

FOOD PLANT PREFERENCES OF
GRASSHOPPERS (ORTHOPTERA:
ACRIDIDAE) OF SELECTED
PLANTED PASTURES IN
EASTERN KANSAS

763
by

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INTRODUCTION

The purpose of this study, near Manhattan, Kansas, during 1965 and 1966, was to increase knowledge of the feeding and behavior of grasshoppers in planted (tame) pastures. Emphasis was placed on the feeding habits of the more common species.

Grasshoppers have long been considered serious plant pests in the Great Plains area of the United States. Loss in production potential of rangelands (including pasture grass and other forage) has been estimated to be \$80,000,000 per year for 1959 and 1960 (Anon., 1965). This does not include funds spent for grasshopper control.

Consequently, much of the research has been directed towards methods of immediate direct control. Little basic research dealing with the biology and ecology of grasshoppers of rangeland has been done and even less on planted pasture species. Neglect in basic research has resulted from such factors as (1) lower economic return from grassland than from cropland; (2) insect damage is often less apparent in grassland than in cropland; and, (3) recent recognition of grasslands as resources deserving intensive scientific investigation.

Publications dealing with taxonomy and direct control of grasshoppers often include some references on the feeding habits and behavior of the various species. Past research on the biology of grasshoppers generally deals with a single or small number of species. These are usually those species of greatest economic importance. The author agrees with Hanson and Vorhies (1938) in concluding that basic research is essential. Grasshoppers as grassland pests cannot be dealt with scientifically unless there is an exact knowledge of their basic biology and ecology. Isely (1944) stated:

"It should be evident that food specificity research will contribute to further progress in working out the control of pest grasshoppers."

This study was initiated to provide greater understanding of the biology and ecology of grasshoppers inhabiting tame pasture habitats through increased knowledge of their feeding and behavioral habits.

REVIEW OF LITERATURE

Of the vast amount of literature on the Acrididae, much is concerned with taxonomy and direct control of cropland species. Little information is available on feeding habits and behavior, type and extent of damage to plants, and host plant relationships of grasshoppers of planted grasslands.

Taxonomic works pertaining specifically to adult grasshoppers of Kansas include those by Brunner (1885, 1887), Isely (1905), Beamer (1915), Claassen (1915), and Hebard (1931, 1934). Many taxonomic papers concerning grasshoppers of other areas also include species common to Kansas. Some are: Alexander (1941), Ball et al. (1942), Brooks (1958), Coppock (1962), Froeschner (1954), Gurney and Brooks (1959), Hebard (1925, 1929, 1936, 1938), Knutson (1940), and Pfadt (1965).

Few taxonomic works have been published on grasshopper nymphal stages. Criddle (1931) and Hanford (1946) described and published keys to nymphs, some species of which are found in Kansas. Brusven (1966) published keys, descriptions, pictures, and ecological notes for the nymphal stages of the subfamily Acridinae of Kansas.

Many of the above taxonomic works include notations on favored habitat, food plants, and seasonal occurrence of various species of the Acrididae.

Lists of grassland species collected during non-taxonomic studies have been made by Arnett (1959), Wilbur and Fritz (1940), Woodruff (1937), and Hebard (1938).

Keys to the flora of Kansas have been prepared by Barkley (1963). Illustrations as well as keys to the grasses of Kansas have been furnished by Gates (1936). Launchbaugh (1964) illustrated and described many of the

native grasses and broadleaf plants found in Kansas rangelands and, to some extent, in tame pasture areas. Many Kansas grassland plants are described by Hitchcock (1950), Stevens (1950), Phillips Petroleum (1963), and the North Central Regional Publication No. 36 (1960).

Opinions of entomologists regarding food preferences of grasshoppers have changed greatly during the last 100 years. The old idea that grasshoppers devour everything green has been accepted by many. However, it was originally applied only in describing Melanoplus spretus Walsh, (Riley, Packard, and Thomas, 1877). Later investigations by Criddle (1933), Isely (1937, 1938, 1944, 1946), Langford (1930), Henkle (1938), Shotwell (1941), Brett (1947), Pfadt (1949), Anderson and Wright (1952), and Scharff (1954) showed that many species of grasshoppers were associated with a restricted number of host plants. Coppock (1962) and Hebard (1931, 1938) listed general food preferences of most species of grasshoppers common to Kansas.

Isely and Alexander (1949) suggested determination of acridid food preferences by examination and identification of plant fragment contents in the grasshopper crop (ventriculus). Mulkern and Anderson (1959) developed a technique necessary for such a study. This technique utilized plant epidermal characteristics for plant fragment identification. Mulkern and Anderson (1959), Pruess (1960), Mulkern, Anderson, and Brusven (1962), Mulkern, Toczek, and Brusven (1964), and Campbell (1966) have conducted crop content analysis studies on most grasshopper species encountered in their studies. Scharff (1961) used crop content analysis to a limited extent in his study of the ecology of Melanoplus sanguinipes on Montana grasslands. Brusven and Mulkern (1960) and Pruess (1960) have published keys for the identification of plant fragments recovered from grasshopper crops.

Plant taxonomic workers have also utilized plant epidermal characters for the identification of plant species and varieties. Davis (1959) differentiated some 40 species of grasses by using various plant epidermal characteristics. Stoddard (1965) identified several varieties of alfalfa, marigold, and some grasses (four Panicum spp.) by leaf epidermal cell patterns. Nittler (1966) differentiated varieties of Kentucky bluegrass (Poa pratensis L.) by this method. Metcalf (1960) furnishes keys for the identification of many European plant species through use of plant anatomical characters. Descriptions and illustrations of many of these characters are included. Several of the more common plant epidermal characters are illustrated and discussed by Esau (1960).

Factors affecting a grasshopper's selection of food plants appear to be quite numerous. Uvarov (1928) pointed out that differential feeding on plants is due primarily to insects seeking water. He concluded that water is the only chemical compound toward which the Acrididae nearly always show positive chemotropism. Criddle (1933) observed that Melanoplus bivittatus (Say) was greatly attracted to sowthistle, Sonchus arvensis L., during dry weather and that this attraction seemed to be due to the large amount of moisture which the plant contained. Wilbur (1936) reported that grasshopper injury to the inflorescence of pasture grasses was largely caused by a search for moisture. Hermann and Eslick (1939) working with grass seedlings of western wheatgrass (Acropyron smithii), smooth brome grass (Bromus inermis), reed canarygrass (Phalaris arundinacea), and several species of Poa noted differential feeding not only among species but within species. The authors offered the explanation that differences were perhaps caused both by the amount of green material available and by the food preferences of the grasshoppers involved.

Brunson and Painter (1938) observed that grasshoppers, when forced to consume a single variety of corn, preferred some plants to others in open-pollinated varieties. These authors suggested that the genetic composition of the plant may influence its susceptibility to attack by grasshoppers.

Barnes (1955), Pfadt (1949b), Pickford (1963), Riegert, Pickford, and Putnam (1965), and Smith (1959) found that certain plants are nutritionally inadequate for some grasshopper species. Painter (1963) suggested that plants and even different parts of the same plant may differ nutritionally. Fraenkel (1959) suggested that insects were attracted by such secondary plant compounds as alkaloids, glucosides, organic acids, saponins, and tannins rather than by the plants themselves.

The relationship of grasshoppers to their environment has long been a point of study and discussion. Parker (1930), Shotwell (1941), and Swenk and Bratt (1941) noted the effects of temperature and moisture on development of certain grasshopper species. Brett (1947) noted interrelated effects of temperature, humidity, and food on the development of Melanoplus sanguinipes.

Cantrall (1943), Friauf (1953), Shotwell (1930, 1948), Uvarov (1928), Isely (1937, 1938), Pfadt (1949a), Vestal (1913), and others have investigated the importance of habitat and host plant associations to grasshopper distribution. Vestal (1913) and Cantrall (1943) concluded that grasshoppers tend to seek habitats best suited for their optimum living conditions. Isely (1937) considered soils and their related vegetation used as food or shelter to be the primary factors in determining local grasshopper communities. Vestal (1913) suggested that grasshoppers of a given habitat tend to increase, decrease, or maintain themselves according to their tolerance to changes in temperature, moisture, soil, plant succession, and in interspecies conflicts.

Grasshoppers with a wide range of tolerance will be most capable of maintaining themselves.

Isely (1938) noted that the adaptation of certain acridids to introduced species of plants had complicated the problem of local distribution. He stated:

"The preference for Bermuda grass on the part of our acrididae was acquired. It is obvious....that vegetation absent in typical virgin, optimum habitats of a species can not,, belong to the original basic food requirements of the species."

Shotwell (1938) partially attributed the increase in numbers of certain grasshopper species, not previously prevalent, to introduced food plants.

The importance of land use on the abundance of grasshoppers has been shown by Arnett (1960), Barnes (1959), Bei-Bienko and Mishchenko (1951), Branson (1942), Buckell (1921), Coyner (1939), Nearney (1958, 1960), Odum (1953), Shotwell (1953), Treherne and Buckell (1924), and Uvarov (1928). Buckell (1921) and Nearney (1958) pointed out that grass sparseness as well as invasion of forbs is conducive to increased grasshopper numbers and injury.

Vegetation height, density, and degree of wetness have been listed as factors affecting grasshopper distribution by such authors as Diver and Diver (1933) and Kaufmann (1965).

Isely (1944, 1946) suggested that grasshoppers have evolved morphological characters which facilitate feeding in their preferred habitat. He found that mandibular morphology of grasshoppers could be correlated with the type of food plant utilized. Using this method, he classified 34 species as graminivorous, 27 as forbivorous, and 18 as herbivorous. Kaufmann (1965) found that Bavarian grasshopper species with differing food preferences showed differences in maxillary lacinae. Also, geophilous grasshoppers, which fed mainly on the ground, had either small arolia or none at all, while acridids found in tall vegetation had large and well developed arolia.

Numerous authors, including Brett (1947), Criddle (1917), Putnam (1954), and Parker, Newton, and Shotwell (1955), have linked grasshopper population increases with drought conditions. However, Nerney (1960) found that on poor or overgrazed Arizona rangeland, grasshopper populations were often greater after years of normal or above-normal rainfall than after those with unusually light precipitation. Scharff (1961) said that a distinction should be made among drought conditions in different geographical areas. In explanation, he stated that in such areas as the Midwest, drought and lowered humidities, while probably furnishing release from disease and parasites thus allowing Melanoplus sanguinipes to increase in numbers, seldom are severe enough to reduce nutrition levels to a semi-starvation condition. Such semi-starvation levels are often present during more critical drought periods in the more arid areas of the western United States.

Smith (1954) summarized information on grasshopper population fluctuations in Kansas for the period 1854 to 1954 and correlated this with climatic factors. He concluded that grasshopper numbers must be dependent upon kind, amount, and quality of food available, though modified by other environmental factors. Available data on food, however, did not permit a correlation to be made with grasshopper population trends.

In summary, the literature cited above indicated much study of the ecology of various grasshopper species. Food selection by grasshoppers seemed to be of prime importance to such ecological studies. Most authors also indicated the need for further research. This study is intended to extend the knowledge of the grasshopper and his relationship to the habitat, through further examination of the food preferences of grasshoppers inhabiting planted pastures.

MATERIALS AND METHODS

Study Area

This study was conducted during 1965 and 1966 in 6 planted pastures, located in east-central Riley County and south-west Pottawatomie County, Kansas. The terrain is rolling, to hilly, with an elevation of 1,000 to 1,100 feet above sea level. All study pastures were located within 15 miles of Manhattan, Kansas.

The climate of this area is normally favorable for forage growth, having an average annual precipitation of 32 inches (81.28 cm.) and an average frost-free season of 172 days. During 1965 weather conditions were somewhat near the average, but during 1966 the spring was exceptionally cool and the summer hot and dry. Precipitation in 1966 was approximately half of normal (Appendix, Table 3).

All pastures studied had vegetation consisting of 1 or more planted forage species not native to eastern Kansas. Individual pastures were selected primarily with regard to vegetation type; but further selection was based upon grasshopper abundance, grasshopper species present, and proximity to Kansas State University.

Grasshopper collection site I (Fig. 1) was located in southwestern Pottawatomie County, approximately 10 miles north and 3 miles east of Manhattan, Kansas. The vegetation of the collection site was predominately western wheatgrass (Agropyron smithii) and Korean lespedeza (Lespedeza stipulacea), (Table 1). The soil type was silty clay. This site was used for 1965 and 1966 studies.

This pasture was overgrazed throughout the study period. Mowing was accomplished twice during each growing season. Management practices plus severe drought led to a very poor pssture condition throughout 1966.

- Fig. 1. Collection site I; an overgrazed western wheatgrass-Korean lespedeza pasture. Site collected during 1965 and 1966.
- Fig. 2. Collection site II; non-grazed smooth brome-sweetclover-alfalfa pasture. Site collected during 1965 and 1966.
- Fig. 3. Collection site III; vegetation largely Kentucky bluegrass, Japanese brome, downy brome, sideoats grama and big and little bluestem. Pasture grazed, then rested, at approximately one month intervals. Site collected during 1965.

- Fig. 4. Collection site IV; an overgrazed smooth brome pasture. Site collected during 1966.
- Fig. 5. Collection site V; a moderately grazed smooth brome pasture. Site collected during 1966.

- Fig. 6. Collection site VI; a non-grazed reed canarygrass-smooth brome area. Site bordered by plantings of soybean, corn, sorghum, sunflower and by smooth brome pasture. Site collected during July, August, and September of 1966.
- Fig. 7. Melanoplus differentialis damage to reed canarygrass within collection site VI.

The study site was bordered by a roadside dominated by alfalfa (Medicago sativa), bindweed (Convolvulus arvensis), and smooth brome (Bromus inermis).

Grasshopper collection site II (Fig. 2) was located in Pottawatomie County, approximately 4 miles north-east of Manhattan, Kansas, and at the south edge of the Tuttle Creek Reservoir spillway. This collection site was utilized for both 1965 and 1966 studies.

During reservoir construction, the topsoil had been stripped from the area, leaving a silty clay subsoil at the surface. The area was then sown to smooth brome, alfalfa, and yellow and white sweetclover (Melilotus spp.), (Table 2). The area was neither mowed nor grazed prior to or during the study period.

Grasshopper collection site III (Fig. 3) was established as a Kansas State University sheep pasture, approximately 1/2 mile north of the city of Manhattan in Riley County, Kansas. The vegetation of this site was predominately Kentucky bluegrass, Japanese brome (Bromus japonicus), downy brome (Bromus tectorum), and big bluestem (Andropogon gerardi), (Table 3). The soil type was silty clay loam. The pasture was periodically heavily grazed, then rested at approximately one month intervals throughout the summer. Because of low grasshopper numbers, this site was utilized only for 1965 studies.

Grasshopper collection site IV (Fig. 4) was located in the Kansas State University horse pasture at the north edge of the university campus. The vegetation of the collection site was principally smooth brome with bindweed being the most common weed species (Table 4). The soil type was silty clay. This collection site was used for both 1965 and 1966 studies.

This pasture was heavily grazed throughout the 1965 and 1966 study period. The area was treated for weed control with 2,4-D herbicide on July 21, 1965,

and on July 16 and September 9, 1966. Mowing was done periodically. Pasture condition was extremely poor during the drought months of July, August, and September of 1966. By August 1, 1966, little green vegetation was apparent.

Grasshopper collection site V (Fig. 5) was located in Riley County, approximately 3/4 mile north of Kansas State University proper. This pasture is managed by the Kansas State University Department of Animal Husbandry.

Smooth brome constituted the major portion of the vegetation. Baldwin ironweed (Vernonia baldwini) and western ragweed (Ambrosia psilostachya) were two commonly occurring weeds (Table 5). The soil type was silty clay.

This pasture was continuously grazed by cattle at a moderate rate throughout the study period. Mowing or herbicidal treatments were not practiced.

Grasshopper collection site VI (Fig. 6 and 7) was located approximately one mile north of Kansas State University campus. It was collected only during 1966. This collection site was situated within a small lowland area at the northeast corner of the university agronomy farm. This area of silt loam soils has an underlying watertable approximately 9 feet from the ground surface.

The collection site was located within and adjacent to a drainage gully which traverses the area. An almost pure stand of reed canarygrass (Phalaris arundinacea) was to be found within the gully basin with a mixed stand of smooth brome graduating to a pure stand of smooth brome at a distance from the gully edge (Table 6). This area was not grazed, however, the gully banks were mowed in the fall of 1966.

The collection site was bordered by study plots of corn, soybeans, and sorghum on the west and by a smooth brome pasture on the east.

Field and Laboratory Studies

A critical evaluation of the vegetation of each site was made three times during the 1965 growing season. In order to gauge the influence of drought upon plant availability, evaluations were made four times during the 1966 growing season. At each evaluation period, plant species making up the vegetation of each site were identified and given a numerical relative abundance rating (Tables 1-6). Plants were ranked 5, 4, 3, 2, 1 and -1 (trace) in decreasing order of abundance (adapted from Cain and Castro, 1959). Such ratings denoted both numbers and relative availability of a plant species to the grasshopper. Identification of plant species was partially accomplished through use of keys, descriptions, and pictures cited in the literature review.

A complete series of histological slides were made, including slides of each plant species from individual collection sites. Leaf and stem samples were taken from the top, center, and base of different plants of the same species and from different parts of the same plant. These samples were preserved in 70 percent alcohol. Later, the preserved material was ground in a Waring blender to a size approximating that found in the grasshopper crop (Mulkern and Anderson, 1959). The procedure utilized was similar to that of Mulkern and Anderson (1959) and Brusven and Mulkern (1960).

Descriptions for the identification of plant fragments were compiled by the author. Keys cited in the Review of Literature were also used.

Grasshopper collections were made at weekly intervals at each collection site throughout the growing season. Collections were not taken on rainy or excessively windy days or when the temperature was below 80° F. Five hundred standard sweeps with a sweep net, 15" in diameter and 28" deep,

constituted one site collection. Collected specimens were preserved in 75 percent alcohol until the crop contents could be analyzed.

Adult grasshopper identifications were verified by taxonomic keys and by comparisons with specimens in the collection of the Kansas State University Department of Entomology. This collection contains a large number of specimens from many previous studies, including those by Wilbur and Fritz (1940), Brusven (1966), and Campbell (1966). Many of the specimens in the collection were identified by A. B. Gurney of the U. S. National Museum and by Hebard (1931, 1934).

