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Research Report 276

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Contents

Tables

Figures

Introduction

A basic precept of insect pest management (IPM) is that the entire complex of insects on a crop should be managed, with chemical control measures being applied only when natural controls fail to keep crop damage within tolerable levels. Even when an economically significant infestation has developed, one may—by the wisest choice of insecticides and rate and timing of application—retain much of the original complex and so help to restore a new balance (Smith 1969).

Because they can be collected at the same time as some of the pests, predators often have been included in IPM sampling. The Pinal County (Arizona) cotton pest management program has included reports on predators prepared by scouts. The present study was undertaken to assess the feasibility of adding parasitic species to the insects sampled in the Pinal County program and others like it.

This report covers a full season of sampling in 19 cotton fields in the Pinal County program and the vegetation, including cotton and other crops, adjacent to the fields. The main sampling period was from mid-June to harvest in 1973, with a short early season supplement in 1974 to round out the crop year.

The method of sampling, processing and identification developed should be adaptable to other programs. The one expensive item required is a stereoscopic microscope of suitable magnification and resolution, with associated light source. This piece of equipment would have to be kept indoors, and most of the processing and all of the identification undertaken there. Meaningful identification of parasites is an impossibility in the field. A few species large and distinctive enough for field recognition may be encountered, but they make up only a small part of the parasite complex.

The main body of the report is a complete accounting of the parasitic insects found in 1197 samples in 1973 and 179 in 1974. Tables 1–4 and Fig. 3 to 20 summarize the data. We were able to identify all of the parasites because we had decided in advance to limit the precision of identification to the level of the genus, and to go to this level only if there might be species in the genus that could be of some potential importance. In some cases we included a genus because we found it to be very abundant, even if it was of doubtful direct importance.

In a search for genera to include, we covered the standard sources of host association data in some detail (Krombein 1958, Krombein and Burks 1967, Muesebeck et al. 1951, Peck 1963, Stone et al. 1965, and Thompson 1943–1965). To the genera selected from these sources, we added others on the basis of host records in The University of Arizona insect collection. If a species had been recorded anywhere as parasitic on any of the field crop pests found in Arizona—or on predators or other parasites associated with Arizona crops—it was entered in the list at the generic level. Other genera were added if they were known to be abundant in this region and parasitic on insects in the same family as species of direct importance.

This raw list of parasites was reduced to manageable proportions by the elimination of genera that had never been reported from Arizona, as soon as we determined that specimens were not turning up in our crop samples. Our rather extensive collection of crop-associated insects, made in 1954 and later years, provided the basic context for most of the decisions. The resulting list became the basis for a series of keys to families and genera. These were updated and modified as the program progressed. The keys and parasite-host summaries may be found in a separate report: Technical Bulletin 236 (Werner 1978).

The identifications were made by two graduate students in entomology with previous experience in identification and systematics, but not with parasitic insects. One of them had helped to construct the first draft of the keys. These workers had little difficulty handling the identification. Every parasite taken was identified, at least to the level of superfamily.

Table 1 lists the host associations that appeared to be the most likely, in the context of the agricultural area of southern Arizona. The actual numbers of specimens identified are also shown in Table 1, and in crop by crop detail in Table 3. The 1974 additions appear in Table 4. Some of the most abundant taxa, such as the trichogrammatid genus *Abbella,* are completely unrelated to the cotton crop, as far as is known. If our precision had stopped at the family in this case, the casual interpreter would probably have thought of the much more familiar trichogrammatid genus, *Trichogramma,* and come to an erroneous conclusion about the value of the population.

Methods and materials

All 19 sampling locations selected for study were planted to cotton in the Pinal County Cotton Insect Pest Management Program in 1973, near the towns of Coolidge, La Palma, Mammoth and Maricopa. The fields were under normal farm management, and many of the cotton fields sampled were sprayed with insecticides at least once during the season (Table 5).

Each sampling location consisted of a central cotton field and four contiguous fields or areas (Fig. 1). Five samples were taken at each location, one from the central field and one from each of the contiguous areas to the north, east, south, and west of the central field. Since some of the adjacent fields were also in cotton, the 19 sampling locations included 33 cotton fields. Some of the adjacent areas were not in crops, but were sampled if there was sufficient vegetation. As the season progressed, some of the adjacent fields were harvested; irrigation, insecticide application, and other unforeseen events also contributed to variation in the number of fields sampled from week to week. Table 5 shows the actual numbers, and an indication of the extent to which insecticide applications had been made during individual weeks.

Samples were taken with a 15-inch diameter heavy duty sweep net. Each sample consisted of 100 strokes of the net, forcefully stroked as far down into the vegetation as functionally possible without hitting soil. The 100 strokes in the central field were made up of 25 from each of four quadrants; those from adjacent areas or fields were taken in one series, along a line at least 50 meters from the edge of the central field and parallel to it (Fig. 1).

Samples were taken every week from June 25 through October 18 of 1973, and every two weeks from April 18 through June 28, 1974. Collected arthropod material was immobilized by sprinkling a few drops of ethyl acetate on the terminal portion of the muslin net bag. Then the apex of the net and its contents were placed inside a 25 $\times$ 30 cm plastic bag for a few minutes. Finally, the net bag was everted into the plastic bag and the contents washed into the plastic bag with a small amount of 70% ethyl alcohol. A label in the bag served to identify the sample. Bags were transferred to a cooled ice chest for transportation to the laboratory. Even though the quantity of alcohol used was small, it served very well to keep the specimens moist and aided in preservation. Isopropyl or denatured alcohol should do as well.

All processing was carried out with the specimens in 70% alcohol. The entire sample was sifted under alcohol, through a Number 14, USDA standard testing sieve (12 mesh/inch, 1.40 mm openings). The sieve was shaken gently in a pan containing enough alcohol to partially immerse it. A sample was transferred to the sieve, the plastic bag washed out with a stream of alcohol, the sieve shaken, and the contents of the sieve transferred to a paper towel for partial drying and identification of the largest parasite taxa. The contents of the sifting pan were strained through fine-meshed cloth and the residue transferred for microscopic examination to a petri dish of 70% alcohol. A helper did the sifting and handling of

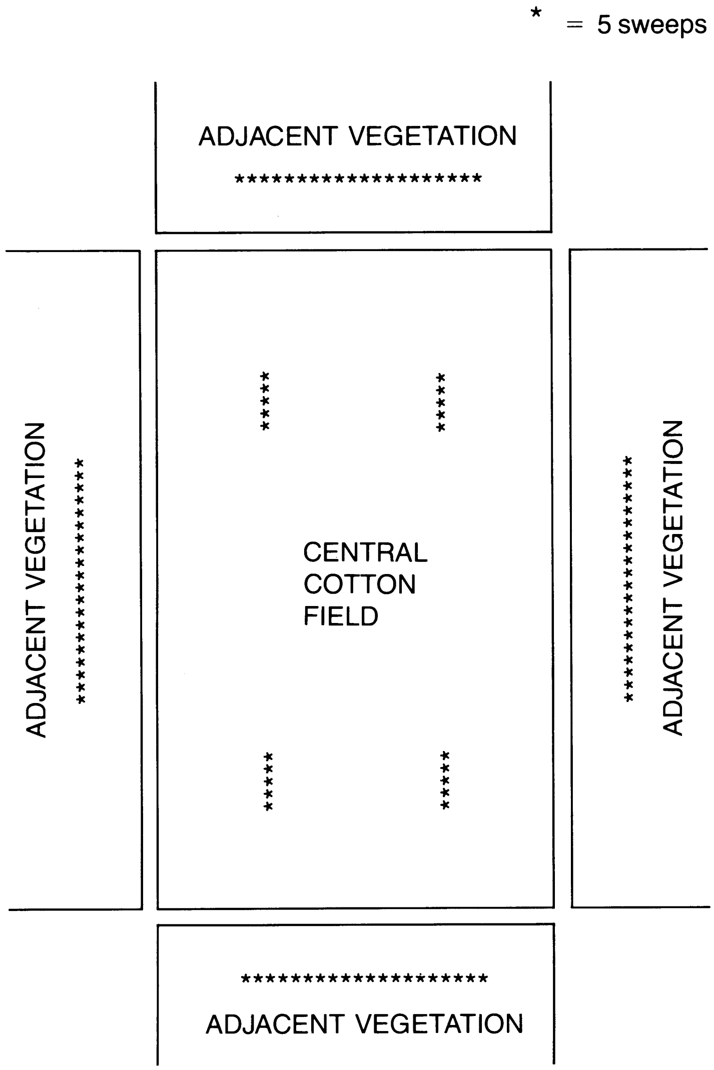

Fig. 1. Schematic of sweep samples taken at each sample location.

Table 1. Number of individual parasites taken in 1973, with probable hosts

Taxon	Probable Hosts	Number on Cotton/ Other Plants	Total Family	Total Superfamily
Diptera				103(502)
Tachinidae		8(20)	103(502)	
Eucelatoria	bollworm	11(25)		
Gymnosoma	stink bug adults	0(23)		
Hyalomya	false chinch bugs	62(402)		
Lespesia	bollworm, cabbage looper, others	6(25)		
Leucostoma	beet armyworm, other Lepidoptera	3(6)		
Plagiomima	bollworm	1(1)		
Hymenoptera				
Bethyloidea				62(81)
Bethylidae	Coleoptera, possibly Lepidoptera	62(81)	62(81)	
Chalcidoidea				3314(22091)
Aphelinidae		0(19)	137(248)	
Aphelinus	aphids	0(3)		
Encarsia	whiteflies, Lepidoptera eggs	131(204)		
Prospaltella	whiteflies	6(22)		
Chalcididae		3(2)	55(188)	
Brachymeria	Lepidoptera, incl. bollworm	1(1)		
Euchalcidia	probably Lepidoptera	46(171)		
Spilochalcis	Lepidoptera, incl. bollworm	5(14)		
Encyrtidae	mainly scale insects	42(189)	811(878)	
Copidosoma	cabbage looper	769(689)		
Eulophidae		9(48)	1136(4513)	
Achrysocharella	leaf miners	384(978)		
Chrysocharis	leaf miners	375(2316)		
Closterocerus	leaf miners, cotton leaf perforator	222(80)		
Elachertus	Lepidoptera	1(1)		
Euderus	Lepidoptera, weevils	0(1)		
Horismenus	Lepidoptera (secondary)	4(4)		
Pnigalio	leaf miners, other insects	2(15)		
Solenotus	leaf miners	27(150)		
Tetrastichus	lacewing and other eggs, alf. chalcid	90(892)		
Zagrammosoma	leaf miners	22(28)		
Eurytomidae	plants, incl. alfalfa seed	29(90)	29(90)	
Mymaridae		3(5)	310(1139)	
Anagrus	leafhopper eggs, other eggs	145(490)		
Anaphes	lygus eggs	30(184)		
Gonatocerus	leafhopper eggs	23(112)		
Mymar	possibly lygus eggs	27(89)		
Polynema	leafhopper eggs, other eggs	82(259)		
Perilampidae	Lepidoptera, other insects	9(8)	9(8)	
Pteromalidae		29(120)	250(620)	

alcohol, and one or two technicians the actual sorting and identification, using Wild M-5 stereoscopic microscopes with a magnification range of 12 to 100 diameters.

The total number of individuals was recorded for each taxon in each of the samples collected, and the information numerically coded onto computer punch cards. A FORTRAN program was written to translate the data of each sample to a form that could be used by the cotton scout and the grower (Fig. 2). Report sheets were provided to the scouts within the week following the taking of the sample. Other FORTRAN programs were developed to summarize the data into the format of Tables 2 and 3, and to generate the seasonal summaries of Fig. 3 to 20. Copies of these programs are available on request from the senior author.

Table 1. continued Number of individual parasites taken in 1973, with probable hosts

Taxon	Probable Hosts	Number on Cotton/ Other Plants	Total Family	Total Superfamily
Amblymerus	alfalfa seed chalcid	4(24)		
Catolaccus	perforator, beet armyworm, others	46(74)		
Eupteromalus	Lepidoptera (secondary?)	1(6)		
Habrocytus	alfalfa seed chalcid	29(88)		
Halticoptera	leaf miners	49(132)		
Heterolaccus	weevils, pink bollworm	2(0)		
Heteroschema	leaf miners	12(12)		
Hyperimerus	mealybugs	3(5)		
Neocatolaccus	weevils	5(5)		
Pachyneuron	aphids	0(15)		
Pseudocatolaccus	gall midges	22(32)		
Pseudomicromelus	gelechiid moths	0(2)		
Psilocera	leaf beetles	19(46)		
Pteromalus	Lepidoptera (secondary)	0(1)		
Syntomopus	leaf miners	6(12)		
nr. Syntomopus	unknown	2(7)		
Trimeromicrus	alfalfa seed chalcid	0(1)		
Zatropis	weevils, pink bollworm	33(38)		
Torymidae	gall midges	8(32)	9(34)	
Podagrion	mantid eggs	1(2)		
Trichogrammatidae		45(151)	568(14373)	
Abbella	leafhopper eggs	167(10062)		
Aphelinoidea	leafhopper eggs	157(3260)		
Trichogramma	Lepidoptera eggs, other eggs	199(900)		
Ichneumonoidea				112(697)
Braconidae		18(25)	99(657)	
Apanteles	bollworm, cabbage looper	2(4)		
Bracon	pink bollworm, leaf rollers	23(9)		
Chelonus	bollworm, beet armyworm	28(196)		
Cremnops	unknown	1(0)		
Iphiaulax	unknown	1(0)		
Meteorus	fall armyworm	1(0)		
Microplitis	bollworm, cabbage looper	1(0)		
Opius	leaf miners	24(422)		
Orgilus	unknown	0(1)		
Ichneumonidae	mainly Lepidoptera	13(40)	13(40)	
Proctotrupoidea		400(864)		1382(3249)
Scelionidae		37(71)	982(2385)	
Telenomus	lacewing and Lepidoptera eggs	534(1382)		
Trissolcus	stink bug eggs	411(932)		
	Total parasites from cotton		**4993**	
	Total parasites from other plants		**26620**	

Results and discussion

The conclusion is inescapable that parasitic insects were not very abundant in the fields sampled, even in alfalfa and other crops that have more insects feeding on them than does cotton. Through the season there was an average of only 26.4 parasites per 100-sweep sample overall, and 9.4 in cotton. Populations were higher early in the 1973 season, with one or two exceptions, and cotton samples generally reflected the situation in the pooled samples (Fig. 3 to 20).

An examination of Table 1, which shows both total numbers taken and possible host associations of the parasite taxa, indicated that only about a fourth of the specimens

Parasites Associated with 1973 Cotton Samples

DATE = 8 16 73 **FARM** = STAMBAUGH **LOCATION** = CENTER **VEGETATION** = COTTON

There are 14 parasite taxa recorded for this sample

PARASITE TAXA =

CODE	NAME	NUMBER	WHAT PARASITIZED
6	POLYNEMA	6	LEAFHOPPER EGGS, PLUS OTHER EGGS
8	ABBELLA	1	LEAFHOPPER EGGS
10	TRICHOGRAMMA	1	LEPIDOPTERA EGGS
14	EULOPHIDAE	1	LEAF MINERS, EGGS
15	CHRYSOCHARIS	1	LEAF MINERS
17	ACHRYSOCHARELLA	2	LEAF MINERS
20	TETRASTICHUS	2	LACEWING AND OTHER EGGS, ALFALFA SEED CHALCID
26	HABROCYTUS	1	PROBABLY SECONDARY PARASITE
31	PSILOCERA	1	LEAF BEETLES
37	ENCYRTIDAE	2	MAINLY SCALES
44	TELONOMUS	5	LACEWING AND LEPIDOPTERA EGGS
45	TRISSOLCUS	6	STINK BUG EGGS
46	PROCTOTRUPOIDEA	18	MAINLY EGGS
47	BETHYLIDAE	1	BEETLES, POSSIBLY LEPIDOPTERA

TOTAL NUMBER OF PARASITES IN THIS SAMPLE =48

Fig. 2. Example of a page of computer output summary.

identified belonged to genera that might be of direct significance to a cotton insect pest management program. Most of the rest were apparently doing an effective job of suppressing leafhoppers and leaf miners somewhere in the ecosystem. The few really numerous taxa were parasites of insect eggs, but not of species of direct importance.

The sweep net is definitely not an effective sampling device for tachinid flies and other larger parasites. The only tachinid taken in even modest numbers was *Hyalomya,* a genus of very small flies that were probably parasitizing false chinch bugs. A complete sampling program would have to include some additional method of sampling the larger species. These are very agile and ordinarily present only in very low numbers.

We feel that our sampling technique is feasible for use on any crop that can be sampled with a sweep net. A vacuum net would probably increase the catch, but at the expense of much additional effort and cost. At the level of precision of this study, the sweep net appears to be satisfactory. Processing might be simplified a little, but one needs a system that ensures minimal contamination from one sample to another and ease of handling in the field. A small field carrier holds the plastic bags and bottles that are required. Much more equipment would hamper other sampling being done in the program.

Identification of parasites to their respective taxa is time consuming. In some instances a trained technician required over four hours to identify the contents of one sample; the average time in midseason of 1973 was about 45 minutes per sample. By this time the identifiers were experienced and the number of specimens per sample was starting to decline. The time could be cut by restricting the examination to a portion of the sample and by reducing the number of taxa counted. Each specimen must be looked at, but the elimination of recording unimportant taxa would save much examination time. A program based on counting just one relatively conspicuous taxon could be much more rapid than ours. We were able to provide information within the week following the taking of the sample; a simpler program would probably permit next-day reporting.

Table 1 shows the taxa identified and counted during the study, with summaries by family and superfamily. Table 2 shows the frequency with which each taxon was recovered from a 100-sweep sample, for all vegetation categories. Table 3 summarizes the number of individuals counted during 1973, on the same basis. Table 4 lists the taxa taken early in the season of 1974, from the same or nearby fields.

