) (Det: R. F. R.).

One specimen was collected at La Unión, Nov. 16, 1955.

This species is commonly known as the potato leafhopper. It occurs throughout the eastern half of the United States up to 2,000 feet elevations, and its possible reduction in yield of potato has been estimated at more than 50 per cent (Painter 1951).

In Colombia, it is considered the most important insect pest of beans, where during some seasons it has destroyed all plants in fields which have not received insecticide applications. It also has been recorded on corn, cowpeas, soybeans, and weeds. Its elevation range in Colombia is from 3,280 to 4,920 feet (Ruppel and DeLong 1956).

This species was considered the most common of the genus Empoasca in Puerto Rico, where it has been recorded on egg-plant, Indigofera sp., Carica papaya, and many other plants (Caldwell and Martorell 1950a). From Cuba, it was reported to be a possible vector of the sugar cane mosaic (Osborn 1926).

Empoasca papae Rup. and DeL. (Det: R. F. R.).

One hundred and seven specimens were collected: eighty-seven at Pasto, Dec. 9, 1955; sixteen at Sonsón, Nov. 17, 1955; and four at La Unión, Nov. 16, 1955.

This species was described from Colombia, where it is the commonest leafhopper in the potato fields, especially in those of the southwestern part of the country. It also was recorded on beans and alfalfa (Ruppel and DeLong 1956).

Empoasca prona Dav. and DeL. (Det: R. F. R.).

Eleven specimens were collected: nine at Sonsón, Nov. 16, 1955; and two at La Unión, Nov. 16, 1955.

This species was described from specimens from Mexico, Costa Rica, and Brazil. In Colombia, it has been collected in small numbers on potato, beans, cowpeas, soybeans, corn and weeds, at elevations ranging from 4,920 to 8,365 feet (Ruppel and DeLong 1956). In Puerto Rico, it was found in the mountains, mainly on grassees and weeds (Caldwell and Martorell 1950a).

Paratanus sativae Young (Det: J. P. K.).

Thirty six specimens were collected at Pasto, Dec. 9, 1955.

Paratanus yusti Young (Det: J. P. K.).

A total of one hundred and forty-one specimens were collected: one hundred at Pasto, Dec. 9, 1955; thirty-three at Duitama, April 12, 1956; five at La Unión, Nov. 17, 1955; two at Sonsón, Nov. 17, 1955; and one at Funza, Oct. 12, 1955.

This species seems to have a larger range of distribution than P. sativae. By the large number of specimens collected it seems to be a species that breeds well on potatoes, especially at Pasto, where most of

the insects were collected. It was reported to be found on potatoes in Ecuador (Yuet and Ceballos 1955).

Scaphoideus sp. (Det: J. P. K.).

One specimen collected at La Unión, Nov. 17, 1955.

The species S. luteolus Van D. is considered the vector of the virus causing the phloem necrosis of the American elm in United States (Baker 1949). From Sudan, S. aegyptiacus Mats. was reported on cotton (Bedford [1937]).

"Tettigonia" sp. A. (Det: J. P. K.).

Two specimens collected at Duitama, April 12, 1956.

"Tettigonia" sp. B. (Det: J. P. K.).

Three specimens were collected: two at La Unión, Nov. 16, 1955; and one at Sonson, Nov. 17, 1955.

Xerophloea viridis (Fab.) (Det: J. P. K.).

One specimen collected at Duitama, April 12, 1956.

This species was recorded in Puerto Rico on grasses and low vegetation (Caldwell and Martorell 1950a) and in Cuba it was considered as one of the most important grass-feeding species and as a possible vector of the sugar cane mosaic (Osborn 1926).

The species X. vanduzeei was reported from California, where it produced symptoms like those of the curly top and yellow aster, on beet and aster respectively, possibly as the effect of a toxic salivary secretion (Severin et al. 1945).

#### DELPHACIDAE

Delphacodes sp. (Det: J. P. K.).

Three female specimens were collected at Funza, March 15, 1956.



Delphacodes near gluciophila Muir (Det: J. P. K.).

Two specimens collected at Sonsón, Nov. 16, 1955.

Delphacodes pacificus (Crawford) (Det: J. P. K.).

Two specimens were collected: one at Funza, Oct. 12, 1955; and one at Duitama, April 12, 1956.

Delphacodes nigra (Crawford) (Det: J. P. K.).

One specimen collected at Funza, March 15, 1956.

This species was recorded on weeds and grasses in Puerto Rico (Caldwell and Martorell 1950b).

Delphacodes saccharicola Muir (Det: J. P. K.).

One specimen collected at Pasto, Dec. 9, 1955.

Most of the species of this genus have been reported on cereals.

D. pellucida (F.) was reported damaging oats in Finland (Kenerve et al. 1957), and injuring cereal crops in Sweden, by sucking the sap and by inserting its eggs into the internodes (Rosen 1955).

D. striatellus Fall. was reported from Russia as vector of a virus disease of cereals (Sukhov 1941) and, from Japan, as vector of the white leaf virus of rice (Malaguti 1956). This fact is of great importance in view of the recent outbreak of the white leaf disease of rice in Colombia and Venezuela. Another species reported as pest of rice in Japan was D. oryzae Mats. (Esaki and Hashimoto 1931).

#### APHIDAE

Macrosiphum solanifolii (Ashm.) (Det: L. M. R.).

About twenty-four specimens were collected at La Unión, Nov. 16, 1955; Sonsón, Nov. 16, 1955; and Pasto, Dec. 9, 1955.



This species has a wide range in distribution and host plants. It has been recorded in England, Germany, Norway, Switzerland, continental United States, Hawaii, Brazil, Peru and many other countries. Of the host plants, beside potato, it has been reported on other solanums, legumes, crucifers and many others. Haine (1951) reported it on potato and twelve other plant species from Germany. From Virginia it was recorded on potato, tomato, egg-plant and sixty-two other hosts (Smith 1919), and from Colorado it was reported to be distributed throughout the region, and on thirty-three plant species, including potato, as summer hosts (Palmer 1952).

Its economic status on potato is as a possible vector of diseases. From England it was reported as vector of two virus diseases of legumes (Chaudhuri 1950). It was found transmitting virus diseases in Peru (Wille [1942]) and responsible for the transmission of the spinach blight in Virginia (Smith 1919).

Myzus circumflexus (Buckl.) (Det: L. M. R.).

One specimen from La Unión, Nov. 16, 1955.

This aphid was reported as common on potato and was recorded on thirty-two different plant species and varieties in Germany (Haine 1951). Look and McAfee (1944) reported it from Hawaii on Carica papaya and rose. In United States, it was found to be the commonest aphid on lilies, especially in greenhouses and cold frames, injuring lily seedlings (Imle and Hartzell 1942). From England it was reported attacking young tomato plants in greenhouses (Speyer et al. 1942), and from Colorado it was recorded on thirteen plant species, including potato (Palmer 1952).

Myzus persicae (Sulz.) (Det: L. M. R.).

The identification was based on about fifty-five specimens collected at La Unión, Nov. 16, 1955; Sonsón, Nov. 16, 1955, and Pasto, Dec. 9, 1955.

This species is of economic importance as a vector of virus diseases to a large number of plants. It has been found transmitting virus diseases of potato, beet, tobacco, tomato, spinach, and other crucifers, clover, citrus and many other plants.

In Germany it was recorded on potato and forty-nine other plant species and varieties (Haine 1951). From India it was reported to be harbored by twenty-one host plants belonging to seven families, including Solanaceae (Samuel 1940). In Brazil, it was found responsible for the transmission of the virus disease "yellow top" of tomato (Coeta 1949), and in Colorado it was found distributed throughout the region, and on eight plant species as winter hosts, and forty-four, including potato, tomato, and egg-plant as summer hosts (Palmer 1952).

Myzus solani (Kltb.) (Det: L. M. R.).

Only two specimens were collected at Sonsón, Nov. 16, 1955; and Pasto, Dec. 9, 1955.

Haine (1951) reported it on potato and thirty-four other plant species from Germany. Speyer et al. (1942) reported it as the commonest aphid on tomato and lettuce in greenhouses in England. As a vector of virus diseases, Severin and Drake (1948) found it able to transmit the sugar beet mosaic. In Peru it was recorded on potato and found responsible for the transmission of virus diseases (Wille [1942]). Zogg et al. (1949) reported this species infesting stored potatoes in Switzerland, and from Colorado it was reported on thirteen plant species, including potato and tomato, and it was also found in flower beds and greenhouses (Palmer 1952).

## Hemiptera

## ANTHOGORIDAE

Orius laticollis Reuter (Det: R. I. S.).

Twenty-one specimens were collected: eighteen at Pasto, Dec. 9, 1955; two at La Unión, Nov. 16, 1955; and one at Soneón, Nov. 16, 1955.

Dr. Sailer, in personal correspondence, reported that this is the first record in the Western Hemisphere of this European species. A characteristic of this species is the presence of few males in the population.

Several species of this genus have been reported as predators on mites, aphids, thrips, psyllids and lace bugs. O. insidiosus (Say) is considered an important source of natural control, as a predator on eggs and young larvae of Heliothis armigera (Hbn.) (Fletcher and Thomas 1943; and Winburn and Painter 1932). O. sauteri Popp was reported destroying the eggs and young larvae of Pyrausta nubilalis (Hbn.) in Japan, before they entered the cotton plants (Koo 1940).

## MIRIDAE

Ellenia sp. (Det: R. I. S.)

Three specimens were collected at Soneón, Nov. 16, 1955.

Miris gualimalanus Dietant (Det: R. I. S.)

Two specimens were collected, one each at Pasto, Dec. 9, 1955; and Usme, April 19, 1956.

In the literature, M. dolobratue (L.) was reported as a pest of grasses in Kentucky and Illinois (Jewett and Townsend 1947; Knight 1941). It also has been considered to be a pest of wheat in Iowa. M. ferrugatue

Fall. was collected in Utah on rye, wheat, barley, oats and native and introduced grasses (Knowlton 1947). Based on these reports, it would be possible to collect this species on potato, when this crop is grown beside fields of wheat, barley or pastures, as is often true. This is one of the few cases in which a species was found at two localities with considerable difference in altitude.

Phytocoris sp. (Det: R. I. S.)

Three specimens were collected at Pasto, Dec. 9, 1955.

The species Phytocoris tiliac F. was reported from England feeding on adults and summer eggs of Paratetranychus pilosus C. and F. on apple, pear, plum, elm, and other plants (Hey 1944).

Proba sallei Stal (Det: R. I. S.)

Fifty-seven specimens were collected: five at Funza, Oct. 12, 1955; two at La Unión, Nov. 16, 1955; five at Soneón, Nov. 16, 1955; thirty-four at Pasto, Dec. 9, 1955; and eleven at Duitama, April 12, 1956.

This species was reported from Ecuador on potato (Yust and Ceballos 1955).

NABIDAE

Nabis sp. (Det: R. I. S.)

Sixteen specimens were collected at Pasto, Dec. 9, 1955.

In general the species of this genus are characterized by their predacious habits. In some cases they have been considered to be an important controlling factor of various insect pests.

The species N. ferue L. has been found feeding on different potato insects. Knowlton (1943) found it feeding on Myzus persicae (Sulz.) in Utah. From North Dakota and Utah it was reported as predator on Empoasca

fabae (Harr.) and E. filamenta (Dsl.) (Munro and Telford 1943; Knowlton 1932). Also in Utah, it was observed killing the potato psyllid, Paratrioxa cockerelli (Sulc.) (Knowlton 1934); and from Virginia, it was reported to be a predator of Laphigma frugiperda (J. E. Smith) (Hofmaster and Grsenwood 1949).

An unidentified species of Nabis was reported from Poland, as a predator of the Colorado potato beetle, Leptinotarsa decemlineata (Say) (Kaczmarek 1955). The species N. punctipennis was reported as predator of Heliothis armigera (Hbn.) on cotton in Peru (Wille 1951).

#### LYGAEIDAE

Polychisme ferruginosus (Stal) (Det: R. I. S.)

Two specimens were collected at Usme, April 19, 1956.

#### SALDIDAE

Saldula sp. (Det. R. I. S.)

One specimen collected at Funza, March 15, 1956.

Drake (1952) reported the species S. pallipss, as the commonest and most widely distributed holarctic species in the Americas. It is found from Alaska south through Central and Insular America, into Brazil, Argentina and Chile. The species S. fernaldi and S. monae are considered indigenous in the Americas.

