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TOMATO PIN WORM (*Gnorimoschema lycopersicella* (Busck)) IN FLORIDA

By GEORGE R. SWANK

The following account of the tomato pin worm (*Gnorimoschema lycopersicella*) is a condensation of a report submitted to the State Plant Board at Gainesville, descriptions of the stages with the details of their activities as well as the tables and drawings being omitted.

The investigation was carried on from April 1 to June 30, 1937. The State Experiment Station insectary was used and the work was done under the direction of Professor J. R. Watson.

The living larvae with which the investigation was started were procured from materials sent in to the State Plant Board taxonomist, Mr. G. B. Merrill, by inspectors working in Osceola, Polk, Orange and Seminole counties, and from materials brought by Professor Watson from Manatee County.

The first adult moths emerged from the collected material on April 22. They were found to be five females and two males. By the next day eleven more adults had emerged.

Seven adults, four females and three males, were placed in a lamp chimney and supplied with a fresh tomato leaf on May 23. Eggs were found on the leaf the next day and these hatched on May 31.

In order to determine the time spent in each instar, without the danger of injuring the tiny larvae in removing them from the leaves, the following technique was followed. Seven adults were confined in a lamp chimney with a fresh tomato leaf for twenty-four hours. The leaf was kept fresh as long as possible by having the petiole pass through a cork into a small bottle of water. Fresh leaves were supplied in each lamp chimney as they wilted or were consumed by the growing larvae. Each day the moths were removed to a different lamp chimney.

When a moth was found dead it was replaced by another moth of the same sex and thus the number was maintained at seven. When the moths were removed the leaf and container were examined and the eggs counted. Occasionally eggs laid the same night had to be supplied from other sources in order to have at least twenty eggs in each lamp chimney.

On May 14 and again on May 21 five larvae were removed from each lamp chimney and placed in separate vials of alcohol. The width of the head capsule of each larva was later taken and by the aid of Dyer's law the following table of larval instars was derived.

First instar—up to 4 days. Avg. 2.33 days
Second instar—from 3rd to 9th day. Avg. 2.65 days
Third instar—from 6th to 10th day. Avg. 3.33 days
Fourth instar—from 9th to 17th day. Avg. 2.04 days
Average number of days in larval stage—10.35 days.

The full grown larva may spend from part of one day up to two days after it has ceased to feed until it changes to a pupa. Only about ten minutes pass from the time the head capsule splits on the back until the last larval skin has been worked to the posterior end of the abdomen.

During the middle of April pupae from larvae which were brought into the insectary lasted from nine to sixteen days with an average of 10.5 days for the 30 cases for which accurate time records were kept. The temperature over this period (April 10-25) averaged* 69.6 degrees F.

The temperature averaged 79.8 degrees F. during the time the next generation was in the pupal stage, from May 20 to June 3. The males spent from 8 to 11 days with an average of 9.11 days while the females averaged only 8.24 days with a spread of from 7 to 10 days. The average for both sexes was 8.64 days as compared with 10.5 days which the previous generation spent in the pupal state.

The adult moths of the third generation were just starting to emerge at the close of the investigation. The indications were that the pupal period would average somewhat shorter but not enough cases could be checked to get accurate results.

Both males and females were found mating the evening of the same day on which they emerged. Copulation takes place

*The average of the maximum and minimum for each day as recorded by the nearby U. S. Weather Bureau thermometers.

during the late evening or early morning and lasts from 10 minutes to an hour and a quarter.

Eggs were deposited by mated females on the first night after they had emerged. Eggs may be laid at any time of the day or night but most of them are laid during the morning or evening twilight at which time the moths are normally more active. It takes only about five seconds to deposit an egg and several may be laid in a few minutes. Eggs may be deposited at any time during the life of the adult female moth which may cover a period of almost a month.

There are indications of considerable seasonal variation in the time it takes to complete a life cycle. Since this work was done in the early summer only, there was not opportunity to check these seasonal variations. It is interesting, however, to compare the results which were obtained in Florida with those published by Campbell[1] and Elmore for California.

Florida (California)	Minimum	Maximum	Average
Incubation	4 (4)	9 (30)	6.7 (8.9)
Larval period	9 (9)	17 (63)	9.8 (27.9)
Pupal period	7 (15)	17 (52)	11.0 (30.2)
Egg to adult	20 (28)	43 (145)	27.5 (67.0)

It will be noticed that the development in Florida for the time of the year covered by this work corresponds rather closely with the minimum for California. This might be expected since the tomato pin worm is probably native to the warmer climates and Gainesville is several degrees closer to the equator than California. During the latter part of June an entire life cycle was completed in 21 days.

