THE IMPORTANCE OF THE FENCEROW AS A SOURCE OF INFESTATION FOR CROP DAMAGING INSECTS

By

RUSSELL D. CAID

Bachelor of Science

Oklahoma Agricultural and Mechanical College

Stillwater, Oklahoma

1954

Submitted to the faculty of the Graduate School of
the Oklahoma Agricultural and Mechanical College
in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
August, 1955

THE IMPORTANCE OF THE FENCEROW AS A SOURCE

OF INFESTATION FOR CROP DAMAGING INSECTS

Thesis Approved:

F. A. Sanders
Thesis Adviser

D. R. Bryan
Member of the Thesis Committee

R. R. Walton
Member of the Thesis Committee

H. I. Featherly
Member of the Thesis Committee

D. E. Howell
Head of the Department

Robert MacVicar
Dean of the Graduate School

PREFACE

It has long been known that crop field borders or "fencerows" furnish one of the best protection areas for wildlife that exist on most farms. However, few people realize that these same borders would serve as hibernation quarters for insects that could attack adjacent growing crops the following season. Perhaps if more information was available concerning the number and kinds of insects that overwinter in such areas, farmers would have a better idea on how to work this land. Although a great number of fencerows could be tilled and kept relatively free of vegetation and trash, many could not. Most farmers do not consider it their job to till the field borders along the right of way of public roads, and in most cases it would be impossible to do so.

It was with these ideas in mind that Dr. F. A. Fenton, Professor of Entomology and Head Emeritus of the Department of Entomology, Oklahoma A. and M. College, suggested that I determine the importance of these fencerows in their relation to the overwintering arthropod population. I have attempted to determine the abundance of both the harmful and beneficial species overwintering in such situations that might have some effect on nearby crops.

I wish to express my sincere appreciation to my major advisor, Dr. F. A. Fenton, for his valuable advice and guidance throughout this study. I wish to acknowledge Drs. D. E. Howell, Professor of Entomology at Oklahoma A. and M. College, R. R. Walton, Associate Professor of Entomology and D. E. Bryan, Assistant Professor of Entomology, for their constructive criticisms on plot locations, sample size and methods; To Dr.

H. I. Featherly, Professor of Botany and Plant Pathology for grass identification; to Dr. H. C. Young, Associate Professor of Botany and Plant Pathology for soil temperature records; to Dr. W. E. Hardy, Associate Professor and Head of the Meteorology Department for rainfall and temperature records; to Miss Kellie O'Neill and E. W. Baker, U. S. D. A., Insect Identification Section, for identification of thrips and mites; to W. L. Wray, Division of Entomology, North Carolina Department of Agriculture, for identification of Collembola; C. C. Hoff, Associate Professor of Biology, University of New Mexico, for identification of pseudoscorpions; to J. H. Young, student, for indentification of ants; to Randall Furr, graduate student, for the photographs used in this thesis, to Messrs. D. E. Russell, graduate student, M. J. Owen and C. M. Wade, students, for assisting in Berlese funnel methods and sample taking.

Russell D. Caid

TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

LIST OF ILLUSTRATIONS

INTRODUCTION

The purpose of this study was to determine the species of insects and other arthropods inhabiting different types of fencerows and to ascertain their abundance at different dates during the winter.

For many years farmers have believed that some injurious insects overwinter in the relatively narrow strips of uncultivated land bordering their crop fields. On most farms these strips of land are more or less undisturbed because of the difficulty of operating modern farm machinery close to them. Most of the fencerows are allowed to grow up in grass, weeds, shrubs and trees, thus making conditions more favorable for insect hibernation. Because these fencerows are seldom tilled or cultivated they form a more or less stable habitat for insects and in addition may also serve as quarters for hibernation of certain crop-infesting species.

All of this work was carried out in the vicinity of Stillwater. All of the plots except one were located on property of Oklahoma A. and M. College. The work was begun in October, 1954 and continued until February of 1955.

Seven types of fencerow plant associations were selected for study as being fairly representative of conditions in Payne County. These were a mixture of bunch grass[1] and bermuda grass[2] located beside a grain sorghum field; bermuda grass and ragweeds[3] beside alfalfa and grain

---

[1] *Andropogon furcatus* and *A. scoparius* L.

[2] *Cynodon dactylon*. (L.)

[3] *Ambrosia arbmisiifolia* L.

sorghum; ragweeds, marestail,[4] ironweed,[5] decaying stumps and ash shrubs growing between wheat and alfalfa; cheat,[6] prairie tripleawn grass,[7] ragweeds and some scattered bunch grass growing beside a cotton field; brush, shrubs, pecan trees, and winter grasses growing beside corn; bermuda grass, (very sparse,) and puncture vines[8] growing beside wheat, and bunch grass and Johnson grass[9] growing beside wheat and oats.

---

[4] Erigeron canadensis L.

[5] Veronia baldwini Torr.

[6] Bromus secalinus L.

[7] Aristida oligonatha Mich.

[8] Tribulais terrestris L.

[9] Sorghum halepense L.

REVIEW OF THE LITERATURE

Information pertaining to fencerows as shelters for potential crop pests is very limited, however much ecological work has been done on soil inhabiting arthropods. Such information was not used in this paper because it did not specifically apply to this problem. Even with all of this information available, Bellinger (1954) states that less is known about this group of arthropods than any other. King (1939) states that soil as a habitat is relatively stable in most respects. He also states that variability of physical factors there is greatly reduced as compared with conditions above its surface. Its relatively low penetrability hampers insect movement, but nevertheless tends to afford them differential protection from enemies of all kinds, by greatly decreasing the latter's ability to make contact with their hosts.

If heavy vegetation is present, the soil is warmer in the winter and cooler in the summer, thus attracting insects in both seasons (Dowdy 1944). Such insects that utilize soil for protection performs some mechanical functions such as exposing new surface area to the weathering forces. Many arthropods also burrow into the soil, thus mixing it as well as providing waterways (Buckle 1921).

According to Ford (1937), the populations of Collembola and soil Acarina increase during the winter months when the moisture content is high. This makes them especially interesting for ecological investigation in that the curves obtained by sampling are true population growth curves reaching their maximum by the reproduction efforts of many rapidly breeding generations. Thus one is able to investigate population behavior

resulting from the cumulative effects of many generations within a period of a few months. Ford also states that most Collembola populations start to increase in October and reach peaks in November and January.

Dambach (1948), found that field borders harbor crop insect pests during both the overwintering period and the growing season. Eight insect pest species were found in shrub field borders in sufficient numbers so that they might be considered as a source of local crop infestation. These included the grape leafhopper, spring cankerworm, potato leafhopper, eggplant flea beetle, chinch bug, cornfield ant, the clover bud weevil and an unidentified pyralid which may have been a sod web-worm.[1] Four of these, the eggplant flea beetle, the clover bud weevil, the chinch bug and the pyralid larvae were present as overwintering forms. This study also revealed 17 crop pests in bluegrass borders. Of the above listed species, all were collected in large enough numbers to be potentially harmful to nearby crops.

---

[1] Scientific names not given in reference.

MATERIALS AND METHODS

Description of Plots

Bunch Grass, Bermuda Grass, Grain Sorghum Association.

This area, hereafter designated as Plot 1, was a permanent fencerow beside a sorghum field (Fig. 1). The plot extended some six to eight feet from the fence to an adjacent road and about three to four feet from the fence to the growing sorghums. The part of the fencerow inside the field was somewhat higher than the adjacent land due to cultivation methods.

Although the area was approximately one-quarter of a mile long, only one hundred yards was used for sampling. The ground had a gentle slope towards the north, although no ditch was present for water runoff. Terraces were run from the fence generally northeastward and emptied at the far side of the field (Fig. 2). The land was a sandy loam type and the vegetation that grew on it was bunch grass, scattered bermuda grass and winter grass.[1] No trees or shrubs of any kind grew along this fencerow.

Grain sorghum grew directly to the west of the fencerow. The stubble remaining at the time the first samples were taken was from six to fifteen inches high. Part of this stubble was plowed under late in October; however the part next to the sampling area was not disturbed until late February, when the remaining land was plowed. The sampling area was not disturbed by this operation.

---

[1] So-called because it was green and appeared to be growing.

Bermuda Grass, Grain Sorghum, Alfalfa Association.

This area, hereafter designated as Plot 2, was a narrow strip of land from a road to a fence which was next to an alfalfa and sorghum field (Figs. 1, 3). The tilled ground was somewhat lower than the fencerow proper. This plot extended some 150 yards to the corner of the field and was about 10 feet wide. A shallow ditch ran through the center of the plot.

The predominating grass was bermuda, and the stand was so thick that it had choked out most of the other vegetation, although a few ragweeds were scattered about. One large bur oak[1] tree was located about mid-way in the plot, and its leaves were scattered along the fencerows.

