Merrill, Geo. B.
Plant Board

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NOTES ON THE BIOLOGY OF LAPHYGMA EXIGUA HUEBNER*

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Several species of Noctuidae occur in the ferneries of Florida and are responsible for more or less injury. *Laphygma exigua* is the most abundant species north of Auburndale. This insect is commonly known in the western states as the sugar-beet army worm, which is the common name recognized by the American Association of Economic Entomologist. In Florida this army worm does not usually betray its relationship to the fall army worm by marches such as are characteristic of the latter species. The plant of economic importance attacked by *L. exigua* in Florida is *Asparagus plumosus* var. *nanus*, ("asparagus fern"). Thus it is known to the growers of *A. plumosus* as the fern caterpillar and the bud worm. The latter name is applied to the first and second instar larva because of its habit of climbing to the bud and chewing a hole at the base of the tender tip.

The first record of *L. exigua* in the United States is that given by Harvey (1876) in the *Canadian Entomologist*. Harvey collected specimens of this insect in Oregon. Larvae were collected in California by Coquillett (Chittenden 1902) in 1882 and 1886. In 1899 Gillette (1899) reported the larvae feeding on sugar-beets in Colorado. Sanderson (1905) reported the larvae damaging cotton in Texas in 1904. Marsh (Campbell and Duran 1929) reported a serious outbreak on sugar-beet in Kansas in 1911, and observed a few larvae on turnips at Phoenix, Arizona in 1916. In a letter Dr. Foster H. Benjamin states that this insect is often confused with *Laphygma frugiperda* and probably for this reason escapes detection. According to Dr. Benjamin *L. exigua* is abundant as far east as Brownville, Texas, and was collected at Quincy, Illinois in 1899, and at Altemont Springs, Florida in 1924. Mr. J. M. Langston of the State Plant

*Contribution from the Department of Entomology, Florida Agricultural Experiment Stations.

Board of Mississippi writes me that he has specimens of *L. exigua* in the collection which were taken at A. & M. College and Starkville, Mississippi in August 1920. Larvae were also collected feeding on corn at Natchez, Mississippi on May 14, 1931.

Specimens sent to the United States National Museum during the summer of 1932 were identified by Dr. Foster H. Benjamin as *Laphygma exigua* Hbn. Although we have no accurate record of its first appearance in the ferneries of the State, it is certain that this insect has been present for a number of years. At the present time the fern caterpillar occurs at Pierson, DeLand, Leesburg, Groveland, Yalaha, Auburndale, Altemont Springs, and Fern Park. It has not been found south of Auburndale, although these ferneries are infested with other species which are as destructive as *L. exigua*.

It is difficult to estimate the amount of damage inflicted by the fern caterpillar because of the fluctuations of the market value of *A. plumosus* during the summer, and because of the variable thoroughness with which control measures are applied. The greatest injury occurs during the rainy season which usually lasts from eight to twelve weeks from mid June or July to September. During much of this period some rain falls almost every day and frequently the amount is large; as much as one inch in an hour is often recorded. These frequent and heavy rains make it difficult to keep the plants covered with an insecticide. Thus the damage multiplies with increased rainfall. The first and second instar larvae, as previously mentioned, have the habit of climbing to the tip of the asparagus shoot and feeding on the tender bud. This feeding on one side of the bud causes it to curl over and eventually to wither. Such tipless sprays are valueless under present market conditions. The older larvae feed on any part of the plant, preferring the soft succulent sprays which have just finished expanding.

Campbell and Duran (1929) give a list of eighteen plants which are attacked by the sugar-beet army worm or fern caterpillar. This list includes, in addition to sugar-beets, table beets, corn, cotton, peas, pepper, a number of wild plants and grasses. Taylor (1931) reports that in South Africa tobacco, grapes, young eucalyptus trees, and lawns, as well as cotton, maize, and peas are attacked by this insect. I have not observed *L. exigua* feeding on any other plant than *Asparagus plumosus* except upon two occasions. Recently larvae were collected feeding on *Gladiolus* sp. which were about twelve inches high. The gladi-

olus field was surrounded by uncultivated grass land, and the field itself had not been cultivated during the summer months. The larvae had probably been feeding on the grasses when the field was plowed and planted to gladiolus. On the other occasion the larvae had become very abundant in a neglected fernery. After consuming the asparagus they devoured the grass growing between the asparagus plants.