The scelionid genus *Telenomus* was found in the greatest number of samples, being well represented in all vegetation categories. The frequency would have been slightly higher, but the genus was not segregated from other proctotrupoids in part of the first week's samples. Its abundance was never extremely high at any time during the season. Interpretation of the meaning of a steady *Telenomus* population can be based only on speculation. Identification of species in this genus is extremely difficult, and ordinarily undertaken only for reared specimens. But the species most likely to be abundant would be *Telenomus chrysopae,* a parasite of *Chrysopa* eggs. If this was the case, the *Telenomus* populations were certainly not beneficial in the short term. On the other hand, the second most regularly encountered parasite, *Trissolcus*, also a scelionid, seems always to be a parasite of pentatomid eggs. It probably serves as a check on the development of stink bug populations.

The abundance of the different groups of parasites on cotton is shown in Table 1. Chalcidoidea comprised approximately 67% of the specimens in the cotton samples, Proctotrupoidea 28%, Ichneumonoidea 2%, Bethyloidea 1%, and flies of the family Tachinidae 2%. The same general relationships hold also if all samples are pooled, with the two abundant leafhopper-associated trichogrammatids skewing the balance even more heavily to the Chalcidoidea (80%).

If one looks at the figures in Table 1 from a different point of view, and assigns them to probable host associations, the following percentages emerge: Lepidoptera 27.7% (15.4% for cabbage looper alone), leaf miners 22.2%, *Chrysopa* 12.5 %, leafhoppers 11.5%, stink bugs 8.5%, and lygus 1%. Some very gross assumptions have to be made to get these figures. If there was a choice among hosts, Lepidoptera were chosen for assignments. Both *Tetrastichus* and *Telenomus* were assigned to *Chrysopa*.

Conclusion

Our studies have shown that it is possible to monitor the populations of parasitic insects on a routine basis, if there is not a compelling reason to carry the identification beyond the level of the genus. A report can be generated rapidly enough that its information could be put to use in an action program. We counted every specimen and still were able to distribute a report in about a week. This time could be substantially reduced by decreasing the number of parasite taxa counted.

We found that parasitic insects were really quite rare on cotton, averaging less than 10 per 100 strokes of the net. At such low density, meaningful sampling becomes difficult. If sampling is to become routine, a substantial investment in time and effort will be required. Some taxa were not taken in the sweep net and these would have to be taken in some other way.

Yet the populations we found were quite obviously keeping most potential insect pests under a level of control. And they were doing so through most of the season, despite their low densities. Monitoring could probably be justified on the basis of sampling as information is needed, particularly during the critical early period, when lygus populations might force early treatment, or when something has happened that is generating large numbers of unusual pests. Leaf-mining insects, probably including the cotton leaf perforator, were being suppressed by parasites where we sampled in 1973. And some crop would certainly have suffered loss to leafhoppers if the huge populations of leafhopper egg parasites disappeared.

We would recommend that anyone contemplating the monitoring of parasites consider carefully the options available. If too high a level of precision of identification were chosen, the benefits of a rapid report would completely disappear.

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TABLE 2. PERCENTAGE FREQUENCY OF OCCURRENCE OF PARASITE TAXA COLLECTED IN 1973

TAXON	VEGETATION TYPE OR CROP CATEGORY										OVER ALL CATEGORIES
	COTTON	WEEDY AREAS	ALFALFA	SORGHUM	GRAIN STUBBLE	DESERT	SAFFLOWR	SAFFLOWR STUBBLE	SUGAR BEETS	MESQUITE	
TELENOMUS	41.9	43.0	38.9	40.0	45.7	37.5	30.6	30.0	60.9	100.0	41.9
TRISSOLCUS	34.1	41.3	28.8	27.7	23.9	32.5	58.3	13.3	69.6	86.7	35.3
ACHRYSOCHARELLA	32.3	37.2	51.4	21.5	10.9	50.0	16.7	3.3	21.7	60.0	34.7
PROCTOTRUPOIDEA	27.4	30.0	38.5	16.9	23.9	42.5	36.1	16.7	56.5	100.0	31.1
CHRYSOCHARIS	25.6	13.5	77.9	12.3	10.9	10.0	13.9	0.0	13.0	26.7	29.4
APHELINOIDEA	16.2	26.0	49.0	10.8	26.1	32.5	33.3	3.3	78.3	20.0	25.8
TRICHOGRAMMA	17.2	23.8	39.9	16.9	13.0	45.0	8.3	0.0	73.9	53.3	24.0
ABBELLA	14.5	14.3	50.0	36.9	6.5	25.0	16.7	10.0	78.3	6.7	23.0
TETRASTICHUS	11.2	20.6	17.8	16.9	6.5	47.5	22.2	0.0	30.4	66.7	16.5
ENCARSIA	13.1	13.0	13.5	4.6	13.0	22.5	5.6	0.0	8.7	26.7	12.5
COPIDOSOMA	16.6	4.0	9.6	9.2	4.3	17.5	2.8	0.0	13.0	46.7	11.7
POLYNEMA	9.6	7.2	24.0	3.1	4.3	10.0	0.0	0.0	60.9	6.7	11.5
CLOSTEROCERUS	17.4	0.9	15.9	1.5	0.0	5.0	0.0	6.7	8.7	13.3	11.1
ANAGRUS	10.2	9.0	9.1	4.6	6.5	15.0	5.6	0.0	78.3	0.0	10.3
HYALOMYA	6.7	8.5	15.4	3.1	10.9	0.0	22.2	20.0	52.2	0.0	9.9
OPIUS	3.7	3.6	35.6	10.8	0.0	2.5	0.0	0.0	0.0	20.0	9.4
ENCYRTIDAE	5.7	14.8	6.7	0.0	2.2	42.5	5.6	0.0	4.3	53.3	8.8
HALTICOPTERA	7.0	5.8	17.3	1.5	2.2	17.5	0.0	0.0	0.0	53.3	8.5
SOLENOTUS	4.5	8.1	23.6	4.6	0.0	7.5	0.0	0.0	8.7	6.7	8.3
BETHYLIDAE	7.4	11.2	6.3	1.5	2.2	10.0	5.6	0.0	13.0	53.3	7.9
CATOLACCUS	7.0	5.8	14.4	1.5	0.0	7.5	8.3	0.0	4.3	26.7	7.6
CHELONUS	4.7	1.3	24.5	7.7	0.0	5.0	8.3	0.0	13.0	0.0	7.6
ANAPHES	4.9	5.8	14.9	0.0	0.0	7.5	2.8	0.0	21.7	33.3	6.9
GONATOCERUS	3.5	6.7	14.4	0.0	2.2	15.0	5.6	0.0	39.1	13.3	6.9
HABROCYTUS	3.9	7.6	14.9	0.0	2.2	5.0	0.0	0.0	13.0	40.0	6.7
EUCHALCIDIA	6.3	5.8	1.0	0.0	4.3	35.0	0.0	0.0	8.7	60.0	6.2
EURYTOMIDAE	4.9	8.5	5.3	3.1	0.0	20.0	0.0	0.0	4.3	46.7	6.1
PTEROMALIDAE	4.9	8.1	3.8	0.0	0.0	25.0	2.8	0.0	8.7	53.3	6.0
MYMAR	3.1	4.5	5.3	3.1	6.5	0.0	0.0	3.3	17.4	6.7	4.0
PSILOCERA	3.5	4.9	3.4	3.1	0.0	12.5	5.6	0.0	0.0	20.0	4.0
EULOPHIDAE	1.6	7.6	3.8	0.0	2.2	12.5	2.8	0.0	0.0	40.0	3.8
ICHNEUMONIDAE	2.3	1.3	9.6	4.6	2.2	2.5	0.0	0.0	8.7	13.3	3.7
ZATROPIS	3.5	2.7	3.8	1.5	0.0	7.5	0.0	0.0	8.7	33.3	3.6
ZAGRAMMOSOMA	3.9	2.7	1.0	1.5	0.0	15.0	0.0	0.0	0.0	6.7	3.0
BRACONIDAE	2.7	1.3	5.8	0.0	2.2	2.5	0.0	0.0	8.7	20.0	3.0
PSEUDOCATOLACCUS	3.7	1.8	3.8	0.0	0.0	2.5	0.0	0.0	0.0	20.0	2.9
ENCARSIA (= SP.A)	3.5	2.7	2.4	0.0	2.2	0.0	2.8	3.3	0.0	6.7	2.8
TRICHOGRAMMATIDAE	1.6	2.2	2.9	3.1	2.2	0.0	8.3	0.0	8.7	0.0	2.3
TORYMIDAE	1.6	3.6	0.5	0.0	2.2	2.5	0.0	0.0	0.0	40.0	2.1
SCELIONIDAE	2.2	1.3	1.0	0.0	0.0	0.0	13.9	0.0	17.4	0.0	2.1
LESPESIA	1.2	0.4	6.7	1.5	2.2	0.0	0.0	0.0	0.0	0.0	1.9
TACHINIDAE	1.6	1.3	4.8	1.5	0.0	0.0	0.0	0.0	0.0	0.0	1.8
BRACON	2.3	1.3	2.4	0.0	0.0	0.0	0.0	0.0	4.3	0.0	1.8

TABLE 2. PERCENTAGE FREQUENCY OF OCCURRENCE OF PARASITE TAXA COLLECTED IN 1973 (CONTINUED)

TAXON	VEGETATION TYPE OR CROP CATEGORY										OVER ALL CATEGORIES
	COTTON	WEEDY AREAS	ALFALFA	SORGHUM	GRAIN STUBBLE	DESERT	SAFFLOWR	SAFFLOWR STUBBLE	SUGAR BEETS	MESQUITE	
AMBLYMERUS	0.8	2.2	1.9	1.5	0.0	12.5	0.0	0.0	0.0	6.7	1.7
SPILOCHALCIS	1.0	2.7	1.9	0.0	0.0	5.0	2.8	0.0	0.0	6.7	1.6
EUCELATORIA	1.8	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6
HETEROSCHEMA	1.4	1.8	2.4	1.5	0.0	0.0	0.0	0.0	0.0	0.0	1.4
PERILAMPIDAE	1.8	0.4	0.5	0.0	0.0	5.0	5.6	0.0	8.7	0.0	1.4
PNIGALIO	0.4	2.2	2.9	0.0	0.0	0.0	2.8	0.0	4.3	6.7	1.3
SYNTOMOPUS	1.0	0.9	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
PROSPALTELLA	1.2	2.7	0.5	0.0	0.0	2.5	0.0	0.0	0.0	0.0	1.2
GYMNOSOMA	0.0	0.9	2.9	0.0	2.2	0.0	2.8	3.3	8.7	0.0	1.1
NEOCATOLACCUS	1.0	0.4	1.4	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.8
HORISMENUS	0.8	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.7
GEN 5 NR SYNTOMOPUS	0.4	0.4	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
TRICHOGRA-IDAE SP A	0.6	0.0	1.4	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.7
APHELINIDAE	0.0	0.4	1.0	0.0	0.0	2.5	0.0	0.0	8.7	6.7	0.6
EUPTEROMALUS	0.2	0.4	1.4	0.0	0.0	0.0	0.0	0.0	8.7	0.0	0.6
HYPERIMERUS	0.6	0.0	0.5	0.0	0.0	5.0	0.0	0.0	0.0	6.7	0.6
APANTELES	0.4	0.4	1.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.5
PACHYNEURON	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	4.3	6.7	0.4
MYMARIDAE	0.2	0.4	0.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.3
CHALCIDIDAE	0.4	0.0	0.0	1.5	0.0	2.5	0.0	0.0	0.0	0.0	0.3
LEUCOSTOMA	0.2	0.0	0.5	1.5	0.0	0.0	0.0	0.0	4.3	0.0	0.3
PODAGRIONIDAE	0.2	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	6.7	0.3
APHELINUS	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	13.3	0.3
PLAGIOMIMA	0.2	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.2
HETEROLACCUS	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
ELACHERTUS	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
PSEUDOMICROMELUS	0.0	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
BRACHYMERIA	0.2	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
ORGILUS	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.1
METEORUS	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
IPHIAULAX	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
EUDERUS	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
MICROPLITIS	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
CREMNOPS	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
PTEROMALUS	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
TRICHOGRA-IDAE SP B	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.1
TRIMEROMICRUS	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
TOTAL SAMPLES TAKEN FOR EACH CATEGORY	511	223	208	65	46	40	36	30	23	15	1197

TABLE 3. NUMBER OF INDIVIDUALS OF PARASITE TAXA COLLECTED IN 1973

TAXON	VEGETATION TYPE OR CROP CATEGORY										OVER ALL CATEGORIES
	COTTON	WEEDY AREAS	ALFALFA	SORGHUM	GRAIN STUBBLE	DESERT	SAFFLOWR	SAFFLOWR STUBBLE	SUGAR BEETS	MESQUITE	
ABBELLA	167	65	7115	1111	4	15	18	5	1728	1	10229
APHELINOIDEA	157	408	1703	8	17	29	28	1	1061	5	3417
CHRYSOCHARIS	375	52	2223	12	5	6	8	0	3	7	2691
TELENOMUS	534	507	268	78	241	27	25	27	106	103	1916
COPIDOSOMA	769	19	122	14	2	19	1	0	3	509	1458
ACHRYSOCHARELLA	384	216	630	23	11	62	8	1	6	21	1362
TRISSOLCUS	411	283	225	39	14	33	93	4	123	118	1343
PROCTOTRUPOIDEA	400	160	271	16	23	35	63	8	99	189	1264
TRICHOGRAMMA	199	175	479	14	7	46	5	0	154	20	1099
TETRASTICHUS	90	652	73	29	4	74	10	0	20	30	982
ANAGRUS	145	39	29	3	4	8	7	0	400	0	635
HYALOMYA	62	48	123	3	22	0	20	12	174	0	464
OPIUS	24	8	400	9	0	1	0	0	0	4	446
POLYNEMA	82	78	118	2	2	5	0	0	53	1	341
CLOSTEROCERUS	222	2	67	1	0	3	0	2	2	3	302
ENCARSIA	104	89	47	3	9	18	2	0	2	4	278
ENCYRTIDAE	42	68	24	0	1	47	3	0	1	45	231
CHELONUS	28	3	172	5	0	2	9	0	5	0	224
EUCHALCIDIA	46	72	2	0	2	23	0	0	2	70	217
ANAPHES	30	54	81	0	0	6	9	0	24	10	214
TRICHOGRAMMATIDAE	45	10	120	2	2	0	6	0	10	0	195
HALTICOPTERA	49	23	80	1	1	13	0	0	0	14	181
SOLENOTUS	27	19	120	3	0	3	0	0	2	3	177
PTEROMALIDAE	29	53	16	0	0	26	1	0	5	19	149
BETHYLIDAE	62	36	16	1	1	5	4	0	4	14	143
GONATOCERUS	23	27	54	0	1	7	3	0	17	3	135
CATOLACCUS	46	15	38	1	0	3	9	0	1	7	120
EURYTOMIDAE	29	29	19	4	0	11	0	0	1	26	119
HABROCYTUS	29	22	45	0	1	4	0	0	3	13	117
MYMAR	27	60	16	2	4	0	0	1	5	1	116
SCELIONIDAE	37	9	19	0	0	0	21	0	22	0	108
ZATROPIS	33	6	8	1	0	4	0	0	3	16	71
PSILOCERA	19	22	8	2	0	8	3	0	0	3	65
EULOPHIDAE	9	21	10	0	1	7	1	0	0	8	57
PSEUDOCATOLACCUS	22	10	16	0	0	1	0	0	0	5	54
ICHNEUMONIDAE	13	5	25	3	1	1	0	0	3	2	53
ZAGRAMMOSOMA	22	9	2	1	0	14	0	0	0	2	50
ENCARSIA (= SP. A)	24	12	7	0	2	0	1	1	0	1	48
BRACONIDAE	18	3	15	0	1	1	0	0	2	3	43
TORYMIDAE	8	17	1	0	1	1	0	0	0	12	40
EUCELATORIA	11	0	25	0	0	0	0	0	0	0	36
BRACON	23	4	6	0	0	0	0	0	1	0	34
LESPESIA	6	1	22	1	1	0	0	0	0	0	31

TABLE 3. NUMBER OF INDIVIDUALS OF PARASITE TAXA COLLECTED IN 1973 (CONTINUED)

TAXON	VEGETATION TYPE OR CROP CATEGORY										OVER ALL CATEGORIES
	COTTON	WEEDY AREAS	ALFALFA	SORGHUM	GRAIN STUBBLE	DESERT	SAFFLOWR	SAFFLOWR STUBBLE	SUGAR BEETS	MESQUITE	
AMBLYMERUS	4	6	6	1	0	9	0	0	0	2	28
TACHINIDAE	8	3	15	2	0	0	0	0	0	0	28
PROSPALTELLA	6	19	2	0	0	1	0	0	0	0	28
HETEROSCHEMA	12	6	5	1	0	0	0	0	0	0	24
GYMNOSOMA	0	5	13	0	1	0	1	1	2	0	23
APHELINIDAE	0	1	7	0	0	1	0	0	9	1	19
SPILOCHALCIS	5	6	4	0	0	2	1	0	0	1	19
SYNTOMOPUS	6	2	10	0	0	0	0	0	0	0	18
PERILAMPIDAE	9	1	1	0	0	2	2	0	2	0	17
PNIGALIO	2	5	6	0	0	0	1	0	2	1	17
PACHYNEURON	0	0	11	0	0	0	0	0	1	3	15
NEOCATOLACCUS	5	1	3	0	0	0	0	0	0	1	10
LEUCOSTOMA	3	0	1	3	0	0	0	0	2	0	9
GEN 5 NR SYNTOMOPUS	2	1	6	0	0	0	0	0	0	0	9
TRICHOGRA-IDAE SP A	3	0	4	0	0	2	0	0	0	0	9
MYMARIDAE	3	1	3	1	0	0	0	0	0	0	8
HORISMENUS	4	1	2	0	0	0	0	0	0	1	8
HYPERIMERUS	3	0	2	0	0	2	0	0	0	1	8
EUPTEROMALUS	1	1	3	0	0	0	0	0	2	0	7
APANTELES	2	1	2	0	0	0	1	0	0	0	6
CHALCIDIDAE	3	0	0	1	0	1	0	0	0	0	5
PODAGRION	1	0	0	0	1	0	0	0	0	1	3
APHELINUS	0	0	0	0	0	1	0	0	0	2	3
PLAGIOMIMA	1	0	0	0	1	0	0	0	0	0	2
HETEROLACCUS	2	0	0	0	0	0	0	0	0	0	2
ELACHERTUS	1	1	0	0	0	0	0	0	0	0	2
PSEUDOMICROMELUS	0	1	1	0	0	0	0	0	0	0	2
BRACHYMERIA	1	0	1	0	0	0	0	0	0	0	2
ORGILUS	0	0	0	0	0	0	1	0	0	0	1
METEORUS	1	0	0	0	0	0	0	0	0	0	1
IPHIAULAX	1	0	0	0	0	0	0	0	0	0	1
EUDERUS	0	1	0	0	0	0	0	0	0	0	1
MICROPLITIS	1	0	0	0	0	0	0	0	0	0	1
CREMNOPS	1	0	0	0	0	0	0	0	0	0	1
PTEROMALUS	0	0	1	0	0	0	0	0	0	0	1
TRICHOGRA-IDAE SP B	0	0	0	0	0	1	0	0	0	0	1
TRIMEROMICRUS	0	1	0	0	0	0	0	0	0	0	1
TOTAL SAMPLES TAKEN FOR EACH CATEGORY	511	223	208	65	46	40	36	30	23	15	1197

Table 4. Summary of data for *Lysiphlebus* and Cynipidae for 1974.