The soil was a clay, light in color and tended to be very compact. Barnyard manure had been applied in heavy quantities to the soil soon after this project was started; however no samples were taken directly on the manured soil.

The dividing line separating the alfalfa and sorghum fields was situated about half-way down the fencerow area being studied (Fig. 3). The alfalfa field was three or four years old according to the general appearance and development of the plants. Only one crop of hay had been cut from this field in 1954; however, the rains in September revived it somewhat and some growth was made before frost. There was an old straw stack on one side of the field, but this was not believed to have influenced insect numbers, as it was about 50 yards from the fencerow.

Ragweed, Marestail, Shrub, Wheat, Alfalfa Association.

This area, hereafter designated as Plot 3, was a typical fencerow

---

[1] Quercus macrocarpa Mich.

between two fields (Figs. 1, 4). There were some tree stumps and a few small shrubs growing in the area. Some ragweeds, marestail weeds and a few sunflowers also grew here. The fencerow itself was from ten to twelve feet in width and close to one-half mile in length. The soil was somewhat dark and sticky when wet. At each end of the area there was a small but dense woodland of oak[1] trees. The fencerow ran north and south and the lands sloped gently toward the north. These was an alfalfa field on the west and a wheat field on the east. The alfalfa had been growing for several years, but the drouth of 1954 severely reduced the stand and reseeding was required in February of 1955.

Many of the fencerows north and west of Stillwater are similar to this one in that some trees and shrubbery usually grow near the fences in the bottom land (Fig. 4). This particular fencerow had quite a few fallen decaying tree limbs where small bushes had been cleared away.

Brush, Shrub, Winter Grass, Corn Association.

This area, hereafter known as Plot 4, was typical of many of the fencerows near Stillwater in that it joined a wooded area and had considerable brush growing in it (Figs. 1, 5). There were several trees growing nearby and their leaves had been shed on the area for many years previously, making the soil rich in organic matter. The vegetation growing here was mainly small elm shrubs[2], sumac bushes[3], and a few ash shrubs[4]

---

[1] Bur oak Quercus macrocarpa Mich.

[2] Ulmus floridana Chapman

[3] Rhus copallina L.

[4] Fraxinus sambucifolia Lambert

along with a good stand of winter grass.

Because of the large amounts of organic matter present the soil was very loose and well aeriated. The soil was black and sticky when wet. There were several large pecan trees[1] growing nearby and this could have affected the types of some forms collected. Corn was growing beside this area, although it was plowed under sometime in late December after the project had been started. The lack of rain in the summer adversely affected the condition of the corn and little insect trouble occurred.

This fencerow was cleared of the brush in January, but it is doubtful whether or not this had any effect on the overwintering forms present. The ground itself was not disturbed and only the brush and shrubs were removed.

Cheat, Prairie Tripleawn Grass, Ragweed, Cotton Association.

This area, hereafter designated as Plot 5, was a fencerow seventy-five yards from Highway 51 (Fig. 1, 6). The vegetation was made up mainly of ragweeds, prairie tripleawn, cheat, and some scattered bunch grass. The grass had been mowed by the highway department late in fall and the clipped vegetation formed a mat-like effect on the area.

Cotton was grown adjacent to this area. Because of the extreme drouth there were few insects of importance in cotton in 1954. This undoubtedly had an important bearing on the numbers and species of insects collected in this fencerow.

---

[1] *Hicoria texana* LeConte.

Bermuda Grass, Puncture Vine, Wheat Association.

This area, hereafter designated as Plot 6, was a relatively cleanly tilled fencerow between wheat and a narrow road through the Agronomy Farm (Figs. 1, 7). The fencerow was rather narrow, and the sparse vegetation present consisted mainly of puncture vines and a small amount of bermuda grass. This particular one was typical of the cleanly tilled fencerows of this area. The soil was part clay and very sticky when damp. The land sloped gently toward the west, but not enough to wash gullies in the field. The ground on the outside of the fence had been worked at the same time the wheat was planted, although the vegetation was not turned under.

Wheat grew on the south side of this area, and was used as an experimental grazing plot by the Animal Husbandry Department. The field was divided into several small plots and one Hereford steer was permitted to graze on each. The lack of moisture in the fall kept the wheat from making a normal growth when first planted.

Bunch Grass, Johnson Grass, Wheat, Oat Association.

This area, hereafter known as Plot 7, was located approximately two miles west of the Agronomy Farm. It was bounded on one side by a public road and on the other by a mixture of oats and wheat (Figs. 1, 8).

The area was some thirty yards wide and had an almost solid stand of Johnson grass and bunch grass. The grass had made a growth of six inches to two and one-half feet. It had fallen down and formed a thick carpet on the ground. The soil was very black and sticky and hard to handle when wet.

This plot was in a wooded swag near Stillwater Creek, although no trees or shrubs grew in the area proper. Water had a tendency to stand

in a ditch near the area after a rain, but drained off the plot itself.

This area was typical of many miles of fencerows in the vicinity of Stillwater both northwest and southeast and especially in the bottom or lower lands. This type of fencerow is never disturbed or mowed. At times, however, it may be burned over either accidentally or purposely by the owner. This particular plot did not appear to have been burned off in many years.

COLLECTING METHODS

Sampling.

The soil sampler consisted of a rigid rectangular metal frame 12 inches long, 6 inches wide and 6 inches high, with the bottom edge sharpened. When in position, this sampler covered a surface area of one-half square foot. It was forced into the soil to a depth of approximately 4 inches. All vegetation, surface trash and soil to a depth of 3 inches was removed. Ten samples were taken at random from each location within the area. Samples were taken both from the inside of the fencerow next to the crop, and from the outside of the fence away from the crop. Each sample was carefully placed in a paper sack and carried directly to the Berlese funnels where they were processed for later examination.

Berlese Funnel Procedure.

Berlese funnels were of the standard 12-inch type. Each funnel had a one-half inch mesh screen at the top of the cone on which to place the sample. One 300-watt electric light bulb was used in each funnel which was covered with a lid after the sample was in place.

The arthropods were trapped in one-half pint jars screwed to the bottom of each funnel. The method used was a modification of the one Dambach used in his work in Ohio (Dambach 1948). Ordinary paper plates were placed in the funnels to hold most of the sample. A 4-inch hole cut in the center of each plate prevented all but a small amount of soil from falling into the collecting jars, and at the same time allowed the living arthropods forced out of the sampler by the heat, to escape downward where they were trapped and preserved by the alcohol.

At first, samples were left in the funnels from 12 to 15 hours, but after the first tests it was found that this was not necessary. Studies showed that there was no difference in the numbers of arthropods collected from samples left in the funnel 15 hours and those left in from 4 to 6 hours. The organisms were caught in a small amount of 50 per cent alcohol.

Examination Methods.

The jars containing the specimens recovered from the Berlese funnels were taken to the laboratory for processing. This consisted of pouring the contents into a petri dish, the bottom of which was marked off into grids to facilitate counting. Each collection was then examined under low magnification[1] by means of a stereoscopic microscope. All species seen were recorded as well as their total numbers.

The identification of all species would have required access to literature on the subject as well as considerable training in specialized fields. Also the time required on the above would have reduced

---

[1] 15x magnification.

considerably the number of samples taken. It was, therefore, necessary to make generalized classifications in many instances and to rely on later determinations by specialists. As an example, the soil mites collected have been identified by Dr. E. W. Baker. However, at the time of examination they were classed as "hard shelled" or "soft shelled." By "hard shelled" is meant those species with a definite hard, shell-like covering over the body. Most of these are known to be predatory; however, this does not always hold true.

Figure 1. Plot locations in the Stillwater and Cherokee townships.
Payne County, Stillwater, Oklahoma.