Identification of nymphal Kansas Acridinae was covered by Brusven (1966). Identification of nymphal Oedipodinae and Cyrtacanthacridinae of Kansas was difficult because of a scarcity of published keys. Criddle (1931) and Handford (1946) observed that most grasshopper genera could be differentiated in nymphal stages on the basis of adult characteristics. This author found adult characters to be of most value in differentiating nymphs of later stages. The author aided Merlyn A. Brusven and John B. Campbell in compiling a reference collection of nymphs of fifty species of grasshoppers found in Kansas pasture and rangeland. This reference collection, though not complete, proved a valuable aid to nymphal identification.

Crop content analysis data were recorded on I. B. M. data sheets as to collection date, location, collection site number, grasshopper species, instar, sex of adult, and plant species ingested. Empty crops and incidence of pollen, fungus, and arthropod parts were also recorded. The I. B. M. data sheets were then sent to North Dakota State University where I. B. M. data processing was done by Dr. Gregory B. Mulkern. These data were converted to tabular form, giving: the total number of specimens of each life stage of a species

collected per site; percentage of the total numbers of each specific life stage of a grasshopper species having ingested a particular plant species in each site; percentage of each life stage with empty crops or with pollen, fungus or arthropod parts ingested (Tables 7-30). In addition, each species was given a grass-forb index number for each site (Tables 33 and 34). The grass-forb index was obtained by subtracting the total percent of individuals of a species ingesting grasses from the total percent ingesting forbs. Grasshopper species whose ratings were 100 to 76 were classified as forb feeders; 75 to 26, mixed feeders preferring forbs; 25 to -25, mixed feeders; -26 to -75, mixed feeders preferring grasses, and; -76 to -100, grass feeders.

RESULTS AND DISCUSSION

A total of 2754 grasshopper crops were analyzed in 1965; 5781 in 1966. Thirty four species were represented. Crop content analyses data are presented in Tables 7 to 30, inclusive. Summaries of the grass-forb indices for each species taken from each collection site are presented in Tables 33 and 34. In some instances, insufficient numbers of individuals of a grasshopper species were collected and studied to show significant results. Crop content analysis tables for those were not included. Results are discussed, however, as they may be important indicators of food preferences. Summaries of numbers of individual species analyzed from each of the six collection sites are presented in Tables 31 and 32.

There is possible bias when comparing numbers of a grasshopper species among individual collection sites. Four species (Arophia simplex, Pardalophora haldemani, Chortophaga viridifaciata and Eritettix simplex) overwinter in Kansas in the nymphal stage. Hence, few early spring, third and fourth instar, specimens were collected. In addition, some species are more difficult to capture with a sweep net such as the subfamily Oedipodinae, in general, and Dissosteria carolina and Chortophaga viridifaciata in particular. Ageneotettix deorum often drops to the ground when disturbed rather than jumping, thus being more difficult to collect. On the other hand, it prefers short vegetation which favors collecting.

Pollen, fungus and arthropod parts were commonly found in the grasshopper crop; the ingestion rate varying with grasshopper species (Tables 7 to 30). Of these materials, fungus mycelium and spores were most commonly found. In many cases, the fungus could be seen growing on the plant fragments. In other instances the crops were almost totally filled with fungus exclusive of much plant material. This apparently indicated direct grasshopper feeding

Table 1. Relative plant abundance ratings (a) on grasshopper collection site I, planted western wheatgrass-Korean lespedeza pasture, Manhattan, Kansas, 1965-1966. Pasture treatment: mowed, heavily stocked. Soil type: silty clay.

Plants	Abundance ratings on							
	1965				1966			
	July 13	Sept. 13	June 5	July 10	July 28	Sept. 27	Avg.	
<u>Perennial grasses</u>								
<u>Acrionyon smithii</u>	4	4	3	4	4	4	4	4
<u>Andropogon gerardi</u>	2	2	2	2	1	1	2	2
<u>Andropogon scoparius</u>	-	-	-1	-1	-1	-1	-1	-1
<u>Bromus inermis</u>	1	1	1	1	1	1	1	1
<u>Schedonardus paniculatus</u>	-1	-1	-1	-1	-1	-1	-1	-1
<u>Sorghastrum nutans</u>	1	1	1	1	1	1	1	1
<u>Tridens flavus</u>	-1	-1	-1	-1	-1	-1	-1	-1
<u>Annual grass</u>								
<u>Aristida oligantha</u>	-1	-1	-1	-1	-1	-1	-1	-1
<u>Setaria spp.</u>	-1	-1	-1	-1	-1	-1	-1	-1
<u>Sedges</u>								
<u>Carex spp.</u>	1	-1	1	-1	-1	-1	-1	-1
<u>Perennial forbs</u>								
<u>Ambrosia psilostachya</u>	2	1	1	2	1	1	1	1
<u>Asclepidora viridis</u>	-1	-1	-1	-1	-1	-1	-1	-1
<u>Aster ericoides</u>	-1	-1	-1	-1	-1	-1	-1	-1
<u>Kuhnia guataporeoides</u>	-1	-1	-1	-1	-1	-1	-1	-1
<u>Medicago sativa</u>	-1	-1	-1	-1	-1	-1	-1	-1
<u>Oxalis stricta</u>	-1	-1	-1	-1	-1	-1	-1	-1
<u>Ruellia ciliosa</u>	-1	-1	-1	-1	-1	-1	-1	-1
<u>Rumex crispus</u>	-1	-1	-1	-1	-1	-1	-1	-1

Table 1 (Cont.)

Plants	Abundance ratings on						
	1965			1966			Avg.
	July 13	Sept. 13	June 5	July 10	July 28	Sept. 27	
<u>Perennial forbs</u>							
<u>Schrankia nuttallii</u>	-1	-1	-1	-1	-1	-1	-1
<u>Solidago missouriensis</u>	-	-	-1	-1	-1	-1	-1
<u>Verbena stricta</u>	-1	-1	-1	-1	-1	-1	-1
<u>Vernonia baldwini</u>	2	2	-1	2	-1	-1	1
<u>Biennial forb</u>							
<u>Cirsium undulatum</u>	-1	-1	-1	-1	-1	-1	-1
<u>Annual forbs</u>							
<u>Chenopodium album</u>	-	-	-1	-1	-1	-1	-1
<u>Eriogonon strigosus</u>	-1	-1	-1	-1	-1	-1	-1
<u>Hibiscus trionum</u>	-1	-1	-1	-1	-	-	-1
<u>Lespedeza stipulacea</u>	5	4	3	5	4	4	4
<u>Solanum carolinense</u>	1	-1	-1	1	1	1	1
<u>Solanum rostratum</u>	-	-	-1	-1	-1	-1	-1
<u>Woody plants</u>							
<u>Rhus radicans</u>	-1	-1	-1	-1	-1	-	-1
<u>Rosa arkansana suffulta</u>	-1	-1	-1	-1	-1	-1	-1
<u>Symphoricarpos orbiculatus</u>	-1	-1	-1	-1	-	-	-1
<u>Vitis vulpina</u>	-1	-1	-1	-1	-1	-1	-1

(a) 5=very abundant, 4=abundant, 3=frequent, 2=occasional, 1=rare, -1=trace.

Table 2. Relative plant abundance ratings (a) on grasshopper collection site II, planted smooth bromesweetclover-alfalfa pasture, Manhattan, Kansas, 1965-1966. Pasture treatment: none, not stocked. Soil type: silty clay.

Plants	Abundance ratings on							
	1965				1966			
	July 13	Sept. 13	June 5	July 10	July 28	Sept. 27	Avg.	
Perennial grass								
<u>Bromus inermis</u>	5	5	5	5	5	5	5	
Perennial forbs								
<u>Ambrosia psilostachya</u>	-1	-1	-1	-1	-1	-1	-1	-1
<u>Asclepias sullivantii</u>	-1	-1	-1	-1	-1	-1	-1	-1
<u>Helianthus maximiliani</u>	-1	-1	-1	-1	-1	-1	-1	-1
<u>Medicago sativa</u>	1	1	1	1	1	1	1	1
<u>Melilotus alba</u>	-1	-1	-1	-1	-1	-1	-1	-1
<u>Melilotus officinalis</u>	1	1	1	1	1	1	1	1
<u>Ruellia humilis</u>	-1	-1	-1	-1	-1	-1	-1	-1
<u>Verbena stricta</u>	-1	-1	-1	-1	-1	-1	-1	-1
Annual forbs								
<u>Croton spp.</u>	-1	-1	-1	-1	-1	-1	-1	-1
<u>Euphorbia (mat-forming spp.)</u>	-	-	-	-	-	-	-	-

(a) 5=very abundant, 4=abundant, 3=frequent, 2=occasional, 1=rare, -1=trace.

Table 3. Relative plant abundance ratings(a) on grasshopper collection site III, Kentucky bluegrass pasture, Manhattan, Kansas, 1965. Pasture treatment: periodically heavily stocked, then rested, at 2 month intervals. Soil type: silty, clay loam.

Plants	Abundance ratings on			Avg.
	July 13	Sept. 13	1965	
<u>Perennial grasses</u>				
<u>Andropogon gerardi</u>	3	3		3
<u>Andropogon scoparius</u>	1	1		1
<u>Bouteloua curtipendula</u>	2	2		2
<u>Chloris verticillata</u>	-1	-1		-1
<u>Poa pratensis</u>	4	4		4
<u>Sorghastrum nutans</u>	1	1		1
<u>Sporobolus cryptandrus</u>	-1	-1		-1
<u>Annual grasses</u>				
<u>Bromus japonicus</u>	3	2		2.5
<u>Bromus tectorum</u>	2	2		2
<u>Setaria spp.</u>	-1	-1		-1
<u>Sedges</u>				
<u>Carex spp.</u>	-1	-1		-1
<u>Perennial forbs</u>				
<u>Achillea millefolium lanulosa</u>	-1	-1		-1
<u>Ambrosia artemisiifolia</u>	-1	-1		-1
<u>Convolvulus arvensis</u>	-1	-1		-1
<u>Taraxacum officinale</u>	1	1		1
<u>Biennial forb</u>				
<u>Cirsium undulatum</u>	-1	-1		-1

Table 3. (Cont.)

Plants	Abundance ratings on		
	July 13	Sept. 13	Avg.
Annual forbs			
<u>Euphorbia serpens</u>	-1	-1	-1
<u>Solanum rostratum</u>	-1	-1	-1

(a) 5=very abundant, 4=abundant, 3=frequent, 2=occasional, 1=rare, -1=trace.

Table 4. Relative plant abundance ratings^(a) on grasshopper collection site IV, planted smooth brome pasture, Manhattan, Kansas, 1965-1966. Pasture treatment: mowed, herbicide treatments, heavily stocked.
Soil type: silty clay.

Plants	Abundance ratings on									
	1965					1966				
	July 13	Sept. 13	June 5	July 5	July 10	July 28	Sept. 27	Avg.		
<u>Perennial grass</u>										
<u>Bromis inermis</u>	5	5	5	5	5	3	3	5		
<u>Annual grasses</u>										
<u>Digitaria sanguinalis</u>	-1	-1	-1	-1	-1	-1	-1	-1		
<u>Eragrostis cilianensis</u>	-1	-1	-1	-1	-1	-1	-1	-1		
<u>Perennial forbs</u>										
<u>Ambrosia artemisiifolia</u>	1	1	1	1	-	-1	-	1		
<u>Convolvulus arvensis</u>	2	2	2	1	1	2	1	2		
<u>Physalis spp.</u>	-1	-1	-1	-1	-1	-1	-1	-1		
<u>Rumex crispus</u>	-1	-1	-1	-1	-1	-1	-1	-1		
<u>Salvia azurea</u>	-1	-1	-1	-1	-1	-1	-	-1		
<u>Annual forbs</u>										
<u>Chenopodium album</u>	-1	-1	-1	-1	-1	-1	-	-1		
<u>Conyza canadensis</u>	-1	-1	-1	-1	-1	-1	-	-1		
<u>Kochia scolaria</u>	1	1	1	1	1	-1	-	1		
<u>Lactuca scariola</u>	-1	-1	-1	-1	-1	-1	-	-1		
<u>Solanum carolinense</u>	-1	-1	-1	-1	-1	-1	-1	-1		

(a) 5=very abundant, 4=abundant, 3=frequent, 2=occasional, 1=rare, -1=trace.

Table 5. Relative plant abundance ratings^(a) on grasshopper collection site V, planted smooth brome pasture, Manhattan, Kansas, 1966. Pasture treatment: moderately stocked. Soil type: silty clay.

Plants	Abundance ratings on				
	1966				
	June 5	July 10	July 28	Sept. 27	Avg.
<u>Perennial grasses</u>					
<u>Bromus inermis</u>	5	5	5	5	5
<u>Poa pratensis</u>	-1	-1	-1	-1	-1
<u>Annual grass</u>					
<u>Bromus japonicus</u>	-1	-1	-1	-1	-1
<u>Perennial forbs</u>					
<u>Ambrosia artemisiifolia</u>	1	1	1	1	1
<u>Ambrosia psilostachya</u>	1	1	1	1	1
<u>Antennaria neglecta</u>	-1	-1	-1	-1	-1
<u>Artemisia vulgaris</u>	-1	-1	-1	-1	-1
<u>Asclepias tuberosa</u>	-1	-1	-1	-1	-1
<u>Astragalus carvocalypus</u>	-1	-1	-1	-1	-1
<u>Lespedeza capitata</u>	-1	-1	-1	-1	-1
<u>Petalostemum multiflorum</u>	-1	-1	-1	-1	-1
<u>Solidago missouriensis</u>	-1	-1	-1	-1	-1
<u>Verbena stricta</u>	-1	-1	-1	-1	-1
<u>Vernonia baldwini</u>	1	1	1	-1	1
<u>Biennial forbs</u>					
<u>Cirsium undulatum</u>	-1	-1	-1	-1	-1
<u>Grindelia squarrosa</u>	-1	-1	-1	-1	-1
<u>Annual forbs</u>					
<u>Amaranthus retroflexus</u>	-1	-1	-1	-1	-1

Table 5. (Cont.)

Plants	Abundance ratings on				
	1966				
	June 5	July 10	July 28	Sept. 27	Avg.
Annual forbs					
<u>Euphorbia</u> (mat-forming spp.)	-1	-1	-1	-1	-1
<u>Euphorbia marginata</u>	-1	-1	-1	-1	-1
<u>Kochia scoparia</u>	-1	-1	-1	-1	-1
<u>Lesidium densiflorum</u>	-1	-1	-1	-1	-1
<u>Solanum carolinense</u>	-1	-1	-1	-1	-1
<u>Solanum rostratum</u>	-1	1	1	1	1

(a) 5=very abundant, 4=abundant, 3=frequent, 2=occasional, 1=rare, -1=trace.

Table 6. Relative plant abundance ratings (a) on grasshopper collection site VI, planted reed canary-grass-smooth brome pasture, Manhattan, Kansas, 1966. Pasture treatment: smooth brome areas mowed, not stocked. Soil type: silt loam and silty, clay loam.

Plants	Abundance ratings on			Avg.
	1966			
	July 23	Sept. 27		
<u>Perennial grasses</u>				
<u>Bromus inermis</u>	5	5	5	5
<u>Eragrostis foetabilis</u>	-1	-1	-1	-1
<u>Festuca arundinacea</u>	-1	-1	-1	-1
<u>Phalaris arundinacea</u>	5	5	5	5
<u>Spartina pectinata</u>	1	1	1	1
<u>Sporobolus asper</u>	-1	-1	-1	-1
<u>Tridens flavus</u>	-1	-1	-1	-1
<u>Annual grasses</u>				
<u>Bromus isoenicis</u>	1	1	1	1
<u>Digitaria sanguinalis</u>	1	1	1	1
<u>Setaria lutescens</u>	-1	-1	-1	-1
<u>Setaria viridis</u>	-1	-1	-1	-1
<u>Sedges</u>				
<u>Carex spp.</u>	-1	-1	-1	-1
<u>Cattail</u>				
<u>Typha latifolia</u>	1	1	1	1
<u>Perennial forbs</u>				
<u>Ambrosia artemisiifolia</u>	-1	-1	-1	-1
<u>Ambrosia psilostachya</u>	-1	-1	-1	-1
<u>Ampelamus albidus</u>	-1	-1	-1	-1

Table 6. (Cont.)

Plants	Abundance ratings on			Avg.
	1966			
	July 28	Sept. 27		
<u>Perennial forbs</u>				
<u>Callirhoe involucrata</u>	-1	-1	-1	
<u>Convolvulus arvensis</u>	1	1	1	
<u>Desmanthus illinoensis</u>	-1	-1	-1	
<u>Lespedeza capitata</u>	-1	-1	-1	
<u>Medicago sativa</u>	-1	-1	-1	
<u>Melilotus alba</u>	-1	-1	-1	
<u>Oxalis stricta</u>	-1	-1	-1	
<u>Physalis spp.</u>	-1	-1	-1	
<u>Polygonum pennsylvanicum</u>	1	1	1	
<u>Ruellia ciliosa</u>	-1	-1	-1	
<u>Rumex crispus</u>	-1	-1	-1	
<u>Sagittaria latifolia</u>	1	1	1	
<u>Vernonia altissima</u>	-1	-1	-1	
<u>Biennial forbs</u>				
<u>Cirsium altissimum</u>	-1	-1	-1	
<u>Gaura parviflora</u>	-1	-1	-1	
<u>Verbascum thapsus</u>	-1	-1	-1	
<u>Annual forbs</u>				
<u>Amaranthus retroflexus</u>	-1	-1	-1	
<u>Chenopodium album</u>	-1	-1	-1	
<u>Coryza canadensis</u>	-1	-1	-1	
<u>Euphorbia marginata</u>	-1	-1	-1	
<u>Euphorbia (mat-forming spp.)</u>	1	1	1	
<u>Lactuca scariola</u>	1	1	1	

Table 6. (Cont.)

Plants	Abundance ratings on		
	July 28	Sept. 27	Avg.
1966			
Annual forbs			
<u>Tribulus terrestris</u>	1	1	1
Woody plants			
<u>Amorpha fruticosa</u>	2	2	2
<u>Populus spp.</u>	-1	-1	-1
<u>Salix spp.</u>	-1	-1	-1
<u>Sambucus canadensis</u>	-1	-1	-1
<u>Vitis vulpina</u>	-1	-1	-1

(a) 5=very abundant, 4=abundant, 3=frequent, 2=occasional, 1=rare, -1=trace.

Table 7. Food ingestions by Orbhulella speciosa in planted pasture collection sites. Manhattan, Kansas 1965.