The adult moths resemble rather closely *Laphygma frugiperda* S. & A., especially the plain gray form. The wing expanse of *L. exigua* ranges from twenty-five to thirty millimeters; the fore wings are broader and paler than in *L. frugiperda;* the reniform and other spots as well as the mottlings are more distinct, but the posterior pair of wings differ very slightly from those of *L. frugiperda.*

Emergence of the adult moths occurs during the night and copulation may take place soon after arriving at the surface of the soil, as is shown by the fact that fertile eggs have been deposited in the laboratory cages the evening following that of emergence. Practically all of the activities are conducted at night, although the moths may be observed flying ahead of one walking through the fernery in the daytime when the moths are present.

In the ferneries the eggs are laid on the underside of the asparagus sprays in masses covered with scales from the abdomen of the female. These masses have been collected from both very young sprays and mature sprays. Egg masses collected in the fernery were composed of 50 to 150 eggs while masses deposited in the laboratory cages ranged from 5 to 145 eggs. Records of forty-five pairs of moths were kept, beginning on June 15 and ending September 23. The average number of eggs deposited by these forty-five females was 516.55 eggs per female. The largest number of eggs laid by a single female was 1171 and the smallest number was 18. Campbell and Duran (1929) report that eleven females laid an average of 330 eggs. The oviposition period usually lasts only 4 or 5 days, the average being 4.80 days. The preoviposition period for these moths was 2 to 3 days, averaging 2.88 days. The moths were fed honey diluted with water. Of the 45 pairs on record the females lived for an average of 8.26 days while the males averaged 8.14 days. This figure may represent a longer life for the males than is the case in nature as they are protected and undisturbed in the cages whereas they would be exposed to a number of dangers in the field. Many of the males died within two or three days after

emerging while some of them lived longer than the females. One male lived twenty-one days and one female lived twenty days.

On July 6 five pint ice cream cartons were placed in the refrigerator each containing a newly emerged male and female *L. exigua* with a spray of asparagus for support and honey water for food. The first carton was removed twenty-four hours later and one carton was removed each succeeding twenty-four hours for four days. The temperature of the refrigerator was maintained at 35° to 40° F. The first female after a preoviposition period of four days, which included the time spent in the refrigerator, laid 413 eggs in four days. The second female after a preoviposition period of five days laid 401 eggs in four days. The third female escaped. The fourth female remained in the refrigerator four days and deposited eggs a day following her removal from the refrigerator. This female laid 496 eggs in six days. The fifth female remained in the refrigerator five days and also deposited eggs the day after her removal. The oviposition period lasted four days during which time 311 eggs were laid. This experiment showed that it was possible for the moths to withstand a temperature of 35° to 40° F. for at least five days and still oviposit normally when the temperature again reached the optimum. Ten egg masses kept in the same refrigerator for four days hatched two days after their removal.

The eggs, like those of other Noctuidae are ribbed, oblate-spheroid in shape, and circular in cross section. The upper third of the egg has the appearance of a cap surmounting the lower two-thirds and separated from the lower portion by a white ring. The eggs are greenish gray in color when freshly laid, becoming cream colored a few hours later, finally becoming dark just before the eggs hatch due to the black color of the larval head. From June 15 to September 19 incubation records were obtained on 470 egg masses deposited on 45 different days, the average incubation period being 2.06 days. During this time the average daily temperature ranged between 79° and 86° F. Taylor (1931) working in South Africa found the incubation period to be from 3 to 7 days during the summer and up to 12 days during the winter.

Eggs observed in the process of hatching were first cut open at the apex by the young larva. The larva continued to feed, gradually enlarging the original opening. After crawling from the egg the larva remained feeding on the shell until it was almost completely devoured, a period from six to eight minutes long. When

this first meal was completed the larva rested near the egg mass a short time before beginning the search for other food. DeOng (1918) reports observing the young larvae feeding gregariously on castor bean beneath a web, during the first and second instars. I have not observed them feeding in such a manner on *A. plumosus* during the three years of constant observations in the fernery. However the first and second instar larvae do spin a web about themselves just before molting and remain inside this web a variable length of time after ecdysis. The newly hatched larva is one millimeter in length, a light green color, with numerous small tufts of hairs scattered about over the body. If disturbed or buffeted about by the wind the first or second instar larva immediately releases its hold on the plant except for a thread of web by which it slowly lowers itself to the ground. If a strong wind is blowing this web acts as a kite string and the small larva may be carried a considerable distance. If the older larva is disturbed, it immediately curls up and falls to the ground. During the hottest portion of the day large numbers of the larvae may be found on the surface of the soil beneath the dense shade provided by the fern plant.