Instances were noted in which the male moths mated more than once. In no case was more than one copulation noted for any female.

Without food the female can be expected to live from six to twenty-five days after copulation while the male will probably die before the sixth day, and frequently do so within forty-eight hours.

If proper food is obtained it is possible that they would live considerably longer. On the second of June 16 virgin females were placed in a large test tube and fed with honey and water daily. Nineteen males which had not mated were treated simi-

[1]CAMPBELL, ROY E. and ELMORE, J. C. The Tomato Pinworm. Bulletin of Dept. of Agri., Vol. XXIV, No. 3, July-Sept., Sacramento, Calif., pp. 301-309.

larly and by June 23 only four males and one female had died. On June 30, at the end of 28 days, seven males and ten females were still alive.

We see, therefore, that feeding increases the length of life possible for unmated moths and would probably increase the length of life after mating also as well as the number of eggs laid. Accurate data were not gathered on this point. The fact that the largest number of eggs deposited over the longest period by a single individual were laid by a female which was being fed honey and water would, however, probably lend weight to this idea.

The largest number of eggs from one female was 138, deposited on 15 of the 18 days she lived after mating. Forty-three eggs was the largest number laid by one female in a 24-hour period. The average number of eggs laid by 24 mated females was 36.1. Two of these died before any eggs were deposited.

Very few eggs were laid by unmated females and none of these hatched. Only one egg was found in groups known to be from fertilized females in which the embryo was not developing and it is possible that this egg had been injured.

The adult moth is a fairly strong flyer although its flights are somewhat shaky or in the form of a spiral during the day. At night their flights are probably longer and this is very likely the way that they spread within a given infested area. It is possible that their natural flights might account for their establishment in another trucking section if it were not too far distant. In Florida, however, where one trucking section may be separated from the next by miles of uncultivated land, this means of dispersal seems improbable except with the aid of air currents.

Further investigation might reveal some native Florida plants on which the larvae could live and develop properly and which would serve to bridge the extensive uncultivated lands. So far no such plant has been found. The nearest approach to it is found in the cherry-tomato which sometimes grows as an escape in waste lands or hammocks. *Solanum sisymbriifolium* Lam. may also occasionally be found growing in Florida as a weed.

A common means of distribution is quite likely on tomatoes or packing material. A bushel of infested tomatoes was brought from the southern part of the state for use in making a check of insect parasitism on the tomato pin worm. They were transported in a burlap sugar sack. Moths emerged from the empty sack from three to ten days after it arrived. Thus it can be seen that containers in which tomatoes are shipped may become a source of infestation for some time even after the tomatoes have been consumed. It is probable that this time would be considerably increased if the pupae were subjected to lower temperatures either through refrigeration or in being shipped to a colder climate.

Ordinarily by the time the tomatoes are ripe enough for the retail market few pin worms still remain in them. Most of them leave the tomato to pupate and often those which do remain are not able to find their way out when they become adult moths. This may be due to the change in the position of the tomato in shipment, to the fact that the hole through which the moth would have escaped has become closed by fungus growth or juice from the broken tissue.

Another possible source of spread of this insect which needs to be investigated and means provided for any control that may be necessary is the shipment of large numbers of tomato plants. It is probable that the transportation of young plants is the most important means of dispersal over the state.

Several attempts were made during the process of this investigation to induce the moths to deposit eggs on various plants or plant parts, other than tomato, with but indifferent success. In addition to this difficulty the fact that larvae will immediately crawl from the plant when they have hatched if the material is not exactly to their taste led to confining the various sized larvae with the material to be tested.

On April 8 when the living material was received from the southern part of the state, 5 larvae of various sizes were placed with several of the common weeds as a preliminary test of their ability to survive. Natal grass *(Tricholaena rosea* Ness.), green briar *(Smilax auriculata* Walt.), pokeweed *(Phytolacca rigida* Small.), cudweed *(Gnaphalium spalutalum* Lam.), Spanish needles *(Bidens pilosa* Linn.), and horseweed *(Leptilon canadense* Linn.), produced only negative results. The larvae all died within a few days with no increase in size nor feeding being evident.