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty									
	Instars					Adults				
	All instars and Adults	1(104)	(a) 2(130)	3(278)	4(109)	5(62)	Male(35)	Female(30)		
Collection site I										
Perennial grasses	44	59	50	32	35	39	50	47		
<u>Agropyron smithii</u>	1	0	0	0	1	3	2	2		
<u>Andropogon gerardi</u>	17	14	12	16	23	17	10	22		
<u>Bromus inermis</u>	1	0	0	4	1	3	0	0		
<u>Schedonnardus paniculatus</u>	5	11	6	9	2	10	5	4		
<u>Sorghastrum nutans</u>										
Annual grasses	2	0	0	0	5	3	4	1		
<u>Aristida oligantha</u>	4	0	0	4	9	3	2	5		
<u>Setaria lutescens</u>										
Unidentified grasses	10	7	12	11	7	10	13	6		
Annual forb	10	11	18	16	11	3	5	12		
<u>Lespedeza stipulacea</u>										
Unidentified forbs	1	0	0	0	0	3	1	0		
Fungus	24	40	37	16	18	14	27	25		
Arthropod parts	7	7	0	4	3	7	8	12		
Empty crops	17	22	20	18	25	12	19	2		
Total specimens analyzed	(434)									
Grass-Forb Index ^(b)	(-71)									
Collection site II										
Perennial grass	100	(5) ^(a) 100	(5) 100	(8) 100	(26) 100	(15) 100	(1) 100	(2) 100		
<u>Bromus inermis</u>										

Table 7. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty							
	Instars				Adults			
	All Instars and Adults	1(5)(a)	2(5)	3(8)	4(26)	5(15)	Male(1)	Female(2)
		Collection site II (cont.)						
Unidentified forbs	1	0	0	12	0	0	0	0
Fungus	18	0	20	12	22	25	0	0
Arthropod parts	9	0	20	12	4	16	0	0
Empty crops	12	0	0	0	15	20	0	50
Total specimens analyzed	(62)							
Grass-Forb Index(b)	(.99)							
		Collection site III						
		(12)(a)	(11)	(5)	(2)	(7)	(38)	(15)
Perennial grasses	6	0	0	25	0	28	3	7
Andropogon gerardi	7	0	12	25	0	14	3	14
Andropogon scoparius	25	18	37	0	0	42	25	28
Bouteloua curtipendula	2	0	0	0	0	0	6	0
Chloris verticillata	29	54	25	25	50	0	31	21
Poa pratensis	3	0	25	0	0	0	0	7
Sorghastrum nutans	1	0	0	0	0	0	3	0
Sporobolus asper	1	0	0	0	0	0	3	0
Sporobolus cryptandrus								
Annual grasses								
Aristida oligantha	6	0	0	0	0	0	9	14
Bromus japonicus	6	9	0	0	0	0	12	0
Setaria lutescens	10	0	25	25	50	0	9	7

Table 7. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty							
	All Instars and Adults		Instars					
	1(12)	(a) 2(11)	3(5)	4(2)	5(7)	Male(38)	Female(15)	Adults
Collection site III (cont.)								
Unidentified grasses	5	18	0	0	14	3	0	0
Grass-like plants								
Carex spp.	1	0	0	0	0	3	0	0
Perennial forb								
Convolvulus arvensis	1	0	0	0	50	0	0	0
Pollen	5	0	25	0	0	0	3	7
Fungus	2	0	0	0	0	0	3	7
Arthropod parts	3	9	0	0	14	3	0	0
Empty crops	13	8	27	20	0	15	6	6
Total specimens analyzed	(90)							
Grass-Forb Index ^(b)	(-97)							
Collection site IV								
Perennial grass		(7) ^(a)	(31)	(13)	(22)	(18)	(51)	(71)
Bromus inermis	97	100	92	90	100	100	97	100
Annual grasses								
Bromus laeonicius	1	0	0	10	0	0	0	0
Eragrostis ciliaris	1	0	0	0	0	0	2	0

Table 7. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	All Instars and Adults		Instars		Adults		
	1(7)	(a) 2(31)	3(13)	4(22)	5(18)	Male(51)	Female(71)
	Collection site IV (cont.)						
<u>Unidentified grasses</u>	1	0	0	0	0	2	1
<u>Annual Forb</u>							
<u>Ambrosia artemisiifolia</u>	1	0	0	0	6	0	0
<u>Unidentified forbs</u>							
Pollen	1	0	0	0	0	0	1
Fungus	23	14	32	50	26	13	21
Arthropod parts	4	0	0	0	6	0	5
Empty crops	19	0	19	23	31	16	33
Total specimens analyzed	(213)						8
Grass-Forb Index	(-.96)						

(a) Actual number of grasshoppers analyzed; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 8. Food ingestions by Ornithella speciosa in planted pasture collection sites. Manhattan, Kansas. 1966.

Crop Contents	of crops containing All Instars and Adults	Percent						of empty parts, or empty Adults
		Instars						
		1(0)	(a) 2(2)	3(19)	4(61)	5(40)	Male(190)	
Collection site I								
Perennial grasses								
<u>Acropyron smithii</u>	60	0	0	52	57	59	60	61
<u>Andropogon gerardi</u>	1	0	0	0	0	0	2	2
<u>Bromus inermis</u>	14	0	0	23	8	13	15	16
<u>Schedonnardus paniculatus</u>	1	0	0	0	1	0	1	0
<u>Sorghastrum nutans</u>	2	0	0	0	0	0	2	3
Annual grass								
<u>Setaria lutescens</u>	2	0	50	11	3	2	2	1
Unidentified grasses	11	0	50	5	15	16	10	11
Annual forb								
<u>Lespedeza stioleacea</u>	4	0	0	5	5	5	5	3
Fungus	40	0	0	35	35	56	41	38
Arthropod parts	2	0	0	0	0	2	2	3
Empty crops	4	0	0	10	3	7	5	1
Total specimens analyzed	(463)							
Grass-Forb Index (b)	(-91)							

Table 8. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty							
	Instars				Adults			
	All Instars and Adults	1(0)(a)	2(0)	3(4)	4(0)	5(0)	Male(1)	Female(0)
Collection site II								
Perennial grass <u>Bromus inermis</u>	100	0	0	100	0	0	100	0
Fungus	100	0	0	100	0	0	0	0
Empty crops	40	0	0	25	0	0	0	0
Total specimens analyzed	(5)							
Grass-Forb Index (b)	(-100)							
Collection site IV								
Perennial grass <u>Bromus inermis</u>	91	100	83	96	86	96	92	92
Annual grasses								
<u>Digitaria sanguinalis</u>	3	0	0	0	4	3	2	3
<u>Eragrostis cilienensis</u>	1	0	0	0	0	0	0	1
Unidentified grasses	4	0	16	4	8	0	6	2
Fungus	67	100	33	60	59	56	68	85
Arthropod parts	5	0	0	0	8	1	4	11
Empty crops	27	88	80	50	25	17	20	8
Total specimens analyzed	(461)							
Grass-Forb Index (b)	(-100)							

Table 8. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty Adults								
	Instars						Adults		
	All Instars and Adults	1(4)	(a) 2(9)	3(45)	4(190)	5(97)		Male(247)	Female(160)
		Collection site V							
<u>Perennial grasses</u>									
<u>Bouteloua curtipendula</u>	1	0	0	0	0	0	0	1	5*
<u>Bromus inermis</u>	87	50	87	76	88	88	88	91	84
<u>Poa pratensis</u>	1	0	12	0	3	1	1	0	1
<u>Annual grass</u>									
<u>Bromus japonicus</u>	1	0	0	0	2	1	1	1	2
<u>Unidentified grasses</u>	5	50	0	14	4	4	4	5	4
<u>Perennial forbs</u>									
<u>Ambrosia psilostachya</u>	1	0	0	0	0	0	0	1	1
<u>Vernonia baldwini</u>	1	0	0	0	1	0	0	0	1
<u>Annual forbs</u>									
<u>Ambrosia artemisiifolia</u>	1	0	0	0	0	0	0	0	1
<u>Kochia scoparia</u>	1	0	0	2	0	0	0	0	0
<u>Solanum carolinense</u>	1	0	0	0	0	0	0	0	1
<u>Unidentified forbs</u>	2	0	0	8	1	4	1	1	3
<u>Fungus</u>	46	0	25	32	34	43	43	53	56
<u>Arthropod parts</u>	8	0	0	2	3	18	18	10	8
<u>Empty crops</u>	23	50	11	24	32	25	25	25	7
Total specimens analyzed	(752)								
Grass-Forb Index ^(b)	(-92)								

Table 8. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	All Instars and Adults			Instars		Adults	
	1(0)	(a) 2(0)	3(0)	4(0)	5(1)	Male(3)	Female(3)
Collection site VI							
<u>Perennial grasses</u>							
<u>Bromus inermis</u>	83	0	0	0	100	100	50
<u>Phalaris arundinacea</u>	16	0	0	0	0	0	50
<u>Annual forb</u>							
<u>Ambrosia artemisiifolia</u>	16	0	0	0	0	33	0
<u>Fungus</u>							
<u>Empty crops</u>	33	0	0	0	0	100	0
<u>Total specimens analyzed</u>	14	0	0	0	0	0	33
<u>Grass-Forb Index(b)</u>	(7)						
	(-84)						

(a) Actual number of grasshoppers analyzed; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 9. Food ingestions by Melanoolus femurrubrum in planted pasture collection sites. Manhattan, Kansas. 1965.

Crop Contents	Percent						
	of crops containing plant parts, pollen, fungus, arthropod parts, or empty			Instars			Adults
	All Instars and Adults 1(104)	(a) 2(130)	3(278)	4(109)	5(62)	Male(35)	Female(30)
Collection site I							
<u>Perennial grasses</u>							
<u>Agropyron smithii</u>	4	2	1	4	5	12	15
<u>Andropogon gerardi</u>	0	0	0	1	0	0	0
<u>Bromus inermis</u>	10	6	13	9	7	25	11
<u>Sorghastrum nutans</u>	0	0	1	1	0	0	0
<u>Annual grasses</u>							
<u>Setaria lutescens</u>	1	0	1	3	0	1	0
<u>Unidentified grasses</u>	3	2	4	3	3	1	0
<u>Perennial forbs</u>							
<u>Ambrosia psilostachya</u>	3	0	3	4	0	5	3
<u>Medicago sativa</u>	4	5	8	4	1	3	0
<u>Vernonia baldovini</u>	1	5	1	2	1	0	0
<u>Biennial forb</u>							
<u>Cirsium undulatum</u>	1	2	0	0	1	1	0
<u>Annual forbs</u>							
<u>Lespedeza stipulacea</u>	46	47	48	47	53	21	26
<u>Solanum carolinense</u>	1	0	0	1	1	0	0
<u>Unidentified forbs</u>	12	20	10	9	10	15	7

Table 9. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars			Adults			
	All Instars and Adults 1(104)	(a) 2(130)	3(278)	4(109)	5(62)	Male(35)	Female(30)
	Collection site I (cont.)						
Pollen	0	1	0	0	0	0	0
Fungus	32	35	32	28	32	36	40
Arthropod parts	12	10	6	8	15	15	21
Empty crops	24	29	33	28	15	8	8
Total specimens analyzed	(748)						
Grass-Forb Index(b)	(62)						13
	Collection site II						
		(11)(a)	(25)	(35)	(17)	(13)	(35)
Perennial grass	42	50	43	27	36	33	51
<u>Bromus inermis</u>							71
Perennial forbs							
<u>Ambrosia psilostachya</u>	1	0	0	9	0	0	0
<u>Helianthus maximiliani</u>	1	0	0	4	0	0	0
<u>Medicago sativa</u>	5	0	6	0	18	8	6
<u>Melilotus</u> spp.	52	25	37	59	45	50	58
Unidentified forbs	10	25	18	9	9	25	0
Pollen	4	25	6	0	0	8	6
Fungus	27	0	25	13	45	50	27
Arthropod parts	4	0	0	0	18	0	6
Empty crops	29	63	36	37	35	7	17
Total specimens analyzed	(143)						0
Grass-Forb Index(b)	(26)						

Table 9. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty Adults							
	Instars				Adults			
	All Instars and Adults	1(12)	(a) 2(5)	3(7)	4(5)	5(8)	Male(1)	Female(1)
Collection site III								
Perennial grasses								
<u>Bouteloua curtipendula</u>	2	10	0	0	0	0	0	0
<u>Poa pratensis</u>	58	70	100	42	40	71	0	0
Annual grasses								
<u>Bromus laeonis</u>	14	0	0	0	0	57	0	100
<u>Setaria lutescens</u>	5	0	0	14	0	14	0	0
Perennial forbs								
<u>Ambrosia psilostachya</u>	2	10	0	0	0	0	0	0
<u>Convolvulus arvensis</u>	14	20	0	14	40	0	0	0
<u>Oxalis stricta</u>	2	0	0	14	0	0	0	0
<u>Taraxacum officinale</u>	14	0	0	14	40	0	100	100
Pollen	17	20	66	0	40	0	0	0
Fungus	23	10	33	0	0	71	0	100
Arthropod parts	2	0	0	14	0	0	0	0
Empty crops	12	16	40	0	0	12	0	0
Total specimens analyzed	(39)							
Grass-Forb Index	(-26)							
Collection site IV								
(33)(a)	(23)	(54)	(103)	(47)	(16)	(14)		
Perennial grass								
<u>Bromus inermis</u>	62	23	70	40	81	76	28	44

Table 9. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	All Instars and Adults		Instars		Adults		
	1(33)	(a) 2(23)	3(54)	4(103)	5(47)	Male(16)	Female(14)
Collection site IV (cont.)							
<u>Annual grasses</u>							
<u>Bromus japonicus</u>	1	4	0	2	0	0	0
<u>Eragrostis ciliaris</u>	1	0	0	0	0	0	11
<u>Unidentified grasses</u>	1	4	5	0	1	2	0
<u>Perennial forbs</u>							
<u>Convolvulus arvensis</u>	21	28	20	45	13	17	0
<u>Physalis spp.</u>	1	4	0	0	1	0	0
<u>Salvia azurea</u>	1	8	0	0	0	0	7
<u>Annual forbs</u>							
<u>Ambrosia artemisiifolia</u>	13	14	15	2	6	17	57
<u>Kochia scoparia</u>	11	23	20	12	5	5	28
<u>Lactuca scariola</u>	1	9	5	2	0	0	0
<u>Unidentified forbs</u>	5	4	0	7	2	2	14
<u>Pollen</u>	7	14	0	2	0	2	64
<u>Fungus</u>	18	38	20	22	6	23	21
<u>Arthropod parts</u>	9	19	0	5	5	7	35
<u>Empty crops</u>	25	36	13	25	30	17	12
<u>Total specimens analyzed</u>	(290)						
<u>Grass-Forb Index^(b)</u>	(-19)						

(a) Actual number of grasshoppers examined; not a percentage.

Table 9. (Cont.)

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 10. Food ingestions by Melanoplus femurrubrum in planted pasture collection sites. Manhattan, Kansas. 1966.

Crop Contents	Percent						
	of crops containing plant parts, pollen, fungus, arthropod parts, or empty			Instars			
	All Instars and Adults	1(0)(a)	2(20)	3(105)	4(77)	5(33)	Male(24) Female(9)
Collection site I							
<u>Perennial grasses</u>							
<u>Acorosyon smithii</u>	4	0	5	7	1	0	9 0
<u>Bromus inermis</u>	4	0	0	4	4	6	14 0
<u>Unidentified grasses</u>	4	0	5	4	5	0	4 0
<u>Perennial forbs</u>							
<u>Ambrosia psilostachya</u>	5	0	0	3	11	6	4 4 0
<u>Medicago sativa</u>	10	0	0	10	16	3	9 12
<u>Solidago missouriensis</u>	1	0	5	0	0	9	0 0
<u>Vernonia baldwini</u>	5	0	0	7	4	6	0 12
<u>Annual forb</u>							
<u>Lespedeza stipulacea</u>	63	0	70	63	61	75	47 62
<u>Unidentified forbs</u>	7	0	11	6	4	6	19 12
<u>Fungus</u>	52	0	47	54	48	45	57 75
<u>Arthropod parts</u>	10	0	0	2	10	12	52 25
<u>Empty crops</u>	9	0	15	9	11	0	12 11
Total specimens analyzed	(268)						
Grass-Forb Index	(75)						

Table 10. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	All Instars and Adults	Instars			Adults		
		1(1)(a)	2(2)	3(42)	4(25)	5(23)	Male(17)
Collection site II							
<u>Perennial grass</u>							
<u>Bromus inermis</u>	20	0	0	3	22	21	42 36
<u>Unidentified grasses</u>	1	0	0	0	0	0	0 9
<u>Perennial forbs</u>							
<u>Ambrosia psilostachya</u>	15	0	0	13	18	26	7 9
<u>Medicago sativa</u>	15	0	50	27	13	5	7 9
<u>Melilotus spp.</u>	46	0	50	37	59	52	57 27
<u>Unidentified forbs</u>	9	100	0	17	4	0	7 9
<u>Fungus</u>	60	100	100	17	22	42	78 63
<u>Arthropod parts</u>	22	0	0	13	22	10	28 63
<u>Empty crops</u>	19	0	0	30	12	17	17 8
<u>Total specimens analyzed</u>	(122)						
<u>Grass-Forb Index</u>	(60)						
Collection site IV							
<u>Perennial grass</u>							
<u>Bromus inermis</u>	67	0	84	65	64	100	25 60
<u>Annual grass</u>							
<u>Dioitaria sanguinalis</u>	1	0	0	1	0	0	0 20

Table 10. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty instars						
	Instars						
	All Instars and Adults	1(1)(a)	2(46)	3(174)	4(36)	5(1)	Male(4) Female(5)
Collection site IV (cont.)							
<u>Unidentified orasses</u>	5	0	7	5	3	0	0
<u>Perennial forbs</u>							
<u>Ambrosia osilostachya</u>	1	0	0	1	0	0	0
<u>Convolvulus arvensis</u>	15	0	0	15	22	0	50 20
<u>Medicago sativa</u>	1	0	0	0	0	0	25 0
<u>Annual forbs</u>							
<u>Ambrosia artemisiifolia</u>	8	0	0	9	12	0	0 0
<u>Kochia scroaria</u>	2	0	3	2	3	0	0 0
<u>Lactuca scariola</u>	1	0	0	0	0	0	25 0
<u>Solanum carolinense</u>	1	0	0	1	3	0	0 0
<u>Unidentified forbs</u>	10	0	3	10	9	0	25 20
<u>Pollen</u>	1	0	0	1	0	0	25 0
<u>Fungus</u>	53	0	46	51	54	100	75 100
<u>Arthropod parts</u>	12	0	11	8	12	0	50 80
<u>Empty crops</u>	36	0	43	40	13	0	0 0
Total specimens analyzed	(267)						
Grass-Forb Index	(-37)						