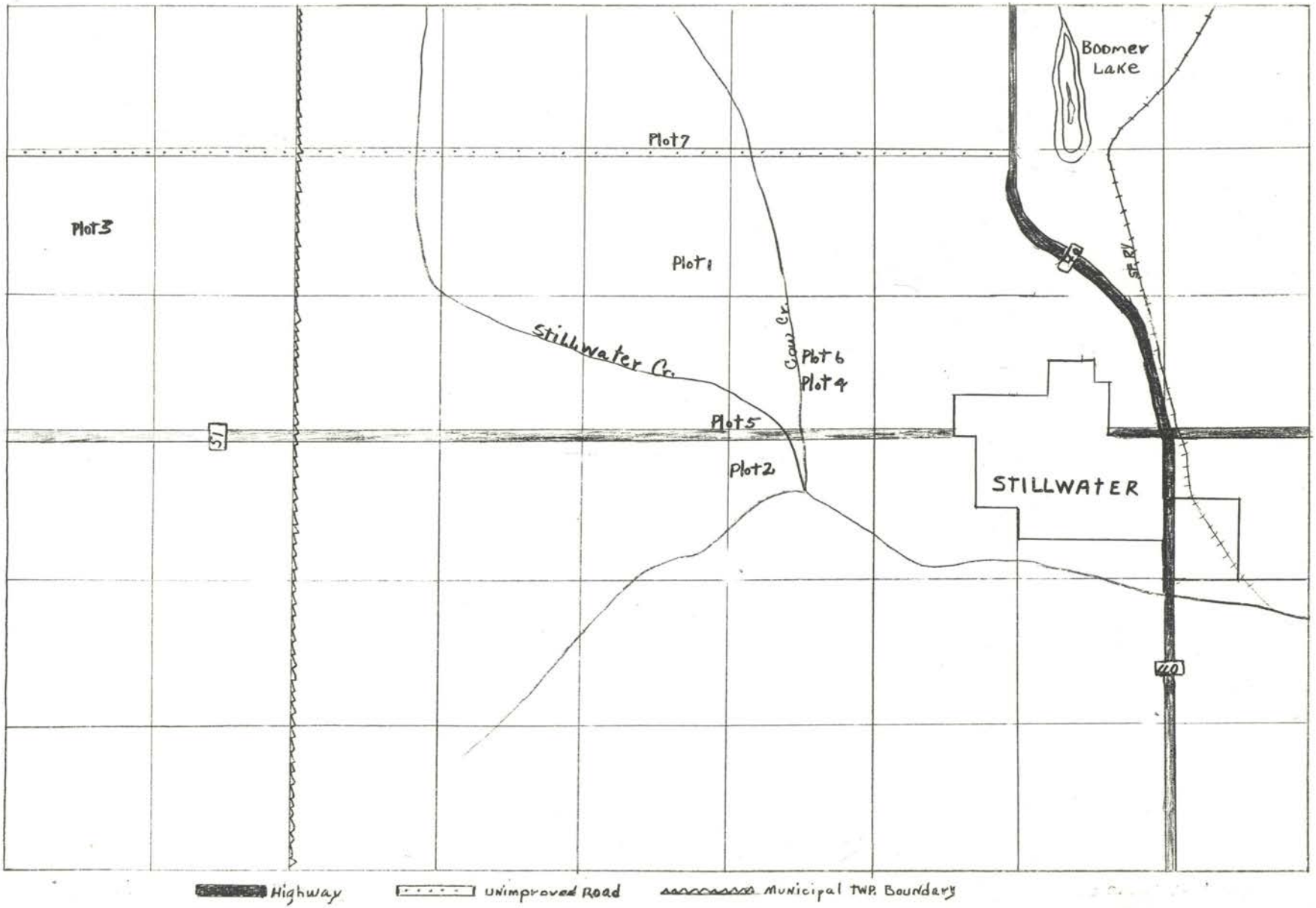

Figure 2. Bunch Grass, Bermuda Grass, Grain Sorghum Association

Figure 3. Bermuda Grass, Grain Sorghum, Alfalfa Association

Figure 4. Ragweed, Marestail, Shrub, Wheat, Alfalfa Association

Figure 5. Brush, Shrubs, Winter Grass, Corn Association

Figure 6. Cheat, Prairie Tripleawn Grass, Cotton Association

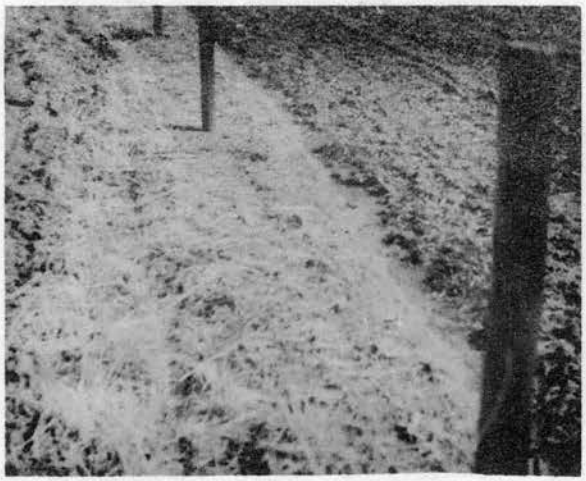

Figure 7. Bermuda Grass, Puncture Vine, Wheat Association

Figure 8. Bunch Grass, Johnson Grass, Wheat. Oat Association

THE ARTHROPOD FAUNA OF FENCEROWS

Plot 1--Bermuda Grass-Bunch Grass Fencerow

Plot 1, in addition to being a regular sampling area, was also used as a check for the other plots sampled at the same time. On only one date, December 1, was it possible to take samples from all plots. On the other five dates, samples were taken from two plots along with a sample from this plot for comparison. This plot was sampled on the following dates: October 22, 29, November 3, December 1, January 28, and February 8.

Harmful Species

Blissus leucopterus (Say): This species was collected in greatest numbers of any of the pest species. This was expected since this plot was adjacent to a sorghum field, this crop being one of its favorite host plants. This particular plot was probably the most suitable for overwintering because of the large number of bunch grass clumps present. Each collection had some chinch bugs present, the range being from 10 collected November 3 to 108 collected December 1. The average was 41 per date of collection. This species represented 6.6 per cent of the total population of all samples studied.

Cicadellidae: Leafhoppers composed a very insignificant part of the collection in Plot 1 (Table 1). Only seventeen individuals were picked up during the course of the collections and many of these were nymphs.

Most of the nymphs and adults were Aceratagallia uhleri (Van Duzee); however, one other species did occur but this has not yet been identified.

Thysanoptera: Thrips also occurred in small numbers, the peak being reached December 1 when 54 were collected. They comprised a little over 2 per cent of the total collections in Plot 1 (Table 1). Thrips, like many other insects, are widespread and may be collected wherever there is protection from severe weather conditions. Most fencerows offer excellent examples of this, thus becoming important hibernation areas. Most of the species collected belonged to the family Thripidae, and to the genus Frankliniella. The following species were collected: Frankliniella fusca (Hinds), Frankliniella exigua Hood, Frankliniella occidentalis (Perg.), two species of Leptogastrothrips and a nymph of Phlaeothripidae.

Curculionidae: These insects were collected in very low numbers, and it is doubtful whether or not they were attracted to the growing crop alongside this fencerow. They were more than likely taking advantage of the protection afforded by the fencerow as very few such insects attack sorghums while they are growing. There were several species represented, the only species which could tentatively be considered as a potential crop pest being one of the so-called billbugs (Calendra parvula Gyll). Many other members of the genus Calendra were collected along with Hypera punctata (Fab.).

Lepidoptera: The lepidoptera were represented by larvae, which made up less than one per cent of the total collection in the plot (Table 1). As far as identification was possible, most of them appeared to be cutworms and armyworms. These two groups are known to attack sorghums and many other crops in the grass family. Agrotis orthogonia Morr. and Peridroma margaritosa Hub. were collected in the greatest numbers.

Aphididae: Root aphids were practically all collected December 1. The numbers ran from 7 to 64. Since most were collected from bunch grass it appears that they infest this pasture grass. The species collected proved to be immature forms of the genus Amoecia.

Beneficial Species.

"Hard Shelled" Acarina: These mites were collected in larger numbers than any other group in the beneficial category. They feed on other mites and small insects, but it is extremely doubtful whether they disturb any drop-infesting insects. The largest number collected was on October 29; however, all collections had some in them. They comprised 9.1 per cent of the total collection in Plot 1. Representatives of the following families were collected: Galumnidae, Galumna sp.; Laelaspid sp.; Phthiracaridae, Pseudotritia sp.; and Camidiidae, Nothrus sp.

Araneidae: The spiders were probably of more economic value than any other beneficial species collected, although they were not picked up in large numbers. Some were collected on each sampling date. The smallest number occurred on October 22, the first collection date, and the largest number were collected November 3. Since spiders are all predatory, it was not necessary to have them identified for the purposes of this study.

Formicidae: The ants collected are listed under the beneficial group. This might be debatable by some, but the species collected are not considered to be harmful. The species collected were as follows: Cremastogaster lineolate Magr., Dorymyrex pyramicus (Roger), Pheidole bicarinata Magr., Pheidole sp., Prenolepis imparis (Say), and Solenopsis texana Wheeler.

Carabidae: The ground beetles were the second largest in numbers collected and comprised some 5.4 per cent of the total collections (Table 1). They are probably second in importance to the spiders so far as beneficial arthropods are concerned. They were mostly small in size and difficult to classify. The following were identified: Calathus sp., Chlaenius tomentosus (Say), Dicaeius sp., Harpalus pennsylvanicus De. G., Harpalus sp., Tachyura sp. (Dej.), Casnonia pennsylvania L., Stenolophus ochropezus (Say).