	Vegetation Type or Crop Category						Over All
	Cotton	Alfalfa	Wheat	Barley	Safflower	Mesquite	Categories
		Percentage Frequency of Occurrence					
Lysiphlebus	0.0	27.8	76.9	75.0	29.4	25.0	30.7
Cynipidae	18.3	41.7	71.8	66.7	47.1	25.0	40.8
		Number of Individuals					
Lysiphlebus	0	118	3046	120	33	1	3318
Cynipidae	20	250	798	52	27	3	1150
Total Samples	71	36	39	12	17	4	179

	Number of Individuals Collected Biweekly for All Types of Vegetation					
(Dates)	4/18–19	5/2–3	5/15–17	5/30–31	6/13–14	6/27–28
Lysiphlebus	1455	1847	16	0	0	0
Cynipidae	21	399	702	21	3	4

Table 5. Number of samples processed in 1973 season.

				Cotton Fields	
Week of	Cotton	Other	Total	Treated in Previous Week	Untreated To Date
6/25	26	41	67	0	33
7/2	25	42	67	1	32
7/9	33	51	84	3	31
7/16	33	50	83	1	30
7/23	33	47	80	2	30
7/30	32	46	78	8	22
8/6	33	43	76	4	18
8/13	31	43	74	7	17
8/20	33	41	74	8	17
8/27	33	37	70	9	16
9/3	33	36	69	6	16
9/10	33	36	69	7	16
9/17	32	36	68	6	13
9/24	30	37	67	6	12
10/1	29	36	65	3	12
10/8	24	34	58	1	12
10/15	16	30	46	1	12
TOTALS	**509**	**686**	**1195**		

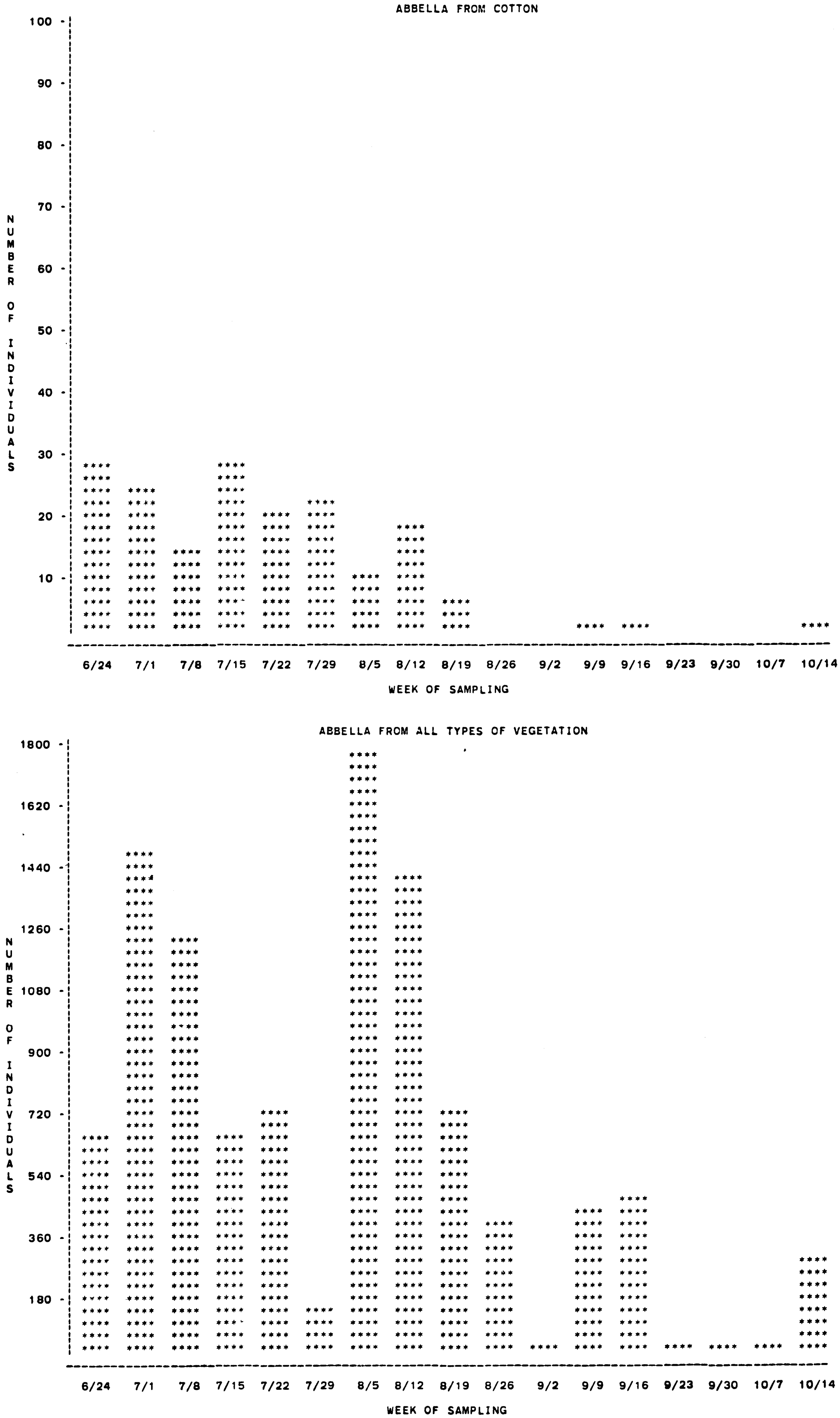


Fig. 3 Specimens of *Abbella* taken in 1973 (Trichogrammatidae).

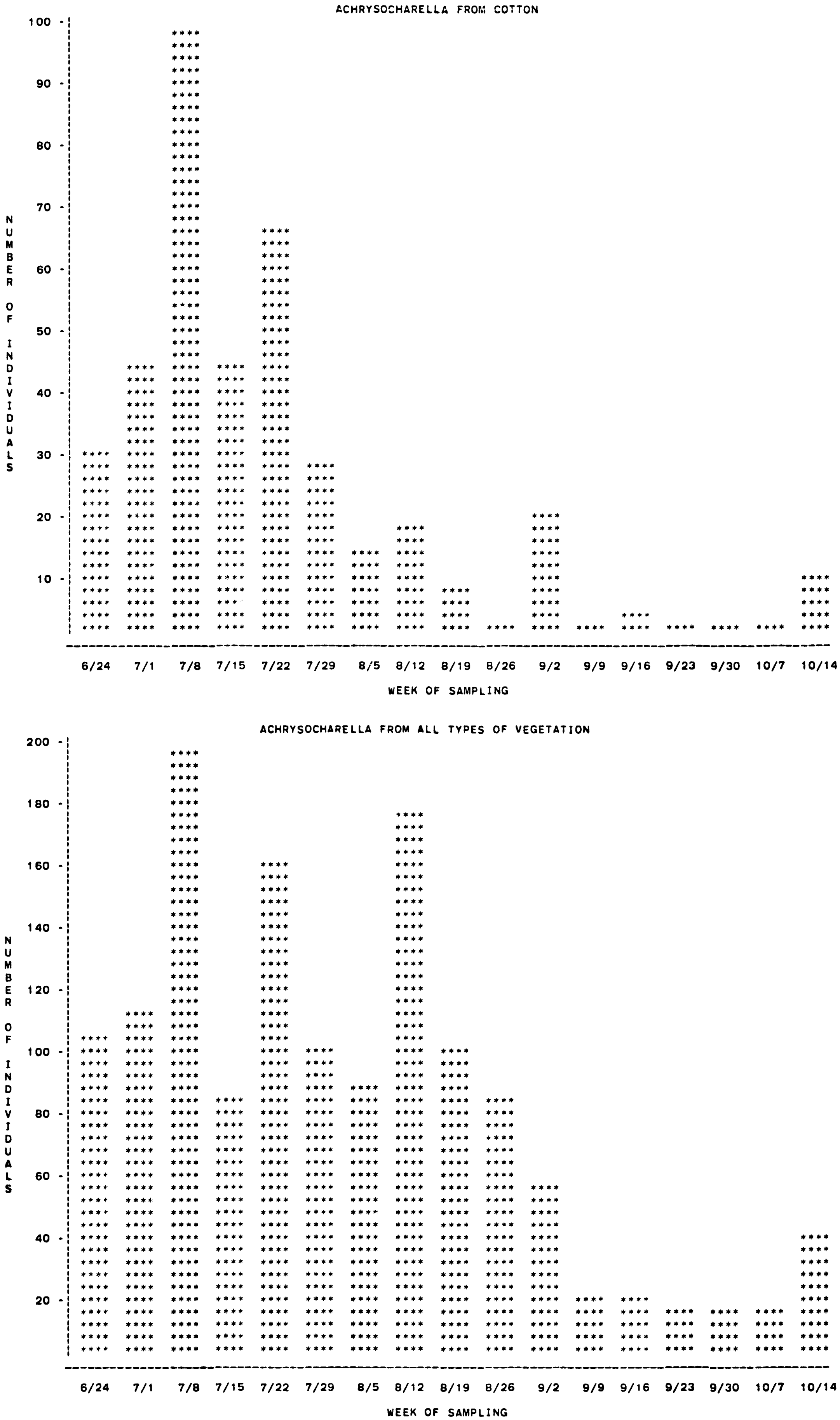


Fig. 4. Specimens of *Achrysocharella* taken in 1973 (Eulophidae).

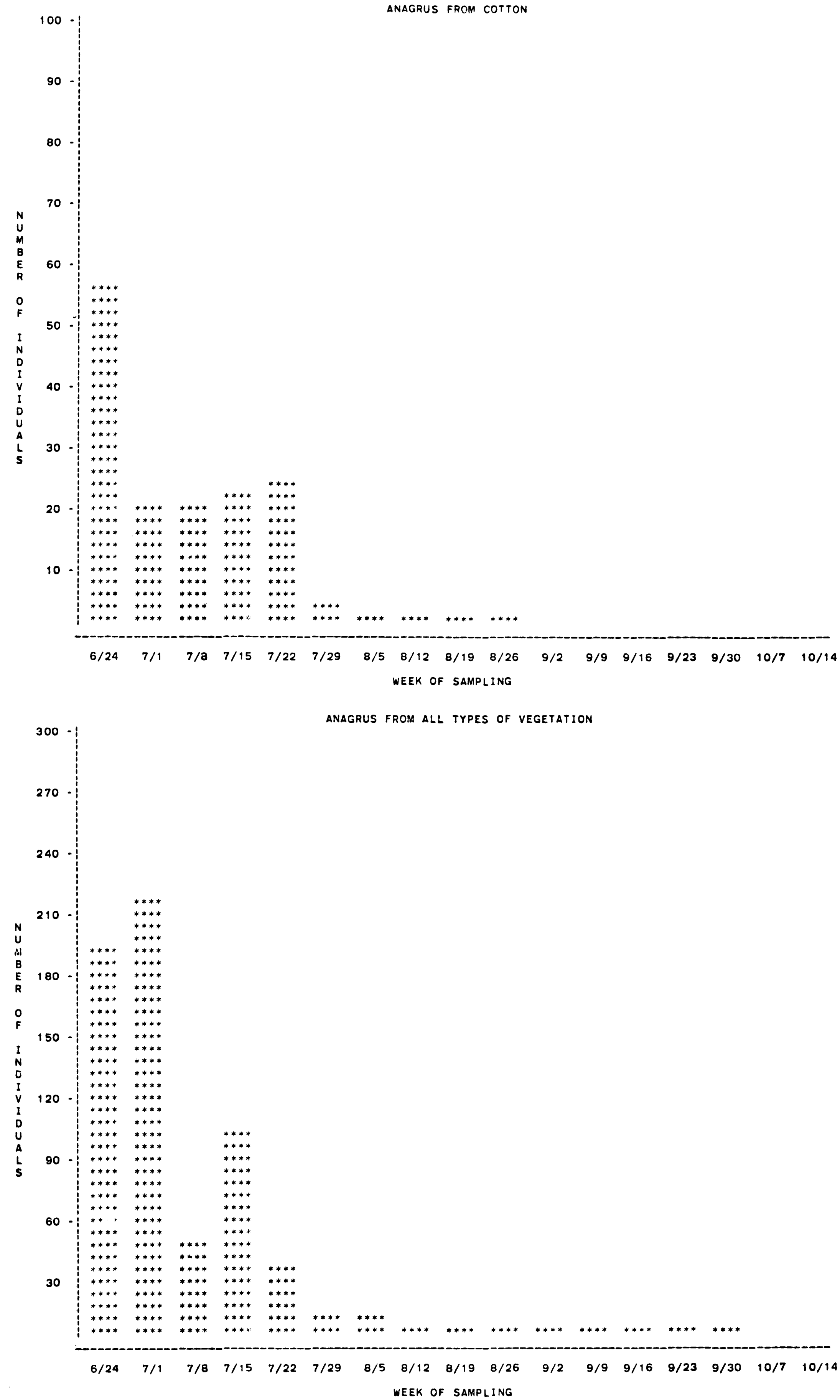
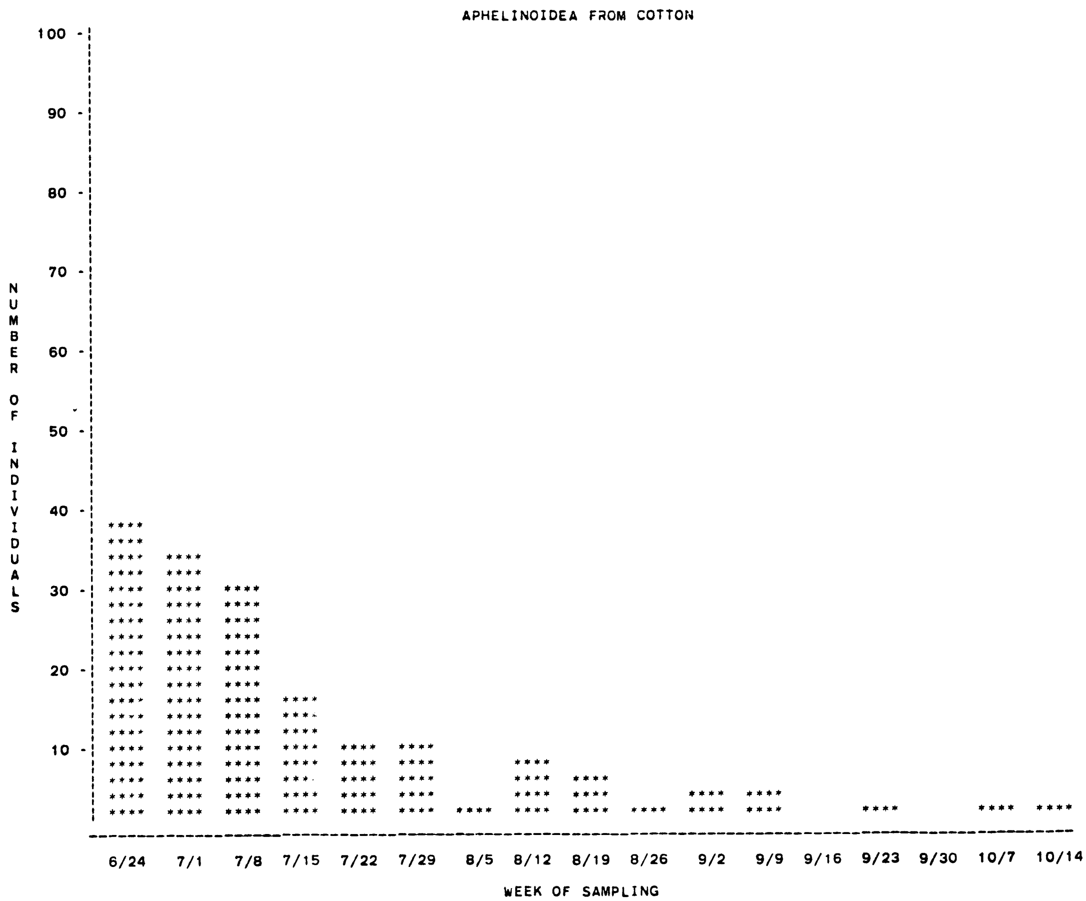


Fig. 5. Specimens of *Anagrus* taken in 1973 (Mymaridae).