Table 10. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty Adults							
	Instars						Adults	
	All Instars and Adults	1(10)(a)	2(54)	3(103)	4(26)	5(9)		Male(6)
Collection site V								
<u>Perennial grasses</u>								
<u>Bromus inermis</u>	55	55	58	54	54	75	33	56
<u>Poa pratensis</u>	2	0	6	2	0	0	0	0
<u>Annual grass</u>								
<u>Bromus japonicus</u>	3	0	3	2	4	12	0	0
<u>Unidentified grasses</u>								
	4	11	0	2	0	0	16	18
<u>Perennial forbs</u>								
<u>Ambrosia psilostachya</u>	4	11	3	4	4	0	0	6
<u>Vernonia baldwini</u>	11	0	24	14	0	12	16	0
<u>Annual forbs</u>								
<u>Ambrosia artemisiifolia</u>	7	0	3	11	4	0	16	6
<u>Kochia scoparia</u>	4	0	3	7	4	0	0	6
<u>Solanum carolinense</u>	3	0	6	1	9	12	0	0
<u>Unidentified forbs</u>								
	11	22	10	8	18	0	33	12
<u>Fungus</u>								
<u>Arthropod parts</u>	28	66	10	22	40	50	33	37
<u>Empty crops</u>	4	0	0	0	0	37	0	31
<u>Total specimens analyzed</u>	29	10	46	31	15	11	0	15
(227)								
<u>Grass-Forb Index(b)</u>								
(-22)								

Table 10. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty instars							
	Instars				Adults			
	All Instars and Adults	1(10)(a)	2(4)	3(12)	4(14)	5(24)	Male(11)	Female(13)
Collection site VI								
<u>Perennial grasses</u>								
<u>Bromus inermis</u>	26	0	0	11	50	22	27	33
<u>Phalaris arundinacea</u>	33	0	50	33	20	31	45	33
<u>Annual grasses</u>								
<u>Digitaria sanguinalis</u>	4	0	25	22	0	0	0	0
<u>Setaria lutescens</u>	1	0	0	11	0	0	0	0
<u>Unidentified grasses</u>	16	0	25	11	10	18	9	25
<u>Perennial forbs</u>								
<u>Ambrosia psilostachya</u>	1	0	0	0	0	4	0	0
<u>Convolvulus arvensis</u>	2	0	0	11	0	0	9	0
<u>Polygonum pennsylvanicum</u>	1	0	0	0	0	4	0	0
<u>Annual forbs</u>								
<u>Kochia scoparia</u>	2	0	0	0	10	0	9	0
<u>Lactuca scariola</u>	2	0	0	0	0	4	9	0
<u>Unidentified forbs</u>	7	0	25	0	10	13	0	0
<u>Pollen</u>	1	0	0	0	10	0	0	0
<u>Fungus</u>	50	0	25	66	40	40	45	75

Table 10. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars			Adults			
	All Instars and Adults	1(10)(a)	2(4)	3(12)	4(14)	5(24)	Male(11) Female(13)
Collection site VI (cont.)							
Arthropod parts	5	0	0	11	0	0	9 16
Empty crops	12	0	0	25	23	8	0 7
Total specimens analyzed	(78)						
Grass-Forb Index(b)	(-63)						

(a) Actual number of grasshoppers examines; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs, 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -23=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 11. Food ingestions by Phoebastria nebrascensis in planted pasture collection sites. Manhattan, Kansas. 1965.

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	All Instars and Adults			Instars			
	1(1)	(a)	2(5)	3(7)	4(1)	5(1)	Adults
Collection site I							
						Male(3)	Female(2)
Perennial grasses	18	0	25	0	0	100	0
<u>Acropyron smithii</u>	6	0	25	0	0	0	0
<u>Bromus inermis</u>	6	100	0	0	0	0	0
<u>Sorghastrum nutans</u>	12	0	0	0	100	0	0
Unidentified grasses							
Perennial forbs	6	0	0	16	0	0	0
<u>Ambrosia psilostachya</u>	6	0	0	16	0	0	0
<u>Medicago sativa</u>							
Biennial forbs	12	0	0	33	0	0	0
<u>Cirsium undulatum</u>							
Annual forbs	31	0	50	33	0	0	100
<u>Lespedeza stipulacea</u>							
Pollen	6	0	0	16	0	0	0
Fungus	18	0	0	16	0	100	0
Arthropod parts	12	0	0	16	0	50	0
Empty crops	20	0	20	14	0	33	50
Total specimens analyzed	(20)						
Grass-Forb Index	(13)						

Table 11. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty Adults							
	Instars			Adults				
	All Instars and Adults	1(75) 2(114)	(a) 3(162)	4(207)	5(57)	Male(44)	Female(24)	
Collection site II								
Perennial grass <u>Bromus inermis</u>	96	98	98	96	96	89	97	100
Unidentified grasses	1	1	0	1	0	0	0	0
Perennial forbs								
<u>Medicago sativa</u>	1	0	0	0	0	2	0	0
<u>Melilotus</u> spp.	2	0	0	2	2	12	4	0
Unidentified forbs	1	0	0	1	1	0	0	0
Fungus	29	31	32	21	30	42	35	15
Arthropod parts	9	10	6	10	5	6	21	25
Empty crops	22	14	30	25	22	17	4	16
Total specimens analyzed (683)								
Grass-Forb Index (-94)								
Collection site III								(1)
	(1)(a)	(1)	(4)	(2)	(0)	(2)	(2)	
Perennial grasses								
<u>Andropogon scoparius</u>	20	0	0	50	0	0	0	0
<u>Bouteloua curtipendula</u>	20	0	0	0	100	0	0	0
<u>Panicum virgatum</u>	10	0	0	25	0	0	0	0
<u>Poa pratensis</u>	50	0	100	25	0	0	100	100

Table 11. (Cont.)

Crop Contents	Percent						
	of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars						
All Instars and Adults	1(1)(a)	2(1)	3(4)	4(2)	5(0)	Male(2)	Female(1)
Collection site III (cont.)							
Fungus	10	0	25	0	0	0	0
Empty crops	9	100	0	0	0	0	0
Total specimens analyzed	(11)						
Grass-Forb Index	(-100)						
Collection site IV							
	(2)(a)	(1)	(4)	(5)	(0)	(0)	(0)
Perennial grass	100	100	100	100	0	0	0
<u>Bromus inermis</u>							
Empty crops	16	0	0	0	40	0	0
Total specimens analyzed	(12)						
Grass-Forb Index	(-100)						

(a) Actual number of grasshoppers analyzed; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 12. Food ingestions by *Phocallistes nebrascensis* in planted pasture collection sites, Manhattan, Kansas, 1966.

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty Adults								
	Instars								
	All Instars and Adults	1(4)	(a) 2(23)	3(518)	4(317)	5(12)	Male(21)	Female(3)	
Collection site II									
Perennial grass <u>Bromus inermis</u>	93	100	93	94	91	100	94	100	
Unidentified grasses	4	0	6	3	6	0	5	0	
Perennial forbs									
Ambrosia psilostachya	1	0	0	1	0	0	0	0	
Medicago sativa	1	0	0	0	1	0	0	0	
Melilotus spp.	1	0	0	1	2	0	0	0	
Unidentified forbs	1	0	0	1	1	0	0	0	
Fungus	53	50	40	47	59	85	82	100	
Arthropod parts	6	0	0	5	5	28	41	33	
Empty crops	23	50	34	23	20	41	19	0	
Total specimens analyzed	(898)								
Grass-Forb Index	-96								
Collection site IV									
Perennial grass <u>Bromus inermis</u>	100	0	100	100	0	0	0	0	
		(0)	(a) (3)	(5)	(0)	(0)	(0)	(0)	

Table 12. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty								
	Instars					Adults			
	All Instars and Adults	1(0)(a)	2(3)	3(5)	4(0)	5(0)	Male(0)	Female(0)	
Collection site IV (cont.)									
Fungus	37	0	33	40	0	0	0	0	0
Arthropod parts	12	0	33	0	0	0	0	0	0
Total specimens analyzed	(8)								
Grass-Forb Index	(-100)								
Collection site V									
Perennial grasses		(0)(a)	(0)	(1)	(0)	(0)	(0)	(0)	(0)
<u>Bromus inermis</u>	100	0	0	100	0	0	0	0	0
Total specimens analyzed	(1)								
Grass-Forb Index	(-100)								
Collection site VI									
Perennial grasses		(0)(a)	(8)	(18)	(36)	(4)	(2)	(2)	(2)
<u>Bromus inermis</u>	26	0	0	33	34	0	0	0	0
<u>Phalaris arundinacea</u>	42	0	37	53	37	66	50	0	0
<u>Spartina pectinata</u>	1	0	0	0	2	0	0	0	0
<u>Sporobolus asper</u>	3	0	12	0	2	0	0	0	0

Table 12. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars			Adults			
	All Instars and Adults	1(0)(a)	2(8)	3(18)	4(36)	5(4)	Male(2) Female(2)
Collection site VI (cont.)							
Annual grasses							
<u>Digitaria sanguinalis</u>	4	0	12	6	2	0	0
<u>Setaria lutescens</u>	6	0	0	6	8	0	0
Unidentified orasses	14	0	37	6	8	33	50
Unidentified forbs	3	0	12	0	2	0	0
Fungus	42	0	37	46	40	66	50
Arthropod parts	1	0	0	0	2	0	0
Empty crops	7	0	0	16	2	25	0
Total specimens analyzed	(68)						
Grass-Forb Index	(-95)						

(a) Actual number of grasshoppers analyzed; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 13. Food ingestions by Melanoplus differentialis in planted pasture collection sites. Manhattan, Kansas. 1965.

Crop Contents	Percent							
	of crops containing plant parts, pollen, fungus, arthropod parts, or empty						Adults	
	Instars							
All Instars and Adults	1(3)(a)	2(27)	3(45)	4(11)	5(11)	Male(2)	Female(2)	
Collection site I								
<u>Perennial grasses</u>								
<u>Acrocydon smithii</u>	8	0	4	8	0	30	0	0
<u>Andropogon gerardi</u>	1	0	0	0	0	10	0	0
<u>Bromus inermis</u>	25	0	45	20	20	20	0	0
<u>Annual grasses</u>								
<u>Aristida oligantha</u>	1	0	0	0	0	10	0	0
<u>Setaria lutescens</u>	4	0	9	0	10	10	0	0
<u>Unidentified grasses</u>	6	0	4	8	10	0	0	0
<u>Perennial forbs</u>								
<u>Ambrosia psilostachya</u>	1	0	0	0	10	0	0	0
<u>Medicago sativa</u>	4	0	9	2	0	10	0	0
<u>Biennial forb</u>								
<u>Cirsium undulatum</u>	1	0	0	0	0	0	50	0
<u>Annual forb</u>								
<u>Lespedeza stipulacea</u>	38	100	22	54	40	10	50	0
<u>Unidentified forbs</u>	10	0	9	5	10	10	0	100
<u>Pollen</u>	4	0	4	8	0	0	0	0
<u>Fungus</u>	20	0	31	20	30	0	0	0

Table 13. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty							
	Instars				Adults			
	All Instars and Adults	1(3)(a)	2(27)	3(45)	4(11)	5(11)	Male(2)	Female(2)
Collection site I (cont.)								
Arthropod parts	11	0	0	11	30	10	50	0
Empty crops	19	66	18	22	9	9	0	50
Total specimens analyzed	(101)							
Grass-Forb Index	(b)							
	(8)							
Collection site II								
Collection site II								
	(0)(a)	(0)	(4)	(4)	(2)	(1)	(1)	(1)
Perennial grass <u>Bromus inermis</u>	30	0	0	25	33	0	100	0
Perennial forbs <u>Medicago sativa</u>	10	0	0	0	33	0	0	0
<u>Melilotus spp.</u>	30	0	0	25	33	0	0	100
Unidentified forbs	30	0	0	50	0	100	0	0
Fungus	20	0	0	25	0	0	0	100
Arthropods parts	30	0	0	50	0	0	0	100
Empty crops	16	0	0	0	25	50	0	0
Total specimens analyzed	(12)							
Grass-Forb Index	(b)							
	(40)							

Table 13. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty Adults									
	Instars					Adults				
	All Instars and Adults	1(1)	(a) 2(0)	3(0)	4(0)	5(0)	Male(0)	Female(0)		
Collection site III										
Empty crop	100	100	0	0	0	0	0	0	0	0
Total specimens analyzed	(1)									
Collection site IV										
Perennial grass		(0)	(0)	(3)	(2)	(10)	(4)	(5)		
<i>Bromus inermis</i>	100	0	0	100	100	100	100	100	100	100
Fungus	5	0	0	0	0	16	0	0	0	0
Arthropod parts	20	0	0	0	0	16	25	40	0	0
Empty crops	16	0	0	0	0	40	0	0	0	0
Total specimens analyzed	(24)									
Grass-Forb Index ^(b)	(-100)									

(a) Actual number of grasshoppers analyzed; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 14. Food ingestions by Melanoplus differentialis in planted pasture collection sites. Manhattan, Kansas. 1966.

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty							
	Instars				Adults			
	All Instars and Adults	1(0)(a)	2(0)	3(30)	4(9)	5(4)	Male(6)	Female(5)
Collection site I								
<u>Perennial grasses</u>								
<u>Agropyron smithii</u>	18	0	0	22	12	0	0	40
<u>Bromus inermis</u>	16	0	0	7	37	33	16	20
<u>Annual grass</u>								
<u>Setaria lutescens</u>	2	0	0	3	0	0	0	0
<u>Unidentified grasses</u>	12	0	0	11	0	0	33	20
<u>Perennial forb</u>								
<u>Vernonia baldvini</u>	2	0	0	3	0	0	0	0
<u>Annual forb</u>								
<u>Leopedeza stipulacea</u>	53	0	0	48	62	66	83	20
<u>Unidentified forbs</u>	6	0	0	11	0	0	0	0
<u>Fungus</u>	40	0	0	48	12	0	83	20
<u>Arthropod parts</u>	12	0	0	0	25	0	50	20
<u>Empty crops</u>	9	0	0	10	11	25	0	0
Total specimens analyzed	(54)							
Grass-Forb Index (b)	(11)							

Table 14. (Cont.)

Crop Contents	of crops containing plant parts, pollen, fungus, arthropod parts, or empty Adults	Percent							
		Instars					Adults		
		All Instars and Adults	1(0)(a)	2(0)	3(1)	4(0)	5(0)	Male(0)	Female(0)
Collection site II									
Perennial grass <u>Bromus inermis</u>	100	0	0	100	0	0	0	0	0
Arthropod parts	100	0	0	100	0	0	0	0	0
Total specimens analyzed (1)									
Grass-Forb Index (-100)									
Collection site IV									
Perennial grass <u>Bromus inermis</u>	85	100	100	100	84	80	100	0	0
Annual grasses									
<u>Digitaria sanguinalis</u>	5	0	0	0	6	0	0	0	0
<u>Eragrostis cilianensis</u>	1	0	0	0	2	0	0	0	0
Unidentified grasses	5	0	0	0	6	0	0	0	0
Annual forb									
<u>Kochia scolaria</u>	1	0	0	0	0	20	0	0	0
Unidentified forbs	1	0	0	0	2	0	0	0	0

Table 14. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	All Instars and Adults	Instars				Adults	
		1(2)(a)	2(5)	3(68)	4(8)	5(1)	Male(0)
		Collection site IV (cont.)					
Pollen	1	0	0	2	0	0	0
Fungus	66	100	50	66	80	0	0
Arthropod parts	17	0	0	20	20	0	0
Empty crops	32	0	20	33	37	0	0
Total specimens analyzed	(84)						
Grass-Forb Index(b)	(-93)						
		Collection site V					
		(3)(a)	(1)	(11)	(1)	(0)	(1)
<u>Perennial grass</u>							
<u>Bromus inermis</u>	93	100	100	78	100	0	0
<u>Perennial forb</u>							
<u>Vernonia baldwini</u>	6	0	0	11	0	0	0
<u>Annual forb</u>							
<u>Ambrosia artemisiifolia</u>	6	0	0	11	0	0	0
<u>Unidentified forbs</u>	6	0	0	0	0	0	100
<u>Fungus</u>	33						
<u>Empty crops</u>	11	66	0	22	100	0	0
<u>Total specimens analyzed</u>	(17)	0	0	18	0	0	0
<u>Grass-Forb Index(b)</u>	(-73)						

Table 14. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty							
	Instars			Adults			Adults	
	All Instars and Adults	1(0)(a)	2(4)	3(69)	4(213)	5(123)		Male(84)
Collection site VI								
<u>Perennial grasses</u>								
<u>Bromus inermis</u>	8	0	25	6	8	8	13	5
<u>Phalaris arundinacea</u>	73	0	75	74	73	74	73	75
<u>Spartina pectinata</u>	1	0	0	0	1	0	1	0
<u>Sporobolus asper</u>	1	0	0	0	1	0	0	0
<u>Annual grasses</u>								
<u>Digitaria sanguinalis</u>	1	0	0	0	1	1	1	1
<u>Setaria lutescens</u>	1	0	0	1	1	1	1	1
<u>Unidentified grasses</u>								
	8	0	0	10	8	8	7	8
<u>Perennial forbs</u>								
<u>Ambrosia psilostachya</u>	1	0	0	1	0	0	0	1
<u>Convolvulus arvensis</u>	1	0	0	0	1	1	0	0
<u>Polygonum pensylvanicum</u>	2	0	0	0	3	1	0	2
<u>Annual forbs</u>								
<u>Ambrosia artemisiifolia</u>	1	0	0	0	0	0	0	1
<u>Kochia scouaris</u>	1	0	0	1	2	1	1	1
<u>Lactuca scariola</u>	1	0	0	0	1	0	1	0
<u>Unidentified forbs</u>								
	4	0	0	6	2	6	1	7

Table 14. (Cont.)

Crop Contents	Percent					
	of croos containing plant parts, pollen, fungus, arthropod parts, or empty			Adults		
	All Instars and Adults	1(0)(a)	2(4)	3(69)	4(213)	5(123)
Fungus	42	0	25	38	43	40
Arthropod parts	4	0	0	6	3	5
Empty crops	12	0	0	14	10	12
Total specimens analyzed	(625)					
Grass-Forb Index ^(b)	(-84)					

Collection site VI (cont.)