From June 14 to October 10 six complete generations of larvae were reared. There are five instars, each instar consisting of an active and inactive period. Before the occurrence of each molt the larva spends some time resting. During this time the old head capsule is gradually forced off, and when this part of the molt is completed the exuvia is much more rapidly removed. Exact records of the length of time consumed by these activities were not obtained. The total time required for the development of the larva from the time it hatches to the beginning of the prepupal stage averaged 11.45 days for the six generations. The following table is a summary of the data collected for the six generations, ten larvae of each generation.

TABLE I.—A SUMMARY OF THE TIME REQUIRED BY EACH INSTAR FOR ITS DEVELOPMENT. THE MEASUREMENTS WERE MADE JUST BEFORE MOLTING BEGAN.

	Ave. Time In Hours Required	Ave. Length In Millimeters
First Instar	56.24	2.49
Second Instar	51.78	5.77
Third Instar	44.00	8.88
Fourth Instar	48.75	13.78
Fifth Instar	74.13	22.85

The two days usually required for the fifth instar larva to make its way into the ground and construct the pupal cell is here considered as being the prepupal stage. The average length of this period was 1.76 days. After forming the pupal cell the prepupa becomes shortened, and takes on a mottled gray color. The skin is shed for the last time and the light green colored pupa appears.

Within a few hours the pupa gradually turns a light brown in color. This color slowly darkens as the pupa grows older until it becomes a deep wine color. The average length of the pupal stage for the six generations reared by October 20 was 5.94 days. The pupa averaged 10.4 millimeters in length, the female pupae being slightly larger than the male pupae. No appreciable difference was observed in the length of time required for the development of males and females.

The first generation of larvae which was abundant enough to cause noticeable damage appeared between April 23 and 28 of this year. A second generation occurred between June 2 and 8. The third generation began to appear July 1. Thereafter the generations became so mixed in the ferneries that it was impossible to distinguish between them. All stages of the insect occurred in the ferneries during the winter of 1931-32. This condition would indicate that the winter is passed by a continuation of development although retarded. The lower temperatures of the winter months tend to materially increase the length of the various stages. The number of generations to be expected in such a case is not known, as the life history studies have not been carried through a winter. The length of the life cycle obtained by adding the averages for the various stages of the six generations reared is twenty-four days. This already gives the insect one more generation in this State than in California, as Campbell and Duran (1929) report five generations for the whole year in California.

During the past summer some of the growers near the laboratory did not attempt to control the fern caterpillar because of market conditions. In these ferneries the larvae frequently became very abundant. This offered an excellent opportunity to collect and study the parasites which attack this insect. Of the eight parasites collected and observed *Chelonus texanus* Cress. was by far the most abundant. Next in importance to *Chelonus texanus* were *Meteorus autographae* Mues. and *Apanteles marginiventris* (Cress.) found in equal abundance. *Euplectrus platyhypenae* How. has been observed from time to time in the

ferneries at Leesburg, but it was never abundant. It was observed to be very abundant in the ferneries at Boynton however. Single specimens of the following parasites were collected: *Hyposoter interjectus* Gahan, *Zele melleus* (Cress.), *Gonia crassicornis* Reinh., and *Eucelatoria rubentris* Coq. *Spilochalcis hirtifemora* (Ash.), *Spilochalcis albifrons* Walsh, *Catolaccus aeneoviridis* (Gir.) and *Mesochorus* sp. were bred from cocoons of *Apanteles marginiventris*. Two predators very abundant in the ferneries were active in destroying larvae of *L. exigua*. These were *Polistes fuscatus* var. *rubiginosus* Lep. and *Podisus maculiventris* Say. There is also a fungus disease *Spicaria prasina* which was very active in destroying larvae of *L. exigua* during the rainy periods. Chickens and guinea hens have been used by some of the growers to help keep down the infestations of worms.