The results were positive or doubtful in the following cases: nightshade *(Solanum gracile* Link.), Florida tomato *(S. aculeatissimum* Jacq.), peppergrass *(Lepidium virginicum* Linn.), potato and tomato foliage which was run as a check.

The reason for the results being doubtful in some of these cases where only negative results appeared later was probably due to the fact that not all of the larvae were tomato pin worm larvae. Several potato tuber moths *(Gnorimoschema operculella* Zell.)* and the nightshade moth *(Gnorimoschema striatella)* were reared from this same material and it is easily possible that there may have been others.

In the later tests, 10 larvae were placed separately on small pieces of host material. These were then each caged in a 1.5 by 15 cm. test tube which was plugged with a cotton stopper. Fresh host material was added daily. The old piece was removed unless the larva was very small and had mined into the leaf. Rather than risk the injury to the small larva in removing it from the leaf-mine it was allowed to feed on the old leaf until it left of its own accord.

In addition to the previous list cotton and corn were tried as host materials from outside of the Solanaceae or nightshade family. Peppergrass *(Lepidium viginicum* Linn.) was also rechecked but in no case was feeding observed on any plant not included in the Solanaceae.

Twenty-two tests were run on plants in the family Solanaceae. The tomato pin worm fed on only nine of these readily enough to carry it through to pupation. They were the garden tomato *(Lycopersicum esculentum* Linn.), cherry tomato *(L. cerasiforme* Dunal.), potato *(Solanum tuberosum* Linn.), eggplant *(S. melongena* Linn.), *S. sisymbrillfolium* Lam., *S. mexicanum,* and two tests on *S. citrullifolium* A. Br.

One of the ten larva placed with the Fragrant Cultivated Tobacco *(Nicotiana* sp.) reached the pupal stage. Since it was a large larva it is possible that it pupated without having eaten after it was placed on the leaf. Unfortunately there was not sufficient time left to run another series.

A few of the larvae fed slightly on *Solanum munistrum* and *Datura stromonium* Linn. As a result they lived longer than those that did not feed but none which were placed on either of these plants formed pupae.

The larva of the tomato pin worm starved when placed with the following Solanaceous plants: *Physaloides physaloides* Linn., *Physalis* sp., *Solanum glacile* Link., *S. capisicastrum* Link., *S. nigrum* Linn., *S. munistrum, Capsicum annum* Linn., *Datura*

*These determinations were made by H. H. Kiefer, Assistant Systematic Entomologist of the State Department of Agriculture, Sacramento, California.

metel Linn., *D. stromonium* Linn., *Nicotiana tabacum* Linn. and *Petunia hybrida* Hort.

A series was also run on tomato petioles. Pieces of petiole with no leaf were placed with the larvae. Most of them ate more or less at the material even though they did not seem to develop properly. In fact one larva lived three times as long as it should have taken it to complete its larval growth but did not grow nor pupate. The average length of time for the ten larvae was almost twice as long as it should have taken to reach the pupal stage, yet none of the ten pupated.

Attempts were made on various occasions to rear the insects on green tomatoes. Fifty of the first larvae received were placed on a green tomato and confined in a lamp chimney. Of these only three emerged as adult moths. At another time tomatoes were supplied in the lamp-chimney series instead of the usual tomato leaf. Where the average number of adult moths for the series was eleven, only one emerged from the chimney containing the tomatoes. These figures are still more significant when it is realized that five or ten larvae were removed from most of the other lamp chimneys and placed in alcohol for the purpose of measurement while none were removed from the lamp chimney containing the tomatoes.

These instances would seem to give the impression that the normal food of the tomato pin worm is the foliage rather than the fruit, that infestation of the tomato is more of an incidental matter. It is true that tomatoes may become highly infested but since the attack is generally under the calyx lobes or at a point where the tomato is in contact with a leaf or another tomato, it would seem to be due to the reaction of the larvae to select a small corner in which to start a mine rather than a preference for the tomato. Observations in the field, however, seem to indicate that the larvae desert the leaves in favor of the tomato when the fruit appears. This point needs further checking under field conditions.

The only important hosts of the tomato pin worm in Florida so far investigated are tomato, potato and eggplant. These are all cultivated plants and as such can be watched by the grower better than weeds or wild plants.

The larvae are so small that the infestation may be much higher than is realized by the casual observer. One hundred twenty-four adult moths were reared on a potted tomato plant which was only twelve inches high. Estimates were made that the average larva consumed about three square centimeters of tomato leaf during its larval development. The amount necessary, however, may be considerably less than this. From these figures it can be seen that the average tomato plant grown in Florida could support several hundred larvae without stopping the production of tomatoes.