Male(84) Female(132)

(a) Actual number of grasshoppers examined; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 15. Food ingestions by Melanoplus sanguinipes in planted pasture collection sites. Manhattan, Kansas. 1965.

Crop Contents	Percent						
	of crops containing plant parts, pollen, fungus, arthropod parts, or empty			Instars			
	All Instars and Adults	1(2)(a)	2(1)	3(8)	4(11)	5(21)	Male(6) Female(12)
Collection site I							
<u>Perennial grasses</u>							
<u>Agropyron smithii</u>	9	0	0	0	0	11	33
<u>Bromus inermis</u>	15	0	0	16	22	11	0
<u>Sorghastrum nutans</u>	1	0	0	0	0	5	0
<u>Annual grass</u>							
<u>Setaria lutescens</u>	5	0	0	16	0	0	16
<u>Perennial forbs</u>							
<u>Ambrosia psilostachya</u>	7	0	0	0	0	11	16
<u>Medicago sativa</u>	5	0	0	0	0	11	16
<u>Biennial forb</u>							
<u>Cirsium undulatum</u>	1	0	0	0	0	0	0
<u>Annual forbs</u>							
<u>Lespedeza stipulacea</u>	45	0	0	50	66	52	33
<u>Solanum carolinense</u>	3	0	0	0	11	0	0
<u>Fungus</u>	37	0	100	33	11	41	50
<u>Arthropod parts</u>	13	0	100	0	22	5	16
<u>Empty crops</u>	16	0	0	25	18	19	0
<u>Total specimens analyzed</u>	(61)						
<u>Grass-Forb Index(b)</u>	(27)						

Table 15. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty Adults								
	Instars					Adults			
	All Instars and Adults	1(0)(a)	2(0)	3(0)	4(11)	5(9)	Male(20)	Female(11)	
Collection site II									
Perennial grass	27	0	0	0	50	14	26	20	
<u>Bromus inermis</u>									
Perennial forbs									
<u>Ambrosia psilostachya</u>	2	0	0	0	0	0	6	0	
<u>Medicago sativa</u>	15	0	0	0	25	0	13	20	
<u>Melilotus alba</u>	57	0	0	0	37	85	46	70	
Unidentified forbs	7	0	0	0	0	0	13	10	
Pollen	5	0	0	0	12	0	6	0	
Fungus	35	0	0	0	37	57	33	20	
Arthropod parts	17	0	0	0	12	28	20	10	
Empty crops	21	0	0	0	27	22	25	9	
Total specimens analyzed	(51)								
Grass-Forb Index	(53)								
Collection site III									
		(6)(a)	(5)	(2)	(6)	(9)	(7)	(3)	
Perennial grasses									
<u>Andropogon gerardi</u>	3	0	0	0	0	0	20	0	
<u>Poa pratensis</u>	35	0	0	50	40	37	100	0	
Annual grass									
<u>Bromus japonicus</u>	58	100	100	50	40	62	0	66	

Table 15. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty instars						
	Instars			Adults			Female(3)
	All Instars and Adults	1(6)(a)	2(5)	3(2)	4(6)	5(9)	Male(7)
Collection site III (cont.)							
Perennial forbs							
<u>Convolvulus arvensis</u>	9	0	20	0	0	12	0
<u>Traxacum officinale</u>	22	0	0	0	40	37	20
Annual forb							
<u>Euchorbia</u> spp.	6	0	0	0	0	25	0
Pollen	6	0	0	0	0	12	0
Fungus	25	66	40	50	0	25	20
Arthropod parts	9	0	20	0	40	0	0
Empty crops	18	50	0	0	16	11	28
Total specimens analyzed	(38)						
Grass-Forb Index(b)	(-52)						

Collection site IV

	(1)(a)	(2)	(11)	(9)	(11)	(3)	(5)
Perennial grass							
<u>Bromus inermis</u>	60	0	100	75	62	50	40
Annual grass							
<u>Bromus laonicius</u>	3	0	0	0	12	0	0
Perennial forb							
<u>Convolvulus arvensis</u>	3	0	0	0	0	0	20

Table 15. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars						
	All Instars and Adults	1(1)(a)	2(2)	3(11)	4(9)	5(11)	Adults Male(3) Female(5)
Collection site IV (cont.)							
Annual forbs							
<i>Ambrosia artemisiifolia</i>	20	0	0	25	12	0	50 40
<i>Kochia scroaria</i>	10	0	0	0	12	25	0 20
<i>Lactuca scariola</i>	3	0	0	0	0	25	0 0
Unidentified forbs	16	100	0	12	12	0	50 20
Pollen	16	0	0	25	12	25	50 0
Fungus	33	100	50	25	25	50	50 20
Arthropod parts	20	0	0	25	37	25	0 0
Empty crops	28	0	0	27	11	63	33 0
Total specimens analyzed	(42)						
Grass-Forb Index(b)	(-20)						

(a) Actual number of grasshoppers examined; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 16. Food ingestions by Melanocolus sanguinipes in planted pasture collection sites. Manhattan, Kansas. 1966.

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	All Instars and Adults			Instars		Adults	
	1(0)	(a) 2(0)	3(4)	4(8)	5(7)	Male(15)	Female(11)
Collection site I							
<u>Perennial grasses</u>							
<u>Agropyron smithii</u>	21	0	0	33	14	13	10
<u>Bromus inermis</u>	28	0	0	66	14	33	20
<u>Unidentified grasses</u>	4	0	0	0	14	0	0
<u>Perennial forbs</u>							
<u>Ambrosia psilostachya</u>	4	0	0	0	14	0	10
<u>Medicago sativa</u>	2	0	0	0	14	0	0
<u>Vernonia baldwinii</u>	7	0	0	0	14	6	10
<u>Annual forb</u>							
<u>Lespedeza stipulacea</u>	59	0	0	0	42	73	70
<u>Fungus</u>	54	0	0	33	42	46	60
<u>Arthropod parts</u>	28	0	0	0	28	26	30
<u>Empty crops</u>	6	0	0	25	12	0	9
Total specimens analyzed	(45)						
Grass-Forb Index (b)	(14)						
Collection site II							
(a)	(0)	(2)	(38)	(36)	(33)	(33)	(31)
<u>Perennial grass</u>							
<u>Bromus inermis</u>	38	0	0	42	27	54	32

Table 16. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars			Adults			
	All Instars and Adults	1(0)(a)	2(2)	3(38)	4(36)	5(33)	Male(33) Female(31)
Collection site II (cont.)							
<u>Unidentified grasses</u>	1	0	0	3	3	0	0
<u>Perennial forbs</u>							
<u>Ambrosia psilostachya</u>	6	0	0	6	6	0	11
<u>Medicago sativa</u>	10	0	0	12	3	12	7
<u>Melilotus alba</u>	47	0	0	39	41	54	50
<u>Unidentified forbs</u>	9	0	100	3	17	0	11
<u>Pollen</u>	2	0	0	3	3	0	0
<u>Fungus</u>	48	0	100	45	44	62	53
<u>Arthropod parts</u>	27	0	0	6	20	25	46
Total specimens analyzed (173)							
Grass-Forb Index (29)							
Collection site IV							
	(0)(a)	(2)	(22)	(5)	(4)	(3)	(7)
<u>Perennial grass</u>	74	0	0	81	50	100	50
<u>Bromus inermis</u>							100
<u>Annual grass</u>	3	0	50	0	0	0	0
<u>Digitaria sanguinalis</u>							
<u>Unidentified grasses</u>	7	0	50	0	25	0	0

Table 16. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty									
	Instars					Adults				
	All Instars and Adults	1(0)(a)	2(2)	3(22)	4(5)	5(4)	Male(3)	Female(7)		
Collection site IV (cont.)										
<u>Perennial forbs</u>										
<u>Convolvulus arvensis</u>	11	0	50	9	25	0	0	0	0	0
<u>Vernonia baldwini</u>	3	0	0	9	0	0	0	0	0	0
<u>Annual forbs</u>										
<u>Kochia scoparia</u>	3	0	0	0	25	0	0	0	0	0
<u>Lactuca scariola</u>	3	0	0	0	25	0	0	0	0	0
<u>Unidentified forbs</u>	7	0	0	9	0	0	50	0	0	0
<u>Fungus</u>	44	0	100	9	25	66	100	80		
<u>Arthropod parts</u>	14	0	0	9	25	33	0	20		
<u>Empty crops</u>	37	0	0	50	20	25	33	28		
<u>Total specimens analyzed</u>	(43)									
<u>Grass-Forb Index(b)</u>	(-56)									
Collection site V										
	(0)(a)	(0)	(3)	(12)	(10)	(7)	(10)			
<u>Perennial grass</u>										
<u>Bromus inermis</u>	83	0	0	100	100	77	100	60		
<u>Unidentified grasses</u>	5	0	0	0	0	22	0	0		

Table 16. (Cont.)

Crop Contents	Percent									
	of crops containing plant parts, pollen, fungus, arthropod parts, or empty						Adults			
	Instars									
All Instars and Adults	1(0)(a)	2(0)	3(3)	4(12)	5(10)	Male(7)	Female(10)			
Collection site V (cont.)										
Perennial forbs										
<i>Ambrosia psilostachya</i>	2	0	0	0	0	0	0	10		
<i>Vernonia baldvini</i>	5	0	0	0	0	0	0	20		
Annual forb										
<i>Ambrosia artemisiifolia</i>	2	0	0	0	0	0	0	10		
Unidentified forbs	10	0	0	0	0	33	0	10		
Fungus	43	0	0	100	25	66	57	10		
Arthropod parts	18	0	0	0	0	22	42	20		
Empty crops	11	0	0	0	33	10	0	0		
Total specimens analyzed	(42)									
Grass-Forb Index (b)	(-68)									

(a) Actual number of grasshoppers examined; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 17. Food ingestions by *Anagotettix deorum* in planted pasture collection sites. Manhattan, Kansas. 1965.

Crop Contents	Percent						
	of crops containing plant parts, pollen, fungus, arthropod parts, or empty			Instars			
	All Instars and Adults	1(0)(a)	2(1)	3(3)	4(0)	5(0)	Female(1)
Collection site I							
<u>Perennial grasses</u>							
<u>Acoroiron smithii</u>	28	0	0	33	0	0	50
<u>Bromus inermis</u>	28	0	100	33	0	0	0
<u>Unidentified grasses</u>	28	0	0	0	0	0	100
<u>Annual forb</u>							
<u>Lespedeza stipulacea</u>	14	0	0	33	0	0	0
<u>Fungus</u>	42	0	100	33	0	0	100
<u>Arthropod parts</u>	14	0	0	0	0	0	0
<u>Empty crops</u>	12	0	0	0	0	0	33
<u>Total specimens analyzed</u>	(8)						
<u>Grass-Forb Index</u>	(-71)						
Collection site II							
<u>Perennial grass</u>							
<u>Bromus inermis</u>	94	0	0	0	100	90	100
<u>Unidentified grasses</u>	2	0	0	0	0	0	0
<u>Perennial forb</u>							
<u>Aspleniodora viridis</u>	2	0	0	0	0	0	10

Table 17. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars			Adults			
	All Instars and Adults	1(0)(a)	2(0)	3(0)	4(11)	5(13)	Male(11) Female(12)
Collection site II (cont.)							
Fungus	39	0	0	0	71	45	40
Arthropod parts	10	0	0	0	14	18	0
Empty crops	19	0	0	0	36	15	9
Total specimens analyzed	(47)						
Grass-Forb Index	(-95)						

(a) Actual number of grasshoppers analyzed; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 18. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty									
	Instars					Adults				
	All Instars and Adults	1(2)	(a) 2(4)	3(7)	4(13)	5(17)	Male(27)	Female(51)		
Collection site II (cont.)										
Pollen	1	0	0	0	0	0	0	2		
Fungus	56	0	25	28	46	41	66	68		
Arthropod parts	10	0	0	0	0	5	4	20		
Empty crops	4	50	0	0	0	0	11	1		
Total specimens analyzed	(121)									
Grass-Forb Index	(-90)									
Collection site IV										
		(0)	(a)	(0)	(0)	(0)	(0)	(5)	(6)	
Perennial grass	100	0	0	0	0	0	100	100		
<u>Bromus inermis</u>										
Fungus	87	0	0	0	0	0	100	80		
Arthropod parts	25	0	0	0	0	0	100	40		
Empty crops	27	0	0	0	0	0	40	16		
Total specimens analyzed	(11)									
Grass-Forb Index	(-100)									
Collection site V										
		(5)	(a)	(1)	(7)	(18)	(36)	(61)	(34)	
Perennial grasses	1	0	0	0	0	0	1	0		
<u>Bouteloua curtipendula</u>										
<u>Bromus inermis</u>	86	66	100	100	0	73	90	82	93	
<u>Poa pratensis</u>	7	33	0	0	0	20	6	5	3	

Table 18. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars			Adults			
	All Instars and Adults	1(5)(a)	2(1)	3(7)	4(18)	5(36)	Male(61) Female(34)
Collection site V (cont.)							
Annual grass							
<u>Bromus laevis</u>	4	0	0	0	13	3	1 6
Unidentified grasses	4	0	0	0	0	3	7 3
Perennial forb							
<u>Vernonia baldwini</u>	1	0	0	0	0	0	1 0
Unidentified forbs	1	0	0	0	0	3	1 0
Fungus	55	33	100	25	26	58	57 67
Arthropod parts	14	0	0	0	6	6	19 22
Empty crops	15	40	0	42	16	13	14 8
Total specimens analyzed	(162)						
Grass-Forb Index	(-98)						

(a) Actual number of grasshoppers analyzed; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 19. Food ingestions by Syrbula admirabilis in planted pasture collection sites. Manhattan, Kansas. 1965.

Crop Contents	Percent						
	of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars			Adults			
All Instars and Adults	1(6)(a)	2(18)	3(10)	4(9)	5(11)	Male(26)	Female(11)
Collection site I							
Perennial grasses							
<u>Agropyron smithii</u>	66	80	58	55	83	70	64
<u>Andropogon gerardi</u>	3	20	0	0	0	0	4
<u>Bromus inermis</u>	12	0	11	22	0	20	16
<u>Sorghastrum nutans</u>	7	0	17	0	16	0	4
Annual grasses							
<u>Aristida oligantha</u>	2	0	0	22	0	0	0
<u>Setaria lutescens</u>	1	0	5	0	0	0	0
Unidentified grasses	7	0	11	11	0	0	8
Annual forb							
<u>Lespedeza stipulacea</u>	2	0	0	0	0	0	4
Pollen	1	0	0	0	0	10	0
Fungus	12	20	29	0	0	10	0
Arthropod parts	4	0	0	11	0	10	4
Empty crops	8	16	5	10	33	9	3
Total specimens analyzed	(91)						
Grass-Forb Index	(-91)						

Table 19. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty									
	Instars					Adults				
	All Instars and Adults	1(2)(a)	2(5)	3(3)	4(4)	5(3)	Male(2)	Female(2)		
Collection site II										
Perennial grass	100	100	100	100	100	100	100	100		
<u>Bromus inermis</u>										
Fungus	10	0	0	0	0	0	100	50		
Empty crops	9	0	0	0	0	33	50	0		
Total specimens analyzed	(21)									
Grass-Forb Index	(-100)									
Collection site III										
Collection site III										
	(4)	(a)	(10)	(15)	(1)	(4)	(13)	(4)		
Perennial grasses	2	0	0	0	0	0	0	25		
<u>Andropogon scoparius</u>										
<u>Bouteloua curtipendula</u>	46	25	42	50	0	75	40	50		
<u>Bromus inermis</u>	2	0	0	0	0	0	10	0		
<u>Koeleria cristata</u>	2	0	0	10	0	0	0	0		
<u>Poa pratensis</u>	12	50	14	10	0	0	0	25		
<u>Sorghastrum nutans</u>	2	0	14	0	0	0	0	0		
<u>Sporobolus asper</u>	2	25	0	0	0	0	0	0		
Annual grasses										
<u>Aristida oligantha</u>	23	0	0	30	0	25	50	0		
<u>Setaria lutescens</u>	10	0	28	10	0	0	0	25		

Table 19. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty									
	Instars					Adults				
	All Instars and Adults	1(4)	2(10)	3(15)	4(1)	5(4)	Male(13)	Female(4)		
Collection site III (cont.)										
Unidentified grasses	2	0	0	0	0	0	10	0		
Biennial forb <i>Cirsium undulatum</i>	2	0	0	0	0	25	0	0		
Pollen	7	0	0	0	0	50	10	0		
Total specimens analyzed Grass-Forb Index(b)	(51) (-98)									
Collection site IV										
		(0)(a)	(7)	(7)	(7)	(8)	(5)	(4)		
Perennial grass <i>Bromus inermis</i>	100	0	100	100	100	100	100	100		
Fungus	6	0	0	0	14	20	0	0		
Arthropod parts	3	0	0	0	0	0	0	25		
Total specimens analyzed Grass-Forb Index(b)	(33) (-100)									

(a) Actual number of grasshoppers analyzed; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 20. Food ingestions by Syrbula admirabilis in planted pasture collection sites. Manhattan, Kansas. 1966.