All of the insects listed above were identified by systematists of the United States National Museum: the Chalcidoidea and Brachonidae by Dr. C. F. W. Muesebeck; the Ichneumonidae by Dr. R. A. Cushman; *Polistes fuscatus* var. *rubiginosus* Lep. by Dr. Grace Sandhouse; *Podisus maculiventris* Say by Dr. H. G. Barber; the Diptera by Dr. J. M. Aldrich; *Laphygma exigua* Hbn. by Dr. F. H. Benjamin; and *Spicaria prasina* by Mr. Erdman West of the Florida Experiment Station. Several of the fern growers have helped to advance the work by generously allowing the author free access to their ferneries at all times.

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UNE LETTRE DU V CONGRES INTERNATIONAL D'ENTOMOLOGIE, PARIS, FRANCE 16 AU 23 JUILLET 1932

J. HAROLD MATTESON[1]

Dear Fellow Entomologists:

Ecrirai les impressions de ce congrés en francais ou anglais ? I presume that for the benefit of all it will be best to write in English, yet if you were here with me at this Congress you would wish more than ever that you had spent the extra half hour (after the smart French student went to bed) in perfecting your French. Everyone is speaking French. The English seem to be having the easiest time due to the fact that they speak softly and we Americans talk in our throats, more guttural and harsh than they, and consequently they are more easily understood. I have had quite a time for the first couple of days trying to speak softly with my lips, (Try it) but after that it was not so difficult, and just about the time that the shores of England called me I found that my French was much improved, and that speaking was becoming a delicious pleasure instead of the superb effort which it proved originally. If someone has told you that you do not need French in Paris, you tell them that as a matter of insurance you are going to carry your French with you, and in the latest approved package for instant use, for you will need it, and no joking. It is my impression that the French are not so much inclined to cheat an American who can make them believe that he understands what they are saying, and can make himself understood to them.

[1]Official Representative of the Florida Entomological Society at the International Entomological Congress.

Possibly you would like a word about the Agronomique (Institut National) the headquarters, for it is here that the scene is laid, and it was here that we spent so many interesting hours. The building is of red brick and is situated on a corner of one of Paris' busiest streets. Entering, on our right is a long hall which we find leads to a larger number of class rooms and laboratories devoted to agriculture. Turning to the right on entering, we have in front of us the tea garden, and on our right the hall which leads to the headquarters of the excursions and the "rogues" gallery of pictures of entomologists conducted by our friend Mr. Scott. Above us is a large room for the convenience of the entomologists, and directly opposite is the auditorium in which were held the general sessions of the congress.

My first impression of Paris was that of many streets, narrow and wide, circling every which way; and here, and there, the strains of music and dancing, for it is the day after Bastile Day. The sidewalks are very wide to provide for the many cafes and restaurants that are everywhere, and which serve in the open air on the various artistic tables and chairs placed on the walk. The little automobiles all blowing their horns will amuse you. The Louvre and Tuileries which extends to the place de la Concorde will make their everlasting impression.

Glancing over the programme of the Congress of Entomology you note that two tours of Paris are provided, a tour of Versailles, excursion to Chantilly, Fountainbleau, and two banquets in addition to the reception at the Hotel de Ville by the Municipalité de Paris and the Séance solennelle du Centenaire de la Société entomologique de France, dans le grand amphitheatre du Museum national d'Histoire naturelle en présence de M. A. Lebrun, President de la Republique; all this in addition to the regular meeting of the sections.

On the sixteenth of July I attended two receptions and at 8 P.M. took dinner at the Hotel Claridge offered to the official delegates by the Entomological Society of France on the celebration of the one hundredth anniversary of the founding of this celebrated society in 1832. We Americans and English joked about the wines offered—Chateau respide, Pontet Canet, Pommard 1923, G. H. Mumm Double Cordon et Cordon Vert, Liqueurs de Marque—served to you whether you liked it or not. Mrs. A. Hartzell and her husband who sat next to me on my right wanted me to drink theirs as well as my own, but Mr. J. J. Davis of Lafayette, Indiana insisted that if I handled what

I had of my own I would be doing well. He was seconded by B. Wahl of Vienne, and J. W. Edwards of London.

Dr. Jeannel welcomed the delegates in the name of the Entomological Society of France. Glancing around I saw M. Bouvier, Dr. L. O. Howard, Dr. W. Horn, Dr. Karl Jordon, M. Alquier, H. F. Johannsen, M. Marchal, E. B. Poulton of Oxford and many others. Following the dinner a reception was held where the delegates had another opportunity to meet each other.