Scavenger Species.

Collembola: The Collembola made up about 77 per cent of this group and 46.3 per cent of the totals (Table 1). They were found generally in large numbers in all collections. The smallest number were collected December 1 and the largest February 8. The same species were generally picked up in all areas as might be expected since Collembola are found in most moist places and under debris of all sorts. The following species were recorded: Family: Entomobryidae, Drepanocyrtus sp., Entomobrya multifasciata Jullberg, Entomobrya pseudoperpulchra Mills., and Orchesella ainsliei Folsom. Family Isotomidae, Proisotama aguae Bacon, Isotoma trispinata MacG, and Isotoma viridis Bourlet. Family Onychiuridae, Onychiurus armatus Tallberg. Family Poduridae, Achorutes armatus Nicolet, and Achorutes humi Fols, and Brachystomella sp. Family Sminthuridae, Neosminthurus curvisetis Guthrie, Sminthurus pumulis Kruusbauer, and Sminthurus facialis Banks. Only one species of this group is of any economic importance, namely Entomobrya multifasciata Jullberg, reported as a household pest.

"Soft Shelled" Acarina: The "soft shelled" Acarina or mites were collected in the second largest number. They were comparatively few in numbers in all collections except on December 1, when 322 were collected for ten one-half square feet samples. The following families were represented: Raphignathidae, Raphignathus sp.; Ascaidae, Bdellidae, and Eupodidae, Penthaleus major.

Staphylinidae: This family is not of much economic importance although it is commonly found in most debris and many other places. Some staphylinids are known to be predatory but most species are scavengers and are attracted to decaying vegetable or animal matter. Those most commonly collected were Mycetoporus sp. and Stenus sp.

Psocidae are common on or in weeds and grasses, especially on wheat straw. These insects were collected in small numbers and were tentatively identified as Psocus striatus Walker.

Discussion.

The Collembola made up about 46 per cent of the arthropods collected in this plot which is not surprising because under favorable conditions this order is well represented in trash and surface litter. The scavengers made up 58 per cent of the total collection in Plot 1, while the beneficial arthropods represented 22 per cent and the harmful ones only 20 per cent of the total (Fig 9). The insects that are classified as beneficial were not capable of preying on the crop species and reducing their numbers greatly, with the exception of the spiders. This fencerow was extremely favorable for the overwintering of chinch bugs, therefore, this insect comprised the largest percentage of the harmful group.

Table 1. Seasonal distribution and comparative abundance of arthropods collected in bermuda grass, bunch grass, fencerow, 1954-55.

Arthropods[1]	Number collected						Total collection	Average per collection	Per cent of total
	Oct.22	Oct.29	Nov.3	Dec.1	Jan.28	Feb.8			
"Soft-shelled"									
Acarina	10	44	15	322	27	49	467	77.9	12.5
"Hard-shelled"									
Acarina	21	100	80	62	17	60	340	56.0	9.12
Araneida	5	15	22	13	14	16	85	14.0	2.27
Chilopoda	0	0	1	0	2	4	7	1.1	[2]
Isopoda	0	0	0	1	0	0	1	--	
Collembola	78	268	198	13	533	638	1728	288	46.3
Formicidae	55	28	26	71	1	8	189	31.5	5.0
Hymenoptera	0	0	0	1	0	0	1	--	
Carabidae	11	27	60	46	27	31	202	33.6	5.42
Staphylinidae	0	15	7	0	7	3	32	5.3	.88
Dermestidae[3]	0	0	1	0	0	0	1	--	
Curculionidae	1	1	4	3	1	3	13	2	
Blissus leucopterus	39	36	10	108	34	19	246	41	6.6
Jalysus spinosus	1	0	0	0	0	0	1	1	
Cydnidae	0	0	0	1	2	1	4	1	
Thysanoptera	4	10	9	54	4	6	87	14.5	2.36
Lepidoptera[4]	1	0	0	0	0	0	1	--	
Lepidoptera	0	16	3	6	0	0	25	4	

Table 1 Con't.

Arthropods[1]	Number collected						Total collection	Average per collection	Per cent of total
	Oct.22	Oct.29	Nov.3	Dec.1	Jan.28	Feb.8			
Anoecia sp	0	0	0	203	1	0	204	34	5.42
Cicadellidae	1	1	2	5	0	8	17	3	
Parcoblatta sp	0	0	0	0	2	0	2	1	
Chloropidae	0	0	0	0	0	1	1	1	
Psocidae	0	16	3	6	0	1	25	4	0.64

[1]See text for more detailed classifications

[2]In this and subsequent tables where the per cent was less than 1 it was not included.

[3]Indicates immature forms.

[4]Indicates immature forms.

Plot 2--Bermuda Grass-Ragweed Fencerow

Harmful Species.

The total number of arthropods collected in Plot 2 was the lowest of any of the seven plots. As was stated before, this fencerow consisted mainly of bermuda grass and was by a field of alfalfa and sorghum. It is interesting to note the number of chinch bugs that were collected here as compared with Plot 1, for comparable dates. Although both plots were adjacent to sorghum fields, Plot 1 had over twice as many as Plot 2 on comparable dates of sampling. The chinch bugs in this plot comprised 74 per cent of the total harmful species (Table 2). The greatest number were collected October 22. The sorghum had been cut and hauled out several weeks before this collection was made.

The other harmful insects such as weevils, root aphids, thrips, click beetles and two species of lepidopterous larvae, were collected in very small numbers.[1] All root aphids were picked up December 1, the same date as those in Plot 1. The only species of thrips found in this plot was Frankliniella fusca (Hinds) and these were very scarce.

Beneficial Species.

The "hard shelled" Acarina made up 83 per cent of the beneficial group and 19.7 per cent of the entire collection in Plot 2 (Table 2). There were several species of these mites. This group of mites, like many of the other arthropods, reached its peak of abundance December 1.

---

[1] Essentially the same species as those in Plot 1.

There were fewer spiders in this plot than in any of the others. Some were collected on each sampling date, but the average was only 4 per five square feet of surface area of soil. The carabids were the only other beneficial forms collected in sufficient number to mention here.

Scavenger Species.

The "soft shelled" Acarina made up 45 per cent of the scavenger population in this plot. They were as numerous here as in any other plot with the exception of Plot 1. The Collembola were collected in greatest numbers and formed 54 per cent of the scavenger species and 34 per cent of the entire collection (Table 2). The numbers were rather small on the first collection date, but increased rapidly during the rest of the collections. The highest numbers were collected January 28, the last collection for this fencerow.

Discussion.

The chinch bugs were the only harmful arthropods collected in large numbers and composed 5.7 per cent of the total collection in this plot (Fig 9). The mites and Collembola made up 83 per cent. The coleopterous larvae were immature ground beetles. Very few were collected. Many other species were collected, but usually only 1 or 2 to a species. The stilt bug, J. spinosus and a dermestid larva are in this category.

Table 2. Seasonal distribution and comparative abundance of arthropods collected in bermuda grass, ragweed fencerow, 1954-1955

Arthropods	Number collected			Total collected	Average per collection	Per cent of total
	Oct. 22	Dec. 1	Jan. 28			
"Soft shell"						
Acarina	11	346	43	400	133	30.0
"Hard Shell"						
Acarina	60	181	21	262	87	19.7
Araneida	7	4	2	13	4	
Chilopoda	1	0	0	1	1	
Isopoda	0	6	0	6	2	
Chernetidea	0	5	0	5	1	
Collembola	43	179	234	456	152	34.0
Formicidae	7	18	0	25	8	1.9
Carabidae	12	13	6	31	10	2.3
Curculionidae	1	1	3	5	1	
Staphylinidae	0	0	1	1	1	
Elateridae	0	1	0	1	1	
Coleoptera[1]	0	4	3	7	2	
Cydnidae	0	1	0	1	1	
Blissus leucopterus	54	10	13	77	25	5.7
Thysanoptera	0	4	1	5	1	
Lepidoptera[2]	0	0	2	2	1	
Psocidae	0	15	1	16	5	1.2
Amoecia sp.	0	11	1	12	4	
Cicadellidae	2	0	0	2	1	
Lygus pratensis	1	0	0	1	1	
Gryllidae	1	0	0	1	1	
Chloropidae	5	0	0	5	1	

[1]Indicates immature forms.

[2]Indicates immature forms.

Plot 3--Ragweed-Marestail-Oak-Ash Fencerow

Harmful Species.

Root aphid nymphs were collected in the largest numbers of any pest species. In most of the other plots this species was collected in the largest number December 1; here, however, most were collected January 28. Thrips were the next most abundant pest species collected and comprised 20 per cent of the entire harmful group (Table 3). This was the highest number recorded in any of the seven plots except the check. The lepidopterous larvae were more numerous in this plot than in any others. Most of these larvae were noctuids and pyralids, many of which could not be classified.