Crop Contents	Percent						
	of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars			Adults			
	All Instars and Adults	1(4)(a)	2(3)	3(4)	4(9)P	5(6)	Male(3) Female(1)
Collection site I							
Perennial grasses	53	0	50	25	14	100	33 100
<u>Acrocyron smithii</u>	3	0	0	0	11	0	0 0
<u>Andropogon gerardi</u>	19	100	0	25	11	0	66 0
<u>Bromus inermis</u>	3	0	0	25	0	0	0 0
<u>Schedonardus paniculatus</u>	3	0	0	0	11	0	0 0
<u>Sorghastrum nutans</u>							
Annual grass	3	0	50	0	0	0	0 0
<u>Setaria lutescens</u>							
Unidentified grasses	11	0	0	25	22	0	0 0
Fungus	38	0	0	50	55	16	66 0
Arthropod parts	3	0	0	0	0	0	33 0
Empty crops	13	75	33	0	0	0	0 0
Total specimens analyzed (30)							
Grass-Forb Index (-100)							
Collection site II							
	(1)(a)	(0)	(1)	(2)	(2)	(4)	(2)
Perennial grass	90	100	0	100	100	100	50
<u>Bromus inermis</u>							
Unidentified grasses	10	0	0	0	0	0	50

Table 20. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars			Adults			
	All Instars and Adults	1(1)(a)	2(0)	3(1)	4(2)	5(2)	Male(4) Female(2)
		Collection site II (cont.)					
Fungus	80	100	0	100	100	50	100
Arthropod parts	10	0	0	0	0	0	0
Empty crops	16	0	0	0	50	0	25
Total specimens analyzed (12)							
Grass-Forb Index (-100)							
		Collection site IV					
		(0)(a)	(0)	(6)	(2)	(2)	(1) (0)
Perennial grass <u>Bromus inermis</u>	100	0	0	100	100	100	0
Fungus	100	0	0	100	100	100	0
Arthropod parts	11	0	0	0	0	50	0
Empty crops	18	0	0	33	0	0	0
Total specimens analyzed (11)							
Grass-Forb Index (-100)							
		Collection site V					
		(2)(a)	(1)	(4)	(1)	(1)	(7) (0)
Perennial grasses <u>Bouteloua curtipendula</u>	7	0	0	0	0	0	14
<u>Bromus inermis</u>	85	0	100	100	100	0	85

Table 20. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty							
	Instars				Adults			
	All Instars and Adults	1(2)(a)	2(1)	3(4)	4(1)	5(1)	Male(7)	Female(0)
Collection site V (cont.)								
Unidentified forbs	7	0	0	0	0	100	0	0
Fungus	50	0	0	75	0	100	42	0
Arthropod parts	7	0	0	0	0	0	14	0
Empty crops	12	100	0	0	0	0	0	0
Total specimens analyzed (16)								
Grass-Forb Index (-85)								
Collection site VI								
		(0)(a)	(0)	(3)	(6)	(13)	(8)	(3)
Perennial grasses								
<u>Bromus inermis</u>	40	0	0	33	33	41	37	66
<u>Phalaris arundinacea</u>	31	0	0	33	50	41	12	0
<u>Sporobolus asper</u>	15	0	0	33	0	16	25	0
Annual grass								
<u>Digitaria sanguinalis</u>	3	0	0	0	0	0	12	0
Unidentified grasses								
	9	0	0	0	16	8	0	33
Fungus	37	0	0	66	50	8	37	100
Arthropod parts	3	0	0	0	0	0	12	0

Table 20. (Cont.)

Crop Contents	Percent					
	of crops containing plant parts, pollen, fungus, arthropod parts, or empty			Adults		
	All Instars and Adults	1(0)(a)	2(0)	3(3)	4(6)	5(13)
					Male(8)	Female(3)
Collection site VI (cont.)						
Empty crops	3	0	0	0	0	0
Total specimens analyzed	(33)					
Grass-Forb Index	(-96)					

(a) Actual number of grasshoppers examined; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 21. Food ingestions by Melanoplus packardii in planted pasture collection sites. Manhattan, Kansas. 1965.

Crop Contents		Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty Adults							
		Instars							
		All Instars and Adults	1(0) ^(a)	2(1)	3(0)	4(3)	5(2)	Male(3)	Female(1)
Collection site II									
Perennial grass <u>Bromus inermis</u>	42	0	0	0	0	0	100	33	0
Perennial forb <u>Melilotus</u> spp.	42	0	0	0	0	0	0	66	100
Unidentified forbs	14	0	0	0	0	100	0	0	0
Fungus	42	0	0	0	0	0	100	33	0
Arthropod parts	42	0	0	0	0	0	100	33	0
Empty crops	14	0	100	0	0	0	0	0	0
Total specimens analyzed	(10)								
Grass-Forb Index (b)	(15)								

(a) Actual number of grasshoppers analyzed; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 22. Food ingestions by Melanoplus packardii in planted pasture collection sites. Manhattan, Kansas. 1966.

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty									
	Instars					Adults				
	All Instars and Adults	1(2)	(a)	2(5)	3(31)	4(32)	5(37)	Male(17)	Female(26)	
Collection site II										
Perennial grass <u>Bromus inermis</u>	3	0	0	20	0	3	5	6	0	0
Perennial forbs										
<u>Ambrosia psilostachya</u>	2	0	0	0	4	9	0	0	0	0
<u>Medicago sativa</u>	4	0	0	0	4	0	5	6	8	8
<u>Melilotus</u> spp.	85	100	60	60	100	90	88	68	79	79
Unidentified forbs	6	0	0	20	0	6	5	6	12	12
Pollen	1	0	0	0	0	3	0	0	0	0
Fungus	31	100	60	60	34	25	8	12	66	66
Arthropod parts	9	0	0	0	0	9	5	12	25	25
Empty crops	10	0	0	0	25	3	8	5	7	7
Total specimens analyzed	(150)									
Grass-Forb Index(b)	(94)									
Collection site IV										
		(5)	(a)	(3)	(3)	(1)	(0)	(0)	(0)	(0)
Perennial grass <u>Bromus inermis</u>	16	40	0	0	0	0	0	0	0	0

Table 22. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty							
	Instars			Adults				
	All Instars and Adults	1(5)(a)	2(3)	3(3)	4(1)	5(0)		Male(0)
Collection site IV (cont.)								
Perennial forbs								
<i>Ambrosia psilostachya</i>	66	60	66	66	0	0	0	0
<i>Convolvulus arvensis</i>	33	40	33	0	100	0	0	0
Unidentified forbs	25	20	33	33	0	0	0	0
Fungus	16	40	0	0	0	0	0	0
Total specimens analyzed	(12)							
Grass-Forb Index	(75)							

(a) Actual number of grasshoppers analyzed; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 23. Food ingestions by Hippiscus rugosus in planted pasture collection sites. Manhattan, Kansas 1965.

Crop Contents	Percent						
	of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	All Instars and Adults	1(5)(a)	2(0)	3(0)	4(2)	5(4)	Male(10) Female(17) Adults
Collection site I							
<u>Perennial grasses</u>							
<u>Agropyron smithii</u>	32	0	0	0	0	0	20 62
<u>Bromus inermis</u>	32	20	0	0	100	0	50 25
<u>Sirochastrum nutans</u>	10	0	0	0	0	50	10 6
<u>Annual grasses</u>							
<u>Bromus japonicus</u>	2	0	0	0	0	0	0 6
<u>Setaria lutescens</u>	5	0	0	0	0	0	0 12
<u>Unidentified grasses</u>	5	20	0	0	0	0	10 0
<u>Annual forb</u>							
<u>Lespedeza stipulacea</u>	16	60	0	0	0	25	20 0
<u>Unidentified forbs</u>	2	0	0	0	0	25	0 0
<u>Fungus</u>							
<u>Arthropod parts</u>	32	20	0	0	0	0	10 62
<u>Empty crops</u>	10	0	0	0	0	0	10 18
<u>Total specimens analyzed</u>	2	0	0	0	0	0	0 5
<u>Grass-Forb Index (b)</u>	(38)						
<u>(-65)</u>							
Collection site II							
	(1)(a)	(0)	(2)	(1)	(0)	(0)	(0)
<u>Perennial grass</u>							
<u>Bromus inermis</u>	75	0	0	100	100	0	0 0

Table 23. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty							
	Instars				Adults			
	All Instars and Adults	1(1)(a)	2(0)	3(2)	4(1)	5(0)	Male(0)	Female(0)
Collection site II (cont.)								
<u>Unidentified forbs</u>	25	100	0	0	0	0	0	0
Fungus	75	0	0	100	100	0	0	0
Total specimens analyzed (4)								
Grass-Forb Index(b)	(-50)							
Collection site III								
<u>Perennial grass</u>		(0)(a)	(1)	(0)	(0)	(0)	(1)	(0)
<u>Poa pratensis</u>	50	0	0	0	0	0	100	0
<u>Annual grass</u>								
<u>Setaria lutescens</u>	50	0	100	0	0	0	0	0
<u>Unidentified grasses</u>	50	0	0	0	0	0	100	0
Pollen	50	0	0	0	0	0	100	0
Fungus	50	0	0	0	0	0	100	0
Arthropod parts	50	0	0	0	0	0	100	0
Total specimens analyzed (2)								
Grass-Forb Index	(-100)							

(a) Actual number of grasshoppers analyzed; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 24. Food ingestions by Hippiscus rugosus in planted pasture collection sites. Manhattan, Kansas 1966.

Crop Contents	Percent						
	of crops containing plant parts, pollen, fungus, arthropod parts, or empty					Adults	
	Instars						
All Instars and Adults	1(0)(a)	2(1)	3(10)	4(6)	5(13)	Male(24)	Female(19)
Collection site I							
Perennial grasses							
<u>Aeropyron smithii</u>	49	0	0	11	66	50	58
<u>Andronogon gerardi</u>	1	0	0	0	0	8	0
<u>Bromus inermis</u>	18	0	0	0	0	25	21
Annual grass							
<u>Setaria lutescens</u>	4	0	0	0	0	0	8
Unidentified grasses							
	21	0	0	44	33	16	12
Annual forb							
<u>Lespedeza stioulacea</u>	12	0	100	44	16	8	4
Unidentified forbs							
	1	0	0	0	16	0	0
Fungus							
	63	0	100	55	66	58	70
Arthropod parts							
	25	0	0	11	33	41	25
Empty crops							
	2	0	0	10	0	7	0
Total specimens analyzed	(73)						
Grass-Forb Index	(-78)						
Collection site V							
	(0)(a)	(0)	(0)	(0)	(0)	(0)	(3)
Perennial grasses							
<u>Bouteloua curtipendula</u>	60	0	0	0	0	0	50
							66

Table 24. (Cont.)

Crop Contents	Percent of crocs containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars			Adults			
	All Instars and Adults	1(0)(a)	2(0)	3(0)	4(0)	5(0)	Male(2) Female(3)
Collection site V (cont.)							
Perennial grasses (cont.)							
<u>Bromus inermis</u>	20	0	0	0	0	0	0 33
<u>Poa pratensis</u>	20	0	0	0	0	0	0 0
Unidentified grasses	20	0	0	0	0	0	0 0
Fungus	20	0	0	0	0	0	0 0
Total specimens analyzed	(5)						
Grass-Forb Index(b)	(-100)						

(a) Actual number of grasshoppers analyzed; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 25. Food ingestions by Melanoplus keeleri in planted pasture collection sites. Manhattan, Kansas 1965.

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars			Adults			
	All Instars and Adults	1(0)(a)	2(1)	3(1)	4(0)	5(2)	Male(0) Female(2)
Collection site II							
Perennial grass <u>Bromus inermis</u>	66	0	0	0	0	100	0 50
Perennial forb <u>Melilotus</u> spp.	66	0	0	0	0	100	0 50
Unidentified forbs	33	0	0	0	0	0	0 50
Pollen	33	0	0	0	0	0	0 50
Fungus	100	0	100	0	0	100	0 100
Arthropod parts	33	0	0	0	0	100	0 0
Empty crops	50	0	100	0	0	50	0 0
Total specimens analyzed	(6)						
Grass-Forb Index	(34)						

(a) Actual number of grasshoppers analyzed; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder;
75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring
grasses; -76 to -100=grass feeder.

Table 26. Food ingestions by Melanoplus keeleri in planted pasture collection sites. Manhattan, Kansas. 1966.

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty									
	All Instars and Adults		Instars					Adults		
			1(0)	2(6)	3(20)	4(18)	5(2)	Male(1)	Female(14)	
Collection site I										
Perennial grass <u>Acrocyron smithii</u>	6	0	20	5	5	0	0	0	0	0
Unidentified grasses	4	0	0	11	0	0	0	0	0	0
Perennial forbs <u>Ambrosia psilostachya</u> <u>Medicago sativa</u>	19 2	0 0	20 0	17 0	22 5	0 0	0 0	0 0	0 0	25 0
Annual forb <u>Lespedeza stipulacea</u>	65	0	60	64	66	50	100	75		
Unidentified forbs	8	0	0	5	11	50	0	0	0	
Fungus	38	0	60	23	44	0	100	50		
Empty crops	7	0	16	15	0	0	0	0		
Total specimens analyzed	(51)									
Grass-Forb Index (b)	(79)									
Collection site II										
Perennial grass <u>Bromus inermis</u>	31	0	12	26	50	0	0	0	100	
		(1)(a)	(10)	(21)	(13)	(1)	(0)	(2)		

Table 26. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars			Adults			
	All Instars and Adults	1(1)(a)	2(10)	3(21)	4(13)	5(1)	Male(0) Female(2)
Collection site II (cont.)							
<u>Perennial forbs</u>							
<u>Ambrosia psilostachya</u>	12	0	25	5	20	0	0 0
<u>Medicago sativa</u>	2	0	0	5	0	0	0 0
<u>Melilotus spp.</u>	58	0	62	73	40	100	0 0
<u>Unidentified forbs</u>	9	100	12	10	0	0	0 0
<u>Fungus</u>							
<u>Arthropod parts</u>	39	100	37	21	50	100	0 100
<u>Empty crops</u>	17	0	0	21	30	0	0 0
<u>Total specimens analyzed</u>	14	0	20	9	23	0	0 0
<u>Grass-Forb Index (b)</u>	(48)						
	(47)						

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars			Adults			
	All Instars and Adults	1(1)(a)	2(10)	3(21)	4(13)	5(1)	Male(0) Female(2)
Collection site IV							
<u>Perennial grass</u>							
<u>Bromus inermis</u>	44	0	100	50	33	0	0 0
<u>Perennial forb</u>							
<u>Convolvulus arvensis</u>	22	0	0	25	33	0	0 0
<u>Annual forbs</u>							
<u>Ambrosia artemisiifolia</u>	22	0	0	0	66	0	0 0
<u>Kochia scoparia</u>	11	0	0	25	0	0	0 0

Table 26. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty							
	Instars				Adults			
	All Instars and Adults	1(0)(a)	2(2)	3(4)	4(3)	5(1)	Male(0)	Female(0)
Collection site IV (cont.)								
Unidentified forbs	11	0	0	0	0	100	0	0
Fungus	44	0	100	25	33	100	0	0
Empty crops	10	0	50	0	0	0	0	0
Total specimens analyzed	(10)							
Grass-Forb Index (b)	(11)							
Collection site V								
Annual forb	100	0	0	0	0	0	100	0
<i>Kochia scoparia</i>		(0)	(0)	(0)	(0)	(0)	(1)	(0)
Total specimens analyzed	(1)							
Grass-Forb Index	(100)							

(a) Actual number of grasshoppers examined; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 27. Food ingestions by Chortophaga viridifasciata in planted pasture collection sites. Manhattan, Kansas. 1965.

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars			Adults			
	All Instars and Adults	1(9)	(a) 2(11)	3(3)	4(1)	5(3)	Male(8) Female(16)
Collection site I							
<u>Perennial grasses</u>							
<u>Acrocyron smithii</u>	20	14	28	0	0	0	28 18
<u>Bromus inermis</u>	10	0	0	0	0	0	14 18
<u>Annual grasses</u>							
<u>Bromus japonicus</u>	2	0	0	0	0	0	0 6
<u>Setaria lutescens</u>	2	0	0	0	0	0	14 0
<u>Unidentified grasses</u>	15	0	14	0	100	0	28 12
<u>Perennial forb</u>							
<u>Medicago sativa</u>	2	14	0	0	0	0	0 0
<u>Annual forb</u>							
<u>Lespedeza stipulacea</u>	41	42	44	0	0	50	28 40
<u>Unidentified forbs</u>	7	28	0	0	0	50	0 0
<u>Fungus</u>	17	14	42	0	100	0	14 6
<u>Arthropod parts</u>	5	14	0	0	0	0	14 0
<u>Empty crops</u>	21	22	36	0	0	33	12 0
Total specimens analyzed	(51)						
Grass-Forb Index	(12)						

Table 27. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty instars							
	Instars					Adults		
	All Instars and Adults	1(0)	(a) 2(0)	3(0)	4(1)	5(0)	Male(1)	Female(1)
Collection site II								
Perennial grass <u>Bromus inermis</u>	100	0	0	0	100	0	100	100
Fungus	33	0	0	0	0	0	0	100
Total specimens analyzed	(3)							
Grass-Forb Index	(-100)							
Collection site III								
Perennial grass <u>Poa pratensis</u>	100	0	0	0	0	0	0	100
Total specimens analyzed	(1)							
Grass-Forb Index	(-100)							
Collection site IV								
Perennial grass <u>Bromus inermis</u>	92	0	0	0	0	66	100	0
Unidentified forbs	7	0	0	0	0	33	0	0

Table 27. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty					
	Instars			Adults		
	All Instars and Adults	(a) 1(0)	2(0)	3(0)	4(3)	5(1)
					Male(0)	Female(9)
Collection site IV (cont.)						
Fungus	15	0	0	0	33	0
Total specimens analyzed	(13)					11
Grass-Forb Index	(-85)					

(a)

(b) Actual number of grasshoppers analyzed; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 28. Food ingestions by Chortophaga viridifasciata in planted pasture collection sites. Manhattan, Kansas. 1966.

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty						
	Instars			Adults			
	All Instars and Adults	1(0)	2(0)	3(0)	4(0)	5(0)	Female(6)
Collection site I							
<u>Perennial grasses</u>							
<u>Agropyron smithii</u>	29	0	0	0	0	0	36 16
<u>Bromus inermis</u>	23	0	0	0	0	0	18 33
<u>Annual grass</u>							
<u>Setaria lutescens</u>	11	0	0	0	0	0	18 0
<u>Unidentified grasses</u>	23	0	0	0	0	0	18 33
<u>Annual forb</u>							
<u>Lespedeza stipulacea</u>	17	0	0	0	0	0	18 16
<u>Fungus</u>	70	0	0	0	0	0	63 83
<u>Arthropod parts</u>	58	0	0	0	0	0	63 50
<u>Total specimens analyzed</u>	(17)						
<u>Grass-Forb Index</u>	(-71)						
Collection site II							
	(0)(a)	(0)	(0)	(0)	(0)	(0)	(1) (2)
<u>Perennial grass</u>							
<u>Bromus inermis</u>	33	0	0	0	0	0	0 50
<u>Unidentified grasses</u>	66	0	0	0	0	0	100 50

Table 28. (Cont.)