On Sunday at ten in the morning the delegates visited the Tomb of Latreille in the cemetery of Pére-Lachaise, followed by the excursion to Chantilly and the visit to the chateau and the forest.

Monday at nine-thirty the Congress itself began in earnest with a general session in the Agronomique under the chairmanship of M. A. Gardey, Minister of Agriculture, followed at two by the meetings of the sections of Entomologie generale; Morphologie, Physiologie, Developpment; Ecologie, Biogeographie; Entomologie appliquée; Apiculture; Nomenclature. This program was carried out daily including tea in the garden of the Agronomique at four in the afternoon especially for our English friends.

A day that I will remember for a long while was Mercredi 20 juillet when we left by big auto busses for the forest of Fountainebleau and the chateau where every emperor of France strode through its stately halls and where Napoleon himself bid adeau to his troops. But better still, the forest was full of butterflies, and I took thirty specimens in about forty minutes that we had to spend in the leafy jungle, much to the enjoyment of M. Le Charles, M. Corti, my most excellent companion of the day, and Mr. F. M. Jones of the Philadelphia Academy of Natural Sciences. After an entire day of marvels for both the traveller and the scientist we returned to Paris at eight in the evening, tired, but not too tired for Sir B. N. Blood, J. W. Edwards and myself to classify the specimens I had captured and make such interesting notes as, "Taken in the path which was so often trod by Napoleon from the Chateau of Fountainebleau to the Carp Pond", or "Beside the field where Millet painted the 'Angelus'."

The outstanding feature of Friday was the banquet au Jardin de Vincennes. Here I had the interesting experience of being told by a French waiter that a tip of ten francs was not sufficient due to the fact that all Americans were rich and could well

afford more. It seemed that the tips were not included in the service for some unknown reason. It was another delightful banquet and while eating we were entertained by some attendants riding by the entrance to the pavilion on camels. Here also the method by which the animals were caged was interesting. To the eye the lions were free to come and go as they pleased but upon closer examination it appeared that a huge moat arranged so that it was impossible for the animals to cross separated them from us.

Saturday was the last regular day of the Congress and the sessions of the sections were held and a final general assembly in which motion pictures of German experiments with color as an essential element in attracting bees to a preparation of sugar and water were shown. The attractiveness of 20 per cent solution of sugar and water was shown and then reduction of the solution produced a reduction of the bees attracted. Dr. L. O. Howard moved to thank the committee in charge of the Congress for its efficiency and the motion carried unanimously. A heated debate on the location of the next congress was held and it was decided that the next congress would be in Madrid, Spain. The International Committee on exchange was abolished and A. Avinoff announced that the dream of Entomologists for such a committee has been fulfilled with the completion of an organization sponsored under the League of Nations. So closed the Fifth International Congress of Entomology.

Just what would be of value to the many entomologists of Florida it is difficult for me to know without knowing the specialty of each entomologist, however, I will give you a few of the notes that I made in the hopes that they may be of value.

Yin-Chi Hsu gave some new morphological findings in Ephemeroptera and said, "On the ventral side of the eighth and ninth abdominal segment above the sternum there are two small oval shaped chitinous bodies, which lie along the median line at the middle of the segment." "A distinct valve was found in between the ileum and the colon. It is very similar to the oesophageal valve." This organ (Johnston's Organ) has been so far recorded in many orders of insects. A similar organ was found in the pedicel of the antennae of Stanonema." There are unicellar mating glands on the inner surfaces of the male forceps. The ventral surface of the egg valve is armed with many minute conical spines beset with numerous small spines."

B. P. Uvarov spoke on Conditioned Reflexes in Insect Behavior, and said, "The best example of a conditioned reflex is

offered by the flower-visiting habit of insects feeding on nectar. The attraction of females to their larval feeding food for oviposition is a case of conditioned reflex which remains inhibited until the sexual maturity. The usual explanations of insects' actions either by instincts, or by forced movements are one-sided, and the problem of insect behavior must be studied with an open mind, by physiological methods."

S. Metalnikov, speaking on Immunité Naturelle et Acquise chez les Insects, named the factors of natural immunity as 1—Phagocytose, 2—Formation of plasmodes ou cellules geantes, 3—Formation des capsules autour des plasmodes, 4—Formation des abcés, 5—Des anticorps: bacteriolysines et antitoxines."