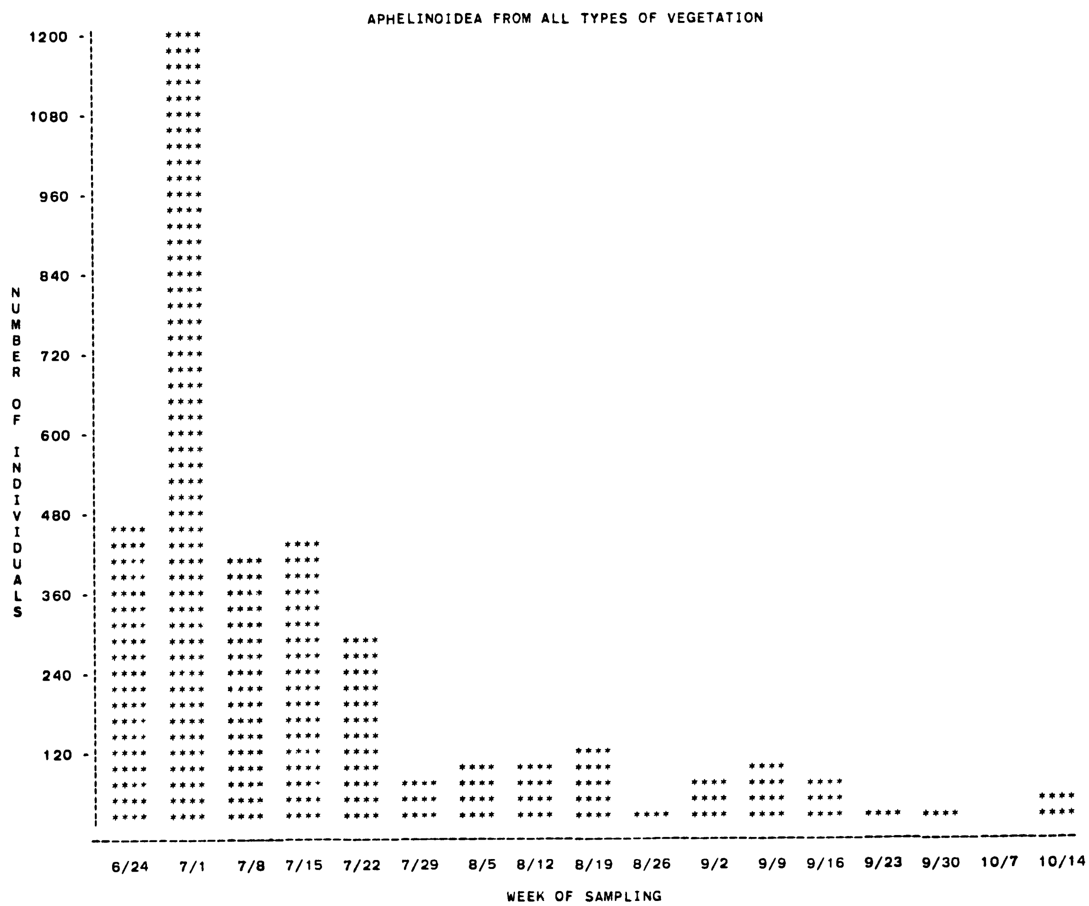
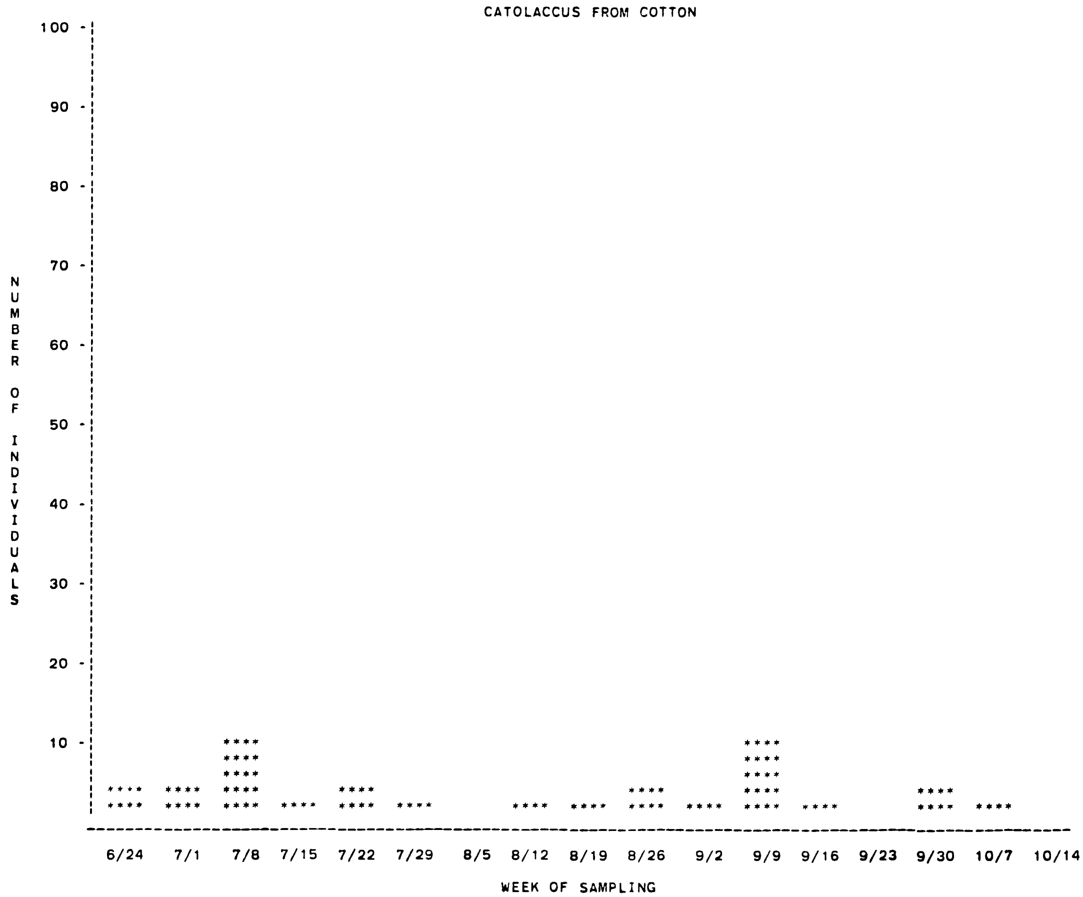


Fig. 6. Specimens of *Aphelinoidea* taken in 1973 (Trichogrammatidae).



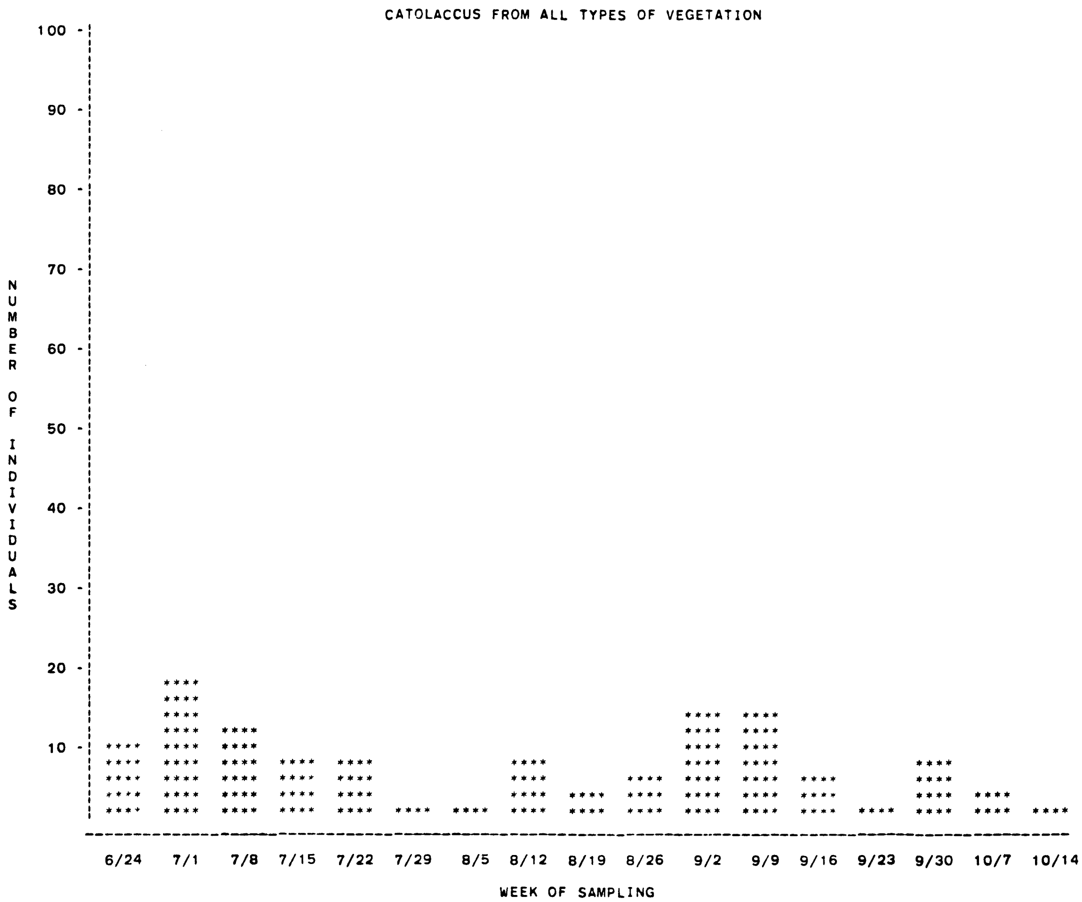
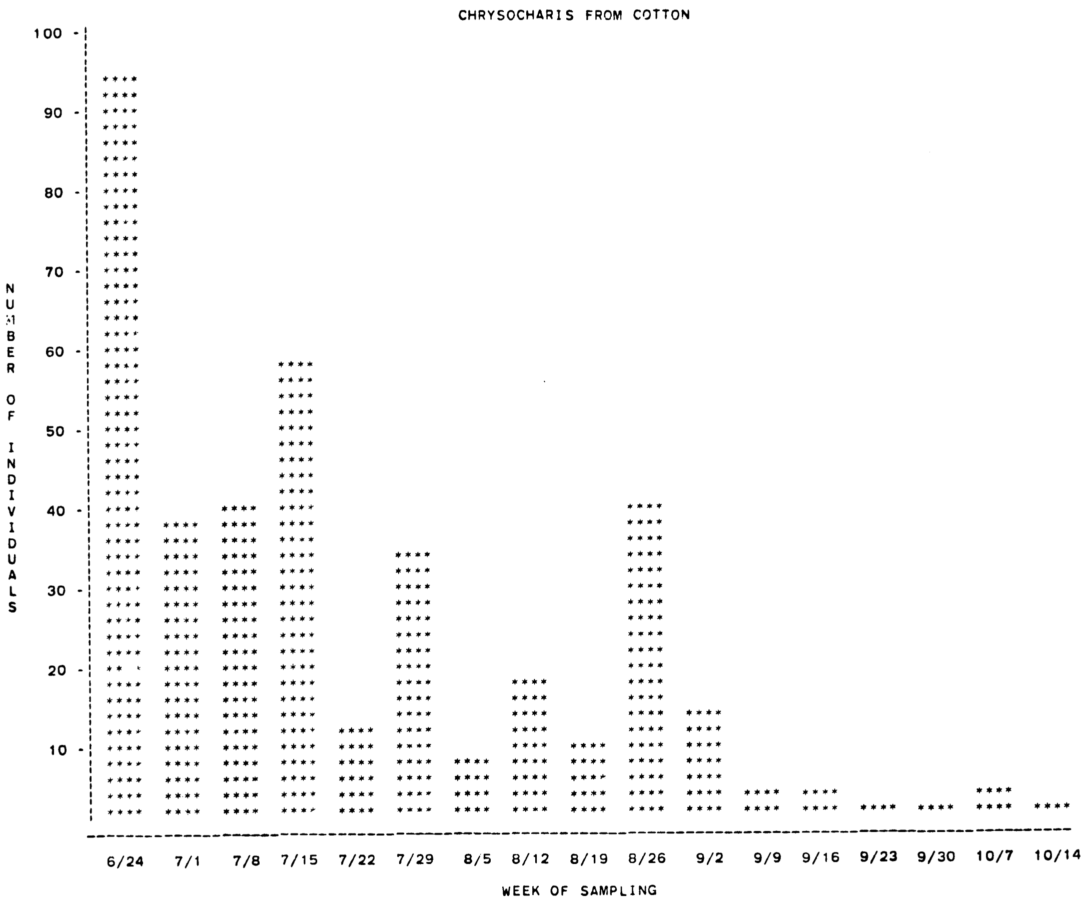


Fig. 7. Specimens of *Catolaccus* taken in 1973 (Ptermalidae).



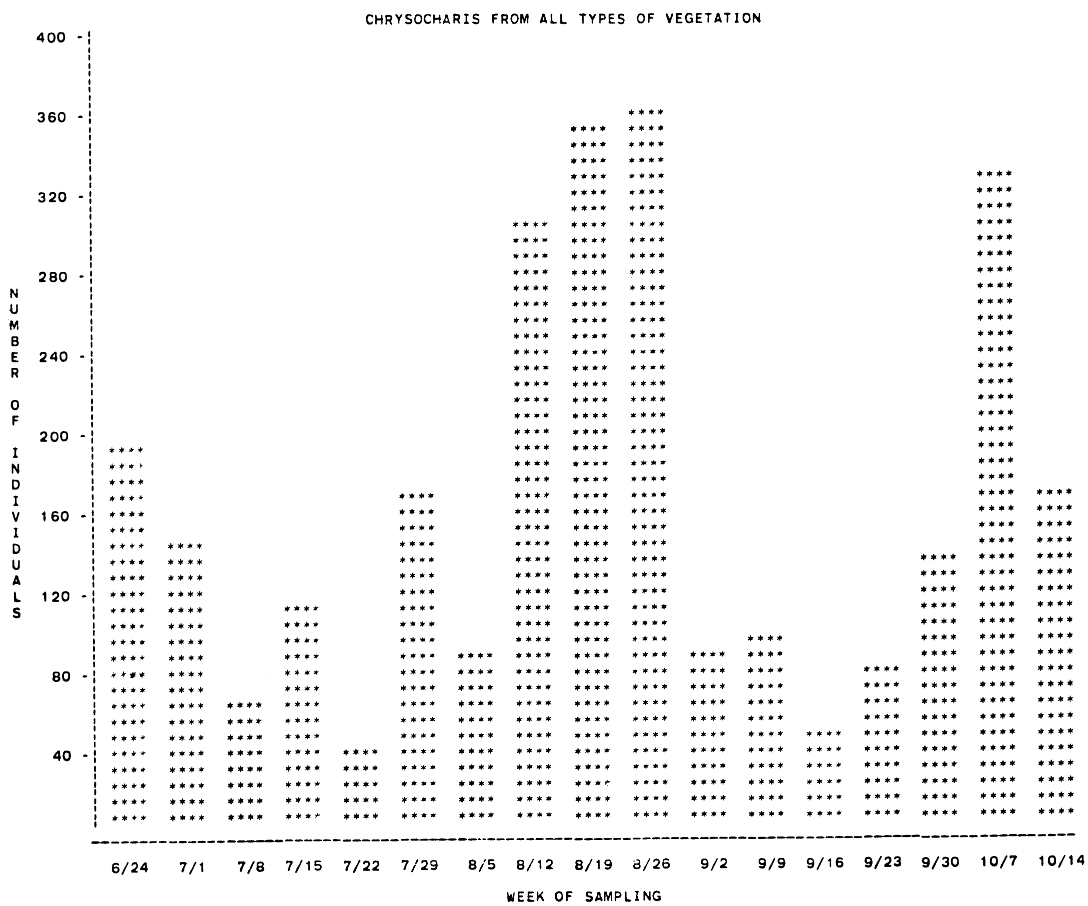
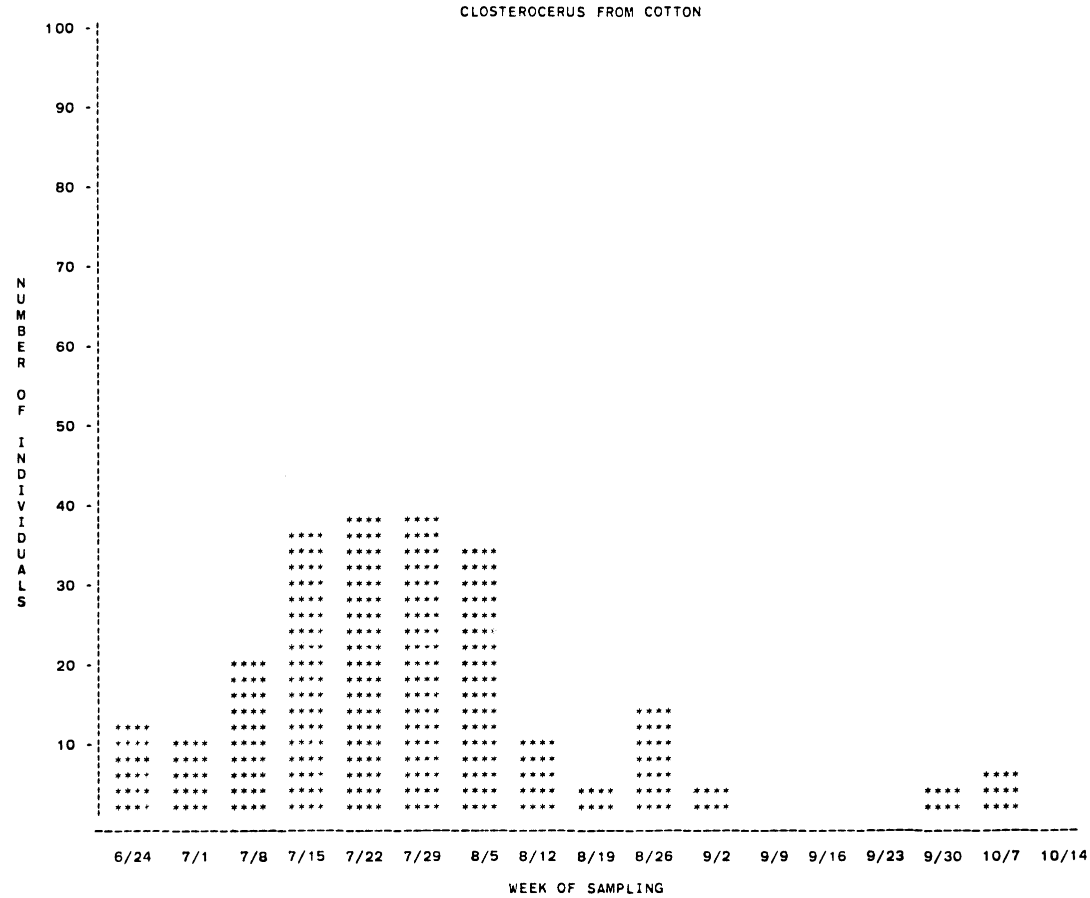


Fig. 8. Specimens of *Chrysocharis* taken in 1973 (Eulophidae).