Crop Contents	Percent of croos containing plant parts, pollen, fungus, arthropod parts, or empty							
	Instars			Adults				
	All Instars and Adults	1(0) (a)	2(0)	3(0)	4(0)	5(0)		Male(1)
		Collection site II (cont.)						
Fungus	100	0	0	0	0	0	100	100
Arthropod parts	66	0	0	0	0	0	100	50
Total specimens analyzed	(3)							
Grass-Forb Index	(-100)							
		Collection site IV						
Perennial grass		(0){a}	(0)	(0)	(0)	(2)	(0)	(2)
<u>Bromus inermis</u>	100	0	0	0	0	100	0	100
Annual grass								
<u>Digitaria sanguinalis</u>	33	0	0	0	0	100	0	0
Fungus	66	0	0	0	0	100	0	50
Empty crops	25	0	0	0	0	50	0	0
Total specimens analyzed	(4)							
Grass-Forb Index	(-100)							
		Collection site V						
Perennial grasses		(0){a}	(0)	(3)	(4)	(1)	(5)	(2)
<u>Bromus inermis</u>	61	0	0	33	66	100	75	50
<u>Poa pratensis</u>	15	0	0	33	0	0	0	50

Table 28. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty Adults							
	All Instars and Adults	Instars					Adults	
		1(0)(a)	2(0)	3(3)	4(4)	5(1)		Male(5)
Collection site V (cont.)								
Annual grass	7	0	0	0	33	0	0	0
<u>Bromus laeonicus</u>								
Unidentified grasses	15	0	0	33	0	0	25	0
Fungus	46	0	0	0	0	100	75	100
Arthropod parts	15	0	0	0	0	0	25	50
Empty crops	13	0	0	0	25	0	20	0
Total specimens analyzed	(15)							
Grass-Forb Index (b)	(-100)							

(a) Actual number of grasshoppers analyzed; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 29. Food ingestions by Melanoplus bivittatus in planted pasture collection sites. Manhattan, Kansas. 1965.

Crop Contents	Percent						
	of crops containing plant parts, pollen, fungus, arthropod parts, or empty			Adults			
	All Instars and Adults	1(6)(a)	2(17)	3(2)	4(0)	5(0)	Male(0) Female(0)
Collection site I							
<u>Perennial grasses</u>							
<u>Agropyron smithii</u>	7	0	11	0	0	0	0
<u>Bromus inermis</u>	14	0	22	0	0	0	0
<u>Unidentified grasses</u>	21	50	0	100	0	0	0
<u>Perennial forb</u>							
<u>Medicago sativa</u>	7	25	0	0	0	0	0
<u>Annual forb</u>							
<u>Lespedeza stimulaea</u>	42	25	55	0	0	0	0
<u>Unidentified forbs</u>	7	0	11	0	0	0	0
<u>Fungus</u>	35	25	33	100	0	0	0
<u>Arthropod parts</u>	14	25	11	0	0	0	0
<u>Empty crops</u>	44	33	47	50	0	0	0
<u>Total specimens analyzed</u>	(25)						
<u>Grass-Forb Index</u>	(15)						
Collection site II							
<u>Perennial grass</u>							
<u>Bromus inermis</u>	81	0	0	0	100	66	100
		(0)(a)	(0)	(0)	(1)	(3)	(4)

Table 29. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty All Instars and Adults	Instars							Adults		
		1(0)(a)	2(0)	3(0)	4(1)	5(3)	Male(4)	Female(4)			
		Collection site II (cont.)									
Perennial forb <i>Melilotus</i> spp.	9	0	0	0	0	33	0	0			
Unidentified forbs	9	0	0	0	0	0	33	0			
Empty crops	8	0	0	0	0	0	25	0			
Total specimens analyzed	(12)										
Grass-Forb Index	(-63)										
Collection site III											
Perennial grass <i>Poa pratensis</i>	33	(0)(a)	(2)	(2)	(1)	(0)	(0)	(0)			
Annual grass <i>Bromus laevis</i>	66	0	0	0	100	0	0	0			
Empty crops	40	0	100	0	0	0	0	0			
Total specimens analyzed	(5)										
Grass-Forb Index	(-100)										

Table 29. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty instars						
	Instars			Adults			
	1(0)(a)	2(2)	3(3)	4(2)	5(0)	Male(0)	Female(0)
Collection site IV							
Perennial grass	100	0	0	100	100	0	0
<u>Bromus inermis</u>							
Perennial forb	50	0	0	66	0	0	0
<u>Convolvulus arvensis</u>							
Fungus	50	0	0	66	0	0	0
Arthropod parts	25	0	0	33	0	0	0
Empty crops	42	0	100	0	50	0	0
Total specimens analyzed	(7)						
Grass-Forb Index (b)	(-50)						

(a) Actual number of grasshoppers examined; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 30. Food ingestions by Melanoplus bivittatus in planted pasture collection sites. Manhattan, Kansas. 1966.

Crop Contents	Percent							
	of crops containing plant parts, pollen, fungus, arthropod parts, or empty							
	Instars				Adults			
	All Instars and Adults	1(0)(a)	2(1)	3(2)	4(1)	5(0)	Male(0)	Female(0)
Collection site I								
Perennial grass <u>Bromus inermis</u>	50	0	0	0	100	0	0	0
Unidentified grasses	50	0	0	100	0	0	0	0
Empty crops	50	0	100	50	0	0	0	0
Total specimens analyzed (4)								
Grass-Forb Index(b)	(-100)							
Collection site II								
		(0)(a)	(0)	(3)	(3)	(3)	(2)	(1)
Perennial grass <u>Bromus inermis</u>	44	0	0	100	0	0	100	100
Perennial forb <u>Melilotus</u> spp.	44	0	0	0	0	100	50	0
Unidentified forbs	11	0	0	0	50	0	0	0
Fungus	66	0	0	100	0	66	100	100
Arthropod parts	44	0	0	0	50	0	100	100

Table 30. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty								
	Instars					Adults			
	All Instars and Adults	1(0)(a)	2(0)	3(3)	4(3)	5(3)	Male(2)	Female(1)	
Collection site II (cont.)									
Empty crops	25	0	0	66	33	0	0	0	0
Total specimens analyzed	(12)								
Grass-Forb Index	(11)								
Collection site IV									
		(2)(a)	(0)	(2)	(2)	(3)	(0)	(0)	(0)
Perennial grass									
<u>Bromus inermis</u>	50	100	0	0	0	0	66	0	0
Unidentified grasses	33	0	0	0	0	100	0	0	0
Annual forb									
<u>Ambrosia artemisiifolia</u>	16	0	0	0	0	0	33	0	0
Unidentified forbs	16	0	0	0	0	0	33	0	0
Fungus	33	0	0	0	0	100	0	0	0
Empty crops	33	50	0	100	0	0	0	0	0
Total specimens analyzed	(9)								
Grass-Forb Index	(-50)								

Table 30. (Cont.)

Crop Contents	Percent of crops containing plant parts, pollen, fungus, arthropod parts, or empty instars						
	All Instars and Adults		Instars				
	1(0)	(a)	2(0)	3(3)	4(8)	5(0)	Male(0) Female(0)
Collection site V							
Perennial grass <u>Bromus inermis</u>	90	0	0	100	87	0	0 0
Perennial forbs <u>Solidago missouriensis</u>	10	0	0	0	12	0	0 0
<u>Vernonia baldwini</u>	10	0	0	50	0	0	0 0
Annual forb <u>Ambrosia artemisiifolia</u>	10	0	0	0	12	0	0 0
Fungus	50	0	0	50	50	0	0 0
Arthropod parts	20	0	0	0	25	0	0 0
Empty crops	9	0	0	33	0	0	0 0
Total specimens analyzed	(11)						
Grass-Forb Index(b)	(-60)						
Collection site VI							
	(0)	(a)	(0)	(0)	(1)	(0)	(0) (2)
Perennial grasses <u>Bromus inermis</u>	66	0	0	0	100	0	0 50
<u>Phalaris arundinacea</u>	33	0	0	0	0	0	0 50
Unidentified forbs	33	0	0	0	0	0	0 50

Table 30. (Cont.)

Crop Contents	Percent							
	of crows containing plant parts, pollen, fungus, arthropod parts, or empty						Adults	
	Instars							
	All Instars	1(0)(a)	2(0)	3(0)	4(1)	5(0)	Male(0)	Female(2)
	And Adults							
Collection site VI (cont.)								
Arthropod parts	33	0	0	0	0	0	0	50
Total specimens analyzed	(3)							
Grass-Forb Index (b)	(-67)							

(a) Actual number of grasshoppers examined; not a percentage.

(b) Percent of species ingesting grasses subtracted from percent ingesting forbs. 100 to 76=forb feeder; 75 to 26=mixed feeder preferring forbs; 25 to -25=mixed feeder; -26 to -75=mixed feeder preferring grasses; -76 to -100=grass feeder.

Table 31. Summary of grasshopper species collected and crops analyzed from each 1965 planted pasture collection site. Manhattan, Kansas.

Grasshopper species	Collection sites				Species total
	I	II	III	IV	
Acridinae					
<u>Ageneotettix deorum</u>	8	47	0	0	55
<u>Boonodon gracile</u>	14	0	0	0	14
<u>Eritettix simplex</u>	2	5	31	0	38
<u>Mermiria maculipennis</u>	0	1	0	0	1
<u>Mermiria neomexicana</u>	0	6	0	0	6
<u>Orbulella speciosa</u>	434	62	90	213	799
<u>Pseudoomala brachyoptera</u>	0	7	0	0	7
<u>Syrbula admirabilis</u>	91	21	51	8	171
Cedipodinae					
<u>Arphia conspersa</u>	0	0	6	0	6
<u>Arphia simplex</u>	24	11	2	7	44
<u>Arphia xanthoptera</u>	25	13	0	0	38
<u>Chortothaca viridifasciata</u>	51	3	1	13	68
<u>Encontolobus sordidus costalis</u>	12	0	0	1	13
<u>Hadrotettix trifasciatus</u>	0	0	1	0	1
<u>Hipodiscus rugosus</u>	38	4	2	0	44
<u>Pardalophora aciculata</u>	0	0	1	0	1
<u>Pardalophora haldemanni</u>	10	17	5	3	35
Cyrtacanthacridinae					
<u>Campylacantha olivacea</u>	10	1	0	1	12
<u>Hesperotettix sociosus</u>	0	2	0	2	4
<u>Hesperotettix viridis pratensis</u>	1	6	0	2	9
<u>Hesperotettix viridis viridis</u>	1	-	-	-	1

Table 31. (Cont.)

Grasshopper species	Collection sites			Species total
	I	II	III	
<i>Cyrtacanthacridinae</i> (cont.)				
<i>Melanoplus bivittatus</i>	25	12	5	49
<i>Melanoplus differentialis</i>	101	12	0	137
<i>Melanoplus confusus</i>	0	2	0	2
<i>Melanoplus femurrubrum</i>	748	143	0	1181
<i>Melanoplus keeleri</i>	0	6	0	6
<i>Melanoplus packardii</i>	0	10	0	10
<i>Melanoplus sanguinipes</i>	61	-	38	141
<i>Phoetaliotes nebrascensis</i>	20	-	11	43
<i>Schistocerca lineata</i>	7	-	-	7

Table 32. Summary of grasshopper species collected and crops analyzed from each 1966 planted pasture collection site. Manhattan, Kansas

Grasshopper species	Collection sites					Species total
	I	II	IV	V	VI	
Acridinae						
<u>Aeneotettix deorum</u>	13	121	11	162	0	307
<u>Booedon gracile</u>	5	0	0	0	0	5
<u>Booedon nubilim</u>	25	0	0	0	0	25
<u>Dichromorpha viridis</u>	0	1	0	0	37	38
<u>Eritettix simplex</u>	0	1	0	1	0	2
<u>Mermiria maculipennis</u>	0	7	0	0	0	7
<u>Mermiria neomexicana</u>	0	7	0	0	0	7
<u>Oecia obscura</u>	0	12	0	0	0	12
<u>Orbulella speciosa</u>	463	5	461	752	7	1688
<u>Pseudopomala brachyptera</u>	0	4	0	0	0	4
<u>Syrbula admirabilis</u>	30	12	11	16	33	102
Oedipodinae						
<u>Arphia simplex</u>	1	13	1	0	1	16
<u>Arphia xanthoptera</u>	11	3	3	12	0	29
<u>Chortochaga viridifasciata</u>	17	3	4	15	0	39
<u>Dissosteira carolina</u>	4	1	0	0	0	5
<u>Encontolohus sordidus</u>	21	0	0	0	0	21
<u>Hadrotettix trifasciatus</u>	0	11	0	0	0	11
<u>Hippiscus rupeosus</u>	73	0	0	5	0	78
<u>Pardalophora apiculata</u>	0	4	0	0	0	4
<u>Pardalophora haldemanni</u>	12	16	0	0	0	28
Cyrtacanthacridinae						
<u>Campylacantha olivacea</u>	8	2	0	0	0	10
<u>Hesperotettix viridis pratensis</u>	3	0	0	0	0	3

Table 32. (Cont.)

Grasshopper Species	Collection sites					Species total
	I	II	IV	V	VI	
<i>Cyrtacanthacridinae</i> (cont.)						
<i>Melanoplus bivittatus</i>	4	12	9	11	3	39
<i>Melanoplus differentialis</i>	54	1	84	17	625	781
<i>Melanoplus femurrubrum</i>	268	122	267	227	78	962
<i>Melanoplus keeleri</i>	51	48	10	1	0	110
<i>Melanoplus packardii</i>	0	150	12	0	0	162
<i>Melanoplus sanguinipes</i>	45	173	43	42	0	303
<i>Photalliotis nebrascensis</i>	0	898	8	1	68	975

Table 33. Grass-Forb Index^(a) rating for each grasshopper species at each 1965 planted pasture collection site. Manhattan, Kansas.

Grasshopper species	Collection sites			
	I	II	III	IV
<u>Acridinae</u>				
<u>Ageneotettix deorum</u>	-71	-95	-	-
<u>Boeodon gracile</u>	-63	-	-	-
<u>Eritettix simplex</u>	-100	-100	-100	-
<u>Mermiria maculioennis</u>	-	-100	-	-
<u>Mermiria neomexicana</u>	-	-67	-	-
<u>Orphulella speciosa</u>	-71	-99	-97	-96
<u>Pseudonoma brachyptera</u>	-	-86	-	-
<u>Syrbula admirabilis</u>	-91	-100	-98	-100
<u>Oedipodinae</u>				
<u>Arphia conspersa</u>	-	-	-60	-
<u>Arphia simplex</u>	-48	-100	-100	-
<u>Arphia xanthoptera</u>	-45	-85	-	-100
<u>Chortophada viridifasciata</u>	12	-100	-100	-85
<u>Encoptolophus sordidus</u>	-100	-	-	-
<u>Hadrotettix trifasciatus</u>	-	67	-	-
<u>Hippiscus rugosus</u>	-65	-50	-100	-
<u>Pardalophora apiculata</u>	-	-	-100	-
<u>Pardalophora haldemanni</u>	-66	-100	-100	-100
<u>Cyrtacanthacridinae</u>				
<u>Campylacantha olivacea</u>	100	100	-	-
<u>Hesperotettix speciosus</u>	-	100	-	-
<u>Hesperotettix viridis pratensis</u>	-	100	-	-
<u>Hesperotettix viridis viridis</u>	-	-	-	-

Table 33. (Cont.)

Grasshopper species	Collection sites			
	I	II	III	IV
<u>Cyrtacanthacridinae (cont.)</u>				
<u>Melanoplus bivittatus</u>	42	-63	-100	-50
<u>Melanoplus confusus</u>	-	100	-	-
<u>Melanoplus differentialis</u>	8	40	-	-100
<u>Melanoplus femurrubrum</u>	62	26	-26	-19
<u>Melanoplus keeleri</u>	-	34	-	-
<u>Melanoplus packardii</u>	-	15	-	-
<u>Melanoplus sanguinipes</u>	27	53	-52	-20
<u>Phaenolotus nebrascensis</u>	13	-94	-100	-100
<u>Schistocerca lineata</u>	84	-100	-	-

Table 34. Grass-Forb Index^(a) rating for each grasshopper species at each 1966 planted pasture collection site. Manhattan, Kansas.

Grasshopper species	Collection sites				
	I	II	IV	V	VI
<u>Acridinae</u>					
<u>Acroceutettix deorum</u>	-100	-90	-100	-98	-
<u>Boopedon gracile</u>	-100	-	-	-	-
<u>Boopedon nubilim</u>	-100	-	-	-	-
<u>Dichromorpha viridis</u>	-	-	-	-	-100
<u>Eritettix simplex</u>	-	-100	-	-100	-
<u>Hermiria maculipennis</u>	-	-100	-	-	-
<u>Hermiria neomexicana</u>	-	-100	-	-	-
<u>Oeala obscura</u>	-	-100	-	-	-
<u>Orphulella speciosa</u>	-91	-100	-100	-92	-84
<u>Pseudopomala brachyptera</u>	-	-100	-	-	-
<u>Syrbula admirabilis</u>	-100	-100	-100	-85	-96
<u>Oedipodinae</u>					
<u>Archia simplex</u>	-100	-85	-100	-	-100
<u>Archia xanthoptera</u>	-40	-33	-100	-100	-
<u>Chortophaga viridifasciata</u>	-71	-100	-100	-100	-
<u>Dissosteira carolina</u>	100	-	-	-	-
<u>Encoptolophus sordidus</u>	-65	-	-	-	-
<u>Hadrotettix trifasciatus</u>	-	-45	-	-	-
<u>Hippiscus rugosus</u>	-73	-	-	-100	-
<u>Pardalophora apiculata</u>	-	-100	-	-	-
<u>Pardalophora haldemani</u>	-50	-64	-	-	-
<u>Cyrtacanthacridinae</u>					
<u>Campylacantha olivacea</u>	100	100	-	-	-
<u>Hesperotettix viridis pratensis</u>	100	-	-	-	-
<u>Melanoplus bivittatus</u>	-100	11	-50	-60	-67
<u>Melanoplus differentialis</u>	11	-100	-93	-73	-84

Table 34. (Cont.)

Grasshopper species	Collection sites				
	I	II	IV	V	VI
<i>Cyrtacanthacridinae</i> (cont.)					
<i>Melanocolus femurrubrum</i>	75	60	-37	-22	-63
<i>Melanocolus keeleri</i>	79	47	11	100	-
<i>Melanocolus packardii</i>	-	94	75	-	-
<i>Melanocolus sanguinipes</i>	14	29	-56	-68	-
<i>Phoetaliotes nebrascensis</i>	-	-96	-100	-100	-95

upon the fungus. Such is also suggested by Mulkern, et. al. (1962). In most instances, uptake of fungus was highest during early instars (Tables 7 to 30). Several possibilities are suggested: (a) grasshopper preference toward fungus; (b) a search for moisture within damp plant residues; and, (c) lack of mobility of early instars thus forcing them to eat nearby fungus-covered plant residues.