Forty sound and 40 infested tomatoes were compared as to their keeping qualities. The most of them were green when the test was started and were matched for size and maturity. They were placed on a table in the insectary and covered with a cloth screen. Each day the tomatoes were examined and those which were rotting were removed. When the test was closed, at the end of 35 days, seven infested tomatoes had lain a total of 939 days or an average of 23 and a half days each, as against 1168 days or an average of 29 days for the sound tomatoes. The tomatoes had all ripened sufficiently to be used by the end of ten days so that under ordinary conditions the difference in keeping qualities would have made little difference between the number of sound and infested tomatoes which reached the retail market.

The presence of a larva or cavity in a tomato is often very difficult to detect. This is especially true if the larva has entered the tomato under the calyx and the calyx is still in place. The hole where the larva entered is not only small and often well hidden but may also be filled with a thin silken web which is not easily seen even after the calyx has been removed. The presence of a few tiny black pellets of frass which are held in the delicate web may often be the only external evidence.

The larva may mine just under the surface of the tomato where it produces a sunken darkened spot covered with a papery tissue after the larva has left. It is more common, however, for the mine to penetrate toward the center of the tomato. The larvae seem to prefer the solid tissue but may occasionally be found in the seed cavity of an unripe tomato.

The reasons why the grower will wish to avoid the tomato pin worm besides the fact of the decrease of production due to the reduced foliage are (1) the destruction of large numbers of young plants in seedbeds, (2) increased cost due to the requirement of closer inspection, (3) loss due to increased culling, (4) the necessity of fumigating tomatoes to be shipped to several states, (5) the danger of larval parts being found in the processed product with resulting decrease in quality and sale value, and (6) the poorer quality of the finished product. In regard to this last point, many tomatoes which are attacked when small become somewhat leathery and remain green in the center when mature. In addition, many tomatoes will be found with the interior of the seed cavity turned black as a result of the entrance of fungi when the larval tunnel was open. These blackened spots require considerable trimming or a resulting inferior product.

Ten parasites emerged from the first material brought into the laboratory. These with six others which emerged from material brought later were sent to the National Museum of Washington, D. C., for determination. Almost one hundred other parasites emerged later but no opportunity was left for study and comparison after the above determinations were returned.

The second supply of material which was brought from Sarasota County about May 30th seemed to be much more highly parasitized than that which had been collected there about six weeks previous. In fact it seemed to be difficult to find larvae in the foliage. However, a quart of foliage which was collected yielded more parasites than half a bushel of infested tomatoes. It is possible that the larvae which were in the tomatoes were better protected from the parasites than those in the leaves.

Pupae and cocoons were buried at various depths in moist and dry sifted sand. The greatest depth from which moths emerged was one-half an inch. One adult out of five succeeded in reaching the surface through this depth of moist sand and two of ten in dry sand. By the time they had reached the surface, however, they appeared light in color due to the loss of scales from their wings and were scarcely able to fly.

SUMMARY

1. The tomato pin worm completed a life cycle in as short a time as 21 days in Florida during the month of June.

2. The egg laying period of the female continues until near enough to the emergence of the next generation so that a continuous infestation may be expected.

3. Under favorable conditions parasites become very numerous and their effect as a check on the number of tomato pin worms is important.

4. The shipment of plants, tomatoes and shipping containers are the most potent means of spreading the insect from one trucking district to another.

5. The feeding of the larvae is confined to tomato, potato, eggplant and a few other plants included in the Solanaceae family. They are unable to complete the life cycle when placed on wild Florida tomato, nightshade or pepper plants.

6. Infestation does not reduce the keeping qualities sufficiently to keep the unsound tomatoes from the retail market.

7. All material remaining in the field after the crop is harvested should be carefully plowed under in order to reduce the danger of the patch becoming a resevoir for infestation of a near-by or a succeeding crop.

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THE INSECT DEPREDATORS OF PURSLANE
(*Portulaca oleracea* L.)