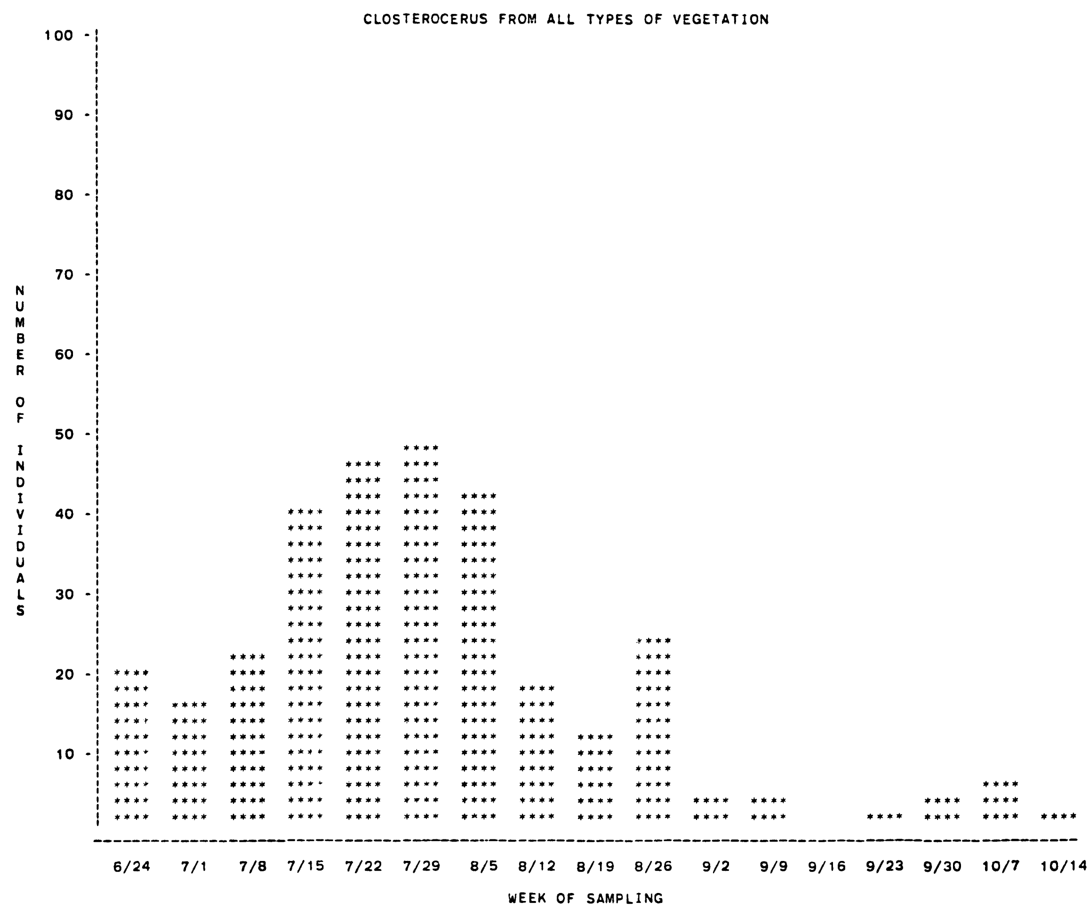
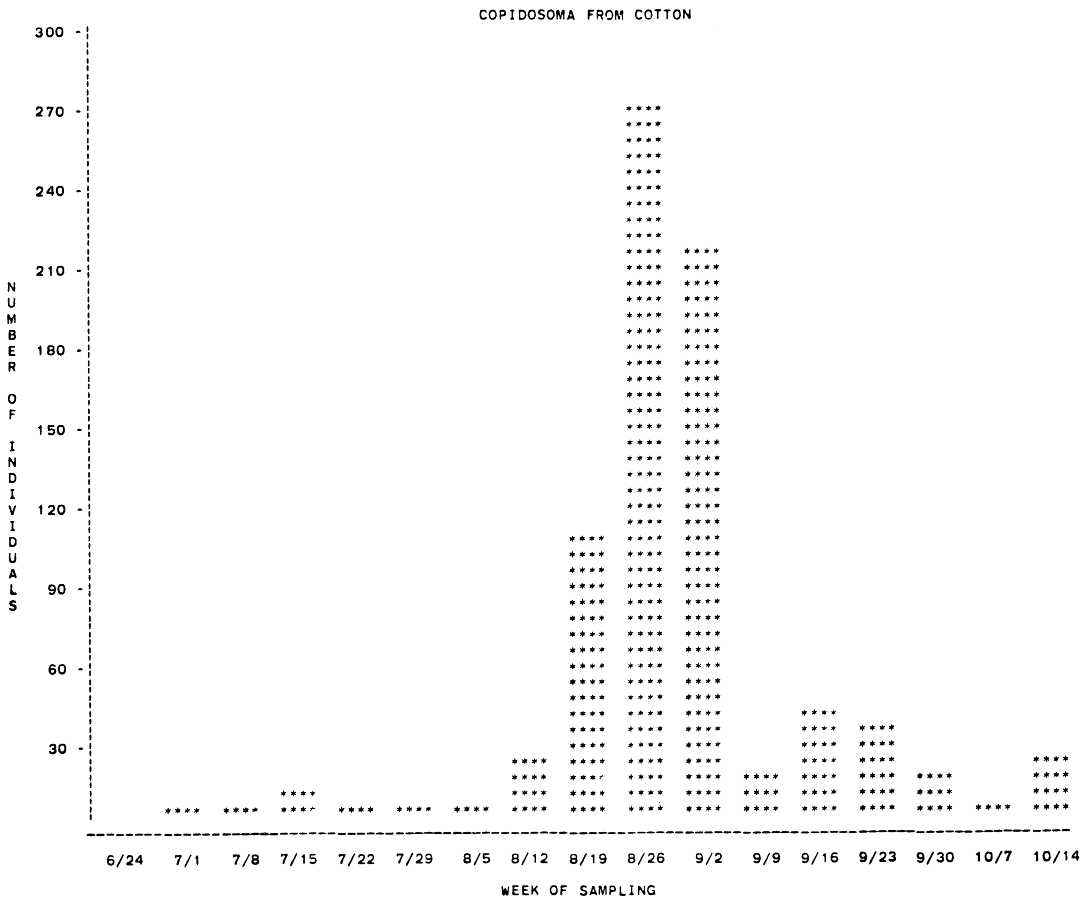


Fig. 9. Specimens of *Closterocerus* taken in 1973 (Eulophidae).



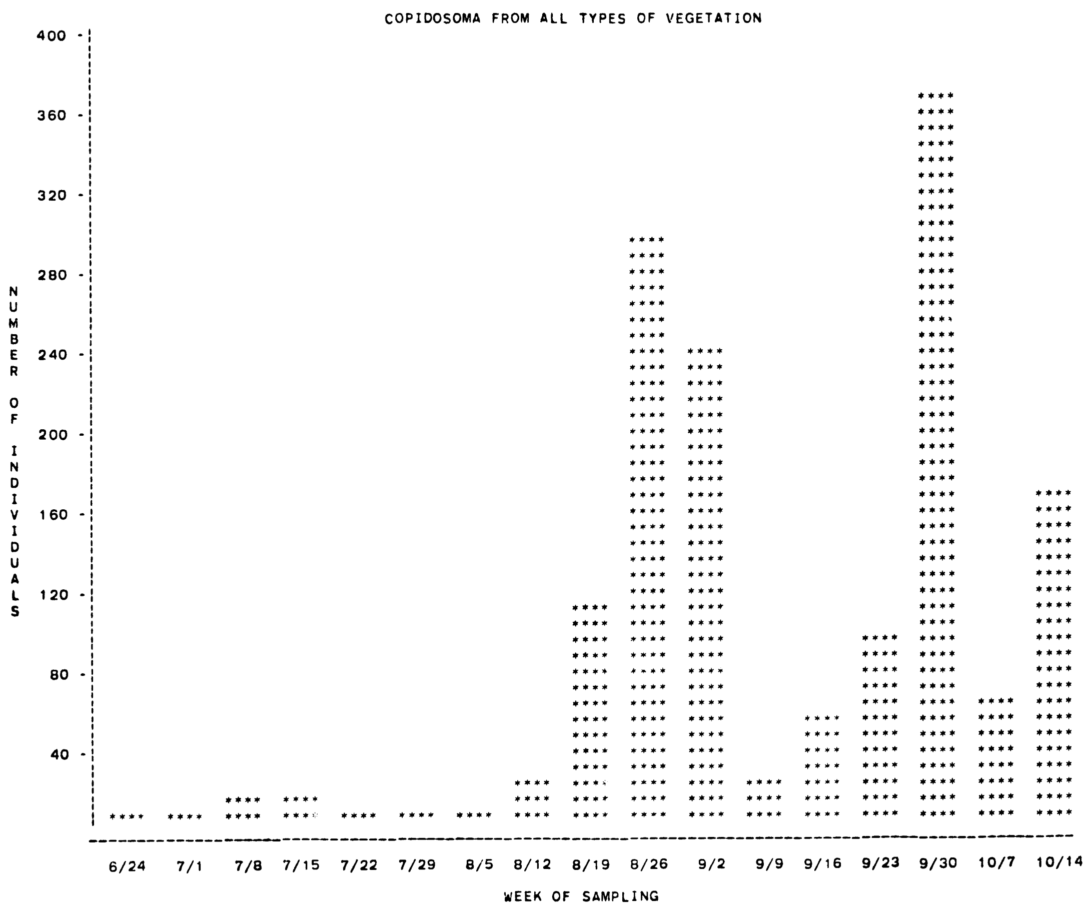
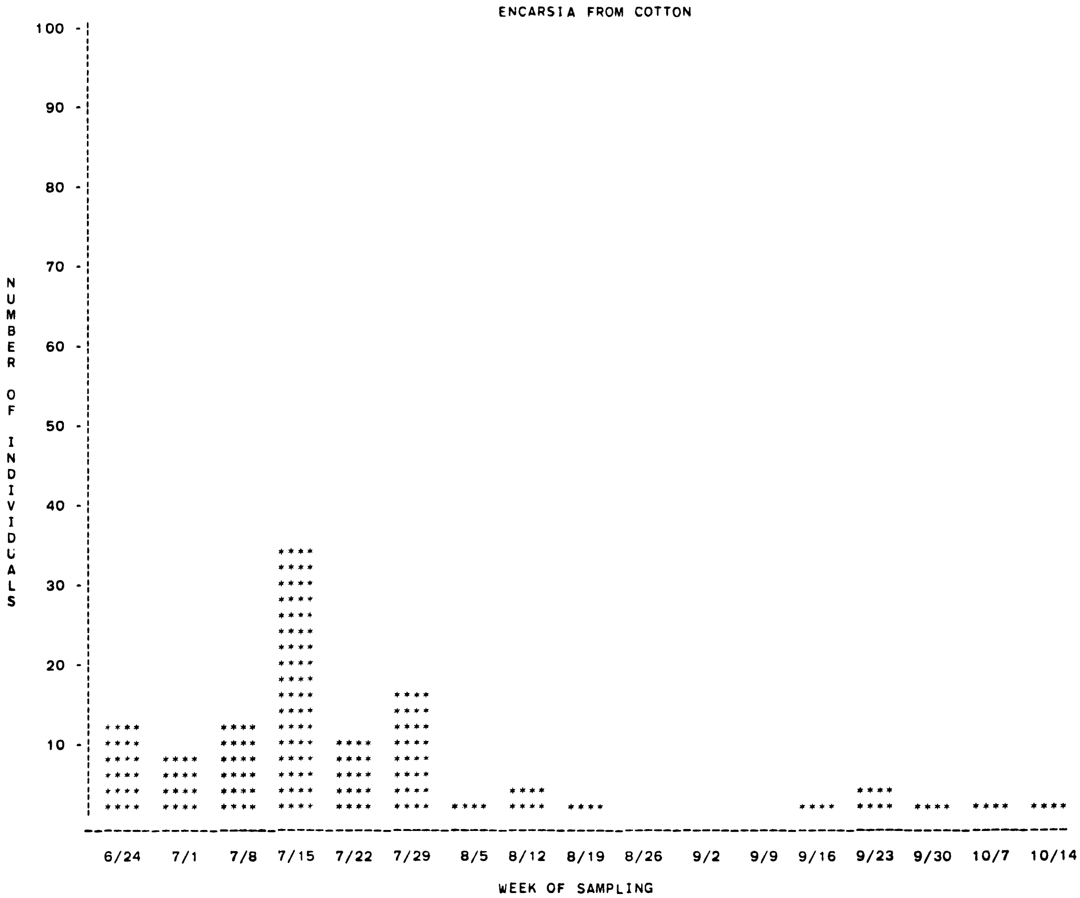


Fig. 10. Specimens of *Copidosoma* taken in 1973 (Encyrtidae).



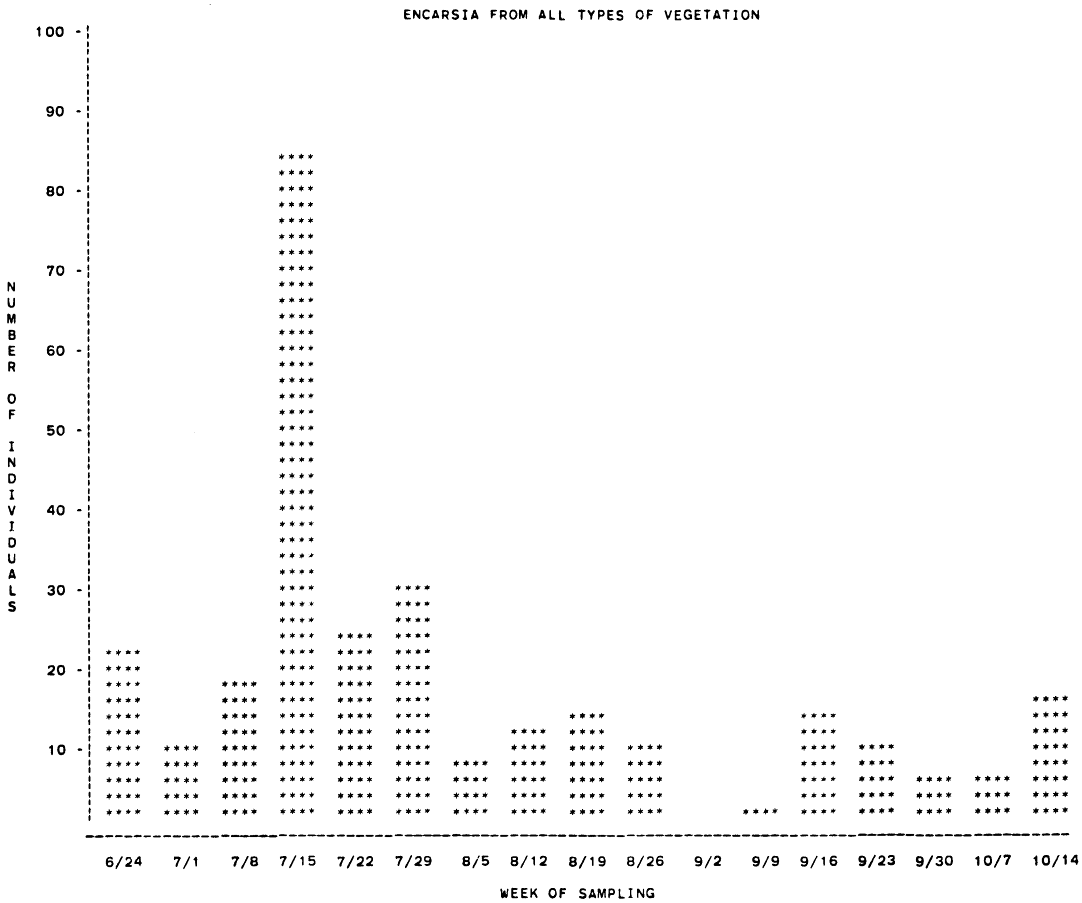
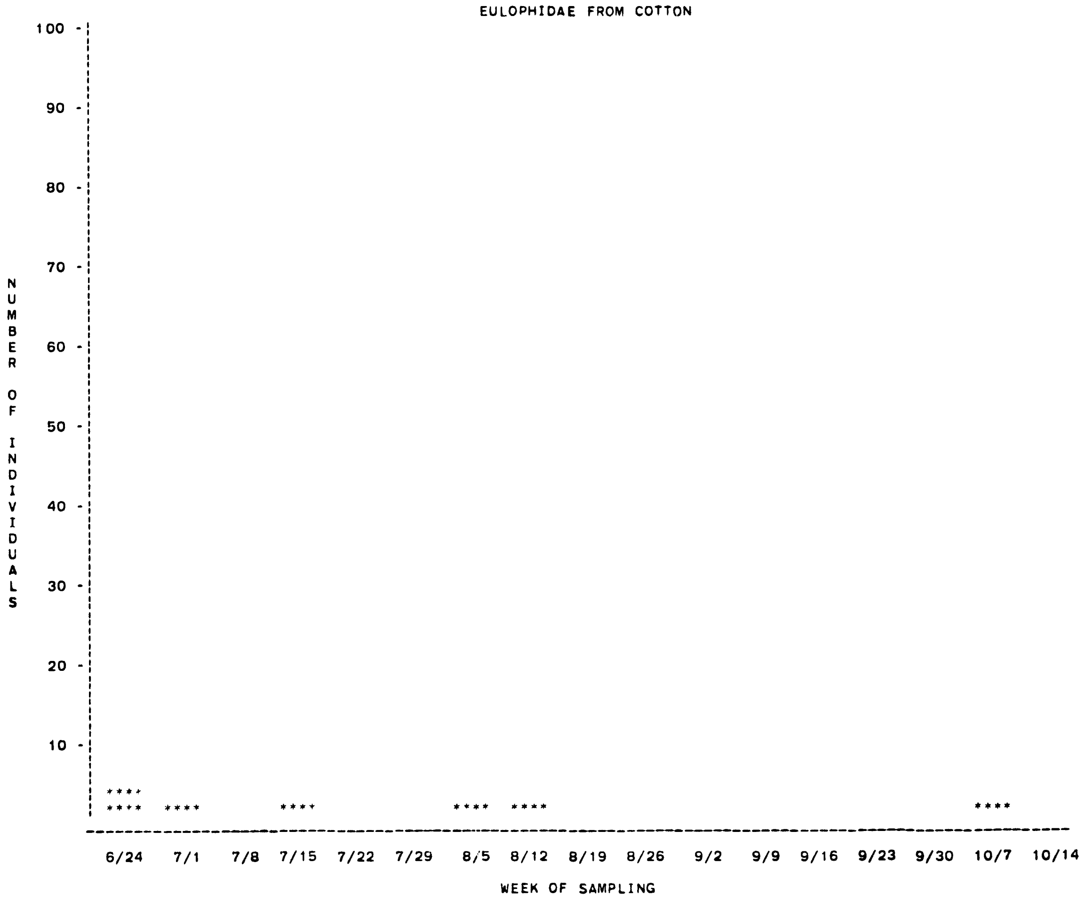


Fig. 11. Specimens of *Encarsia* taken in 1973 (Aphelinidae).