#### PENTATOMIDAE

Thyanta perditor (F.) (Det: R. I. S.)

One specimen collected at Pasto, Dec. 9, 1955.



The species Thyanta custator (F.), the common stink bug, has been reported as a cotton pest from Arizona, California, and St. Vincent (Stevenson and Kauffman 1948; Smith 1942; and Hutson [1918]). The same species was considered a severe pest of tomato fruits in California (Michelbacher et al. 1952).

## Neuroptera

### HEMEROBIIDAE

Twenty-five specimens of this family were collected at: La Unión, Nov. 16, 1955; Sonsón, Nov. 16, 1955; and Pasto, Dec. 9, 1955.

Dr. R. C. Smith identified the specimens under the following three species, but he sent the material to Dr. F. M. Carpenter to check the identifications, and at the time of this report no further identifications were received.

#### Hemerobius sp. (Det: R. C. S.)

Species of this genus have been reported as predators of aphids and other insects. A larva of Hemerobius sp. was found as a predator of larvae of Colorado potato beetle, Leptinotarsa decemlineata (Say) in Czechoslovakia (Moucha 1952). Miller (1928) reported Hemerobius sp. as an important natural enemy of the spirea aphid, Aphis spiraeicola Patch, in Florida.

H. stigma was considered an effective predator of Chermes pini L. and C. strobi Htg. pests of pine in England (Wilson 1938). H. pacificus Banks has a wide range in distribution in the western United States, from Alaska to Mexico, and some of the hosts on which it has been found feeding are European red mite, red spiders and two spotted spider mite. It also



has been observed feeding on apple aphids, tomato aphids and cotton aphids (Essig 1958).

Hemerobius simulans Walker (Det: R. C. S.)

Wesmaelius sp. (Det: R. C. S.)

The species, W. concinnus Stsph., was reported as a predator of Chermes pini L. and C. strobi Htg. from England (Wilson 1938).

#### Coleoptera

##### HYDROPHILIDAE

Tropisternus lancifer Shp. (Det: P. J. S.)

One specimen collected at Usame, April 19, 1956.

This is an aquatic species, and some larvae of the same genus were reported to have certain habits that make them important as mosquito pupal predators (Hintz 1951).

##### STAPHYLINIDAE

A total of six specimens of beetles of this family were collected at Duitama, April 12, 1956; and Funza, Oct. 12, 1955. They seem to be two different species, but no specialist was available at the United States National Museum to make the identifications.

##### CANTHARIDAE

Discodon sp. (Det: T. J. S.)

One specimen collected at Sonsón, Nov. 16, 1955.

## LAMPYRIDAE

Photinus sp. (Det: T. J. S.)

One specimen collected at La Unión, Nov. 16, 1955.

## ELATERIDAE

Pomachilius euturalis Cand. (Det: T. J. S.)

Three specimens were collected at La Unión, Nov. 17, 1955; and Sonson, Nov. 17, 1955.

## CRYPTOPHAGIDAE

Atomaria sp. (Det: P. J. S.)

One specimen was collected at Paeto, Dec. 9, 1955.

The species most commonly reported in the literature is A. linearis Steph., as pest of sugar beet. Edwards and Thompson (1934) reported it as a serious pest and stated that it may kill about 70 per cent of the plantings, attacking shoots, roots, foliage and crowns. They found that low temperatures and extreme humidity during the seedling period contribute to the outbreak. In the Ukraine it was reported as a serious pest of beet, and that while most of the infested beets have fungus diseases, it was found that the insect does not transmit the fungi (Zabolotskaya 1936). In England, it is not only a pest of beets, but also of mangel, especially in eastern and southeastern regions (Jary and Austin 1939; Massee 1937). A case was found where it is not a pest, but a beneficial insect, as pollinator of apple in southeastern England (Massee 1937).

The species A. psallioticola was reported from South Africa from mushroom beds (Hinton 1941).

## LATHRIDIIDAE

Melanophthalma (Melanophthalma) sp. (Det: L. M. W.)

Six specimens collected at Pasto, Dec. 9, 1955.

The species M. gibbosa Hbst. was found to be common on potato foliage during the summer in New Zealand (Cottier 1931b) and reported as not transmitting the virus of the leaf-roll of potato (Cottier 1931a).

## COCCINELLIDAE

Coccinellina emarginata (Muls.) (Det: E. A. C.)

A total of five specimens were collected: three at Pasto, Dec. 9, 1955; and two at Duitama, April 12, 1956.

Eriopie connexa (Germ.) (Det: E. A. C.)

Eleven specimens were collected: one at Funza, Oct. 12, 1955; one at Duitama, April 12, 1956; and nine at Usme, April 19, 1956.

This species was reported as a predator of Toxoptera graminum (Rond.) (Hayward 1940) and was considered an important predator of the roe aphid, Macrosiphum rosae (L.), in Argentina (Lopez Cristobal 1944).

Hinda fifteen-maculata Ws. (Det: E. A. C.)

One specimen collected at La Unión, Nov. 16, 1955.

## SCARABAEIDAE

Ancognatha scarabaeoides Burm. (Det: O. L. C.)

Eleven specimens were collected at Funza, Dec. 23, 1958.

In Colombia this species is mainly a graminous crops pest, but also attacks the potato tubers, making holes that are not very deep. It is found all over the country. The severity of its damage depends on the larval population in the soil, which is larger in newly open soils that

have been covered with pastures for long periods (Posada 1958).

#### CHRYSOMELIDAE

Alticinae - genus not ascertained (Det: G. B. V.)

One specimen collected at Pasto, Dec. 7, 1955.

Chaetocnema spp. (Det: G. B. V.)

Seven specimens representing three species were collected: species 1 at Funza, Oct. 12, 1955; Sonsón, Nov. 16, 1955; and Pasto, Dec. 9, 1955; species 2 at Funza, Oct. 12, 1955; and species 3 at Pasto, Dec. 9, 1955.

Most of the species of this genus have been reported as pests of cereals and sugar beets. C. pulicaria Melsh. and C. denticulata (Ill.) were reported from Maryland as pests of corn and as vectors of the bacterial wilt of corn (Rand and Cash 1933; Poole 1945). The species C. aridula Gyll. and C. hortensiae Geoffr. were found the most common flea beetles attacking wheat, barley and spring sown rye in Siberia, where the larvae mine in the stems and the adults feed on the green leaves (Rubtsov 1935). The same species were reported from Sweden attacking the stems of wheat sown in the summer (Johansson 1942).

It seems that the species C. tibialis (Ill.) is one of the most serious pests of sugar beet. It has been reported from Spain, where in certain areas the damage by these insects to sugar beet reaches 100 per cent of the crop (Canizo 1952). In Austria in 1948, it caused great damage, killing the seedlings (Watzl 1950), and in Italy it was reported as one of the most dangerous insects on sugar beet (Ghidini 1947).

From Puerto Rico and Jamaica have been reported C. amazona and C. apricaria respectively, attacking the foliage of sweet potato (Catoni 1922; Ritchie 1917).

Epitrix spp. (Det: G. B. V.)

Two different species were found in the collected material and tentatively were distinguished as species 1 and species 2. Two hundred and sixty-six specimens were identified as species 1 which were collected at all the localities, except Usme. Only three specimens of the species 2 were collected, two at Funza, Oct. 12, 1955; and one at Sonson, Nov. 16, 1955.

These beetles were among the most common insects in each one of the collections. In Colombia they are considered a serious pest of potatoes, especially on young plants, and the plantings may be destroyed if no measures of control are applied. The damage is done to the foliage by the adults making small holes in the leaves, and by the larvae to the foliage, but no damage has been observed by the larvae on the tubers in Colombia.

Dawe (1916) recorded the species E. nigrosenea Har. on potato in Colombia, attacking the young, tender leaves and sometimes ruining the entire plantings.

Elsewhere in the United States the species E. cucumeris (Harr.), commonly known as potato flea beetle, is considered a serious potato insect pest, but it also has been reported attacking other plants such as crucifers. Another species that causes damage to potatoes, is the tuber flea beetle, E. tuberic Gent. The larval damage of this species is considered a factor of major importance in the production of high quality potatoes in Nebraska (Hill and Tate 1944). The adult form was observed feeding on leaves of a large number of wild and cultivated plants in British Columbia, where it has become a serious pest of potato since 1944, when it was first observed (Neilson and Finlayson 1953). MacCarthy (1951) reported



that under cage conditions E. subcristata (Lec.) causes a similar damage on potato tubers as that of E. tuberis. In British Columbia it was found that this species not only injured the tubers but also the foliage (MacCarthy 1953). This species has been established in British Columbia since 1949, and in a survey of insect populations in potato fields, it was found most abundant in small unirrigated fields (MacCarthy 1956). Munro (1954) reported from Bolivia an unidentified species of Epitrix causing damage to potato leaves.

Other species of this genus have been recorded attacking other plants. E. parvula F. was recorded injuring egg-plant in the Dominican Republic (Russo 1927), and the same species was reported from Jamaica as a pest of sweet potato and tobacco (Edwards 1930). In experiments conducted at Virginia Experiment Station, it was found that this species feeds mainly on solanaceous plants, which in order of importance were tobacco, potato, tomato, egg-plant and pepper (Glase 1943).

E. fuscata Crotch was reported as abundant on egg-plant, but few on potato during 1937-1938 in Pennsylvania (Hallock 1939), and E. argentinensis Bryant was reported on tobacco in Argentina (Hayward 1942). Phyllotreta sp. (Det: G. B. V.)

One specimen collected at Paeto, Dec. 9, 1955.

The species, P. affinis, was reported as pest of potato in Britain and Ireland (Warburton [1920]; Pethybridge 1915). But, most of the species of this genus have been recorded as pests of crucifers. Froet (1949) reported that ten different species of Phyllotreta were collected on crucifers in Pennsylvania, and that all of them had been recorded as pests in the United States and Canada. In Poland, six different species were found damaging rape and turnip rape during the summer (Hárdtl 1952). P. armoracea



(Koch) was reported as a pest of horseradish in Germany, where the larvae mine in the leaf-stalks; other species which also were found attacking crucifers were: P. atra F., P. cruciferae Gze., P. nemorum L., and P. indulata Kutsch (Böning 1938).

Pollard (1956) reported P. cheiranthi Weise from Sudan, as an important pest of crucifers, especially seedlings. From Britain, Smith and Markham (1946) recorded one species of Phyllotrsta as responsible for the transmission of the turnip yellow mosaic virus, this being the first time in Britain that a biting insect was reported as a vector of a virus disease.

Nodonota sp. (Det: G. B. V.)

Three specimens were collected: two at La Union, Nov. 16, 1955; and one at Sonson on the same date.

The species of this genus seem to be general feeders. Steiner and Chapman (1937) in a survey of food plants of N. puncticollis (Say) in New York, found larvae and pupae among roots of Trifolium agrarium, Potentilla canadensis, Hieracium pratense and H. aurantiacum, during the spring of 1937; adults were observed feeding on dogwood, Cornus spp. Severe injury was caused to fruits and slight injury to leaves of apples, pear and peach. They also were found feeding on eleven other plants. Usually the plants injured were close to those that harbored the larvae.

In Louisiana, N. tristis (Oliv.) was found destroying young buds of cotton and feeding in other parts of the plant above ground (Folsom 1936), and Essig (1958) reported this species as common in many parts of North America, where the adults feed on leaves of peach, plum and other trees and shrubs.

Systema spp. (Det: G. B. V.)

A total of five specimens were collected: one at Sonsón, Nov. 17, 1955, which was determined as Systema sp. 1, possibly exclamationee Boh.; and four at Duitama, April 12, 1956, determined as Systema sp. 2.

Based on the literature, the species of this genus seem to be more general feeders than specific ones, since the same species may be found on taxonomically unrelated plants.

S. taeniata (Say) has been reported as pest of potatoes from New Mexico and Virginia (Eyer and Enzie 1939; Underhill 1928) but it also was found in soybean fields in Minnesota (Kretzschmar 1948).

S. blanda (Mele.) has been reported as a potato pest from Virginia (Underhill 1928) and from Nebraska, where it was numerous in early summer, especially in irrigated fields (Hill and Tate 1944). Calvino et al. (1920) listed it as one of the principal insect pests of tomato in Mexico, and Biesell (1941) recorded it on cotton in Georgia. He stated that the occurrence of outbreaks of this species is not influenced by temperature, but that dry periods during the fall, winter and spring permits the population to increase.