The chinch bugs were scarce in this fencerow due to the lack of bunch grass and sorghums growing nearby. Many small Diptera of the family Chloropidae were picked up in this fencerow. It is well known that they can be collected in alfalfa fields in large numbers in the fall of the year. They are known to overwinter in dead grass and at least two species of this group are known to attack wheat. They are Meromyza americana Fitch and Oscinella frit (Linn). Several of these species were picked up. Collections by the writer in alfalfa showed a high population of chloropids in this particular alfalfa field in the fall of 1954. More click beetles were picked up in this plot than in any other. Most were found October 22 in the first collection. It is siginifcant that they failed to appear in soil samples taken to a depth to 6 inches in the alfalfa in late November.

The other four species of harmful insects, the clover leaf weevil,[1] leafhoppers,[2] spotted cucumber beetles[3] and miscellaneous weevils were collected in very small numbers. All of these are known to spend much of the summer in alfalfa fields, but are not first rank pests. Spotted cucumber beetles were very numerous in the alfalfa during collections made by the writer in the same fall, but only one beetle was taken from any of the other plots.

Beneficial Species.

The beneficial arthropods of this plot were by far the largest group as far as numbers of individuals were concerned. The "hard shelled" Acarina alone comprised 50 per cent of the entire collection. These were essentially the same species as those collected in the other plots. The collection made on January 28 had more in it than the other two combined. A possible reason for this was 3 days of fairly warm weather prior to the collection date (Table 8). According to Ford (1937), Acarina may build up by the cumulative effects of many generations within a period of a few months. However, the population was very high on the first collection, October 22 (Table 3), then declined sharply on December 1, and reached its peak on January 28. This would seem to disagree with Ford's theory. The atmospheric and soil temperatures were much higher on December 1 than on January 28 (Tables 8, 9), but it might have been possible for

---

[1] Hypera punctata (Fabr.).

[2] Mostly Aceratagallia uhleri (Van Duzee).

[3] Diabrotica Undecimpunctata howardi Barb..

the population on December 1 to have produced at least two generations by January 28.

Ths spiders were also more numerous in this plot than in any of the others with the exception of the check. Probably the reason for this is due to the attraction to the insects in the alfalfa. Sweeps made in this alfalfa field in the fall of 1954 showed fairly large numbers of them. The ants occurred in about the same numbers in this plot as in the others. However, the ground beetles were considerably more numerous.

Scavenger Species.

The Collembola made up the largest portion of this group. The highest numbers were collected January 28, and the lowest numbers December 1. The "soft shelled" Acarina were taken in next to the largest number, most being collected December 1. Pill bugs were far more abundant in this plot than in any of the others, possibly because there was more decaying matter here than in any of the other plots (Table 3). The Staphylinidae were very abundant here, but the same species as collected elsewhere.

Discussion.

Plot 3 had more species represented than any other plot, though not as large a population as some of the others. It had the highest numbers of "hard shelled" Acarina, spiders, Carabidae, Chloropidae, Isopoda, and Elateridae. There was a considerable amount of decaying wood and tree limbs. This fencerow had not been disturbed for several seasons. There are many insects attracted to alfalfa and this might affect the number collected here. (See Figure 9 for comparison of the beneficial, harmful and scavenger groups.)

Table 3. Seasonal distribution and comparative abundance of arthropods collected in ragweed, marestail, ironweed fencerow, 1954-1955.

Arthropods	Number collected			Total collected	Average per collection	Per cent of total
	Oct. 22	Dec. 1	Jan. 28			
"Soft shelled"						
Acarina	97	136	62	295	98	10.6
"Hard shelled"						
Acarina	500	138	766	1404	468	50.6
Araneida	14	8	5	27	9	
Chilopoda	0	0	1	1	1	
Isopoda	58	19	8	85	28	3.06
Collembola	106	22	327	455	151	16.4
Formicidae	23	0	0	23	7	
Hymenoptera	1	0	0	1	1	
Carabidae	9	71	140	220	73	7.8
Curculionidae	2	1	1	4	1	
Staphylinidae	31	1	5	37	12	
Coleoptera[1]	0	8	17	25	8	
Elateridae	8	3	1	12	4	
Diabrotica 12-punctata	0	1	0	1	1	
Blissus leucopterus	1	1	0	2	1	
Cymidae	1	3	0	4	1	
Thysanoptera	8	18	22	48	16	1.8
Lepidoptera[2]	8	30	7	45	15	
Amoesia sp.	0	33	56	89	29	3.07
Cicadellidae	1	1	1	3	1	
Parcoblatta sp.	1	1	0	2	1	
Chloropidae	0	19	10	29	9	

[1]Indicates immature forms.

[2]Indicates immature forms.

Plot 4--Brush-Shrub-Pecan Tree Fencerow

Harmful Species.

A smaller percentage of harmful species was collected in this plot than in any of the others (Table 4). This was primarily due to the large number of Collembola collected, thus making the number of harmful insects small in comparison to the total numbers collected in the entire plot. Chinch bugs were collected in the largest numbers of the harmful group, followed next by chloropids. Thrips, leafhoppers, weevils and lepidopterous larvae were collected in very small numbers. These are important pests of certain crops. The small numbers found would indicate that possible early damage to any crop growing adjacent to this fencerow would be minor.

Beneficial Species.

Beneficial species were also extremely scarce and the per cent of the total was by far the lowest of the study. They comprised only 3.6 per cent of the total collection (Fig. 9). The "hard shelled" Acarina made up some 73 per cent of the entire beneficial group. The ants and spiders were collected in normal numbers but the carabid numbers were very low (Table 4).

Scavenger Species.

This group of arthropods made up 94.9 per cent of the entire number collected in this plot. The Collembola made up 98 per cent of this group and 93 per cent of the entire collection in this plot (Table 4).

They were collected in enormous numbers the first collection, but the last one on January 28 had very few in it. The reason for this is not known. One of the phenomena observed in the population studies of Collembola was the great fluctuations in numbers that occurred. A marked drop in the population found in one plot did not always occur in another plot. Since the dates of collection and methods of processing the samples were the same, there must have been some limiting factors present which operated independently of temperature and humidity. This indicates the possibility of some natural enemy of the Collembola.

Discussion.

This plot contained the largest number of Collembola and the main reason for this was thought to be the high content of organic matter in the soil. There were many pecan trees growing nearby and their decaying leaves made an ideal habitat for the Collembola. Very few species collected were injurious to corn or any other crop. The scavengers comprised 94.9 per cent of the total population in this plot (Fig. 9). This particular plot had the largest total arthropod population of any plot by far, due to the large number of Collembola collected.

Table 4. Seasonal distribution and comparative abundance of arthropods collected in brush, shrub, winter grass fencerow, 1954-1955

Arthropods	Number collected			Total	Average	Per cent
	Oct. 29	Dec. 1	Jan. 28	Collected	Collection	of Total
"Soft shelled"						
Acarina	66	21	40	127	42	1.77
"Hard shelled"						
Acarina	100	58	31	189	63	2.64
Araneida	12	6	0	18	6	
Chernetidea	0	1	0	1		
Collembola	2628	3941	91	6660	2220	92.6
Formicidae	27	3	0	30	10	
Carabidae	12	6	3	21	7	
Staphylinidae	0	6	0	6	2	
Curculionidae	0	0	1	1	1	
Blissus leucopterus	53	33	2	88	29	1.23
Cicadellidae	2	0	1	3	1	
Lepidoptera[1]	0	0	2	2	1	
Chloropidae	6	0	0	6	2	
Psocidae	3	0	0	3	1	
Thysanoptera	1	0	0	1	1	
Periplaneta sp.	1	1	0	2	1	
Gryllidae	1	0	0	1	1	

[1] Indicates immature forms.

Plot 5--Cheat-Prairie Tripleawn Grass-Ragweed Fencerow

Harmful Species.

The total number of harmful species in this plot was fairly low, and made up only 28 per cent of the total collection (Fig. 9, Table 5). Of this number the chinch bugs were the most numerous with 58 per cent. This plot was close to a sorghum field, although it did not join it directly. The family Chloropidae was here in larger numbers than in the other plots (Table 5). This was probably due to the number of alfalfa fields nearby. The thrips found in this plot belonged to the genus Frankliniella and were few in number. The leafhoppers collected were A. uhleri (Van Duzee); they may feed on cotton but rarely damage it. The lepidopterous larvae were cutworms and probably migrated from the alfalfa fields. The immature root aphids were collected in very small numbers only on December 1, as they were in many of the other plots.

Beneficial Species.