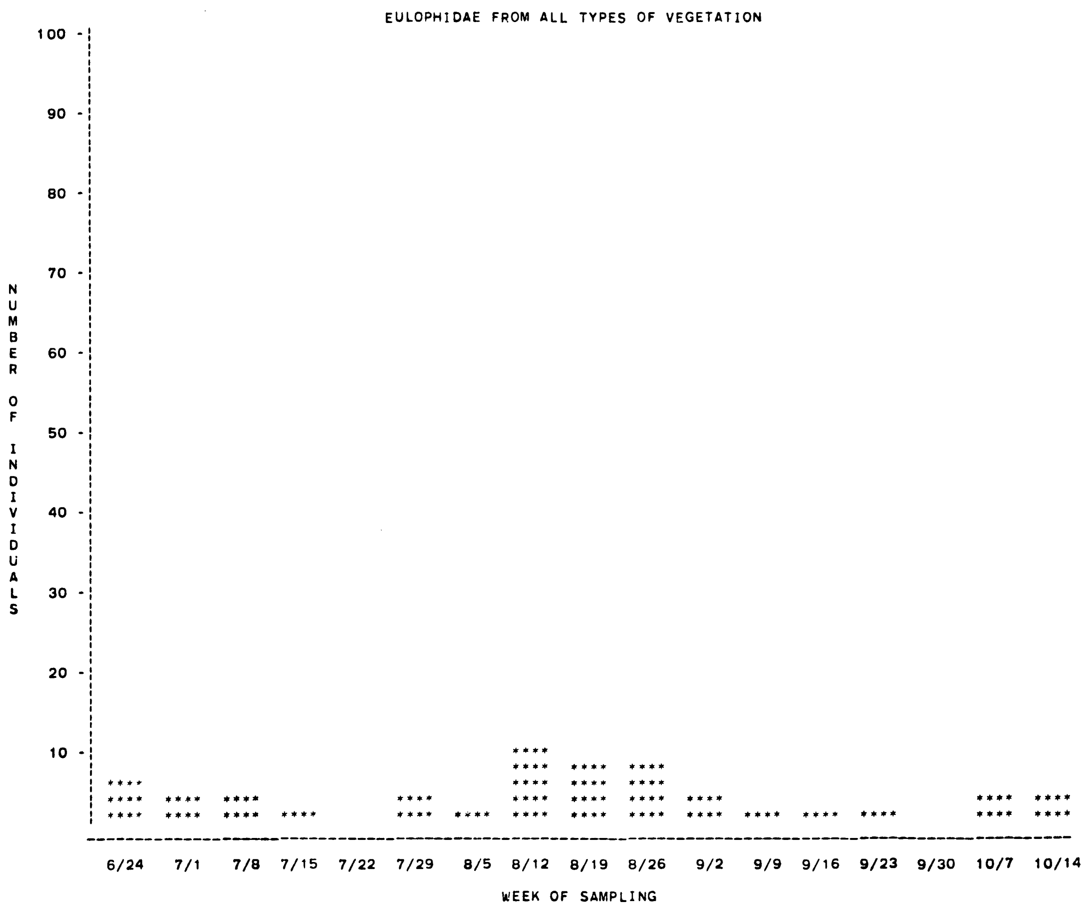
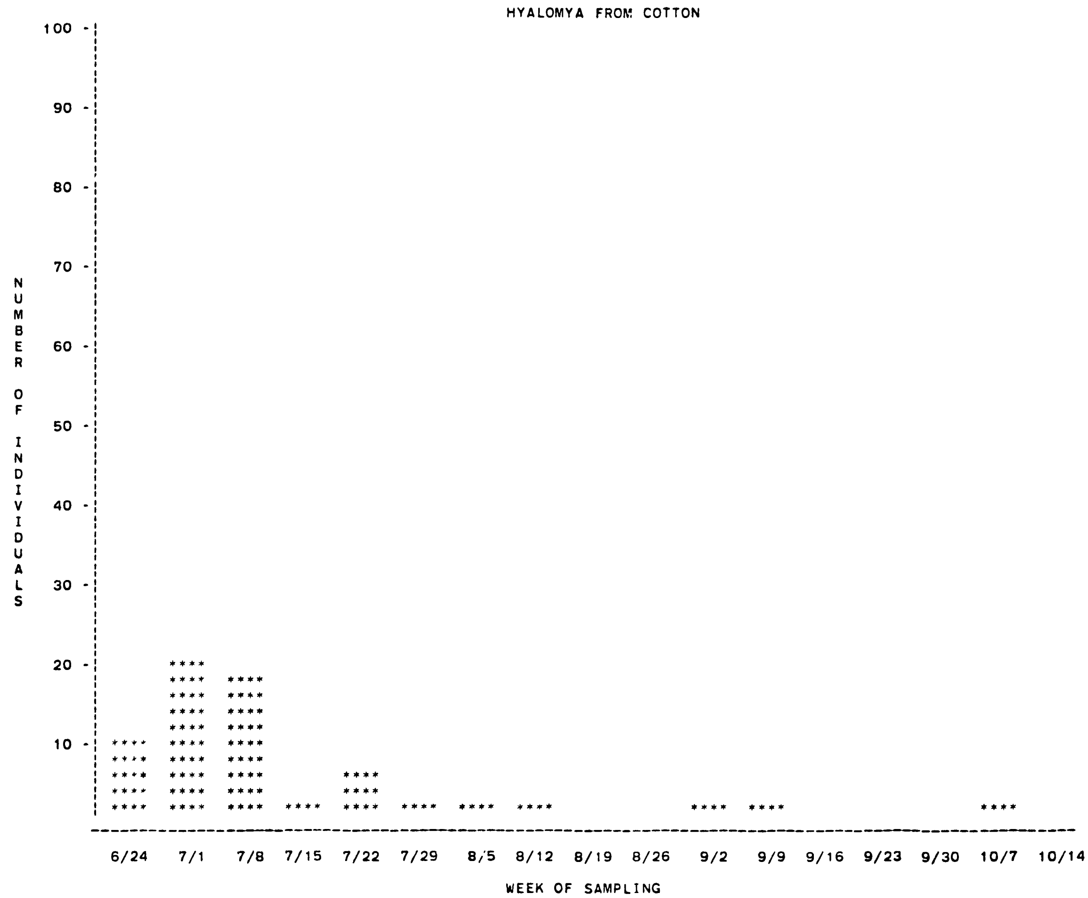


Fig. 12. Specimens of Eulophidae not identified to genus taken in 1973.



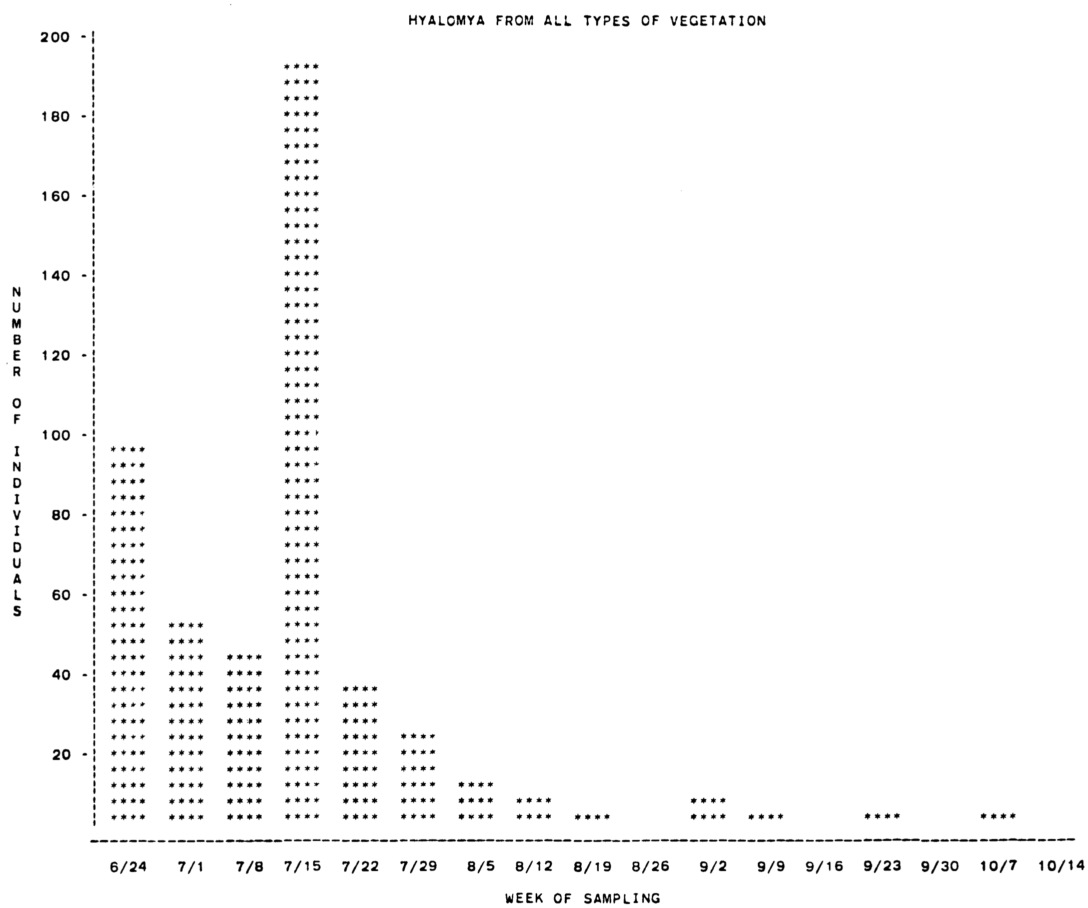


Fig. 13. Specimens of *Hyalomya* taken in 1973 (Tachinidae).

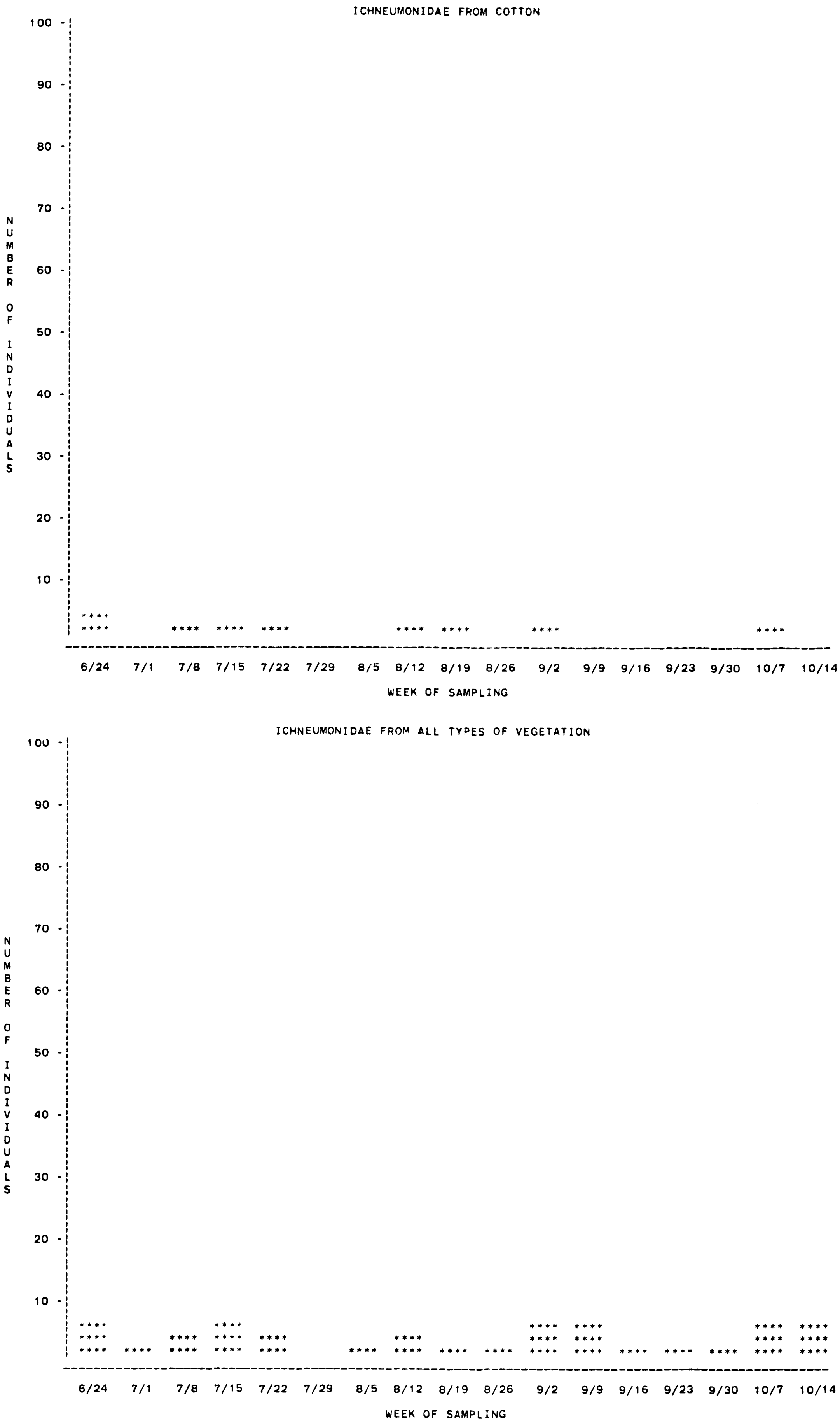
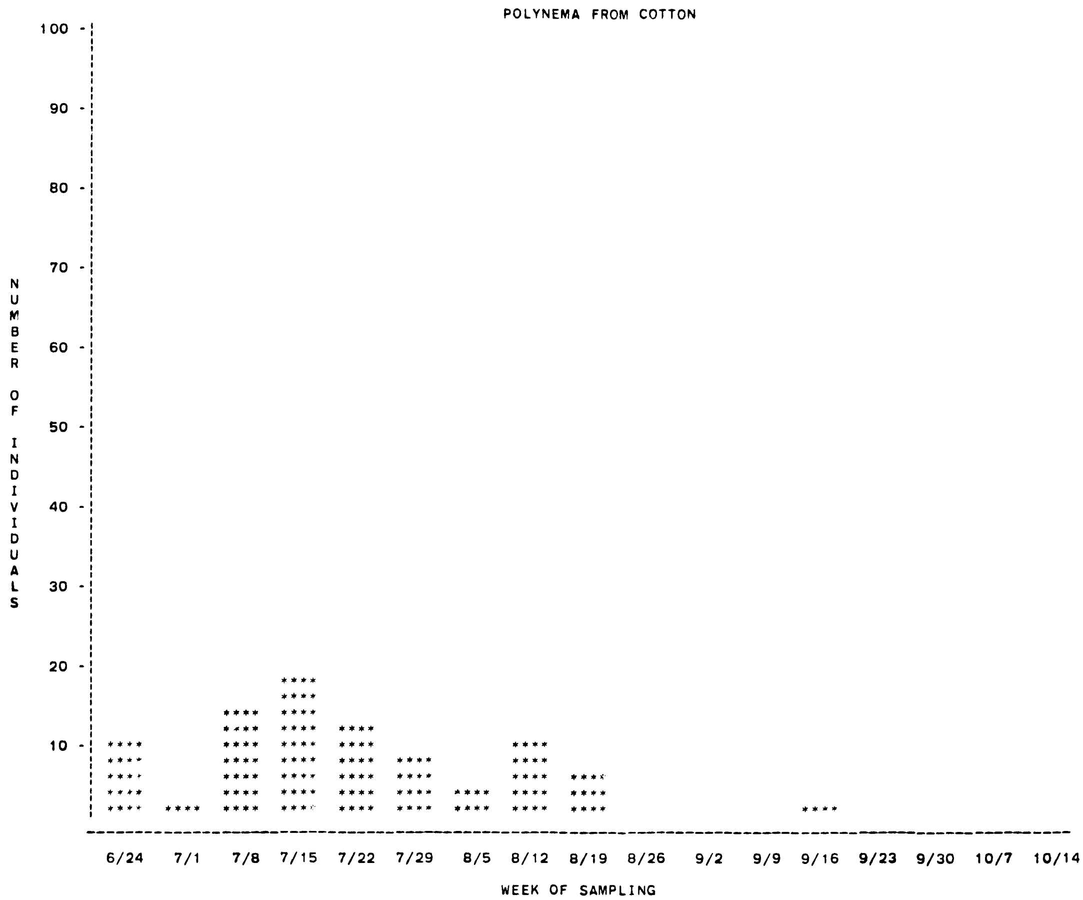


Fig. 14. Specimens of all genera of Ichneumonidae taken in 1973.