Goss (1930) reported the species S. elongata (F.) transmitting potato virus diseases in United States. The same species was reported from Louisiana on cotton, damaging the squares, bracts and leaves, and as able to kill small plants (Foleom 1936). S. hudsonias (Foret.) was reported as an occasional pest of potatoes in Ohio (Gui 1938), and S. frontalis (F.) was found in soybean fields in Minnesota (Kretzschmar 1948) and reported as a minor pest of rice in the United States (Douglas and Ingram 1942).

## Diptera

## CHIRONOMIDAE

Genus and species unknown. (Det: W. W. W.)

Three specimens representing more than one species were collected: one at Pasto, Dec. 9, 1955; one at La Unión, Nov. 17, 1955, and one at Funza, Oct 12, 1955.

## PHORIDAE

Genus and species unknown. (Det: W. W. W.)

Two specimens representing more than one species were collected: one at La Unión, Nov. 16, 1955, and one at Pasto, Dec. 9, 1955.

The adults of this family may be found on certain flowers and leaves; the larvae generally feed on decayed vegetable or animal matter; some are parasites of ants, bees or beetles (Essig 1958).

## SYRPHIDAE

Allograpta sp. (Det: W. W. W.)

One specimen collected at Pasto, Dec. 9, 1955.

The species of this genus are considered important predators on aphids. One of the commonest species cited in the literature is A. obliqua (Say). It is a widespread and common species throughout North and South America, and its larvae are general and effective predators of aphids (Essig 1958). This species was found in large numbers preying on Aphis gossypii Glov., the vector of the rosette disease of lilies in Bermuda (Waterston 1938). Also from Bermuda it was reported giving good control of the aphid Cinara

sp., on Bermuda cedar (Waterston 1944). Miller (1928) reported this species from Florida, as a predator of the green citrus aphid, Aphis spiraeicola Patch; and in Maine it was found among several syrphid larvae feeding on an aphid infesting the red pine (Bean 1950). Wildermuth and Walter (1932) reported the species A. fracta O. S. as the most important predator of the corn leaf aphid, Aphis maidie Fitch., in the United States.

Allograpta exotica (Wied.) (Det: W. W. W.)

Four specimens were collected: three at La Unión, Nov. 16 and 17, 1955; and one at Soneón, Nov. 16, 1955.

This species has been reported from Argentina as a predator, helping in the biological control of Toxoptera graminum (Rond.), a serious pest of cereals (Lopez Cristobal 1941), and also attacking the aphid Anuraphie schwartzi Börner, on peach (De Santis 1942).

Melanostoma inflatifrons Fluhe (Det: W. W. W.)

One specimen collected at Pasto, Dec. 9, 1955

Melanostoma punctulatum v.d.W (Det: W. W. W.)

A total of thirty-six specimens were collected: eight at Soneón, Nov. 16 and 17, 1955; and twenty-eight at Pasto, Dec. 9, 1955.

Species of this genus have been recorded as predators of aphids. Dunn (1949) observed M. mellinum L. feeding on potato aphid in northern England. An uncommon case was reported by Robertson (1939) where M. fasciatum Macq. was preying on larvae of Plutella maculipennis (Curt.), an important pest of cruciferous crops in New Zealand, but considered that it gave little control.

Mecograpta sp. nr. calceolata (Macq.) (Det: W. W. W.)

A total of four specimens were collected, one each from Funza, Oct. 12, 1955; La Unión, Nov. 17, 1955; Pasto, Dec. 9, 1955; and Duitama, April 12,

1956.

Tubifera tenax (L.) (Det: W. W. W.)

One specimen collected at Pasto, Dec. 9, 1955.

This species, commonly known as drone-fly, has been recorded in the literature as Eustalis tenax L. It is easily confused with the hive bee, and as these, it is active in sunshine and feeds on flowers. Virgil, Aristotle, and other ancient authors referred to this species as "bees". There is one evidence that this fly is rarely preyed upon by birds, and it is quite possible that it is a distasteful insect. If this is so, its resemblance to the bees can be taken as a basis of Mullerian mimicry (Imms 1951).

LONCHAEIDAE

Genus and species unknown (Det: C. W. S.)

One specimen collected at Usme, April 19, 1956.

Lonchaea sp. (Det: C. W. S.)

A total of eight specimens were collected: five at Sonsón, Nov. 16, 1955; one at La Unión, Nov. 17, 1955; and two at Pasto, Dec. 9, 1955.

L. aurea Macq. was found in Libya feeding in potato tubers attacked by the potato tuber moth, Gnorimoschema operculella (Zell.), and it was reported as unable to attack sound fruits or vegetables (Martelli 1942). The same species was also reported from Libya infesting pepper fruits, in which the larvae feed, sometimes injuring the seeds (Martelli 1939). In Queensland this species was found on tomato fruits already injured by other insects (Sloan 1941).

The species L. aristella Beck has been reported from Greece as a pest of fruit trees (Ayoutantis et al. 1951), and from France on fig fruits



(Ghesquière 1950).

In Brazil, L. pendula Bez. seems to be a common species. It has been observed in coffee and cassava (Pinto da Fonseca 1934), and in citrus plantings (Gomes 1942), and it was also reported as an important pest of cassava, attacking the new shoots and fruits, and as a secondary pest of oranges (Zikan 1944).

L. flavidipennis Zett. was reported from England as to be attracted by asparagus stems infested with the asparagus miner, Agromyza simplex Loew. (Barnes 1937). Maggots of L. hirtithorax were found in Oregon on stems of Lupinus polyphyllus Lind. (Rockwood 1951), and L. gibbosa de Meij. was reported from Netherlands Indies as a minor pest of citrus (Voûte 1935).

#### LAUXANIIDAE

##### Camptoprosopella sp. (Det: C. W. S.)

Two specimens were collected at La Unión and Sonsón, Nov. 16, 1955.

Genera and species unknown (Det: C. W. S.)

A total of forty-two specimens representing two different species were collected: two at Funza, Oct. 12, 1955; sixteen at La Unión, Nov. 16 and 17, 1955; and twenty-four at Pasto, Dec. 9, 1955.

##### Sapromyza sp. (Det: C. W. S.)

Four specimens were collected, one each at Funza, Oct. 12, 1955; La Unión, Nov. 16, 1955; Sonsón, Nov. 16, 1955; and Pasto, Dec. 9, 1955.

#### SCIOMYZIDAE

##### Dichrochirosa sp. (Det: C. W. S.)

One specimen collected at Duitama, April 12, 1956.

## HELEOMYZIDAE

Genus and species unknown (Det: C. W. S.)

Only one specimen was collected at Uams, April 19, 1956, but it could not be identified because it was damaged.

## AGROMYZIDAE

Liriomyza sp. (Det: R. H. F.)

Eight specimens were collected at Funza, Oct. 12, 1955 and Dec. 23, 1958.

Dr. Foote, in personal correspondence, stated that "these specimens do not run in Frick's key."

The species of this genus are well known as leafminers of a large number of cultivated plants. Mallo (1951) reported from Argentina a leaf miner species on potato, as belonging to this genus.

Wolfenbarger (1948) reported from Florida the species L. pusilla (Meig.) as a destructive pest of potato and tomato during the period of 1945 to 1948. Also in Florida, Wilson and Gemung (1957) considered the same species to be a problem in the production of cowpeas. Tilden (1950) observed in California that the females of this species insert their eggs in the host plant leaves, and that the larvae can move from one leaf to another. L. solani was reported mining in leaves of potato and tomato in Sweden (Rydén 1929), and mining leaves of tomato in the greenhouses in Britain (Speys and Parr 1949).

L. langei Frick has been found mining leaves of peas, celery, sugar beet, spinach and aster in Washington, Idaho, and California. The shapes of the mines differ on the several hosts. Economic damage by this species has only been reported from California on peas and aster (Frick 1951), and

on sugar beet in the southern part of the state (Wilcox and Howland 1955).

The valley leaf miner, L. subpueilla (Frost), is considered a pest of kidney beans (Lange et al. 1953a), and melon in California (Michelbacher, et al. 1953). L. orbona, the pea leaf miner, was reported from California as a pest of peas, spinach and other plants (Lange and Smith 1947). From Hawaii, L. hawaiiensis Frick, was reported to be a leaf miner pest of tomato (Mitchell and Sherman 1952).

Liriomyza sp. probably undescribed. (Det: R. H. F.)

A total of one hundred and forty-eight specimens were collected at all the localities, but it was more abundant at Pasto and Funza, where about 95 per cent of the specimens were collected.

In Colombia this species, as a leaf miner, is considered among the most important potato pests. Revelo et al. (1956) stated that this species is found in all the potato growing regions of Colombia, at altitudes over 7,500 feet, and that beside potato, it breeds well on Solanum nigrum and Galinsoga parviflora L., common weeds along the edges of the potato fields. The mines are circular and translucent, generally between the veins, with the larval excrements spread over all the mined area. The most severe damage occurs on the lower parts of the plants. The old mines become brittle, and resemble the damage of the late blight, caused by Phitophthora infestans.

Liriomyza sp. probably ecuadoriensis Frost (Det: R. H. F.)

A total of seventy-four specimens were collected: fifty-six at Pasto, Dec. 9, 1955; nine at La Unión, Nov. 16 and 17, 1955; and nine at Sonsón, Nov. 17, 1955.

Revelo et al. (1956) reported L. ecuadoriensis Frost as a potato tuber pest in Colombia, and considered it had a restricted distribution as a

sporadic pest.

## DROSOPHILIDAE

Drosophila spp. (Det: W. W. W.)

A total of fifty-four specimens, representing possibly two species, were collected: eleven at La Unión, Nov. 16 and 17, 1955; thirty-two at Soneón, Nov. 16 and 17, 1955; and eleven at Pasto, Dec. 9, 1955.

Beside the great importance of most of the species of this genus in genetical studies and for tests with insecticides, some have been reported infesting ripe fruits, generally associated with other insects. In this case they have been considered minor pests, except when the infested fruits were going to be processed, when they constitute a problem, especially because of the difficulty of their control.

The species D. funebris F. and D. busckei Coq. were reported as common, among the insects associated with decaying potatoes in the field and storage bins, but they were found not to be responsible for the dissemination of the bacterial diseases black leg and seed-piece decay of potato (Bonds 1939).

Drosophila sp. was reported together with Lonchaea aurea Macq. and sarcophagide, infesting tomato fruits already injured by other insects in Queensland (Sloan 1941). D. suzuki Mats. was reported from Japan infesting cherries and grapes (Kanzawa 1939); and D. repleta Well. was reported from Madagascar as a pest of oranges (Frappa 1931). Both species were observed on peaches and plums. D. nigricuria Patterson and Mainland was recorded on corn in Guatemala and Mexico (Painter 1955). D. funebris F. was reported from Russia feeding on stored onion (Isaev 1931).

Drosophila flexa Loew (Det: W. W. W.)

A total of thirty-three specimens were collected at La Unión and Sonsón, Nov. 16 and 17, 1955.

Nectanogastralla ep. (Det: W. W. W.)

Only one specimen collected at Pasto, Dec. 9, 1955.

Scaptomyza new species near bipunctipennis Wheeler (Det: W. W. W.)

Twenty-four specimens were collected and sent for study to Dr. Hackman in Finland.

Scaptomyza new species near picifemorata Hackman (Det: W. W. W.)

A total of ninety-one specimens were collected: fourteen at La Unión, Nov. 16 and 17, 1955; forty-nine at Sonsón, Nov. 17, 1955; twenty-four at Paeto, Dec. 9, 1955; and four at Duitama, April 12, 1956.

Scaptomyza pallida (Zett.) (Det: W. W. W.)

Three specimens collected at Pasto, Dec. 9, 1955.

Scaptomyza parapicata Hackman (Det: W. W. W.)

Seventy specimens were collected at Funza, Oct. 12, 1955; La Unión, Nov. 16 and 17, 1955; Sonsón, Nov. 16 and 17, 1955; Paeto, Dec. 9, 1955; and Duitama, April 12, 1956.

Scaptomyza picifemorata Hackman (Det: W. W. W.)

Twelve specimens collected at Paeto, Dec. 9, 1955.

Scaptomyza wheeleri Hackman (Det: W. W. W.)

A total of twenty-four specimens were collected at Sonsón, Nov. 16 and 17, 1955; La Unión, Nov. 17, 1955; and Paeto, Dec. 9, 1955.

Six species of this genus, including two new species, were found in the material collected on potato in Colombia.