H. J. ROMM, Tuskegee, Ala.

INTRODUCTION

It is only within relatively recent years that workers have begun to turn their attention to a study of the part played by weeds in the economy of our noxious insects. The need for such information is greatly increased by our knowledge of the role of insects and weeds in the dissemination of the various maladies of cultivated plants. Thus, Lindford (71) has shown that *Emilia flammea* Cassin, a weed common in pineapple fields of Hawaii, is the "reservoir" for the serious disease of pineapples known as Yellow-Spot, and that the onion thrips *(Thrips tabaci* Lind.) transmits this malady from *Emilia* to pineapples. Drake, Harris, and Tate (26) proved that aphids, commonly feeding on purslane and other weeds in the onion fields of Iowa, often in their wanderings from plant to plant stop to imbibe the juices of the onion and by so doing may become the vectors of that peculiar disturbance, Yellow Dwarf of onions. Their studies show that it would be impossible for these aphids to live and complete their development on the onion; yet they are the sole natural vectors of Yellow Dwarf.

Not only is the relation between insects and weeds important in the spread of plant diseases; this relation is equally important to cultivated crops in many other ways. This is brought about in part by common weeds serving as favorite hosts, thereby harboring insects and promoting undesirable insect populations. So efficient are weeds in this respect that their insect depredators, because of a diminishing food supply, often shift their attacks to adjoining cultivated crops and there do untold damage. There are countless examples which will illustrate the intricacy of this relationship between insects, weeds, and crop plants. Davidson (21) gives a very striking example of certain aphid species which, in their annual cycle, will migrate in the autumn from a group of numerous, unrelated, herbaceous, summer host-plants to a few, closely related woody-stemmed winter hosts. In the spring they migrate back to their summer hosts.

In grassy and weedy gardens, where cutworms are wont to lay their eggs, considerable damage is done to cultivated plants. The cutworms migrate to the cultivated plants when their natural food supply is exhausted.

Forbes (44) has shown that the corn-root aphid is dependent in the early spring upon such weeds as purslane, ragweed, foxtail, smartweed and crab grass before corn is planted. Decker (23) found that along the margins of fields, cultivated crops like corn, during certain seasons, are attacked by the common stalk borer, *Papaipema nebris* Guenee, after the larvae have begun their development on grasses or weeds.

To encourage the increase of insects in the interest of weed control would at first appear to be contrary to the general principles of pest suppression; but there are some records of such which are both interesting and convincing. For example, the Russian thistle is usually present in great abundance in Canada in many sections where clean farming is not practiced. However, this noxious weed does not cause undue alarm because the growers have learned that the sugar beet webworm, *Loxostege sticticalis* Guenee, will check its spread. The sugar beet webworm will also feed upon cultivated plants and many weeds, including purslane, when Russian thistle is not present.

Again the use of insects in combating weeds finds a classic example in Australia. Here the cactus is an important plant introduction. Within recent years it has become established in New South Wales and Queensland, spreading over sixty millions of acres and causing great alarm by forming impenetrable thickets over thousands of square miles of territory. Certain insects which feed upon the cactus in Mexico and South America have now been introduced into Australia for the express purpose of controlling this dangerous weed. Latest published reports show that almost unbelievable results in reclaiming this land have been obtained from the use of these insects.

Metcalf and Flint (84) cite the work of Glick, who in an unpublished manuscript records that a species of sawfly eliminated purslane from a ten-acre field of onions, although neighboring fields were much troubled with this weed. On numerous occasions the author observed the purslane sphinx, *Celerio lineata* Fab., feeding on the foliage and stems of purslane, keeping it from seeding. According to Hyslop (63) *Centorhynchus marginatus* Payk., was introduced accidentally into this country. It feeds upon the seeds of the noxious dandelion, *Taraxicum officinale* Web., often destroying one-quarter of the seed. Marcovitch (77) reported that milk vetch *(Astragalus canadensis* L.), a very common weed of Minnesota, is kept from becoming a weed of the first rank by its insect enemies. The agromyzid fly which feeds upon lantana and keeps it from seeding in Queensland was introduced into Hawaii by Koebele for the purpose of controlling the spread of this plant.

Weeds at times may be thought of as being beneficial in that they harbor numbers of parasites which develop upon their insect depredators. These parasites are often of great value in destroying many other insects which might become very destructive to crop plants. In the writer's experiments several white-lined sphinx moth larvae were taken from purslane in the field and caged. Later they pupated but the adults never emerged, for they had been parasitized by certain hymenopterous forms. Two of the pupae were dug up and examined. They contained well-developed parasitic larvae. This illustration has been given to show the relationship between weed feeders and the parasities in their control. The control of plant-feeding insects by other insects is very complicated. It has been found that many parasites increase to such a degree as to prevent any appreciable damage.