This group composed some 14.5 per cent of the entire collection in Plot 5 (Fig. 9). The "hard shelled" Acarina comprised about 87 per cent of the beneficial arthropods found and 12.7 per cent of the entire collection. They appeared to be the same species as those collected in the other plots and reached their peak of abundance October 29. Very few were collected December 1; then on February 8, the numbers were up again. Ants were somewhat more numerous in this plot than in the others. However, this fencerow did not seem to be any more favorable for them than the rest.

The number of spiders was about the same in this plot as the rest but the Carabidae were much scarcer. One reason for this might be the fact that cotton grew adjacent to this fencerow. Not many Carabidae are seen in the cotton fields in the summer. They usually tend to stay in the alfalfa fields in the greatest numbers.

Scavenger Species.

This group comprised 82.6 per cent of the entire collection for Plot 5 (Fig. 9). The Collembola represented 87 per cent of this group and 77 per cent of the entire collection. More than 95 per cent of these were collected February 8 (Table 5). The atmospheric temperature on this particular day reached 67°F; the highest of any of the collection dates for this plot (Table 8).

Several of the other plots reached their peak of arthropod abundance December 1, but on that date only two individuals were collected in this plot. The "soft shelled" Acarina comprised only 4 per cent of the total collection and were fairly low in numbers compared to most of the other plots. The greatest numbers were collected October 29 and then the population gradually declined to the last of the collections. More specimens of the family Psocidae were collected here than in any other plot. They may have been attracted to the decaying straw and grass that had been cut from the right-of-way by the Highway Department. This vegetation had been clipped several times during the year and there was a considerable amount of decaying organic matter on the ground. Pill bugs and staphylinids made up the remaining scavenger species in this plot.

Discussion.

This plot was adjacent to cotton, but few species that affect this crop were collected. The severe drouth of 1954 reduced the number of insects usually associated with cotton, so this may not represent a true picture of this type fencerow in normal years. Usually one would expect to find at least a few boll weevils hibernating close to the cotton fields, but not a single one was found. Collembola were collected in the greatest numbers, followed next by the "hard shelled" Acarina. The harmful arthropods collected in the largest numbers were the chinch bugs, representing 1.6 per cent of the total collection (Fig. 9). The thrips were probably the most injurious species collected as far as the cotton was concerned.

Table 5. Seasonal distribution and comparative abundance of arthropods collected in cheat, prairie tripleawn, ragweed fenmerow, 1954-1955

Arthropods	Number collected			Total collected	Average per Collection	Per cent of total
	Oct. 29	Dec. 1	Feb. 8			
"Soft shelled"						
Acarina	100	63	18	181	60	4.1
"Hard shelled"						
Acarina	305	11	246	562	187	12.7
Araneida	4	6	11	21	7	1.0
Isopoda	10	0	0	10	3	
Chermetidea	0	0	1	1	1	
Collembola	71	2	3349	3422	1140	77.3
Formicidae	17	11	17	45	15	1.0
Carabidae	6	3	4	13	4	
Curculionidae	1	0	0	1	1	
Coleoptera[1]	11	7	0	18	6	
Staphylinidae	0	0	4	4	1	
Blissus leucopterus	7	13	52	72	24	1.6
Lepidoptera[2]	3	3	0	6	2	
Psocidae	19	4	0	23	7	
Amoecia sp.	0	10	0	10	3	
Thysanoptera	1	5	1	7	2	
Cicadellidae	1	3	1	5	1	
Coccidae	1	0	0	1	1	
Isoptera	2	0	0	2	1	
Chloropidae	11	11	1	23	7	

[1]Indicates immature forms.

[2]Indicates immature forms.

Plot 6--Bermuda Grass-Puncture Vine Fencerow

Harmful Species.

The harmful arthropods of Plot 6 (Table 6) comprised only 2.5 per cent of the total collection, which was rather low (Fig. 9). This plot was a typical cleanly tilled fencerow and this is the main reason for the low number of harmful arthropods. Only four chinch bugs were collected despite the fact that sorghum grew nearby; however, the only vegetation growing here was bermuda grass and puncture vines which may account for this. Thrips were collected in the largest numbers, although they do not attack wheat, the crop growing adjacent to this area. The lepidopterous larvae were collected in the second largest numbers and could have possibly affected the wheat as most of them were cutworms. The leafhopper, A. uhleri, (Van Duzee) was picked up in very small numbers. This species is known to stay in wheat in the early spring, but there is no definite proof that they damage it. The other two species found were the tarnished plant bug, Lygus pratensis (Say) and a species of weevil. However, numbers were so small that their damage was potentially insignificant.

Beneficial Species.

This group comprised 13 per cent of the total number of arthropods collected in this plot (Fig. 9). This was a comparatively low percentage compared to the other plots. The "hard shelled" Acarina made up 59 per cent of the beneficial group and 7.7 per cent of the entire collection. The largest numbers were collected on November 3; after this they gradu-

ally declined. The ground beetles were collected in the next largest numbers. Most of these were small and it is doubtful whether or not they prey on insects of any size. The spiders were represented in each sample, although not in large numbers (Table 6). The ants were all collected on the first collection date. This was probably due to their wide range in hunting food and their collection in this plot was probably accidental. The centipedes were collected on two different dates after rains (Table 8).

Scavenger Species.

The scavenger species in this plot made up 84 per cent of the total collection. The Collembola made up 97 per cent of this and 82 per cent of the total collection. The "soft shelled" Arcania were collected in the smallest number in this plot, although they were collected on each sampling date. The reason for this was probably the lack of vegetation in the habitat. The Psocidae, pill bugs, and Stahpylinidae were collected in very small numbers and probably were not attracted to this particular fencerow but were merely seeking shelter there.

Discussion.

This plot had a comparatively low number of total individuals in it as compared to some of the other plots. Very few of the harmful species collected would affect the wheat growing adjacent to this plot. Only the lepidopterous larvae and the chinch bugs of this group are known to damage small grain severely, although some of the other species are known to feed on it occasionally. The Collembola made up 82 per cent of the entire collection. Most of the scavengers were collected in large numbers on each of the collection dates despite the apparently poor habitat (Fig. 9). All the other arthropods collected, with the exception of the thrips, were fewer than in the other plots.

Table 6. Seasonal distribution and comparative abundance of arthropods collected in bermuda grass, puncture vine fencerow, 1954-1955

Arthropods	Number collected			Total collected	Average per collection	Per cent of total
	Nov. 3	Dec. 1	Feb. 8			
"Soft shelled"						
Acarina	23	10	8	41	13	1.8
"Hard shelled						
Acarina	100	45	30	175	58	7.7
Araneida	6	8	2	16	5	
Chilopoda	2	2	0	4	1	
Isopoda	1	0	0	1	1	
Collembola	488	699	680	1867	622	82.1
Formicidae	21	0	0	21	7	
Carabidae	52	15	12	79	26	3.5
Staphylinidae	0	3	2	5	1	
Coleoptera[1]	0	1	0	1	1	
Curculionidae	0	3	2	5	1	
Blissus leucopterus	0	1	3	4	1	
Thysanoptera	19	5	10	34	12	
Lepidoptera[2]	8	2	1	11	3	
Psocidae	1	0	1	2	1	
Cicadellidae	2	1	0	3	1	
Gryllidae	1	0	0	1	1	
Lygus pratensis	1	0	0	1	1	

[1] Indicates immature forms.

[2] Indicates immature forms.

Plot 7--Bunch Grass-Johnson Grass Fencerow

Harmful Species.

This plot had the fourth highest percentage of harmful arthropods, although the total number was the lowest of the seven plots (Table 7). The chinch bugs were collected in the largest numbers probably because this was a fairly good overwintering site for them. The number found here did not compare with those found in other plots, however, the probable reason being the lack of sorghum fields in the near vicinity. A. uhleri (Van Duzee) was collected in the next largest number in this plot. They probably came out of the oats and wheat nearby to find protection in this fencerow. The immature root aphids were also picked up here in small numbers on December 1. Only one spotted cucumber beetle was picked up in this plot, and was the second one collected in this study. They were known to be abundant in alfalfa fields in the fall of 1954. The other harmful species such as the snout beetles, thrips, and click beetles were taken in such small numbers that they were not considered to be of major importance to these crops.

Beneficial Species.

The beneficial arthropods made up 34.7 per cent of the total collection, which was the second highest of the entire group (Fig. 9). The "hard shelled" Acarina made up 98 per cent of this group and 31.5 per cent of the entire collection of this plot. They were taken in largest number November 3, the first collection, and then declined in numbers until the last collection. The ground beetles were picked up in the lowest

numbers in this plot, although some were picked up in each collection. The spiders were collected in small numbers; however, they were about as numerous as those in other plots. The ants and centipedes were taken in extremely small numbers and were of minor importance as far as being beneficial.

Scavenger Species.