Some species of this genus have been recorded in the literature as leaf miners, but most of the references are from Europe. Hukkinen and



Vappula (1935) reported Scaptomyza sp. injuring turnip leaves in Finland. In Denmark, larvae of S. incana Meig. were recorded mining in cauliflower heads (Plantesygdomme i Danmark 1940-1944). Böning (1938) reported the species, S. flavaola Meig., as an occasional pest of horee-radish in Germany; and Stalker (1945) reported the species S. graminum Fallen as a leaf miner, feeding in leaves on deciduous vegetation, but occasionally breeding on over-ripe fruits.

#### ASTEIIDAE

##### Asteia expansa Sabr. (Det: C. W. S.)

Eleven specimens were collected at La Unión, Nov. 16 and 17, 1955; and Sonson, Nov. 17, 1955.

#### EPHYDRIDAE

##### Discocerina nitida Cresson (Det: W. W. W.)

Two specimens collected, one each at Duitama, April 12, 1956; and Pasto, Dec. 9, 1955.

##### Discocerina obscurella (Fallen) (Det: W. W. W.)

Seven specimens were collected: one at La Unión, Nov. 16, 1955; one at Sonson, Nov. 17, 1955; and five at Pasto, Dec. 9, 1955.

A species of this genus, possibly D. nitida Cresson, was reported as a pest of apple in Colombia, tunneling in the fruits and preventing their development (García and Gallego 1947).

##### Hydrellia vulgaris Cresson (Det: W. W. W.)

One specimen collected at Pasto, Dec. 9, 1955.

The species of this genus most commonly recorded in the literature as a pest of cereals, especially in Europe, is H. griseola Fall., known as

the barley mining fly. From France it was reported as a polyphagous species attacking all cereals. The young larvae mine in the outer leaves, and in early spring the young plants may be destroyed; the adults oviposit on new growth, especially of barley and oats (Mesnil 1931). Linnaniemi (1935) reported it from Finland, where it was considered an important pest, attacking barley, oats, and winter wheat. From Russia, it was reported injuring barley (Engel'hart 1936) and damaging onion leaves (Isaev 1931).

Lange et al (1953b) reported the rice leaf miner, H. griseola var. scapularis Loew, as a serious pest in California during 1953. They attributed the outbreak partly to the cool temperatures registered during May of that year.

Linnellia sp. (Det: W. W. W.)

One specimen collected at Sonson, Nov. 16, 1955.

Lytogaster sp. (Det: W. W. W.)

Two specimens collected at Usme, April 19, 1956.

Peilopa sp. (Det: W. W. W.)

Two specimens collected at Duitama, April 12, 1956.

An interesting species of this genus, because of its larval habits, is P. petrolei Coq., which larvae live in crude oil or petrolsum pools. The adults may be found around crude oil pools, or about refineries and oil tank farms (Eseig 1958).

Scatophila sp. (Det: W. W. W.)

Two specimens collected at Funza, Oct. 12, 1955.

#### CHLOROPIDAE

Conioecinella (new species?) (Det: C. W. S.)

Seventeen specimens collected at Pasto, Dec. 9, 1955.

Conioecinella spp. (Det: C. W. S.)

A total of six specimens were collected: one at Uame, April 19, 1956; five at Pasto, Dec. 9, 1955.

The species C. albipalpis was found in Finland destroying the growing point of the oats, during late spring (Kallio 1950).

Diecogaetrella gruenbergi End. (Det: C. W. S.)

One specimen collected at Funza, Oct. 12, 1955.

Elachiptera sp. (Det: C. W. S.)

A total of nine specimens was collected: one at Funza, Oct. 12, 1955; three at Pasto, Dec. 7, 1955; four at Duitama, April 12, 1956; and one at Uame, April 19, 1956.

Sabrosky (1948) wrote that the flies of this genus are very common, and that some species have been reported as pests of various plants, but that the evidence suggests that the larvae probably feed upon decaying organic matter, such as old leaf sheaths or decaying plant tissue and grasses, following the damage done by other insects.

These comments are confirmed by some of the references found in the review of the literature concerning species of this genus. Goodliffe (1942) recorded in southern England the species E. cornuta on corn, associated with larvae of the frit fly, Oscinella frit (L.), and commented that they were presumably feeding on detritus produced by the frit fly. But, from Sweden, it was reported as a wheat pest (Johansson 1943).

The species, E. scrobiculata Strobl. and E. bimaculata Lw., were reported from Morocco as frequently associated with Atherigona soccata Rond., a sorghum pest, but doing no damage (Eleton and Fleuzet 1943). From France, E. orizae was reported on rice (Séguy 1949), and in Canada, E. costata was recorded attacking wheat (Simmonds 1952).

Hippelates sp. (Det: C. W. S.)

One specimen was collected at La Unión, Nov. 16, 1955.

Hippelates aequatorialis Beck. (Det: C. W. S.)

Five specimens collected at Pasto, Dec. 9, 1955.

Hippelates flavipes Loew. (Det: C.W.S.)

One specimen collected at Sonsón, Nov. 16, 1955.

Hippelates viridiniger End. (Det: C. W. X.)

A total of fifty-six specimens was collected at all the localities, except Usmé; it was most abundant at La Unión and Sonsón, where about 80 per cent of the specimens were collected.

The small flies of this family are commonly known as eye-gnats, by their habit of feeding on the eyes of animals and man, and more than a pest, they are very annoying. Soberón y Parra and León y Blanco (1943) reported flies of this genus as possible vectors of the "pinto disease" on animals, caused by treponema.

Dow et al. (1951) in a study of the chloropid flies in Florida, observed that H. bishoppi Sabr. breeds more commonly during the spring, and that it was more abundant in citrus growing areas than at places where the land was in truck crops. From Colombia, Garcés and Gallego (1947) reported the species, H. pallipes (Loew.), as a pest of apples in the Department of Antioquia.

Oscinella spp. (Det: C. W. S.)

Fourteen specimens were collected: two at La Unión, Nov. 16 and 17, 1955; one at Sonsón, Nov. 16, 1955; eight at Duitama, April 12, 1956; and four at Usmé, April 19, 1956; but they were in such bad shape that they could not be identified to species.

Several species of this genus have been reported as pests of cereals and grasses. The most common is Q. frit (L.), known as the frit fly. Simmonds (1952) reported it, associated with other species of the same genus, as a pest of wheat in Canada and eastern United States. It was also reported from Sweden as the most important pest of wheat in the summer (Johansson 1943), and in Poland was considered the commonest and most harmful insect pest present on wheat, rye, barley, and oats, during 1941-1945 (Golebiowska 1951). Sheals (1950) reported that this species is not responsible for the "blindness or blast" in oats, in spite of the direct attack of the larvae on the panicles. From England this species was reported as a serious pest of corn seedlings, but some differences in the amount of damage were observed among open pollinated varieties, hybrids, and inbreds (Haskell 1951).

Shvtzova (1929) reported from Russia these species: Q. pratensis Meig. on winter rye, Q. anthracina Meig. and Q. kerteszi Beck on the grass Bromus inermis, and Q. pusilla Meig. on summer and winter cereals. In Kansas, the species Q. frit (L.) and Q. minor Adams were collected on pasture grasses (Wilbur and Sabrosky 1936). And in Guatemala, Painter (1955) collected pupae of Q. magicornis Duda on corn stalks.

Oscinella nigronotata Duda (Det: C. W. S.)

Six specimens were collected at La Unión, Nov. 16, 1955; and Sonson, Nov. 17, 1955.

One larva of this species was collected in a corn ear, at Antigua, Guatemala, by Painter (1955). If this is a corn insect, the possibility of collecting it on potato is great, especially when potato is grown near corn fields. This was the situation at the two localities above mentioned.



Thaumatomyia glabrina (Beck.) (Det: C. W. S.)

A total of one hundred and fifty-two specimens was collected: one hundred and forty-two at Pasto, Dec. 9, 1955; six at Funza, Dec. 23, 1958; and four at Duitama, April 12, 1956.

The species, T. notata Meig. and T. glabra Meig., were observed in Hungary feeding on the aphid Pemphigus burearivae L., which was infesting lettuce roots (Aczél 1942). T. apache was reported feeding on the cabbage root aphid Pemphigus populi-transversus Riley, and it was observed that the predator was more abundant in well irrigated areas, while the aphid injury was more severe on fields lacking water (Wene and White 1953). From Sweden, the species T. notata Meig. was reported on wheat (Johansson 1943).

Tropidoecinis sp. (Det: C. W. S.)

Fourteen specimens were collected at all the localities, except Usme. At the time of the identification they were damaged, making it impossible to determine them to species.

Tropidoecines orbitalis (Duda) (Det: C. W. S.)

Forty-eight specimens were collected: eight at La Unión, Nov. 17, 1955; thirteen at Sonsón, Nov. 16 and 17, 1955; twenty-three at Pasto, Dec. 9, 1955; and four at Duitama, April 12, 1956.

The species T. albipalpis Meig., was bred in small numbers from potted plants of wheat in the laboratory during the summer in England (Goodliffe 1942).

## SPHAEROCERIDAE

Genus and species unknown. (Det: C. W. S.)

One specimen collected at La Unión, Nov. 16, 1955.

Archiborborus sp. near orbitalis Duda (Det: C. W. S.)

Thirty specimens collected at Pasto, Dec. 7 and 9, 1955.

Leptocera spp. (Det: C. W. S.)

Eighty-three specimens representing at least five species were collected: twenty-two at Funza, Oct. 12, 1955, and March 15, 1956; thirty-nine at Pasto, Dec. 9, 1955; eight at La Unión, Nov. 16, 1955; six at Sonsón, Nov. 16, 1955; four at Duitama, April 12, 1956; and four at Usme, April 19, 1956.

Leptocera sp. near fontinalis (Fall.)

Thirty-eight specimens were collected: twenty-four at Funza, Oct. 12, 1955, and March 15, 1956; eight at Pasto, Dec. 9, 1955; five at Sonsón, Nov. 16, 1955; and one at Duitama, April 12, 1956.

In Germany, larvae of L. fenestralis Fall were observed on shoots of rye (Lamas and Meuche 1941), and in England, the species L. heteroneura Hal. was considered as a potential pest of cultivated mushrooms (Austin 1937).

TACHINIDAE

Genera and species unknown. (Det: C. W. S.)

Three specimens, representing two species, were collected: two at Pasto, Dec. 9, 1955; and one at Sonsón, Nov. 16, 1955.

Most of the members of this family are considered beneficial insects, the larvae being parasitic on a large number of destructive pests, and playing an important role as the natural check of plant-feeding insects (Essig 1958).

"New species and possible new genus near Neocraspedothrix" (Det: C. W. S.)

Sixty specimens were collected: five at Sonson, Nov. 17, 1955; one at La Unión, Nov. 17, 1955; forty-three at Pasto, Dec. 9, 1955; and eleven at Duitama, April 12, 1956.

C. W. Sabrosky kept some of the specimens for study, and commented that this is an unusually interesting species, apparently undescribed.

Crocota spp. (possibly new) (Det: C. W. S.)

Two specimens were collected, one each at Pasto, Dec. 9, 1955, and Sonson, Nov. 16, 1955.

Microphthalma sp. (Det: C. W. S.)

One specimen collected at Usme, April 19, 1956.

The species of this genus most commonly reported is M. diejuncta Wied. From Canada it was reported as an internal parasite of white grubs, Phyllophaga spp. (Hammond 1949). In the southern United States it has been recorded as a parasite of larvae of the beetle Bueteola ruficeps (Lec.), a pest of rice in that part of the country (Douglae and Ingram 1942); and from Asia Minor it was reared from larvae of Laphygma exigua (Hbn.), a serious pest of sugar beet (Steiner 1936).

#### SARCOPHAGIDAE

Genus and species unknown. (Det: C. W. S.)

Two specimens collected at Funza, Oct. 12, 1955.

Sarcophaga spp. (Det: C. W. S.)

Two female specimens were collected, one each at Sonson, Nov. 16, 1955, and Duitama, April 12, 1956.

Sarcophaga (Andinoravinia) rufipes Tne. (Det: C. W. S.)

Eighty-six specimens were collected: three at Funza, Oct. 12, 1955;

four at Sonsón, Nov. 16 and 17, 1956; one at La Unión, Nov. 17, 1955; and seventy-eight at Pasto, Dec. 7 and 9, 1955.