From what has been said above it may be seen that a study of the relationships between insects and weeds may often be of great importance. In this paper the author has confined himself to a study of the insects which feed upon the herbaceous weed, *Portulaca oleracea* L., or common purslane. Much use was made of the literature on the subject in order to compile as complete as possible a list of those insects feeding on it.

THE PLANT (*Portulaca oleracea* L.)

The species *Portulaca oleracea* L., is a common plant of India—its natural home. It occurs over Europe and North America, being especially abundant in gardens. Records show that purslane was carried westward from Asia to Europe, and for centuries it was used as a salad and pot herb. This plant was observed in Massachusetts as early as 1693. Since then its spread has been very rapid. This rapidity of spread is due in a large measure, one writer has said, to the carelessness of the early Pennsylvania Germans, who were very fond of it as a vegetable.

Purslane is a procumbent annual, with mostly alternate, oblong-cuneate leaves about one-half inch long. The flowers are yellow, sessile and axillary. The seeds are black.

Some authorities have called purslane a "Cosmopolitan Weed" because of its wide distribution. It is not uncommon here in the United States to find it in cultivated grounds around dwellings and also in waste places.

Purslane has some direct economic value. Knight (69) says that the juice from its leaves will relieve swelling and pain inflicted by the hairs from the body of the white-marked tussock-moth larva. It is also of value as food for hogs, a purpose to which quantities are devoted. The seeds are used in medicine.

SUMMARY AND LITERATURE

A careful and comprehensive search of the literature has failed to disclose any previous lists dealing specifically with insects feeding on purslane. However, there are many isolated records in various text books, taxonomical works, catalogues, and host-plant indices. It has been the problem of the writer to gather these, to supplement them with his own field observations and rearing records, and to organize and present the whole in a detailed and usable list. All told, eighty-three species, distributed in their Arthropodan orders, are recorded in this paper.

INDEX TO THE FLORIDA ENTOMOLOGIST

An index to volumes 1 to 19 inclusive of the Florida Entomologist is now in preparation. This index contains a table of contents arranged by volumes and an index of the insects by specific and varietal names. This index is to be sold at 75c a copy. Orders should be sent to J. W. Wilson, Business Manager, Lakeland, Florida. Subsequent volumes will have an index in the last number of each volume.

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LIST OF INSECTS FOUND ON PURSLANE

Scientific Name: Genus	Scientific Name: Species	Part of Plant Affected	Observations
COLEOPTERA—			
Chrysomelidae			
Diabortica	duodecimpunctata *(Fabr.)*	Leaves	A few were observed eating small holes in the leaves.
Diabortica	longicornis *Say* 37, 38, 39,* 84, 137	Roots	
Diabortica	vittata *(Fabr.)*	Leaves	Observed in large numbers eating small holes in the leaves.
Disonycha	crenicollis *(Say)*	Leaves	Many were found.
Disonycha	caroliniana *(Fabr.)* 9, 151	Leaves	
Disonycha	mellicollis *(Say)* 27	Leaves	
Graphops	pubescens *(Melsh.)*	Roots	A few were taken.
Systena	taeniata *(Say)*	Leaves	A number were found feeding on the foliage.
Curculionidae			
Centrinaspis	perscitus *Hbst.*	Tunnels roots and stem	A few of the larvae were taken from the stem.
Ceutorhynchus	portulacae *Marshall* 79	Tunnels leaves	
Baris	portulacae *Marshall* 79	Roots and stems	
Hyperodes	echinatus *Dtz.*	Leaves	A few were taken from caged plants.
Sitona	hispidula *Fabr.*	Leaves	A few were taken from caged plants.
Sitona	flavescens *Marsh.*	Roots	Taken from a number of caged plants.
Scarabaeidae			
Lachnosterna	rugosa *Melsh.* 43	Roots	
DIPTERA—			
Agronyzidae			
Phytomyza	palliata *Coq.* 46	Mines the leaves	
Anthomyiidae			
Hylemyia	cilicrura *Rd.*	Sprouting seeds	
Cecidomyiidae			
Campylomyza	*sp.* 132	Roots	
Joannisia	*sp.* 132	Roots	
Empididae			
Platypalpus	crassifemoris *Fitch.* 132	Roots	

*NOTE: The number appearing after each species refers to the reference in the bibliography.

(To be continued)