The scavengers made up the greater proportion of the arthropods collected in this plot (Fig. 9). Of these the Collembola and "hard shelled" Acarina predominated. The Collembola comprised some 79 per cent of the scavengers and 46 per cent of the entire arthropod population collected in this plot. The first collection was fairly low in numbers, but each succeeding collection increased significantly over the preceding. The "soft shelled" Acarina made up 10.6 per cent of the total collection in Plot 7. They were collected in the greatest numbers December 1 as they were in many other plots. The pseudoscorpions[1] were picked up in the greatest numbers in this plot. The pill bugs, psocids, and staphylinids were picked up in small numbers only, and were not considered too important as members of this group.

---

[1] Microbisum parvulum (Banks).

Table 7. Seasonal distribution and comparative abundance of arthropods collected in bunch grass, Johnson grass fenceraw, 1954-1955

Arthropods	Number collected			Total collected	Average per collection	per cent of total
	Nov. 3	Dec. 1	Feb. 8			
"Soft shelled"						
Acarina	50	69	30	149	50	10.6
"Hard shelled"						
Acarina	258	129	52	439	146	31.5
Araneida	4	7	5	16	5	
Chilopoda	0	2	0	2	1	
Isopoda	1	0	0	1	1	
Chernetidea	0	5	5	10	3	
Collembola	105	181	358	644	214	46.3
Carabidae	3	8	1	12	4	
Elateridae	1	0	0	1	1	
Curculianidae	1	0	1	2	1	
Diabrotica 12-punctata	0	1	0	1	1	
Coleoptera[1]	42	2	0	44	14	3.2
Hemiptera	1	0	0	1	1	
Blissus leucopterus	8	15	10	33	11	2.4
Amoeia sp.	0	10	0	10	3	
Psocidae	2	0	4	6	2	
Formicidae	0	1	3	4	1	
Thysanoptera	0	1	0	1	1	
Staphylinidae	0	2	1	3	1	

[1]Indicates immature forms.

Table 8. Atmospheric and soil temperatures[1] from October through February, Stillwater, Oklahoma.

	October				November				December			
	Air		Soil		Air		Soil		Air		Soil	
D[2]	M[3]	M[4]	M[3]	M[4]	M[3]	N[4]	M[3]	M[4]	N[3]	N[4]	N[3]	N[4]
1	79	66			58	36	54	40	55	34	45	40
2	90	69			57	21	46	35	70	28	45	32
3	92	72			43	30	40	38	70	36	49	31
4	93	72			54	36	45	38	70	45	49	35
5	73	58			67	26	49	31	51	24	49	44
6	63	54			79	43	58	39	47	30	42	31
7	80	51			82	40	60	41	54	25	39	33
8	84	60			76	41	56	42	54	28	40	28
9	91	65			75	51	61	47	58	29	41	30
10	92	72			76	43	62	45	59	38	40	28
11	90	74			75	44	63	36	41	29	43	36
12	86	59			74	41	59	45	41	16	45	30
13	92	63			75	43	58	36	55	26	32	20
14	84	51			71	44	58	47	58	27	36	25
15	66	40			74	41	60	40	57	43	38	24
16	74	37			77	44	60	46	49	31	41	34
17	88	46			73	52	60	52	46	33	35	30
18	88	49			67	50	57	52	54	27	34	30
19	84	55			68	37	55	44	63	30	38	25
20	78	54			71	37	57	40	59	29	42	25
21	74	55			65	41	50	44	68	26	39	27
22	71	52			58	33	50	44	66	32	42	27
23	71	50			73	38	54	40	60	28	45	29
24	69	54	71	56[5]	65	41	48	42	63	43	40	26
25	75	57	75	62	51	35	44	38	63	49	45	35
26	73	47	64	56	66	35	50	38	49	37	45	43
27	51	36	52	45	68	37	50	38	77	38	40	30
28	68	38	48	47	63	42	47	43	36	24	26	24
29	63	45	58	44	53	28	45	32	43	9	24	22
30	62	29	49	38	58	39	46	40	45	22	20	10
31	59	30	49	38					40	20	26	16

[1]Temperature in °F. [2]Date. [3]Maximum. [4]Minimum. [5]Records not available until this date.

Table 8. Con't.

	January				February			
	Air		Soil		Air		Soil	
D[2]	N[3]	N[4]	N[3]	M[4]	M[3]	M[4]	M[3]	M[4]
1	59	31	34	20	62	38	40	30
2	57	29	33	21	41	31	30	25
3	67	52	47	33	40	31	28	25
4	68	61	51	47	38	31	27	20
5	67	37	50	35	48	28	31	20
6	47	31	38	28	47	28	30	29
7	45	25	28	23	42	20	28	17
8	50	34	31	24	67	31	28	34
9	48	29	30	23	70	44	46	30
10	41	30	32	24	67	17	23	14
11	40	24	26	21	38	8	16	14
12	47	31	31	23	39	12	16	14
13	44	17	25	17	61	24	32	14
14	52	31	32	21	68	26	40	19
15	51	28	32	23	67	43	42	31
16	46	39	32	29	60	32	44	29
17	45	42	32	30	63	27	41	28
18	47	26	30	28	61	46	42	37
19	29	23	20	18	61	25	38	20
20	35	28	21	18	37	16	20	18
21	46	28	27	19	41	19	25	16
22	41	25	23	18	48	19	30	18
23	44	20	21	17	56	27	36	19
24	48	33	28	20	52	21	32	20
25	57	25	35	20	66	28	39	20
26	57	33	35	23	76	50	38	36
27	48	14	24	16	56	28	42	28
28	40	27	24	21	79	45	56	38
29	55	29	30	17				
30	52	28	32	20				
31	64	38	40	20				

Table 9. Inches of precipitation from October 1 to February 28, 1954-1955, Stillwater, Oklahoma

	October		November		December		January		February	
D[1]	P[2]	S[3]	P[2]	S[3]	P[2]	S[3]	P[2]	S[3]	P[2]	S[3]
1	T[4]									
2	0.26									
3			0.17				T		T	
4									1.03	
5							0.10			
6	0.17									
7										
8										
9										
10							T		T	
11	0.54				0.42					
12					0.22					
13										
14										
15										
16					T					
17					T		0.65	1.05		
18							0.6		0.18	
19			T						0.10	
20										
21										
22	0.60									
23										
24										
25	0.13				1.11					
26	T		0.30		0.29					
27	T				0.40	10.0				
28										
29										
30										
31										
Totals	1.70	0	0.47	0	2.44	10.0	0.75	1.05	1.31	0

[1]Date. [2]Precipitation in inches. [3]Snow in inches. [4]Traces.

COMPARATIVE ABUNDANCE OF ARTHROPODS COLLECTED

There were 14 orders of arthropods collected in this study, 11 of which belonged to the class Insecta. Some of the orders such as Homoptera, Diptera, Chilopoda and Chelonethida had few representatives as far as species numbers were concerned. The order Hemiptera was represented almost entirely by chinch bugs.

Collembola: More insects of this group were collected than any other natural group. Fourteen species were present. More were found in Plots 4 and 5 than in any other type of fencerow habitats. Collections from these plots on comparable dates were much higher than those from the check. As a general rule the populations in all plots increased in numbers as the season advanced.

Acarina: This group was collected in the second largest numbers. Both the "soft shelled" and the "hard shelled" mites are considered here. Plot 3 had the highest number of Acarina of the group with Plots 1, 5, and 7 having the next highest numbers. There was no peak of populations recorded as some plots reached their peak early in the season and some late. The temperature seemed to have little effect on them because some plots reached their peak during the coldest weather of the season.

Chinch Bugs: This insect pest occurred most abundantly in Plot One. Plots 2, 4, and 5 were next highest with approximately the same number in each, their peaks being reached in December. All of these plots were fairly close to fields of sorghum and all but Plot 4 had some clumps of bunch grass in them. Plot 4 had a high amount of organic matter in it.

Araneida: Compared to insects and mites, few spiders were collected.

More were found in Plot 1. Some spiders were collected on each sampling date with the exception of one, and were probably the most important species in the beneficial group.

Carabidae: This family was also important as a beneficial group and representatives were picked up on each sampling date. Plot 3 had the most Carabidae present, followed by Plots 1 and 6. The other plots had about equal numbers in them. Most of the ground beetles collected were extremely small in size.

Formicidae: These insects were collected in the largest numbers in Plot 4, with all the rest having about the same, except Plot 7 which was very low. Plot 1 along with Plot 5 was the only one having ants in each collection. Most of these ants were very small and only a few Texas harvester ants were found.

Chloropidae: These small Diptera were collected only in 3 plots. Plot 3 had the most probably because it was adjacent to an alfalfa field. It was known that they were harbored here because the author found them to be quite abundant in sweep samples early in December. Plots 4 and 5 were also close to alfalfa fields.