Several species of this genus have been recorded as parasites of important pests. Sarcophaga sp. was considered one of the most important parasites of Alabama argillacea (Hbn.) on cotton in Colombia (Llanos 1940). S. lambens Wied. has been found parasitizing larvae of Diatraea saccharalis (F.) in Brazil, and reared from larvae of Alabama argillacea in Argentina (Parker 1953). Also in Brazil, it was reared from larvae of Sacadodes pyralis Dyer, a major pest of cotton in Argentina, Colombia and Venezuela (Callan 1947). Box (1952) in investigation on the sugar cane borers, reared this species of sarcophagid from larvae of Diatraea buskella rosea Heinr. on sugar cane and corn.

But one of the most important roles of the flies of this genus has been in the biological control of grasshoppers. Several species have been found in Argentina, United States and other countries, to be important parasites. Buckell and Spencer (1945) reared twelve species of Sarcophaga from Melanoplus mexicanus mexicanus (Seuse.) in British Columbia. S. (Acridiophaga) caridei was found to be a parasite of grasshoppers in Argentina (Lloyd 1951).

Douglas and Ingram (1942) found adults of Duethoela rugiceps (Lec.), a rice pest in southern United States, parasitized by S. rapax Wlk. The same species, and S. latisterna Parker were reared in Texas from larvae of Heliothis erigera (Hbn.) (Bibby 1942). In Wisconsin, S. latisterna and S. cimbicis Towns. were reared from larvae of Macronoctua onusta Grote (Breakey 1929).

One case was found in which a species of this genus is not a beneficial insect. In Brazil, S. surrubea Wulp. has been recorded as parasite of

Apis mellifera L. (Ronna 1936).

MUSCIDAE

Dasymorellia ep. (Det: C. W. S.)

Two specimens were collected at Usme, April 19, 1956.

Dasymorellia trichops Mall. (Det: C. W. S.)

Seven specimens were collected at Pasto, Dec. 7 and 9, 1955.

This species is known from Brazil, Peru and Bolivia. It has also been recorded in Ecuador and Colombia (Snyder 1949).

Morellia ochrifacies (Rond.) (Det. C. W. S.)

Twenty-one specimens were collected: one at Soneón, Nov. 17, 1955; nineteen at Pasto, Dec. 7, 1955; and one at Funza, March 15, 1956.

The species M. hortensia, was reported from Aseam, India, associated with cattle (Thomson 1947).

Myospila mediatibunda (F.) (Det: C. W. S.)

Three specimens were collected at Pasto, Dec. 9, 1955.

This species was reared from larvae of the Irie borer, Macronoctus onusta Grote, in Wisconsin (Breakey 1929). Keilin (1917) described the larvae of this species as carnivorous, feeding upon sarcophagid larvae, as well as on certain small Anthomyiids and Borboride which accompanied them.

Identifications for some of the specimens were not received soon enough to be included with a review of the literature. They are, however, included in the following list:



## SIMULIDAE

Simulium incrustatum Lutz (Det: A. S.)

Two specimens were collected at Sonsón, Nov. 16, 1955.

## BIBIONIDAE

Philia spp. (Det: A. S.)

Two specimens were collected, one each at Sonsón, Nov. 16, 1955, and Pasto, Dec. 9, 1955.

## MYCETOPHILIDAE

Euphrosyne sp. (Det: A. S.)

One specimen was collected at Funza, Oct. 12, 1955.

Procydoneura morosa Edw. (Det: A. S.)

One specimen was collected. (Specimen and locality records retained at Washington.)

## SCIARIDAE

Bradysia spp. (Det: A. S.)

Seven specimens were collected: five at Pasto, Dec. 9, 1955; and two at Funza, Oct. 12, 1955 and March 15, 1956.

Rhynchosciara sp. (Det: A. S.)

One specimen was collected at Sonsón, Nov. 17, 1955.

Zigonsura sp. (Det: A. S.)

Two specimens were collected, one each at La Unión, Nov. 16, 1955, and Pasto, Dec. 9, 1955.

## TABANIDAE

Dasybasis sp. (Det: A. S.)

One specimen collected at Usme, April 19, 1956.

## EMPIDIDAE

Platypalpus sp. (Det: R. H. F.)

Six specimens were collected at Pasto, Dec. 7 and 9, 1955.

Drapetis sp. (Det: R. H. F.)

Only one specimen was collected at La Unión, Nov. 16, 1955.

## DOLICHOPODIDAE

Dianthorus sp. (Det: R. H. F.)

Nine specimens were collected: six at Pasto, Dec. 9, 1955; two at Sonsón, Nov. 17, 1955; and one at Duitama, April 12, 1956.

## OTITIDAE

Euxesta annonae (F.) (Det: R. H. F.)

Two specimens were collected, one each at Sonsón, Nov. 16, 1955 and Pasto, Dec. 9, 1955.

Euxesta obliquestriata Mend. (Det: R. H. F.)

Only three specimens were collected at Sonsón, Nov. 16, 1955.

Rivellia sp. (Det: R. H. F.)

One specimen was collected at La Unión, Nov. 16, 1955.

## TEPHRITIDAE

Paroxyyna spp. (Det: R. H. F.)

One hundred and thirty-six specimens, representing at least two species, were collected at Sonsón, La Unión, Duitama, Uame and Pasto. At the last locality about 73 per cent of the specimens was collected.

Dr. Foote commented that at least two species are represented in this material, but that the present description and published material for this genus in the Americas are very poor.

Trupansa reticulata Hend. (Det: R. H. F.)

Eleven specimens were collected at Pasto, Dec. 9, 1955.

## AGROMYZIDAE

Agromyza sp. (Det: R. H. F.)

Two specimens were collected at La Unión, Nov. 16, 1955.

Cerodontha sp. (Det: R. H. F.)

Only one specimen was collected at Funza, Oct. 12, 1955.

Phytobia sp. (Det: R. H. F.)

One specimen was collected at Pasto, Dec. 9, 1955.

Dr. Foote, in personal correspondence, commented that probably none of these species are described.

## MUSCIDAE

Anthomya oculifera (Big.) (Det: D. de O. A.)

One specimen was collected at Sonsón, Nov. 16, 1955.

Calythea crenata (Big.) (Det: D. de O. A.)

Two specimens were collected at Pasto, Dec. 7 and 9, 1955.

Coenosinae (Det: D. de O. A.)

Two specimens were collected, one each at Pasto, Dec. 9, 1955, and La Union, Nov. 16, 1955.

Euryomma rufifrons (Stein) (Det: D. de O. A.)

Two specimens were collected at Pasto, Dec. 7 and 9, 1955.

Fannia sp. (Det: D. de O. A.)

One specimen was collected at Pasto, Dec. 9, 1955.

Helina spp. (Det: D. de O. A.)

Two specimens were collected at Pasto, Dec. 9, 1955.

Helina sp. near marginipennis (Stein) (Det: D. de O. A.)

One specimen was collected at Pasto, Dec. 9, 1955.

Heliographa atrovittata (Stein) (Det: D. de O. A.)

Five specimens were collected: four at Pasto, Dec. 9, 1955; and one at Usme, April 19, 1956.

Heliographa graciletarsis (Stein) (Det: D. de O. A.)

Seven specimens were collected: five at Pasto, Dec. 9, 1955; one at Sonson, Nov. 17, 1955; and one at Usme, April 19, 1956.

Hydrotaea sp. (Det: D. de O. A.)

One specimen was collected at Pasto, Dec. 9, 1955.

Hylemya cilicrura (Rond.) (Det: R. H. F. and D. de O. A.)

Two hundred and fifty-four specimens were collected at all the localities. The larger number was at Pasto, from which 82 per cent of the total came.

Hylemya virgata (Stein) (Det: D. de O. A.)

Eight specimens were collected at Pasto, Dec. 9, 1955.

Limnophora sp. (Det: D. de O. A.)

Six specimens were collected: five at Pasto, Dec. 9, 1955, and one

at Funza, March 15, 1956.

Schoenomyza sp. (Det: D. ds O. A.)

One specimen was collected at Sonson, Nov. 17, 1955.

## Hymenoptera

### ICHTNEUMONIDAE

Diplazon lastatorius (F.) (Det: L. M. W.)

One specimen was collected at Pasto, Dec. 9, 1955.

Some of the species of the genus Diplazon are parasites of predacious syrphids, but they are not highly specialized (Schneider 1950). The above species and two other species of Diplazon were found parasitizing puparia of the syrphid Metasyrphus wiedemanni Johnson, of which the larvae were feeding on aphids (Bean 1950). De Santis (1942) reared this species in Argentina from pupae of Allograpta exotica (Wied.) on rose. And in Fiji, it was reared from Syrphus corollae var. vitisensis Bsz., a predator of Rhopalosiphum nymphaeas (L.) (Lever 1944).

Exochus sp. (Det: L. M. W.)

One specimen collected at Pasto, Dec. 9, 1955.

Various species of this genus have been recorded as parasites of lepidopterous fruit pests. An undetermined species was found in California parasitizing larvae of Spilonota ocellana (D. and S.), an important pest of prunes (Madsen and Borden 1949). Also in California, another undetermined species of Exochus was reared from pupae of Argyrotaenia citrana (Fern.) (Basinger 1935). The species E. pleuralis was reared in Utah from the strawberry leaf-rollers, Ancyliis comptanas fragariae (W. and R.) and Anacamptis fragarilla Busck (Knowlton 1937).



In Canada, E. annulicrus was reared from puparia of Cacoecia melaleucana Walker on flowers of Trillium grandiflorum (Judd 1952); and E. erythronotus Grav. was reared from Plutella maculipennis (Curt.), damaging cabbage and cauliflower in Germany (Torka 1929).

Horogenes sp. (Det: L. M. W.)

Twenty-nine specimens were collected at Pasto, Dec. 9, 1955.

The species of this genus have mostly been reported as parasites of lepidopterous larvae. A common species is H. punctorius Roman, parasite of the European corn borer Pyrausta nubilalis (Hbn.). In Switzerland, it was found in corn stalks heavily infested with the borer in 1948 (Zogg et al. 1949). In Connecticut it was found to parasitize 22 per cent of the first generation larvae and 8 per cent of the second generation (Arbuthnot 1955). It also was reported as a prevalent parasite of the borer in New England and as an established one in New York and New Jersey (Arbuthnot 1950).

The species Angita (Horogenes) sureka Ashm. was reared from larvae of Argyrotaenia citrana (Fern.), a pest of raspberry and blackberry in Oregon, and was considered to give good control (Rosenstiel 1949). In California, A. ferrugineipes Ashm. was reared from larvae of Keiferia lycopersicella (Busck), a pest of tomato (Elmore and Howland 1943).  
 "Hemitelini - probably new genus near Alegina" (Det: L. M. W.)

Three specimens were collected at Pasto, Dec. 9, 1955.

Itoplectis sp. probably new (Det: L. M. W.)

One female specimen was collected at Sonsón, Nov. 16, 1955.

A common species reported as primary parasite of lepidopterous pests is I. conquisitor (Say). Nickels (1951) reported it from Texas as parasite of the pecan nursery casebearer Acrobasis caryvorella Rag. In New Jersey

it was found on cocoons of the oriental fruit moth Grapholita molesta (Busck) (Brunson and Allen 1948), and in Canada, it was recorded as one of the principal parasitic species of the spruce budworm, Choristoneura fumiferana (Clem.) (Daviault 1946).

The species I. obesus Cushman was considered to give good help in the control of Argyrotaenia citrana (Fern.), on raspberry and blackberry in Oregon (Roehetiel 1949).

Mesochorus sp. (Det: L. M. W.)

Seven specimens were collected at Pasto, Dec. 9, 1955.

The species of this genus have been reported as secondary parasites. In Iowa M. aprilinus was recorded as secondary parasite of Proparce sexta (Johan.), which was damaging potato foliage (Webster 1915). M. pectoralis Ratz. was reported as an internal parasite of Apanteles glomeratus L. in Germany and Poland (Blunck 1944). The same species was found in Germany parasitizing larvae of Apanteles rubecula Marsh., which is an important parasite of Pieris rapae (L.) (Blunck 1951).

From Virginia, M. discitergus Say was recorded parasitizing Apanteles sp. (Hofmaster and Greenwood 1949). The species M. phyllotretae was reared from several species of Phyllotreta parasitized by larvae of Microctonus in France (Jourdeuil 1957).

Nepiera sp. (Det: L. M. W.)

One male specimen was collected at Pasto, Dec. 9, 1955.