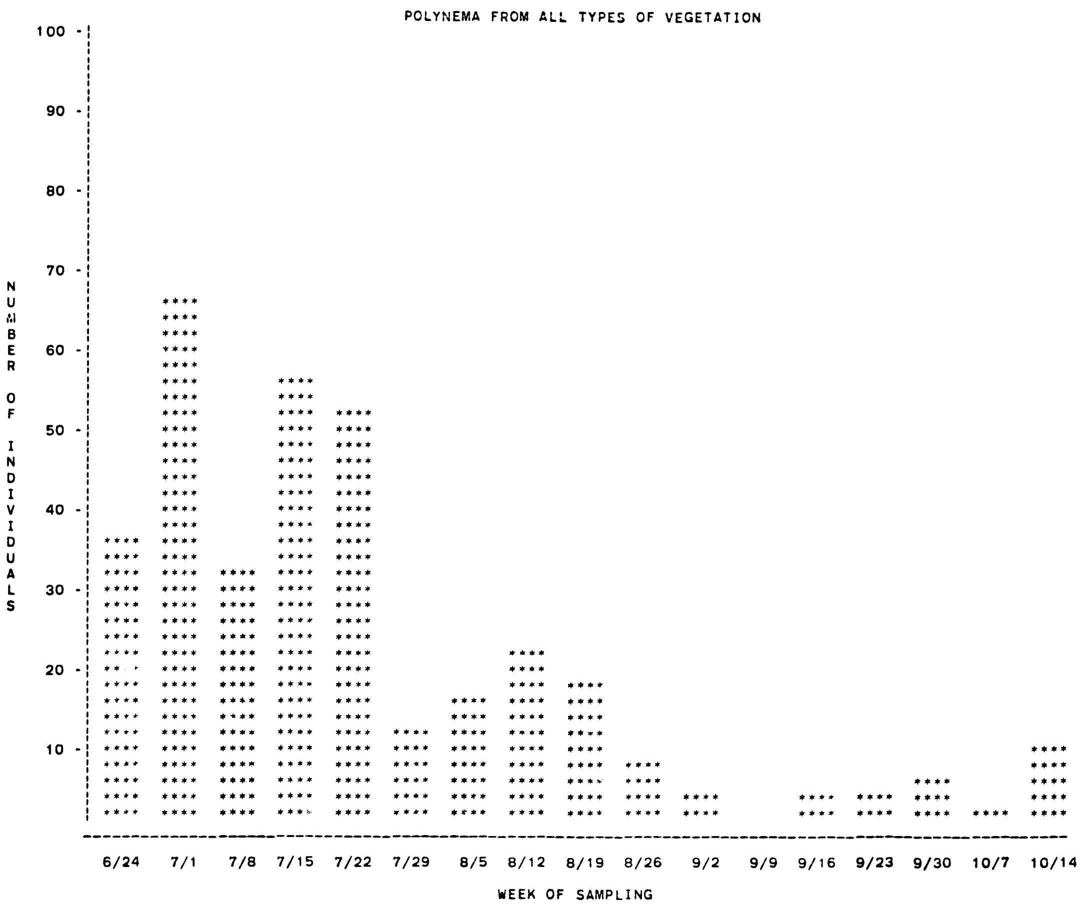
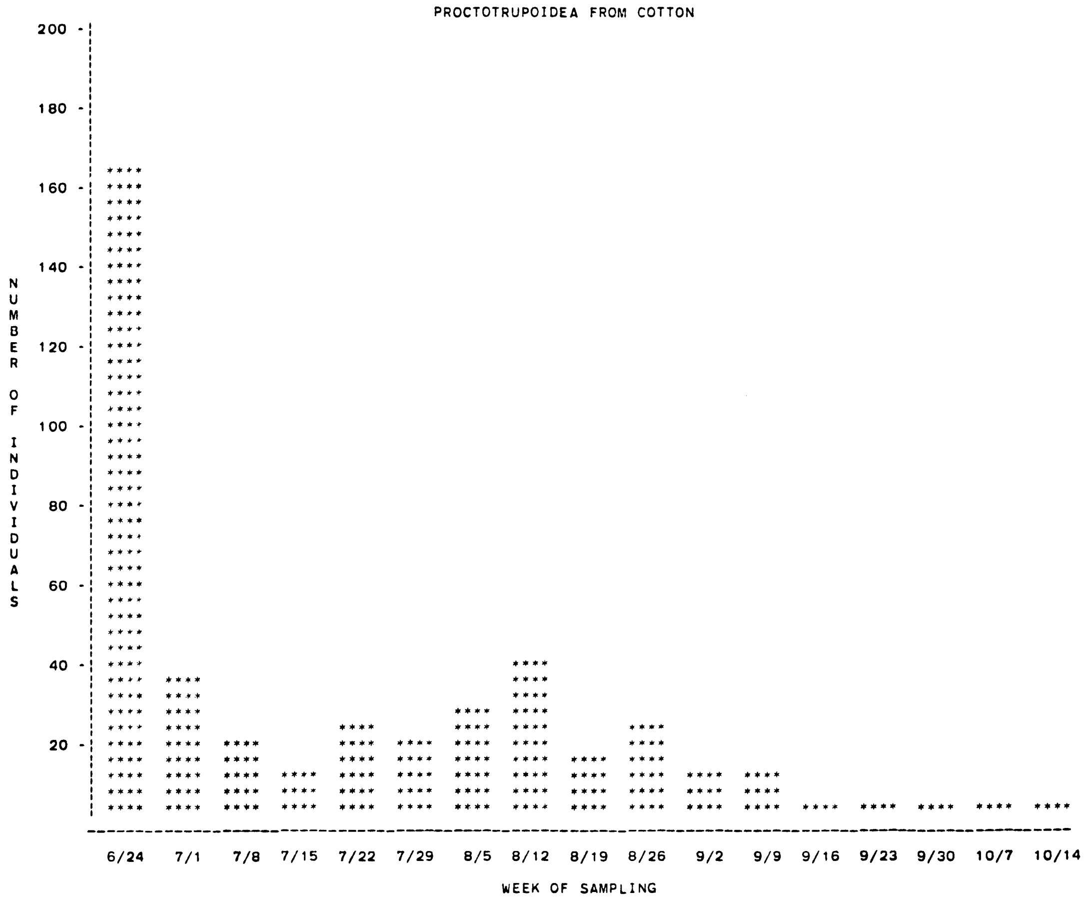


Fig. 15. Specimens of *Polynema* taken in 1973 (Mymaridae).



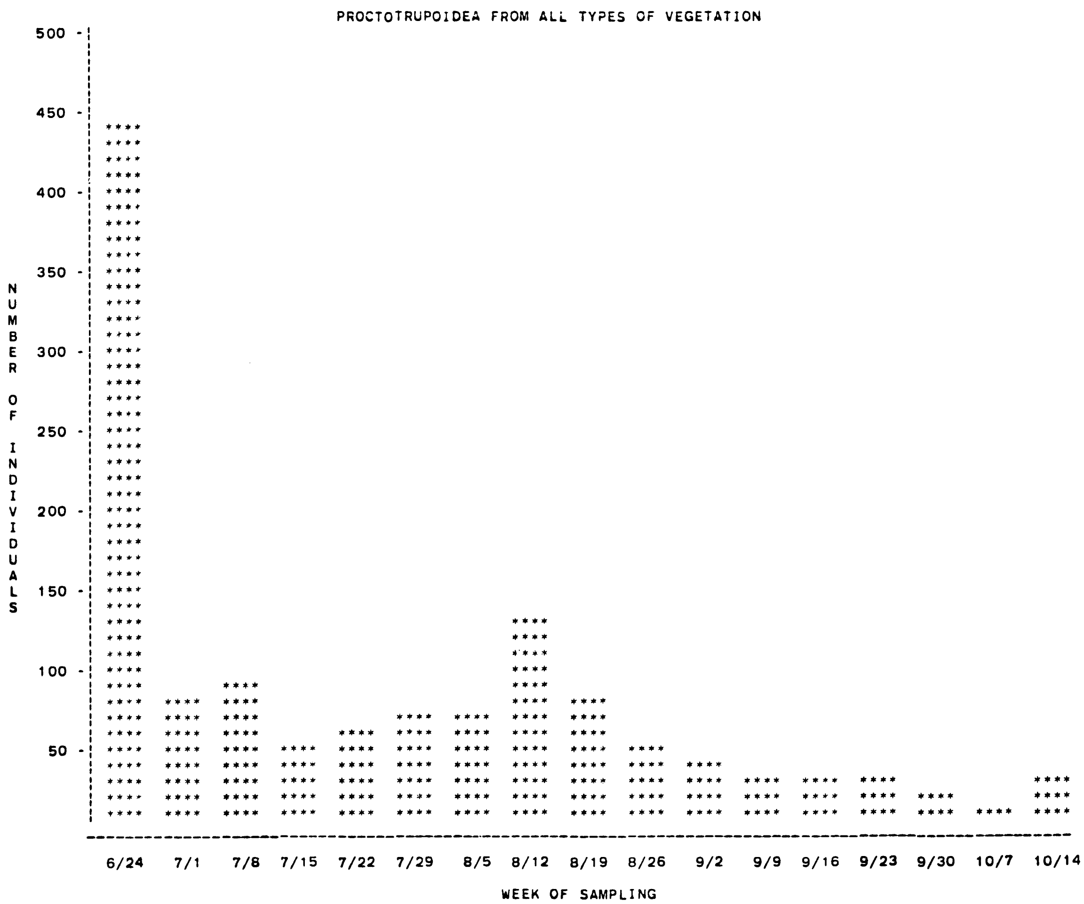
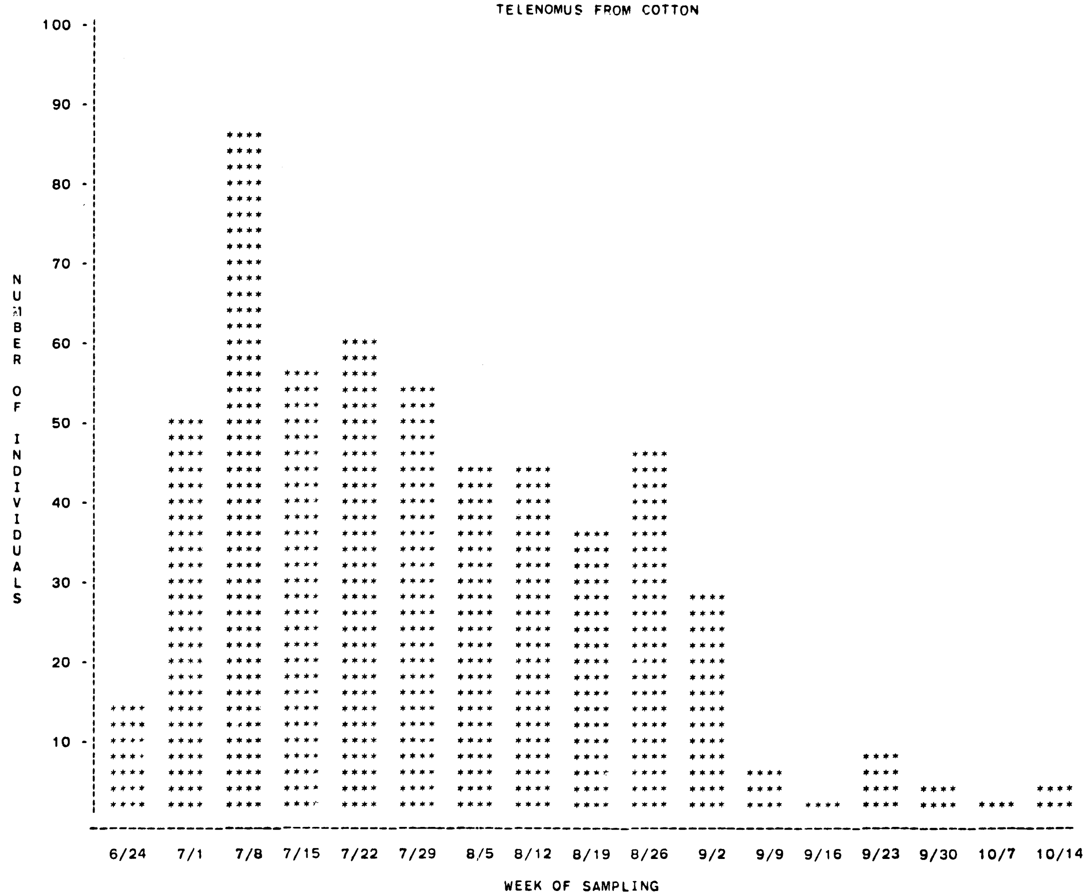


Fig. 16. Specimens of Proctotrupoidea not identified to genus taken in 1973 (week of 6/24 includes some *Telenomus* and *Trissolcus*).



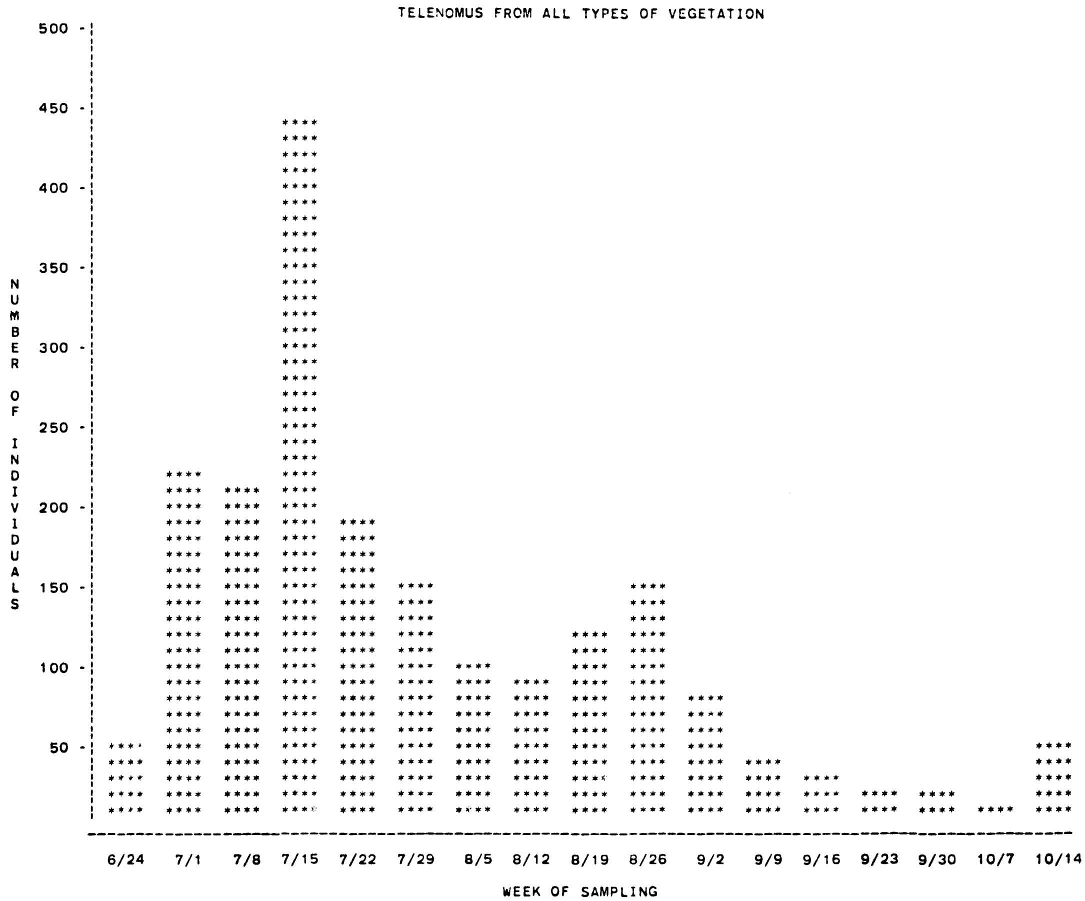
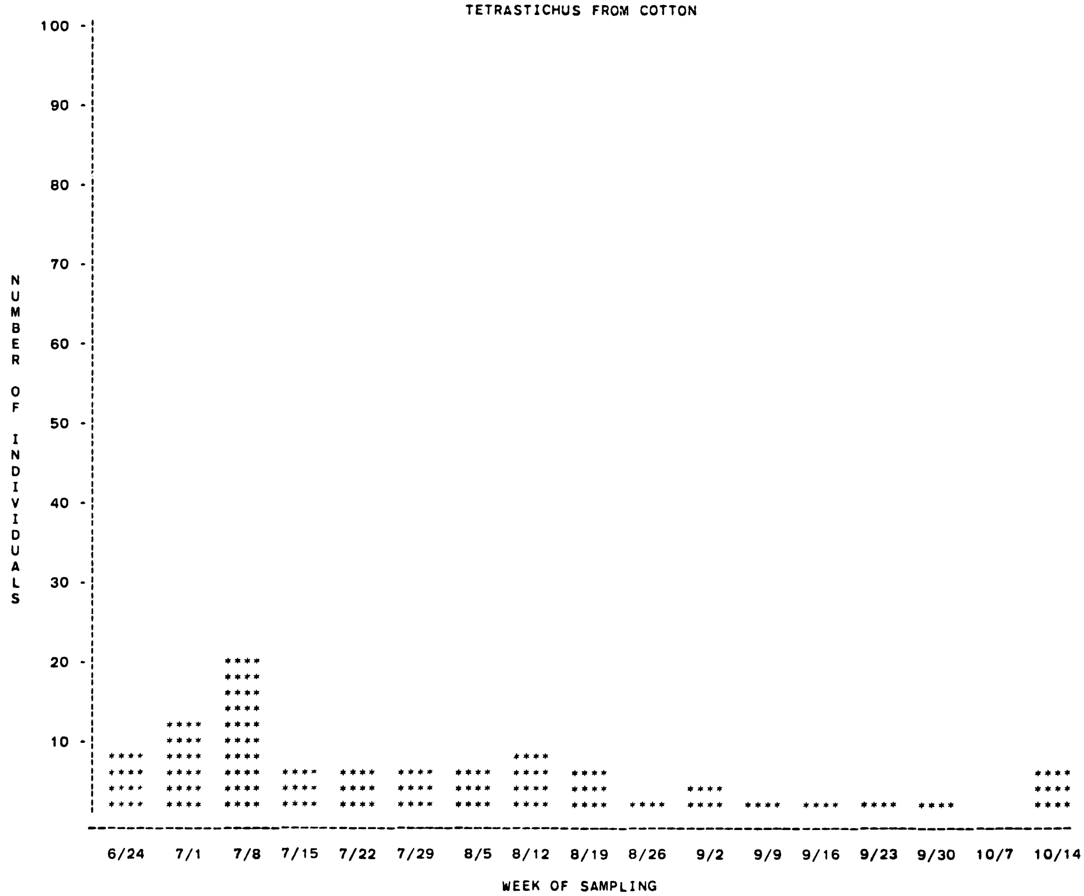


Fig. 17. Specimens of *Telenomus* taken in 1973 (Scelionidae; some specimens taken in week of 6/24 included in Prototrupoidea).