Anoecia sp.: This insect was represented entirely by immature forms. Plot 1 had the highest number, although practically all were collected on the same date. Plot 3 had the second highest number with Plots 2, 5 and 7 having about the same. The others did not have any collected in them.

Thysanoptera: This group of insects should be considered fairly injurious and was found in all plots. Plot 1 had the highest numbers with Plots 3 and 6 having the next highest. These fencerow populations were low but could build up enough to cause considerable harm to adjacent growing crops the following year. Most of the thrips collected belonged to the genus

Frankliniella whose members are fairly general feeders.

Most of the other arthropod species collected were so few in number that it was impossible to tell which plots had the most in them. Some species were picked up only in a few samples and it was not known whether their occurrence was accidental or not.

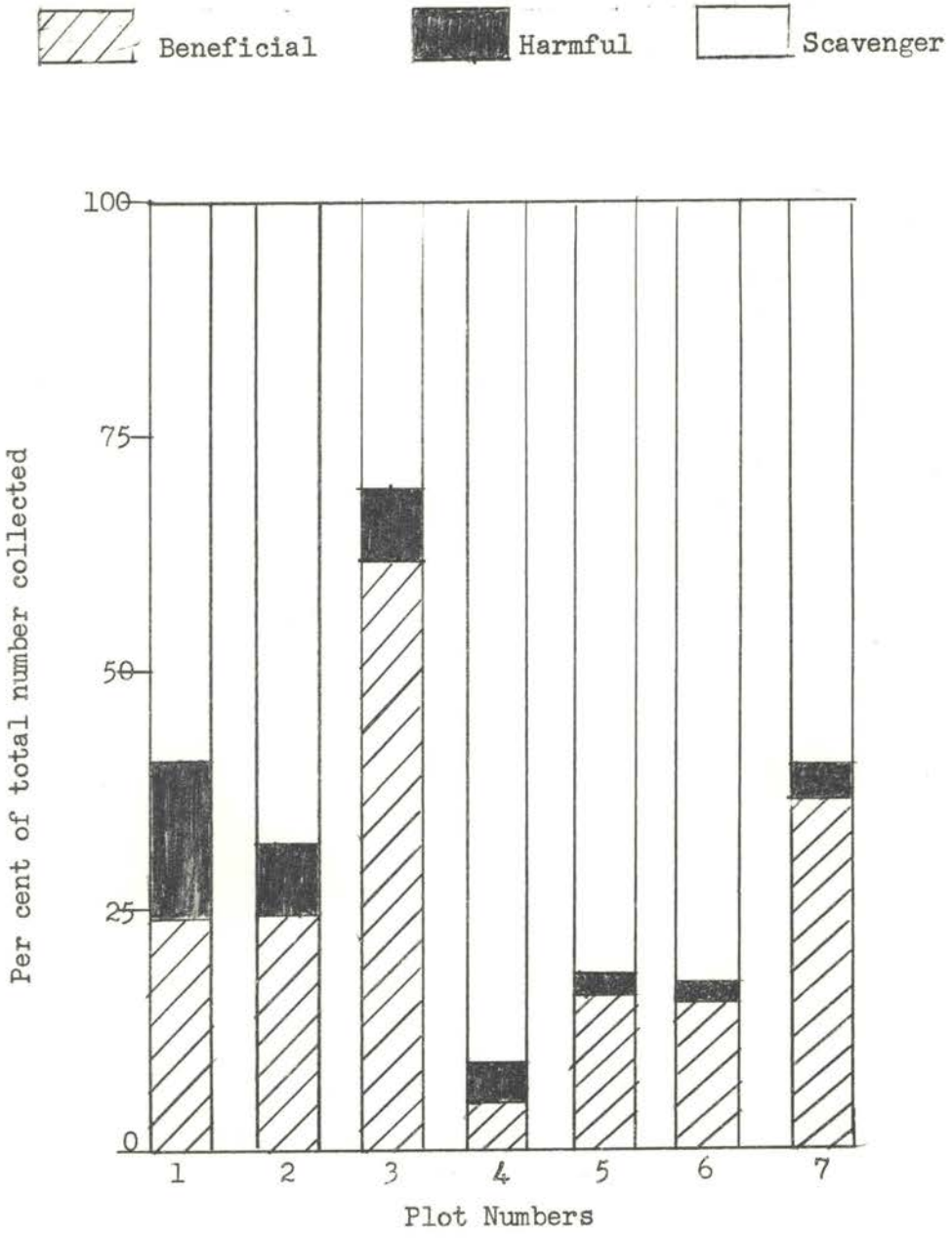

Figure 9. Comparative percentages of harmful, beneficial and scavenger species collected in each plot.

Summary and Conclusions

Seven different types of fencerows bordering six different crops were sampled. The work was started October, 1954 and terminated in February, 1955. Collembola were collected in the largest numbers followed by the Acarina. These two orders combined made up the majority of the population in all samples.

The fencerow associations that had the most decayed organic matter, such as Plots 3 and 4, had the most arthropods present; however, they consisted mainly of Collembola. The fencerow association that contained the most economically important pest species of arthropods usually had some bunch grass present. The bermuda grass, alfalfa, sorghum association had the fewest numbers of any of the plots sampled.

It is evident from this study that during the winter of 1954-55, fencerows served as overwintering quarters for certain crop pests. Those found in the largest numbers were chinch bugs, lepidopterous larvae, thrips, the so-called "bill bugs," leafhoppers, click beetles, and two species of chloropids. Of these only the chinch bug, several species of thrips and lepidopterous larvae appeared in sufficient numbers to cause harm to adjacent crops. The other species listed are capable of building up to a damaging level any time.

Taking the project as a whole, only those fencerows containing bunch grass and being adjacent to sorghums had damaging levels of pest species. Other fencerows beside such crops as wheat, oats, cotton, corn, and alfalfa did not have damaging levels of pest species present. These fencerows harbored pests but except for chinch bugs, their numbers were small.

Some of these fencerows contained far greater numbers of beneficial and scavenger species than the did harmful ones. This study, therefore, has shown that at least in some years, fencerows are not as important in harboring insect pests as has been believed. They also serve as a shelter for many beneficial species which might not only survive in better shape to destroy harmful species the next crop growing season, but also prey upon the pest species during the winter. The cleaner the fencerow, the fewer insects it sheltered.

LITERATURE CITED

Bellinger, P. E. 1954. Studies of soil fauna with special reference to the Collembola. Conn. Agr. Sta. Bull. 583. 127 pp.

Buckle, P. 1921. On the ecology of soil insects on agriculaural land. Jour. Ecol. 11:93-102.

Dambach, C. A. 1948. A study of the ecology and economic value of crop field borders. Ohio State Univ., Grad. School Studies, Biol. Sci. Ser., 2: 1-204.

Dowdy, W. W. 1944. A community study of a disturbed deciduous forest area near Cleveland, Ohio with special reference to invertebrates. Ecol. Monog. 14 (2): 194-223

Fenton, F. A. 1952. Field crop insects. The Macmillan Company, New York, p. 209-218, 284-324.

Ford, J. 1937. Fluctuations in natural populations Collembola and Acarina. Jour. Anim. Ecol. 6:98-111.

Hays, P. 1927. Prairie insects. Ecol. 8 (2) 238-250.

King, K. M. 1939. "Symposium on insect populations (population studies of soil insects)". Ecol. Monog. 9 (3):270-286.

Scott, D. B. Jr. 1953. The economic biology of Collembola. Jour. Econ. Ent. 46 (6):1048-1051.

VITA

Russell D. Caid
candidate for the degree of
Master of Science

Thesis: THE IMPORTANCE OF THE FENCEROW AS A SOURCE OF INFESTATION FOR CROP DAMAGING INSECTS

Major: Entomology

Biographical and Other Items:

Born: January 26, 1932 near Leslie, Arkansas

Undergraduate Study: O. A. M. C., Stillwater, Oklahoma 1950-1954

Graduate Study: O. A. M. C., Stillwater, Oklahoma

Experiences: Farming, 1942-50; Employed part-time by U.S.D.A., 1953-54; Supervised cotton insect control work, Summers of 1953-54.

Member of Phi Sigma

Date of Final Examination: June, 1955

THESIS TITLE: THE IMPORTANCE OF THE FENCEROW AS A SOURCE OF INFESTATION FOR CROP DAMAGING INSECTS

AUTHOR: Russell D. Caid

THESIS ADVISER: Dr. Frederick Azel Fenton

The content and form have been checked and approved by the author and thesis adviser. The Graduate School Office assumes no responsibility for errors either in form or content. The copies are sent to the bindery just as they are approved by the author and faculty adviser.

TYPIST: Grace E. Hudson