The species N. fuscifemora Gahan was reported to be a parasite of Gnorimoechma operculella (Zell.) from southern California (Essig 1958). In California, Nepiera sp. was reared from larvae of Argyrotaenia citrana (Fern.), a serious pest of oranges and grapefruit (Easinger 1935).

Orthocentrus sp. (Det: L. M. W.)

Two specimens were collected: one female at Usme, April 19, 1956; and one male at Pasto, Dec. 9, 1955.

"Phobocampe sp. ?" (Det: L. M. W.)

Four specimens were collected: one at Funza, Oct. 12, 1955; one at La Unión, Nov. 16, 1955; and two at Sonsón, Nov. 16, 1955.

"Phygadeuon sp. ?" (Det: L. M. W.)

One male specimen was collected at Pasto, Dec. 9, 1955. To determine the correct genus, female specimens are necessary.

Several species of this genus have been reported as parasites of flies of the genus Agromyza (Eseig 1958). An undetermined species of Phygadeuon was reared from puparia of Hylemya antiqua (Meig.), a pest of onions in Austria (Schreier 1953). In Canada another species was found parasitizing Hylemya brassicae (Bouché.), a serious pest of cruciferous crops (Wilkes and Wishart 1953), and from Morocco, Eleton and Fieuzet (1943) reported Phygadeuon sp. as a parasite of larvae of Atherigona soccata Rond., a sorghum pest.

"Plestiecinæ" - Megastylus sp. ? (Det: L. M. W.)

One male specimen was collected at Pasto, Dec. 9, 1955. In this case is also necessary to have female specimens to determine the genus.

Pristomerus sp. (Det: L. M. W.)

Two specimens were collected at Pasto, Dec. 9, 1955.

The species of this genus have mainly been reported as parasites of lepidopterous larvae. P. vulnerator (Panz.) was reported as parasite of larvae of Carpocapea pomonella (L.) in Holland (Bos 1942), and as a native parasite of Grapholita molesta (Bueck) in France (Roehrich 1954).

P. chinensis Ashm. was reared from larvae of Cydia glycinivorella Mats. in Manchuria. It was also reported as parasite of C. molesta (Busck) from Japan, Korea and China (Uchida 1940).

P. testaceicollie Cam. was recorded in India as endoparasite of Eublemma amabilis Moore and Holcocera pulverea Meyr, two important predators of Laccifer lacca (Kern) (Negi, et al. 1945).

Stenomacrus sp. ? (Det: L. M. W.)

One specimen was collected at Uame, April 19, 1956.

#### BRACONIDAE

Apanteles sp. (Det: C. F. W. M.)

Twelve specimens were collected: one at Funza, Oct. 12, 1955; three at La Unión, Nov. 16, 1955; five at Sonsón, Nov. 17, 1955; and three at Paeto, Dec. 9, 1955.

This genus has world wide distribution. Most of the species have been recorded as parasites of lepidopterous larvae, and in many cases they have been used in the biological control of important pests.

Blanchard (1947) recorded in Argentina the species A. areolaris from a gelechiid on Solanum bonariensis, and A. subandinus from Gnorimoschema operculella (Zell.), the potato tuber moth. A. congregatus Say was recorded as a primary parasite of Protoparce sexta (Johan.) which was attacking potato foliage in Iowa (Webster 1915).

In Brazil, A. balthazari Ashm. was reared from cotton bolls infested with Flatydra gossypiella (Saund.) (Sauer 1938).

Harold Box in his several studies on the biological control of the sugarcane borers in South America, has reported several species of Apanteles found on larvae of Diatraea spp.



Aphaereta sp. (Det: C. F. W. M.)

One specimen was collected at Funza, March 15, 1956.

Several species of this genus have been recorded as parasites of Diptera.

Aphaereta sp. was found parasitizing Hylemya brassicae (Bouche) in Canada (Wilkes and Wishart 1953). In Austria, A. cephalotes (Hal.) was reared from a few puparia of H. antiqua (Meig.), a serious pest of onions (Schreier 1953). The species A. difficilis was reared from H. radicum L. and H. brassicae in Morocco (Nixon 1939).

A. musca Ashm. was reported to be one of the most important parasites reared from larvae of the spruce budworm, Choristoneura fumiferana (Clen.), in Canada (Daviault 1946), and the same species was reared from puparia of Rhagoletis pomonella (Walsh) in New York (Middlekauff 1941).

The species A. auripes (Prov.) has been reported parasitizing various Diptera, and was collected from a corn hill in Guatemala (Painter 1955).

Aphidius spp. (Det: C. F. W. M.)

Ten specimens, apparently representing several species, were collected: four at La Unión, Nov. 16, 1955; and six at Pasto, Dec. 9, 1955.

The species of this genus are well known as primary aphids parasites. Webster (1915) reported from Iowa the species A. polygonaphis Fitch as parasite of Macrosiphum solanifolii (Ashm.), one of the potato aphids. On the same host, Smith (1919) reported the species A. rapae Curt. from Virginia. From England, the species A. ervi, A. matricariae and A. avenae Hal. were reported as primary parasites of potato aphids, of which the last was considered the most important (Dunn 1949).

A. avenae Hal. was also reported from England, together with A. granarius as the most important factor in the biological control of corn



aphide in South Wales (Arthur 1945). From Japan, A. granarius was reported as a primary parasite of Macrosiphum granarium (Kby.) on wheat (Sugiyama and Kawase 1952). The species A. platensis was reported as a parasite of Toxoptera graminum (Rond.) from Argentina (Hayward 1940; Griot 1949). A. testaceipes was recorded as a parasite of the corn leaf aphid, Aphis maidis Fitch (Wilson 1948) and of Toxoptera graminum (Griot 1949) in the United States. A. phorodontis Ashm. was considered an important factor in the natural control of Aphis gossypii Glov. on cotton in Peru, during the spring of 1940 (Wille 1941), and it was also observed in Canada parasitizing Myzus persicae (Sulz.) on tobacco and tomato in greenhouses during the winter 1936 (McLeod 1938).

Bracon sp. (Det: C. F. W. M.)

One specimen was collected at Pasto, Dec. 9, 1955.

This genus has world wide distribution and most of its species are parasitic on Lepidoptera. B. cuyanus was described from Argentina, reared from larvae of the potato tuber moth Gnorimoschema operculella (Zell.) (Blanchard 1948). The species B. cephi (Gahan) was reported as the most important parasite of the wheat stem sawfly, Cephus cinctus Nont., in western Canada (Nelson and Farstad 1953). B. vestitoides Viev. was reported as an important parasite of Anthonomus vestitus Boh., a major pest of cotton in Peru (Berry 1947).

Leiothron new species (Det: C. F. W. M.)

Two specimens were collected at La Unión, Nov. 17, 1955.

An undetermined species of this genus was recorded in Russia as parasite of Galerucella viburni Payk., a pest of Viburnum spp., a kind of ornamental plant (Zorin 1931). Grossheim (1928) reported from the Ukraine the species L. lituratus Hal. as the most active and common parasite of

adults of Sitona spp.

Meterorus sp. (Det: C. F. W. M.)

One specimen was collected at Funza, Oct. 12, 1955.

Several species of this genus have been reported as parasites of many lepidopterous larvae, such as species of Feltia, Leucania and others. Madsen and Borden (1949) reared the species M. ictericus Nees from larvae of Spilonota ocellana (D. and S.), which were about to pupate. This species is an important pest of prunes in California. From Washington, M. argyrotaenia Johansen was reported as the most important parasite of Argyrotaenia citrana (Fern.) (Johansen and Breakey 1949).

Metsorus chilensis Porter (Det: C. F. W. M.)

One specimen was collected at Pasto, Dec. 9, 1955.

This species was reported as a parasite of Feltia malefida Gn. from Argentina (Blanchard 1936), and in Bolivia it was commonly reared from cutworms infesting potato tubers (Munro 1954).

Microctonus sp. (Det: C. F. W. M.)

One specimen collected at La Unión, Nov. 16, 1955.

Smith (1953) compiled a list of the species of this genus together with their distribution and host records. As a result of their habits all the species were considered beneficial, except M. brevicollis Holliday, which was reported by Mussebeck to parasitize the carabid Galerita sp. in Virginia and Iowa. Adults of beetles of the families Chrysomelidae and Curculionidae are their most frequent hosts. Several species are considered as primary factors in the control of certain flea beetles.

The species M. epitricis (Visr.) was reported as a parasite of the tobacco flea beetle, Epitrix hirtipennis (Melsh.), on tobacco in Virginia (Dominick 1943). The same species was also reported from Virginia

parasitizing E. parvula on potato, during the spring and on tobacco in the summer (Wene and Dominick 1943).

M. vittatae Mues was reared from several species of Phyllostreta in the United States (Smith and Peterson 1950), and reported as a primary parasite of adults of Phyllostreta in France (Jourdhueil 1957).

Opius sp. (Det: C. F. W. M.)

A total of thirteen specimens was collected: six at La Unión, Nov. 16, 1955, and seven at Sonson, Nov. 16, 1955.

The species of this genus have been reported as parasites of leaf miner flies and fruitflies. Several species of Opius were reported from Arizona, as parasites of a species of Liriomyza on cantaloupes and lettuce (Hills and Taylor 1951). Unidentified species of Opius have been recorded as primary parasites of L. pusilla (Meig.) in California (Tilden 1950), parasitizing larvae of the tomato leaf miner L. solani in Britain (Speyer and Parr 1949). Other species were reared from larvae and pupae of L. subpusilla (Frost) on melons in California (Michelbacher et al. 1951).

O. stritiventris Gah. was reported from Virginia as the most important parasite of the native holly leaf miner, Phytomyza illicicola Loew (Underhill 1943), and O. liogaster Szépl, was reported to have checked an infestation of Agromyza phaseoli Cop. on cowpeas and beans in Southern Rhodesia, Africa (Jack 1942).

O. crawfordi Vier. was reported as the commonest parasite of the Mexican fruit fly, Anastrepha ludens (Loew), but giving a low percentage of control (Baker et al. 1944). The species O. lectus Gah. and O. ferrugineus Gah. were reared from puparia of Eragoletia pomonella (Walsh), in New York (Middelskauff 1941). From Hawaii, O. oophilus Fullway, was reported as an important parasite of fruit flies. It was observed that the

braconid ovipositor on the fruit fly eggs, develops as an egg-larval parasite, and emerges from the host puparium (Bosch and Haramoto 1951).

Trioxys sp. (Det: C. F. W. M.)

One specimen was collected at Funza, Oct. 12, 1955.

Several species of this genus have been reported as aphid parasites.

T. utilis was reared in Italy and France from the yellow clover aphid, Myzocallis trifolii (Monell) (Muesebeck 1956). T. cirsii Curt. was recorded as parasite of the oak aphid, M. annulata Htg. in Tasmania, Australia (Miller 1947). Also from Tasmania, Evans (1939) reported the species T. aceris Hal. parasitizing the oak aphid, but he stated that this species is not indigenous to Tasmania.

Trioxys sp. was reported from India parasitizing Toxoptera aurantii Boy., the tea aphid, which mainly occurs in nurseries and on tea recently pruned (Rau 1936).

#### EULOPHIDAE

Chrysocharis sp. (Det: B. D. B.)

Two female specimens were collected at Funza, Oct. 12, 1955.

The species of this genus have mainly been recorded as parasites of leaf miner flies, and in general, they have been found working together with braconid wasps of the genus Opius. From Peru, the species C. ainsliei Crawford was reported parasitizing Agromyza flaveola Fall., which was attacking leaves and stems of flax (Wille [1942]). The same species was found in California helping to check the melon leaf miner Liriomyza subpueilla (Frost) (Michelbacher et al. 1951).

C. cubensis was reared from a leaf miner on sugarcane (Gahan 1932).

C. parki Crawford was recorded in Arizona as a parasite of leaf miners of



the genus Liriomyza, attacking cantaloupes and lettuces (Hills and Taylor 1951), and the species C. gemma Wlk. and C. syma Wlk., were introduced into British Columbia for the control of Phytomyza ilicis (Curt.), a leaf miner of the English holly (Downes and Anderson 1940).

Euparacrias phytomyzae (Brethes) (Det: B. D. B.)

A total of thirty-seven specimens, twenty-four females and thirteen males, was collected: at La Unión, Nov. 17, 1955; Sonsón, Nov. 17, 1955; and Pasto, Dec. 9, 1955.