G. Haeussler summarized the general information concerning the oriental fruit moth and its parasites accumulated during the course of investigations conducted by the Bureau of Entomology in France and Italy.

B. P. Uvarov, in speaking of the Physiological basis of applied entomology, said that Ecological point of view which is now firmly established in applied entomology, tends to stress the study of the environment, while the insect as a living organism is often neglected. The importance of the environment is in the responses on the part of the insect towards various external factors and these responses can be studied only from the physiological point of view.

I had the pleasure of presenting a list of the butterflies of Florida and urging the establishment of international bureau where the entomological works of the world could be tabulated and duplication of efforts checked. In line with this was the announcement of Dr. Avinoff on the last day of the Congress and the announcement of Dr. W. Horn that the Deutsches Entomologisches Institut under his direction had commenced the cataloguing of entomological works from about 1864 to 1925 and further urged that all entomological publications be sent to him.

Dr. Poulton of Oxford discussed Mackatee on protective coloration, pointed out that the eye is attractive on the butterfly to the birds and so accounts for the eye like spots on Hemiargus and Leptotes and certain other families of butterflies as being an imitation of the eye which is first attracted by the birds and which results in freedom for the insect. He cites examples to prove this theory.

Other subjects discussed which at a later date for the cost of preparation and mailing may be secured from me are: "La res-

piration pendant le vol chez les Lépidopteres, Recent advances in applied entomology in Canada, Sur les populations hybridées des Lépidodtéres dan la zone de contact entre races genetiques, Les Larves primaries des Méloides, Erlauterungen zu meinem System der Lepidoptera, Notice entomologique sur le Var et quelques points de la Côte d'Azur, Sense ecology and numbers of insects, Un Trechus cavernicole du Maroc, The axillary venation of the Insects, Organs odoriferants chez les Insectes, Sur les ailles d'insectes, Some fundamental aspects of parasitism in Insects, Aperçu sur la biologie de l'Urania rephaeus, Les Insectes parasites des plantes cultivées en Nouvelle-Calédonie, Notes sur la Mouche des fruits, Sur une invasion de la cochenille, Das Auftreten der San José Laus in Europe, Natural control of some tropical insects, and many others, a complete list of which may be had at a later date.

To completely cover this Congress would be to write a book and as the space is limited I close with the wish that you may be able to attend the next Congress and to assure you that if there is anything of particular interest on which you wish more information to assure you of my willingness to cooperate.

THE BEAN LEAFHOPPER SITUATION

The bean leafhopper situation in Florida at this time is just the reverse of that of a year ago. In the fall of 1931 *Empoasca fabae* (Harris) was less abundant than usual in the northern and central portions of the state. Some growers found it necessary to employ control measures but many fields of beans produced good crops without any control measures being used. In the Everglades, on the other hand, the leafhoppers were extremely abundant and it was practically impossible to produce a crop of beans even with frequent spraying with contact insecticides. The infestation continued throughout the mild winter and large acreages of the early spring crop were completely destroyed. The insects were found everywhere in the region and the young beans became infested almost as soon as they came through the ground. Professor R. N. Lobdell of the Everglades Experiment Station reported that in one instance young beans having only the first two leaves and located in the middle of a forty acre field had an average infestation of seven adult leafhoppers per plant.

The writer has recently investigated the leafhopper situation

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in the region surrounding the southern end of Lake Okeechobee where thousands of acres of beans are now growing. The leafhoppers were present in all fields visited but in every case they occurred in relatively small numbers. In no instance was the infestation sufficiently severe to cause any appreciable damage and artificial control measures seemed entirely unnecessary at that time.

A very different condition exists in the central portion of the state in the region extending southward from Gainesville for a distance of one hundred-fifty miles. Here practically every field shows injury resulting from the feeding of the leafhoppers. In some fields where no control measures were used the plants are almost all dead. In others the plants have not been killed but are so severely injured that they will yield little or no fruit. In a few isolated fields and in others where the land was prepared well in advance of planting time the injury from leafhoppers is much less severe though even here the yield will doubtless be affected.

The bean leafhopper is known to be practically free from predaceous and parasitic enemies and it seems probable that its abundance or scarcity in a region may largely be determined by weather conditions. There are not sufficient weather data from the two regions of Florida above discussed to enable one to deduce just what factors may have been responsible for the abundance of leafhoppers in one region and the comparative scarcity of the insects in the other. A. N. TISSOT.