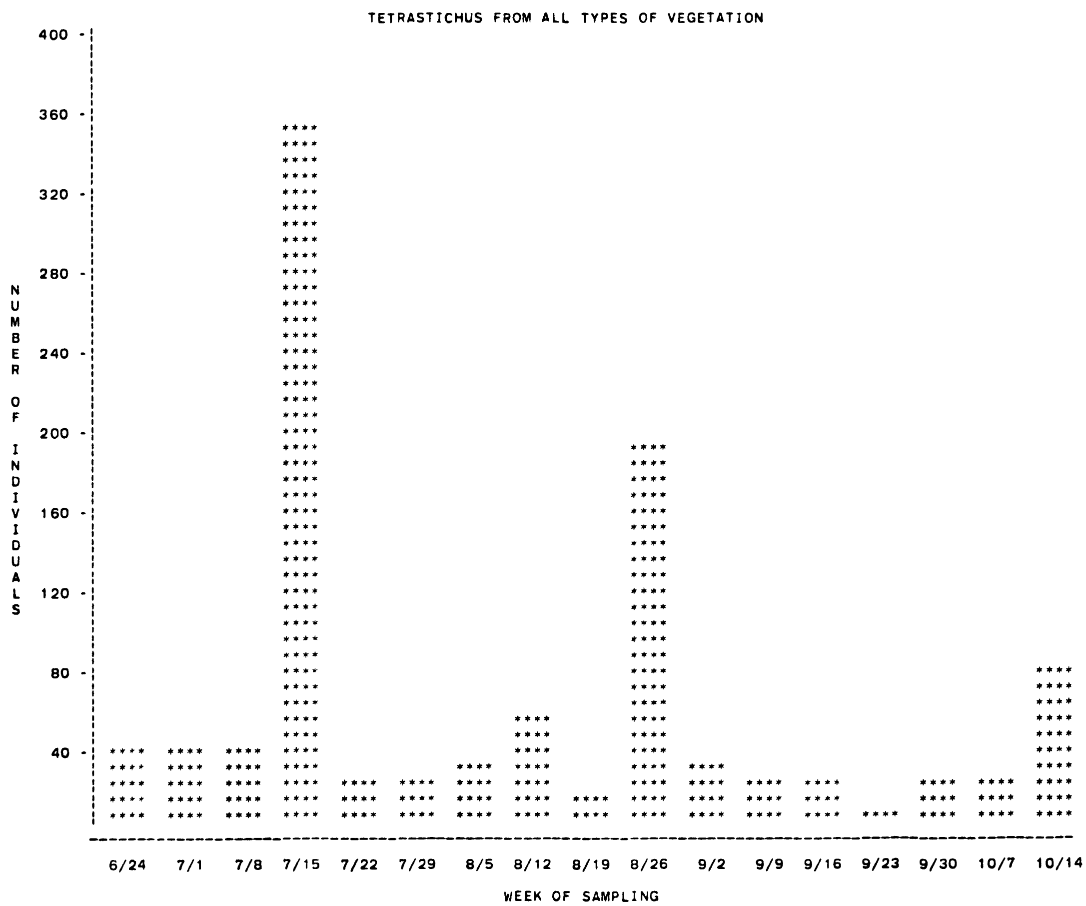
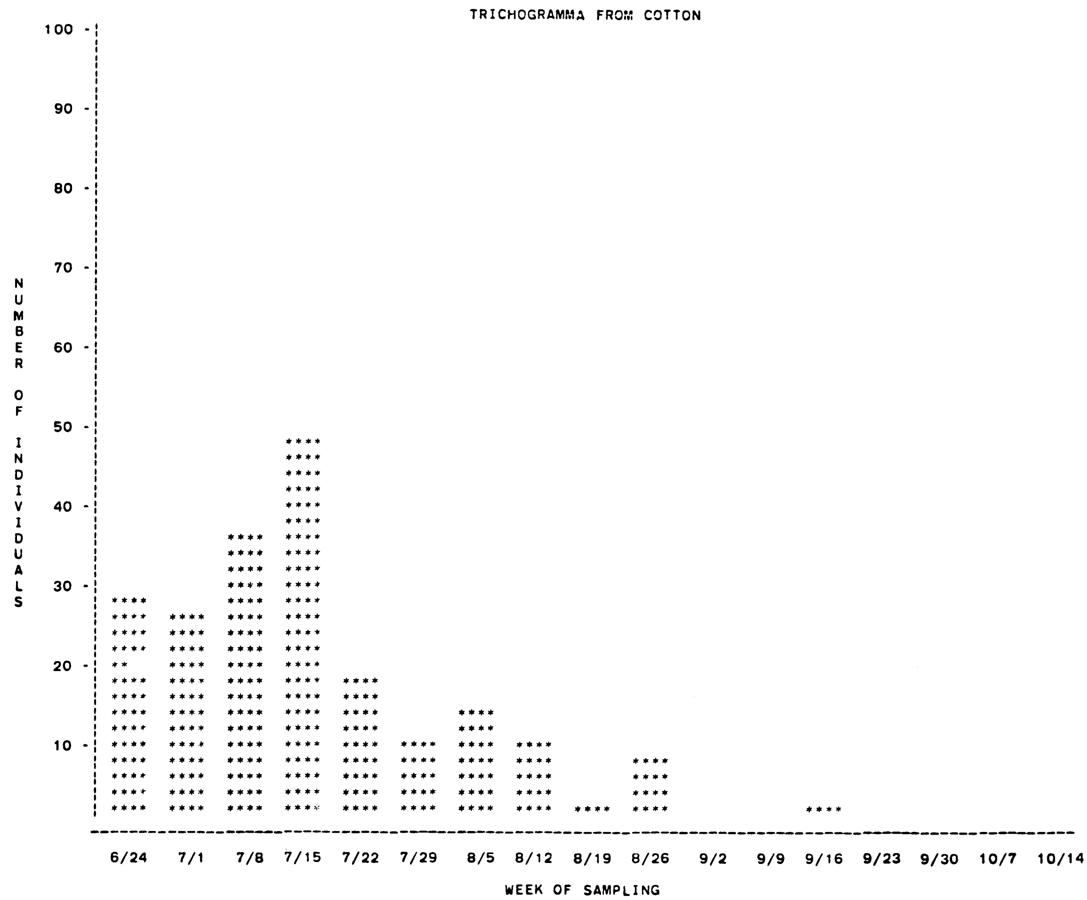


Fig. 18. Specimens of *Tetrastichus* taken in 1973 (Eulophidae).



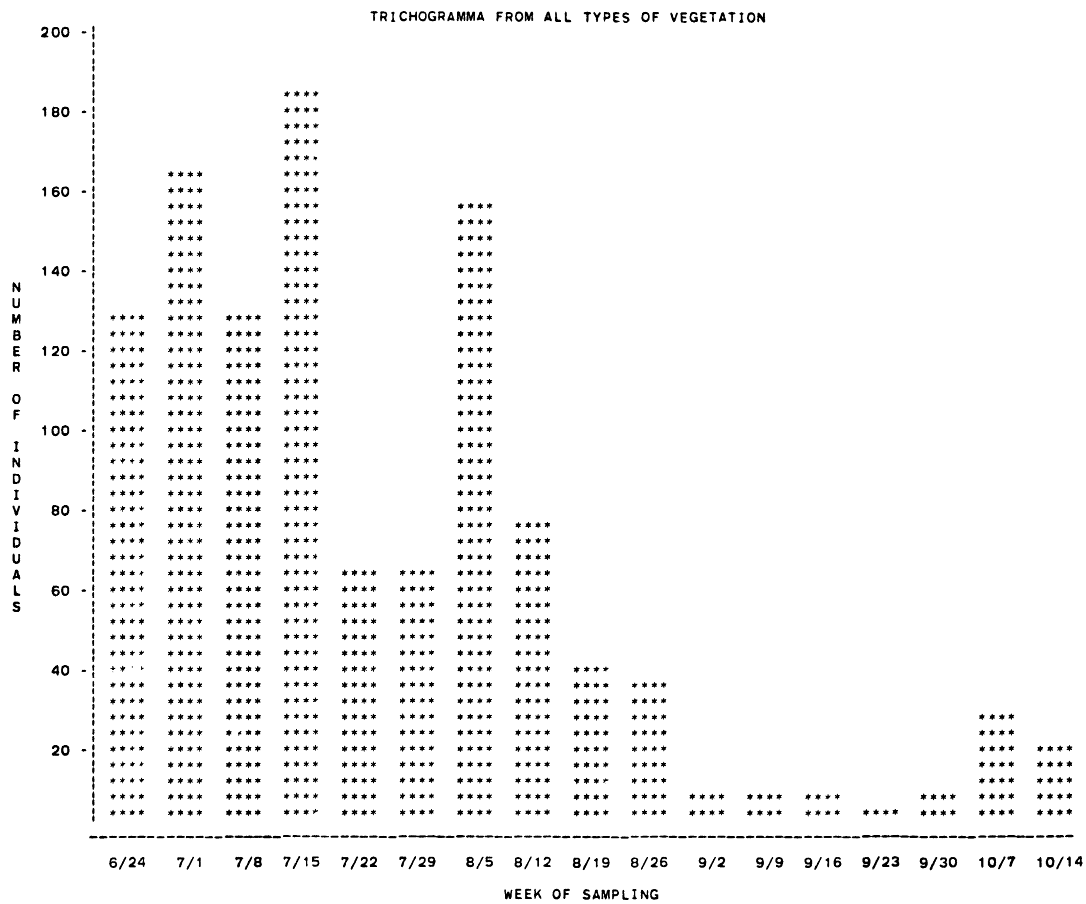
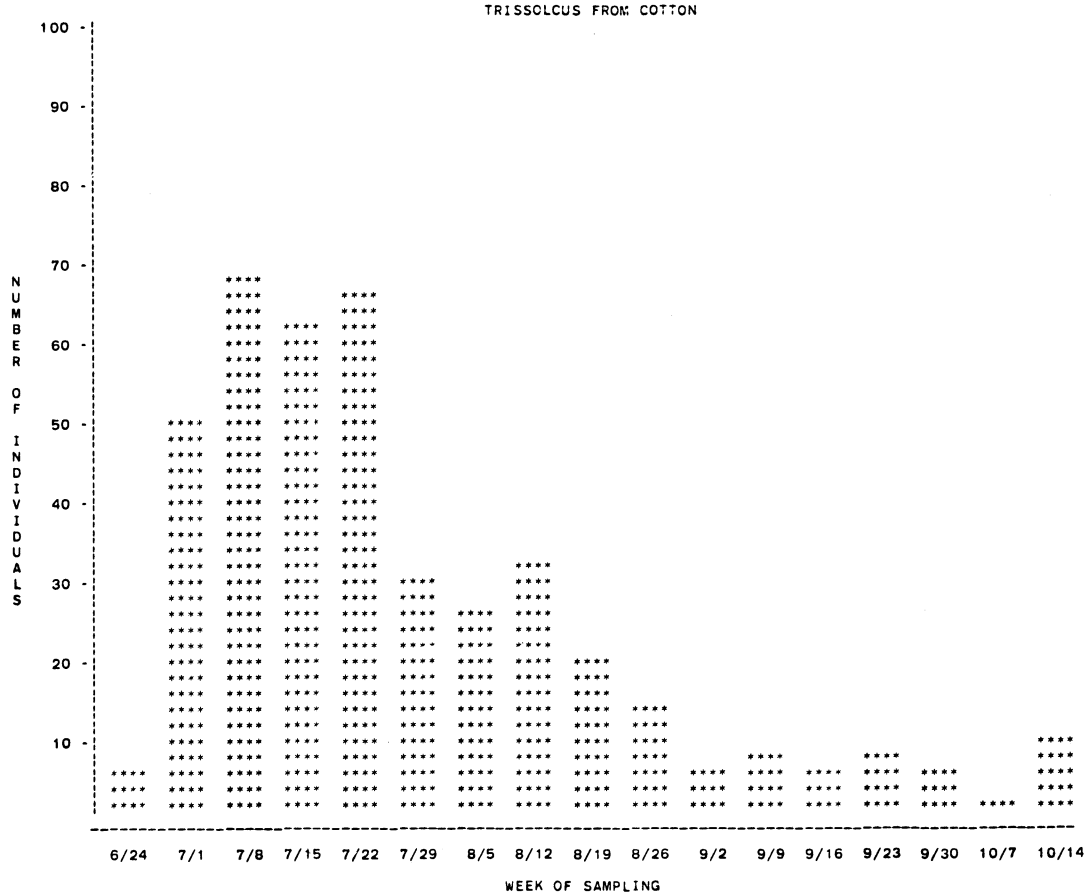


Fig. 19. Specimens of *Trichogramma* taken in 1973 (Trichogrammatidae).



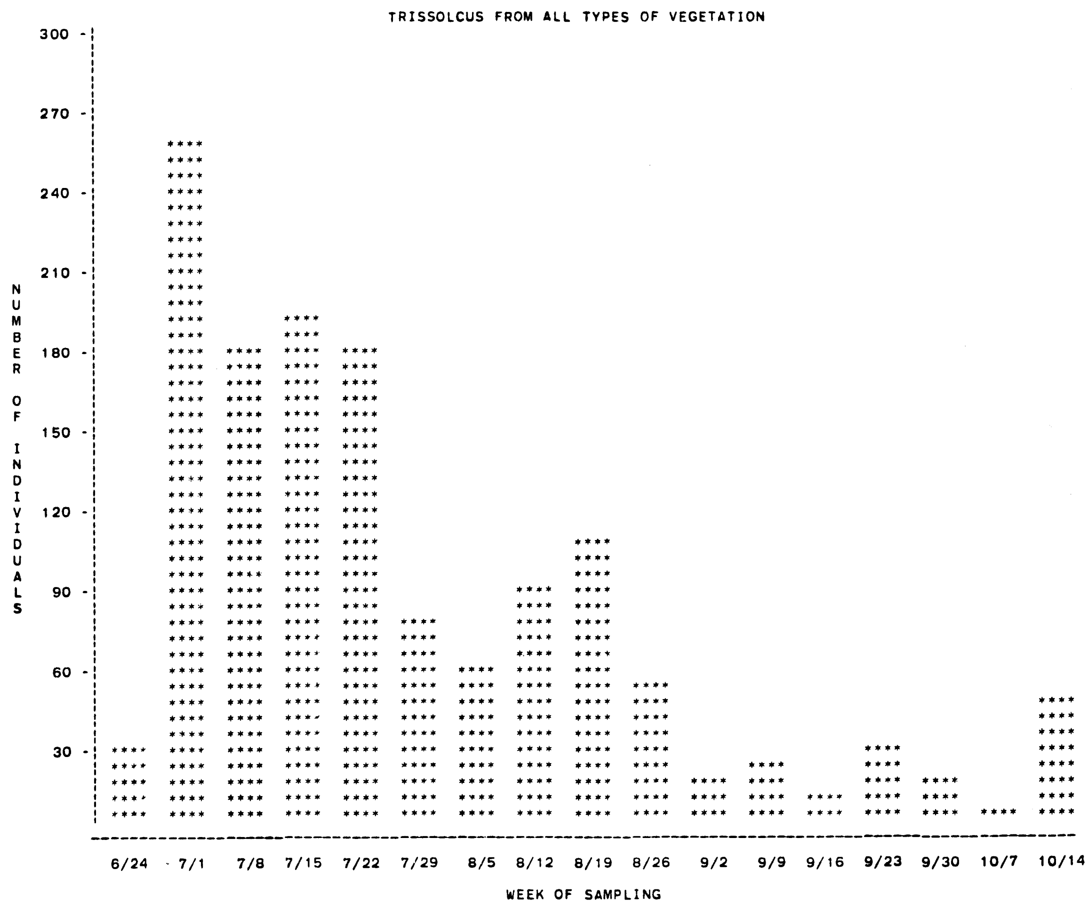


Fig. 20. Specimens of *Trissolcus* taken in 1973 (Scelionidae; some specimens taken in week of 6/24 included in Proctotrupoidea).

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