#### TORYMIDAE

Zaglyptonotus sp. (Det: B. D. B.)

One female specimen was collected at Duitana, April 12, 1956.

#### PTEROMALIDAE

"Pteromalini" (Det: B. D. B.)

Three male specimens were collected at Pasto, Dec. 9, 1955.

Habrocytus sp. (Det: B. D. B.)

One female specimen was collected at Pasto, Dec. 9, 1955.

Some species of this genus are considered secondary parasites, but others have been recorded as primary parasites. Among those of the first group are H. blunckii and H. eucerus Ratz., which were found in Germany and Poland, parasitizing Apanteles glomeratus in Pieris brassicae (Blunck 1944), and Basinger (1935) reared an undetermined species of Habrocytus from Homius basalis (Prov.) and Apanteles aristoteliae Visr. on Argyrotaenia citrana (Fern.).

Among some of the species reported as primary parasites are: H. phycidis Ashm. parasitizing Coleophora malivorella Riley, an apple pest in eastern



and central United States and in Canada (Beachsr 1947). The same species was reared in Canada from larvae of Tortrix packardiana Fern. (Daviault 1946). In Switzerland, the species H. faeciatus Thoms. was reared from larvae of Anthonomus piri Koll., a pest of pears (Bovey 1943), and from Georgia, H. cerealella Aehm. was reported as an occasional parasite of Sitotroga cerealella (Oliv.), in the laboratory (Webb and Alden 1940).

Halticoptera sp. (Det: B. D. B.)

A total of forty-nins specimens, thirty-six females and thirteen males, was collected: at Funza, Oct. 12, 1955; Sonson, Nov. 16, 1955; and Pasto, Dec. 9, 1955.

The species of this genus have mostly been reported as dipterous leaf miner parasites. Halticoptera sp. was reported from Brazil as parasite of Agromyza brasiliensis, a potato tuber miner (Mendes 1940). In Arizona, H. eenea (Wlk.) was recorded as the most abundant parasite of of Liriomyza sp., a leaf miner of cantaloupes and lettuce (Hills and Taylor 1951). The same species was reported parasitizing the leaf miner Agromyza melampyga Loew, from Canada (Boyce 1939), and A. virens Loew, which was mining the stems of nursery plants of guayule, from California (Lange 1944).

The species H. fuscicornis Wlk. has been recorded as a parasite of the frit fly, Oscinella frit (L.), in England (Imms 1930) and Germany (Riggert 1935). H. patellana Dalm. was reared from puparia of Agromyza cepae Her., infesting onion in Germany (Nietzke 1940).

Zatropie sp. (Det: B. D. B.)

One female specimen was collected at Pasto, Dec. 9, 1955.

Several species of this genus have been reported as parasites of lepidopterous larvae. Elmore and Howland (1943) reported Zatropie sp. as

a parasite of Keiferia lycopersicella (Busck) on tomato, from California. From Brazil, Sauer (1941) reported a species of Zatropis near incertus Ashm. as a parasite of larvae of Chalcodermue bondari Mshl., attacking cotton; and Rude (1937) reported Z. incertus parasitizing pink bollworm larvae, Platyedra gossypiella (Saund.), on cotton in Mexico.

#### CYNIPOIDEA - ANACHARITINAE

Anacharis sp. (Det: L. H. W.)

Fourteen specimens were collected: thirteen at Pasto, Dec. 9, 1955; and one at Umea, April 19, 1956.

Dr. L. H. Weld reported (in correspondence) that all seem to be the same species. He said that no species have ever been described from South America, and that they run in Das Tierreich close to A. eucharoides (Dalm.), reared from cocoons of lace wing flies.

#### PROCTOTRUPIDAE

Phaenocerphus spp. (Det: C. F. W. M.)

Two specimens were collected, representing two different species, one each at Sonson, Nov. 17, 1955; and Funza, Dec. 23, 1958.

From Britain the species P. viator Hal. was reported as a parasite of the larvae of Pterostichus niger, a carabid (Eastham 1929).

#### DIAPRIIDAE

Aclista sp. (Det: C. F. W. M.)

One specimen was collected at Pasto, Dec. 9, 1955.

Pentapria sp. (Det: C. F. W. M.)

One specimen was collected at La Unión, Nov. 16, 1955.

## BETHYLIDAE

Perisierola sp. (Det: K. V. K.)

One specimen was collected at La Unión, Nov. 16, 1955.

Species of this genus have been recorded as parasites of larvae of Lepidoptera. An undetermined species which was observed parasitizing larvae of Laphigma frugiperda (J. E. Smith) and Heliothis armigera (Hbn.) in Texas, was introduced into Hawaii, where it was seen attacking second and third instars of L. frugiperda and one or more early instars of H. armigera (Bianchi 1944). In Italy, a species resembling P. gallicola Kieff. was found parasitizing larvae of Ancylie selenana Gn., a pest of apples (Lucchese 1943).

Adults of P. cellularis Say were observed attacking larvae of H. armigera in Texas (Bibby 1942); and in Brazil, P. nigrifemur was reared from cotton bolls infested by Platyedra gossypiella (Saund.) (Sauer 1938).

## VESPIDAE

Polybia ignobilis (Hal.) (Det: K. V. K.)

One specimen collected at La Unión, Nov. 16, 1955.

In Brazil, P. sericea Oliv., P. occidentalis scutellaris White and P. atra Oliv. were among the ten most numerous species of wasps collected in cotton fields, where they are predators of larvae of Platyedra gossypiella (Saund.). It was considered that during the period December 1936 to January 1937, the wasps destroyed 87.6 per cent of the larvae in the blossoms (Sauer 1938). Later, Leiderman and Sauer (1953) reported that larvae of Laphigma frugiperda (J. E. Smith) were destroyed by P. atra and P. occidentalis scutellaris. Also from Brazil, Lima et al. (1950) considered the species

P. nigra to be an important natural enemy of Schistocerca cancellata.

Stelopolybia pallidipes (Oliv.) (Det: K. V. K.)

One specimen was collected at La Unión, Nov. 16, 1955.

Several species of this genus have been reported from Brazil (Zikam 1951).

#### HALICTIDAE

Caenohalictus sp. (Det: K. V. K.)

One specimen was collected at Pasto, Dec. 9, 1955.

The species C. implexus was described from Paraguay (Moure 1950).

#### NOTES ON THE RESISTANCE OF POTATO VARIETIES TO THE INSECTS

In the introduction it was stated that one aim of this paper was to report the results of the tests of potato varieties for their resistance to insects. Since literature on the subject was reviewed by Painter (1951, 1958) his works were used as the only sources of reference.

Painter pointed out that varieties of potato and species of Solanum with some indication of resistance to fourteen insect species have been reported. The most extensive works on the subject have been on leafhoppers (Empoasca spp.), flea beetles (Epitrix spp.), Colorado potato beetle (Leptinotarsa decemlineata (Say)), aphids (Myzus persicae (Sulz.) and Macrosiphum solanifolii (Ashm.)), and the potato psyllid (Paratrioza cockerelli (Sulc.)).

Cultivated species as well as wild species of Solanum have been included in a search for sources of resistance. Painter (1951) reported the work of Slesman on the populations of leafhoppers on 12 wild species

of Solanum in comparison with Solanum tuberosum, in which it was found that most of them, except Solanum bulbocastanum, had very low populations. The work of Trouvelot and his co-workers in France, and others in Germany, on the resistance of species of Solanum and interspecific hybrids to the Colorado potato beetle, were also recorded by Painter (1951).

Painter (1951, p. 411-412) stated that the plants show a greater morphological diversity in certain areas near the center of origin of the crop than in other areas, and that varieties taken from the region showing this morphological multiformity may include, among their physiological variation, characters for insect resistance.

With the consideration of these statements and the geographical location of Colombia, in or near the center of origin of the cultivated species of potato, the trials herein reported were planned. The main objects of the project are to evaluate the varieties of potato grown in Colombia for their resistance to the insect pests, and to seek sources of resistance to those insects.

#### Material and Methods

All well planned programs of insect resistance in crop plants should be cooperative work between the entomologists and the plant breeders, where each one should handle their respective problems, but should also be interested in the difficulties and possibilities of the other's field (Painter 1951). In Colombia, the project was arranged in cooperation with the Program of Potato Improvement of the Department of Agriculture Investigations (DIA), which will handle the plant breeding part of the project.

The material tested included about 350 varieties and some hybrids, which constitute the Colección Central Colombiana (Colombian Central Collection),



maintained at the Centro Nacional de Investigaciones Agrícolas "Tibaitatá", Bogotá, and Granja "Obonuco" at Pasto. Of these materials, 212 varieties belong to Solanum andigenum, 136 to Solanum tuberosum, 2 to Solanum colombianum, and 10 represented six other species of Solanum.

The data herein included were obtained from field tests carried on at Bogotá and Pasto during the years 1957 and 1958. In all the trials the varieties were planted in an isolated field, usually far away from other potato plantings and surrounded by plantings of wheat or barley. This was done in order to secure a uniform insect population and avoid the effect of insecticides. Each variety was represented by a 7.2 foot row, each row planted at 1.6 foot interval from the next. The arrangement of the fields after planting was of a randomized block design. Check rows of a variety commonly grown in the region and known to be susceptible to leafminer and other insect attack were planted at both ends of the so-called blocks, and at intervals, every 20 rows. As current cultural practices, each field received a pre-emergent spray of a weed-killer, and weekly sprays of fungicides.

Painter (1951) stated that in the early stages of these kinds of projects, where large numbers of varieties and strains are to be tested, sometimes it is necessary to sacrifice accuracy if the numbers can not otherwise be handled. He said that the resistance is measured by the comparison with a variety or the average of a group of susceptible varieties. The measure can be done by using counts of insect populations or by estimating the amount of damage. The latter was the way followed in the tests reported. For each variety an evaluation of the damage done was made for the following insects: flea beetles (Epitrix spp.), budworms

(several species), leafminere (Liriomyza ep. and a microlepidoptera\*), and also aphids, thrips and cutworms. The damage done by each one of these pests is so characteristic, that only rarely is there occasion for being confused in regard to the insect doing the damage.

In order to keep uniformity in the evaluation of the injury by the different insects, six categories, each one with a grade, were established.

The grading scale used was:

- 0 Without damage.
- 1 Very little damage.
- 2 Some damage.
- 3 Common damage, as the present in plantings where control measures are followed.
- 4 Conspicuous or abundant damage.
- 5 Severe damage.

Usually the grading was made at the time known to be the most appropriate for the presence of the pest in the potato fields.

#### Results and Discussion

According to Painter (1951) the use of the estimation of the amount of damage gives a measure of the combined effects of preference, anti-biosis and tolerance. In order to separate these three different kinds of resistance, more accurate methods and techniques should be used.

The main difficulties found in the development of this project were the use of the same scale of grading to measure different types of damage, and the absence of large enough populations of aphids, cutworms and thrips, to make a perceptible amount of damage to warrant recording. As a result

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\* The exact identification of this insect has not been received, but it belongs to the family Gelechiidae.

the grading was made only for flea beetles, budworms and leafminers.

After the records were examined it was found that there were no differences among the varieties within a species, or among species, to the attack of flea beetles and budworms, at any of the two localities. A slight difference was found in the 1957 test at Bogotá, between S. tuberosum and S. andigenum, when the average damage by flea beetles to each species was compared.

More satisfactory results, giving some differences in the resistance within varieties or species to the flea beetle and budworms, could perhaps be secured by the use of a more accurate method to evaluate their damage and separate the differences. For flea beetles, Painter (1951) reported that several workers have been able to find differences in injury to varieties of potato by recording the number of adults per plant or the number of punctures per leaf or leaflet.

Even though this method of assigning grades for the different amounts of damage did not work with the flea beetles and budworms, it did fairly well with the leafminers. Damage grade for the varieties of S. andigenum and S. tuberosum by two species of leafminer, obtained at Bogotá and Pasto during the years 1957 and 1958 are given in Table 2 and 3 respectively. Before considering in detail the results, it is important to explain the conditions of the experiment in regard to these particular insects. In Colombia, the potato leafminers are represented by two species of insect generally distributed in the potato growing areas. One is Liriomyza sp. (Diptera, Agromyzidae), and the other is a microlepidoptera, probably Gelechiidae. Recent damage by each species is characteristic and difficult to confuse. The dipteran makes irregular mines, generally between the larger veins and the excrementa are spread over the mine. The

Table 2. Damage grade of varieties of *S. andigenum* and *S. colombianum* by two species of leafminer, at two localities in Colombia, South America. (Varieties with grade 2 or lower in two or more tests.)

Record No. (a)	Variety	(b)		(c)	
		1957	1958	1958	1958
2	Yema	2	1	3	4
4	Lizaraza blanca	2	1	3	4
5	Lizaraza rosada	2	2	*	*
39	Italiana	2	2	3	4
43	Pana blanca	1	2	4	4
44	Bijagua o Morada	2	1	4	4
45	Tocana blanca	1	2	**	**
51	Caiceda careta	2	2	4	4
52	Arracachuela blanca	2	2	3	4
58	Pajarita morada	2	2	3	4
61	Tuquerrena negra o Sabanera	2	2	3	4
105	Curipamba	3	2	2	4
107	Leona	2	1	3	2
112A	Pamba rosada - Sel.	**	**	2	2
112B	Pamba rosada - Sel.	1	1	2	2
114	Ojona or Ojo de buey	2	1	3	3
132	Chaucha negra	2	2	3	3
134	<u>Solanum colombianum</u>	2	3	2	3
137	Negra	1	2	3	5
138	Brasilá	1	1	3	4
141	Pamba blanca	2	2	3	4
142	Pamba morada	1	2	3	5
161	Huevo de indio	2	2	3	5
162	Ecuatoriana	1	2	3	4
165	Pamba colorada	1	2	*	*
167	Rosa	1	2	3	5
169	Mampuera	2	2	2	4
170	Plancha blanca	2	2	3	4
196	Curipamba	2	2	3	4
198	Algodona	1	2	3	4
204	Negra ceji-blanca	1	2	5	5
205	Rosada	1	2	3	4
207	Tableada blanca	2	1	3	4
208	Tableada morada	2	2	*	*
221	Pijagua	1	2	3	3
238	Guata	1	2	3	4
263	Guata blanca	2	2	3	4
280	<u>Solanum colombianum</u>	2	2	3	4
300	Pali-negra	2	1	*	*
306	Argentina	2	2	*	*

Table 2. (Concl.)

Record No. (a)	Variety	Bogotá (b)		Pasto	
		1957	1958	1958 (c)	1958 (d)
307	Argentina	2	2	4	4
386	Pajara puntelanza	2	2	4	4
388	Congola	1	2	4	4
398	Pana	1	2	3	4
404	Pana azul	2	2	4	4
410	Manzana	1	1	**	**
549	-----	1	2	3	4
927	<u>S. andigenum</u> (1)	2	2	*	*
934	<u>S. andigenum</u> (7)	1	2	3	4
935	<u>S. andigenum</u> (8)	2	1	3	4
938	<u>S. andigenum</u> (11)	1	1	3	4

- (a) Record numbers in the Colombian Central Collection.  
 (b) Includes damage by Liriomyza sp. and a microlepidopteron leaf-miner, mostly the former.  
 (c) Damage by Liriomyza sp. only.  
 (d) Damage by a microlepidopteron leafminer.  
 \* Variety planted but did not grow.  
 \*\* Variety not planted.



Table 3. Damage grade of varieties of S. tuberosum by two species of leafminer, at two localities in Colombia, South America. (Varieties with grade 3 or lower in two or more tests.)

Record		Bogotá		Pasto	
No.	Variety	(b)		1958	1958
(a)		1957	1958	(c)	(d)
98	G. L. S. Madison selfed	1	2	**	**
99	GMO. EKP/9 (TI/5, 1171) FUK	3	2	**	**
334AB	Sel.	3	1	**	**
582	Craig's Snow white - England	5	2	3	4
644	BRA-3133 Dr. Pigot - Belgium	4	3	2	4
671	C. P. C.:1591 a(25) - Cambridge	4	4	2	3
727	-----	**	2	3	4
728	C-110-13 - Chile	1	2	**	**
749	1664 a(1) - Scotland	3	1	**	**
756	41956 - United States	5	1	3	4
799	Furore - Holland	3	2	**	**
800	Industrie - Holland	3	3	**	**
847	Ari - Holland	3	3	**	**
857	Concordia - Germany	3	2	**	**
869	Stevenson's no. B-3518 - U. S.	3	1	**	**
878	Stevenson's no. B-3533 - U. S.	3	1	3	4
881	Stevenson's no. B-3548 - U. S.	3	2	**	**
888	Stevenson's no. B-1416 - U. S.	3	2	**	**

(a) Record numbers in the Colombian Central Collection.

(b) Includes damage by Liriomyza sp. and a microlepidopteron leafminer, mostly the former.

(c) Damage by Liriomyza sp. only.

(d) Damage by a microlepidopteron leafminer.

\*\* Variety not planted.

microlepidopteron produces more or less rounded mines, usually at the tip of the leaflets, and the excrements are deposited in a definite place. Old damage of both species is easily confused with each other and with spots of late blight produced by Phytophthora infestans. The abundance of either species is variable from year to year. During the year 1957 and 1958 the damage by the microlepidopteron was so inconspicuous at Bogotá, that it was considered worthless to record the grades for each species individually, as was done at Pasto, where the damage by each species was noticeable. This will explain in part the large differences in the grades recorded for the same variety at the two localities.

In order to present the most valuable information from the standpoint of resistance, in Table 2 there are included all varieties of S. andigenum that gave a grade of 2 or lower, two or more times. In Table 3, it was necessary to change the basis for the classification of the varieties of S. tuberosum to a grade of 3 or lower, because when the concept of Table 2 was used, only varieties number 98 and 728 would have been included. This led to the general conclusion that the varieties of S. tuberosum are more susceptible to the attack of leafminers than the varieties of S. andigenum. This may be due to the fact that the varieties of the latter species have been grown over a longer period of time in the area, than those of S. tuberosum, many of which have been recently introduced. As Painter pointed out, strains which have been exposed to a particular insect for long periods of time are sometimes found to carry genes for resistance to that insect.

In comparing the damage grades for the two species of leafminer obtained in the test of 1958 at Pasto, it was observed that the damage by the lepidopteron species was more severe than that by Liriomyza sp. In general, there were few differences in the susceptibility to the

microlepidopteron leafminer between the varieties of S. tuberosum and S. andigenum.

From only one test it is impossible to draw exact conclusions, but given the greater severity of damage by the microlepidopteron and the lack of difference in the susceptibility of the two species of Solanum, obtained in that test, it appears evident that the basis of resistance to this species is different from that of Liriomyza sp.

After having examined the grades obtained for each variety, it was found that only a selection of the variety of S. andigenum, Pamba roeada, recorded under the number 112B, had low grades in all the tests and to both species of leafminer. The fact of consistent low grades shown by this selection, and its good agronomic characteristics, make it an important material to be included in future breeding for resistance to leafminers in potato.

As stated before, several hybrids were included in the tests. The results obtained are not presented here, since very little is known about the parental resistance, but some observations are given.

During the first test at Bogotá, during 1957, it was surprising that the row planted with the hybrid recorded under the number 53-11-17, a product of the cross between S. malichense x (S. rybinii x S. rybinii), maintained a grade of zero during all its growing season, especially considering that this hybrid was exposed for a longer time than any other. The same strain showed a grade of 2 for leafminers, during the test in 1958 at the same locality. This fact indicates that certain wild species may carry resistance to the leafminers, and perhaps the possibility of incorporating this resistance into the cultivated varieties, which present better agronomic characteristics.

After computing the average grades for groups of hybrids, using only the records of the first test, the following information was noted. The 20 hybrids of S. tuberosum x S. tuberosum, as a whole, showed a lower average damage grade than the 4 hybrids of S. andigenum x S. andigenum, and it was still lower than the average grade for the 171 varieties of S. andigenum used in that particular test. This notation may not be true, because of the large differences between the number of the varieties in each group.

#### SUMMARY

This work includes the reports of the collections of foliage insects made on potato, (Solanum andigenum Juz. and Buk.), and notes on potato varietal tests in a search for sources of resistance to certain of the insect pests in Colombia, South America.

About 2,950 specimens were collected at representative localities in the growing regions of the crop in that country, representing about 208 species. Of these, 32.2 per cent were identified to species, 59.7 per cent to genera, and the remaining 8.1 per cent to higher categories. In all the material there were found at least eight new genera and 6 new species. A particularly interesting case was the finding of the European hemipterous species Orius laticollis Reuter, which seems to be recorded here for the first time in the Western Hemisphere.

The foliage pests of more economic importance to the crop in Colombia are: the leafminers, Liriomyza sp. and a microlepidopteron Gelechiidae, the flea beetles, Epitrix spp., the aphid, Myzus persicae (Sulz.), and the leafhoppers, Empoasca spp.

Tests in a search for plant resistance to potato insects were carried out in Colombia during 1957 and 1958, using the material of the Colombian Central Collection, and consisted of about 350 varieties and some hybrids. Several species of Solanum were represented, but the larger numbers of varieties represented selections of S. andigenum Juz. and Duk., and S. tuberosum L.

In general the varieties of S. tuberosum are more susceptible to the attack of the leafminer Liriomyza sp. than those of S. andigenum. However, there appeared to be few differences in the susceptibility of the two species of Solanum to the attack of a microlepidopteron leafminer among the varieties studied.

Some important observations in these tests were that only a selection of a variety of S. andigenum, called Pamba rosada, had low grades in all the tests and to both species of leafminer. A hybrid between two wild species of Solanum showed the lower grade in the first test and in the second, the grade was still low, but not as low as in the first.

When comparing the grades obtained in the first test for the different groups of hybrids, it was found that the hybrids of S. tuberosum x S. tuberosum, as a whole, had a lower average damage grade than those of S. andigenum x S. andigenum.



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INSECTS ON POTATO FOLIAGE WITH NOTES ON INSECT  
RESISTANT POTATO VARIETIES IN COLOMBIA

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The purposes of this study were (1) to gain a better knowledge of the foliage insects found on potato (Solanum andigenum Juz. and Buk.) in Colombia, and (2) to search for sources of resistance in varieties of potato to the most important pests.

Collections of insects were made at six representative localities in the potato growing regions in Colombia, by sweeping the plants. A total of 2,950 specimens were collected, which after being identified represented seven orders, fifty-seven families and two hundred and eight species. Of these only 32.2 per cent could be identified to species, 59.7 per cent to genera, and the remaining 8.1 per cent only to higher categories than genera.

Among the material there were found at least eight new genera, and a number of new species. An interesting new record was the finding of the European hemipterous species Orius laticollis Reuter, which seems to be recorded here for the first time from the Western Hemisphere.

A review of the literature is given for each one of the genera and species collected. References to the insects found elsewhere on potato and other crops were included.

The foliage pests of economic importance to the crop in Colombia are the leafminer, Liriomyza sp. and a microlepidopteron Gelechiidae; the flea beetles, Epitrix spp.; the aphid, Myzus persicae (Sulz.); and the leafhoppers, Empoasca spp., especially papae Rup. and DeL.

Tests in a search for plant resistances to potato insects were carried out in Colombia during 1957 and 1958, using the material of the Colombian Central Collection, which consisted of about 350 varieties and some hybrids. Several species of Solanum were represented, but the larger numbers of varieties represented selections of S. andigenum Juz. and Buk.

and S. tuberosum L.

For each variety a row of five plants was planted. In order to secure the insect populations, all the varieties were planted in a field far away from other potato fields and surrounded by plantings of wheat or barley, also known susceptible varieties were planted on the edges of the field and at intervals between the varieties. Each variety was graded for damage by flea beetles (Epitrix spp.), budworms (several species), and leafminers (Liriomyza sp. and a microlepidopteron Gelechiidae), using a grading scale of 0 to 5, where 0 represented no damage and 5 severe damage.

In general the varieties of S. tuberosum were more susceptible to the attack of the leafminer, Liriomyza sp., than those of S. andigenum. However, among the varieties studied, there appeared to be few differences in the susceptibility of varieties of the two species of Solanum to the attack of the microlepidopteron leafminer.

Some important observations in these trials were that only a selection of a variety of S. andigenum, called Pamba rosada, had low grades in all the trials and to both species of leafminers. A hybrid between two wild species of Solanum showed the lower damage grade to leafminers in the first test but in the second, the grade while still low, was not as low as in the first.

In comparing the grades obtained in the first test for the different groups of hybrids, it was found that the hybrids of S. tuberosum x S. tuberosum, as a whole, had a lower average damage grade than those of S. andigenum x S. andigenum.