Ingestion of fungus by adults collected from overgrazed western wheat-grass-Korean lespedeza, collection site I (Table 1) and overgrazed smooth brome, collection site IV (Table 4) increased greatly during the drought period of late July, August, and September, 1966. In these areas at this time pasture condition was very poor with little living vegetation present, thus forcing grasshopper feeding upon dead plant materials.

Ingestion of arthropod parts also varied with grasshopper species (Tables 7 to 30). However, the Oedipodinae and Cyrtacanthacridinae, in general, showed higher ingestion rates of arthropod parts than did the Acridinae. Such arthropod fragments were most often legs, antennae, wings, and scales of Diptera, Lepidoptera, and Orthoptera. In a few instances whole mites or spiders were found. Lavigne and Pfadt (1962) concluded that many grasshoppers actively seek injured or dead insects for food or moisture. The actual role of such materials in the grasshopper diet is unknown, however. Mulkern, et. al. (1962) suggest that the widespread ingestion of such materials by certain grasshopper species seems to indicate that they may play a significant part in the nutrition of those species.

Females of some species, notably Orphulella speciosa and Syrbula admirabilis, ingested a greater volume of plant material than did males. Kaufmann (1965), in studying Bavarian grasshoppers, also recorded greater food ingestion by females of many species. His studies showed, however,

that males of these same species assimilated a larger percent of ingested food than did the females. Thus, less volume of food was required by the males. This author suggests that the smaller size of the males of most species must also be taken into consideration.

The severe drought period of 1966 (Table 3, Appendix) afforded an opportunity to study grasshopper feeding reactions to drought stresses. During this period, no significant changes in food plant preferences were noted. Little variance in pasture condition was noted on those areas under good grazing management. Sites I and IV were, however, overgrazed throughout the study period, accompanied by greatly decreased pasture conditions. As the vegetation dried, the grasshopper population largely migrated into lower areas of green vegetation. By late July, 1966, the vegetation within these areas was largely dried. At this time, there was a significant increase in ingestion by grasshoppers of fungus-covered plant residue and arthropod parts. The proportion of empty crops also increased greatly, often to 50 percent of those examined. By mid-August, 1966, overall grasshopper numbers had greatly declined.

Acridinae

A total of 3288 grasshopper crops representing 11 species were analyzed during 1965 and 1966. Grass-forb indices ranged from -63 to -100 during the two year period, indicating a high preference for grasses. Acridinae species represented 40 percent of the individuals collected throughout 1965; 38 percent during 1966.

Ageneotettix deorum. Crop analysis was conducted on 55 specimens during 1965; 307 during 1966. Grass-forb indices ranged from -71 to -100 over the two years, indicating a grass feeder (Tables 17 and 18). Grass ingestion

percentages generally ranked closely with relative abundance of species of grasses present. In western wheatgrass-Korean lespedeza collection site I (Table 1), however, specimens ingested smooth brome at a level indicating selection for that plant.

The species maintained itself relatively well during the 1966 drought period, with numbers declining only slightly as the drought continued. Ingestion of fungus and arthropod parts greatly increased during this period.

This species was collected largely from ungrazed smooth brome collection site II (Table 2) and moderately grazed smooth brome collection site V (Table 5). No specimens were found in Kentucky bluegrass collection site III (Table 3) or reed canarygrass collection site IV (Table 4).

Boopeton gracile. Crop content analyses were completed on 14 specimens during 1965 and 5 specimens during 1966. The data are not tabled. The grass-forb index for the specimens analyzed was -100 indicating a grass feeder. The ingested grasses were western wheatgrass, smooth brome, and yellow bristlegrass (Setaria lutescens). B. gracile was found only at western wheatgrass-Korean lespedeza collection site I (Table 1).

Boopeton nubilum. Crop contents of 25 specimens collected at western wheatgrass-Korean lespedeza collection site I (Table 1) were analyzed but the data are not tabled. The grass-forb index for the specimens analyzed was -100, placing it in the grass feeder group. The ingested grasses were western wheatgrass and smooth brome.

Dichromorpha viridis. Crop contents of 38 specimens were analyzed. Of these, 37 were collected at reed canarygrass-smooth brome collection site VI (Table 6). No food ingestion tables are included. The grass-forb index for the specimens studied was -100 with reed canarygrass and tall dropseed (Sporobolus asper) being most often ingested.

Eritettix simplex. Forty specimens were analyzed as to crop contents. Of these, 31 were collected during 1965 from Kentucky bluegrass collection site III (Table 3). Crop analyses data are not tabled. All grass-forb indices were -100 with Kentucky bluegrass and sideoats grama most often ingested.

Mermiria maculipennis. Crop analysis was conducted upon 8 specimens, all found at smooth brome-sweetclover site II (Table 2). Data are not tabled. The grass-forb index placed it in the grass feeder group with smooth brome most often ingested.

Mermiria neomexicana. Eleven specimens were analyzed for crop contents with smooth brome being most often ingested. Specimens were found only at smooth brome-sweetclover collection site II (Table 2). Data are not tabled.

Opeia obscura. Twelve specimens were found during 1966 at smooth brome-sweetclover collection site II (Table 2). The grass-forb index for the specimens was -100 with smooth brome most often ingested. Data are not tabled.

Orphulella speciosa. A total of 799 crops were analyzed during 1965; 1688 during 1966 (Tables 7 and 8). The grass-forb indices ranged from -71 to -100 over the two years, thus designating it as a grass feeder. Ingestion percentages of cultivated grasses ranked closely with relative abundance of the grass species present. Thus, this species showed definitely higher ingestion percentages of western wheatgrass in site I; of smooth brome in collection sites II, IV, and V; and of Kentucky bluegrass and sideoats grama in site III.

The species was found in all tame pasture sites with the exception of reed canarygrass-smooth brome collection site VI (Table 6), being most abundant in moderately grazed smooth brome collection site V (Table 5), overgrazed smooth brome collection site IV (Table 4) and western wheatgrass-Korean lespedeza collection site I (Table 1). It was first in overall order of abundance.

This species seemed better able to sustain itself throughout the drought period of 1966 than most other species studied. Numbers declined only slightly as the drought continued. Ingestion of fungus and arthropod parts greatly increased during the drought period.

Pseudonomala brachyptera. Crop content analyses were conducted on 7 specimens during 1965 and 4 during 1966. The data are not tabled. All specimens were collected from ungrazed smooth brome-sweetclover collection site II (Table 2), and had ingested smooth brome.

Syrbula admirabilis. Crop content analysis was conducted on 171 specimens during 1965; 102 during 1966. Grass-forb indices ranged from -85 to -100 over two years, indicating it was a grass feeder (Tables 19 and 20). This species was found in all collection sites with grass ingestion percentages ranking closely with relative abundance of species of grasses present.

Oedipodinae

Crop contents of 481 specimens representing 9 species were analyzed during 1965 and 1966. Grass-forb indices ranged from 12 to -100 over the two years. Oedipodinae species were generally classed as grass feeders or mixed feeders preferring grasses. Species of this subfamily represented 9 percent of the individuals collected throughout 1965; 4 percent during 1966.

Arphia conspersa. Crop contents of 6 specimens were analyzed during 1965. No specimens were found during 1966. The data are not tabled.

The grass forb index for the specimens analyzed was -60 indicating a mixed feeder preferring grasses. Kentucky bluegrass was most commonly ingested.

Arphia simplex. Crop analysis was conducted on 44 specimens during 1965 and 16 specimens during 1966. Data are not tabled. Grass-forb indices normally ranged from -85 to -100 during the two year period, thus establishing

This species seemed better able to sustain itself throughout the drought period of 1966 than most other species studied. Numbers declined only slightly as the drought continued. Ingestion of fungus and arthropod parts greatly increased during the drought period.

Pseudonomala brachyotera. Crop content analyses were conducted on 7 specimens during 1965 and 4 during 1966. The data are not tabled. All specimens were collected from ungrazed smooth brome-sweetclover collection site II (Table 2), and had ingested smooth brome.

Syrbula admirabilis. Crop content analysis was conducted on 171 specimens during 1965; 102 during 1966. Grass-forb indices ranged from -85 to -100 over two years, indicating it was a grass feeder (Tables 19 and 20). This species was found in all collection sites with grass ingestion percentages ranking closely with relative abundance of species of grasses present.

Oedipodinae

Crop contents of 481 specimens representing 9 species were analyzed during 1965 and 1966. Grass-forb indices ranged from 12 to -100 over the two years. Oedipodinae species were generally classed as grass feeders or mixed feeders preferring grasses. Species of this subfamily represented 9 percent of the individuals collected throughout 1965; 4 percent during 1966.

Arphia conspersa. Crop contents of 6 specimens were analyzed during 1965. No specimens were found during 1966. The data are not tabled.

The grass forb index for the specimens analyzed was -60 indicating a mixed feeder preferring grasses. Kentucky bluegrass was most commonly ingested.

Arphia simplex. Crop analysis was conducted on 44 specimens during 1965 and 16 specimens during 1966. Data are not tabled. Grass-forb indices normally ranged from -85 to -100 during the two year period, thus establishing

it as a grass feeder. In western-wheatgrass-Korean lespedeza collection site I (Table 1) during 1965, however, the grass forb index was -48 because of a higher ingestion of Korean lespedeza. The grass-forb index for the same site during 1966 was -100.

Arohia xanthoopera. Crop contents of 67 specimens were analyzed during the two year period. Data are not tabled. Grass-forb indices ranged from -33 to -100, indicating it to be a mixed feeder preferring grasses.

Chortoohaga viridifasciata. Crop analysis was conducted on 68 specimens during 1965; 39 during 1966. Grass-forb indices ranged from 12 to -100 over two years (Tables 27 and 28). Highest rates of forb ingestion occurred at western wheatgrass-Korean lespedeza collection site I (Table 1) where there was much feeding upon Korean lespedeza. Grasses were ingested at a high rate throughout all planted pasture collection sites.

Fungus and arthropod parts were commonly ingested, being at a higher rate during the drought period of 1966.

Dissosteria carolina. Crop content analysis was conducted on 5 specimens collected during 1966. Data are not tabled. Four specimens found at western wheatgrass-Korean lespedeza collection site I (Table 1) had ingested Korean lespedeza.

Encotolophus sordidus. Crop contents of 34 specimens were analyzed. Of these, 33 were collected at western wheatgrass-Korean lespedeza collection site I (Table 1). No food ingestion tables are included.

The grass-forb indices indicated that the species preferred grasses; these being ingested at a rate approximating the relative abundance of the species of grasses present. Korean lespedeza was the only forb ingested.

Hadrotettix trifasciatus. Crop analysis was done upon 12 specimens, 11 of which were found during 1966. Food ingestion tables are not included.

All specimens were collected at smooth brome-sweetclover collection site II (Table 2). The grass-forb index for the specimens analyzed indicated a mixed feeder preferring grasses. Smooth brome was most commonly ingested.

Hippiscus rugosus. Crop content analysis was conducted upon 44 specimens during 1965; 78 during 1966. Grass-forb indices ranged from -50 to -100 over two years, indicating a mixed feeder preferring grasses (Tables 23 and 24). Most specimens were taken from western wheatgrass-Korean lespedeza collection site I (Table 1) where western wheatgrass was preferred. Ingestion rates of smooth brome and Korean lespedeza were comparable although the latter was more abundant within the collection site.

High ingestion rates of fungus and arthropod parts were recorded from third instar through adults.

Pardalophora apiculata. Crop contents of 5 specimens were analyzed. Data are not tabled. All specimens had ingested grasses and were found at smooth brome-sweetclover collection site II (Table 2) and Kentucky bluegrass collection site III (Table 3).

Pardalophora heldemanii. A total of 35 crops were analyzed during 1965; 28 during 1966. Data are not tabled. Grass-forb indices ranged from -50 to -100 during the two years, thus designating it a mixed feeder preferring grasses. Grasses were normally ingested according to their relative abundance within the collection sites. Korean lespedeza and sweetclover were two most commonly ingested forbs in western wheatgrass-Korean lespedeza collection site I (Table 1) and smooth brome-sweetclover collection site II (Table 2).

Cyrtacanthacridinae

A total of 4766 grasshopper crops representing 13 species were analyzed during 1965 and 1966. Grass-forb indices ranged from 100 to -100 indicating greatly diverse feeding habits. Most, however, were classed as forb feeders, mixed feeders, or mixed feeders preferring forbs. Cyrtacanthacridinae species represented 51 percent of the individuals collected during 1965; 58 percent during 1966.

Camoylacantha olivacea. Crop analysis was conducted on 22 specimens during 1965 and 1966. Food ingestion tables are not included. The grass-forb index for the specimens analyzed was 100 indicating a forb feeder. Western ragweed (Ambrosia psilostachya) was the primary host plant.

Twenty one specimens were collected at western wheatgrass-Korean lespedeza collection site I (Table 1) and smooth brome-sweetclover collection site II (Table 2) where western ragweed was readily available.

Heserotettix speciosus. Crop content analysis was completed on 4 specimens, all collected during 1965 from smooth brome-sweetclover collection site II (Table 2) and smooth brome collection site IV (Table 4). Food ingestion tables are not included. The grass-forb index for the specimens was 100 indicating a forb feeder. Common ragweed (Ambrosia artemisiifolia), alfalfa, and sweetclover were ingested.

Heserotettix viridis pratensis. Crop content analysis was made on 12 specimens during 1965 and 1966, and data are not tabled. The grass-forb index for the specimens was 100 indicating a forb feeder. All specimens were found at western wheatgrass-Korean lespedeza collection site I (Table 1) and smooth brome-sweetclover collection site II (Table 2). Missouri goldenrod (Solidago missouriensis) and baldwin ironweed (Vernonia baldwini) were ingested with most regularity.

Melanoplus bivittatus. Crop content analyses was completed on 49 specimens during 1965 and 39 during 1966. Grass-forb indices ranged from 42 to -100 and varied with the collection site (Tables 29 and 30). In general, however, it was classified as a mixed feeder preferring forbs in those sites where forbs were abundant. In sites where forbs were not abundant, the species readily ingested grasses. Smooth brome seemed most preferred of the grasses.

Melanoplus confusus. Two specimens were found on smooth brome-sweetclover collection site II (Table 2) during 1965. Both had eaten sweetclover. No food ingestion tables are included.

Melanoplus differentialis. Crop content analysis was conducted on 137 specimens during 1965; 781 during 1966. This species was found in all planted pasture sites with the exception of Kentucky bluegrass collection site III (Table 3), but was most abundant in reed canarygrass-smooth brome collection site VI (Table 6) where 625 specimens were taken during 1966.

Grass-forb indices (Tables 13 and 14) ranged from 40 to -100 with a two year average of -64 indicating a mixed feeder preferring grasses. The grass-forb index for specimens taken from reed canarygrass-smooth brome collection site VI (Table 6) was -84 with 73 percent of the specimens collected having ingested reed canarygrass (Fig. 7).

Melanoplus femurrubrum. Crop analysis was completed upon 2143 specimens during the two year study period. Specimens were found at all collection sites with the exception of Kentucky bluegrass collection site III (Table 3), but were most abundant in western wheatgrass-Korean lespedeza collection site I (Table 1). M. femurrubrum ranked second in overall abundance throughout the study.

The grass-forb indices ranged from 75 to -63 but generally indicated that the species was a mixed feeder preferring forbs (Tables 9 and 10). The grass-forb indices changed appreciably among the different collection sites.

In reed canarygrass-smooth brome collection site VI (Table 6) the grass-forb index was -63 (Table 10). This resulted from the high ingestions of reed canarygrass and smooth brome which had a high abundance rating in this site. In western wheatgrass-Korean lespedeza collection site I (Table 1) the grass-forb index was 75 resulting from high ingestions of Korean lespedeza, the most abundant forb.

Melanoplus keeleri. Crop analysis was completed on 116 specimens, largely collected during 1966 from western wheatgrass-Korean lespedeza collection site I (Table 1) and smooth brome-sweetclover collection site II (Table 2).

Grass-forb indices generally indicated this species to be a mixed feeder preferring forbs (Tables 25 and 26). Korean lespedeza and sweetclover were most often ingested.

Melanoplus packardii. Crop content analysis was conducted on 172 specimens during the two year study period. Of these, 162 were collected during 1966 and largely from smooth brome-sweetclover collection site II (Table 2).

Grass-forb indices (Table 21 and 22) ranged from 15 to 94, the latter being the index for collection site II (Table 2). Sweetclover was the most commonly ingested plant.

Melanoplus sanguinipes. This species has been reported to have caused heavy damage to grasslands of the United States during drought years. It

was found in moderate numbers in all collection sites with the exception of reed canarygrass-smooth brome collection site VI (Table 6).

The grass-forb indices ranged from 53 to -68, but where most abundant this species was rated as a mixed feeder (Tables 15 and 16). Alfalfa, sweetclover, and smooth brome showed the greatest ingestion percentages.

Third instar to adult specimens ingested moderate amounts of fungus and arthropod parts. As with many other species, ingestion of fungus and arthropod parts increased during the 1966 drought period.

Phoetaliotes nebrascensis. Crop contents of 1018 specimens were analyzed during the two years. Of these, 898 specimens were collected during 1966 from smooth brome-sweetclover collection site II (Table 2).

Grass-forb indices normally ranged from -95 to -100 indicating a grass feeder (Tables 11 and 12). The grass forb index for all specimens collected from smooth brome-sweetclover collection site II (Table 2) was -95.

Schistocerca lineata. Seven specimens were found during 1965 at western wheatgrass-Korean lespedeza collection site I (Table 1); 5 from smooth brome-sweetclover collection site II (Table 2). No specimens were found during 1966. Food ingestion tables are not included.

Crop content analysis showed ingestions of Korean lespedeza, baldwin ironweed, and smooth brome at collection site I (Table 1). All specimens analyzed from smooth brome-sweetclover collection site II (Table 2) had ingested smooth brome.

SUMMARY

The investigation to determine the feeding habits and behavior of grasshoppers in planted (tame) pastures of eastern Kansas was conducted during the frost-free seasons of 1965 and 1966. All pastures studied had

vegetation consisting of one or more planted forage species not native to the study area. Emphasis was placed on the food preferences of the more common grasshopper species.

Crop content analyses indicated that grasshoppers, in general, are selective in their choice of food plants; the degree of selectivity varying with the grasshopper species. No significant changes in food plant preferences during various stages of the life cycles of the species studied were noted. Most Acridinae species were classified as grass feeders; grass ingestion percentages often ranking closely with relative abundance of grass species present within the grasshopper collection sites. Oedipodinae species were normally classed as grass feeders or mixed feeders preferring grasses. Cyrtacanthacridinae species had more diverse feeding habits. Crop analyses grass-forb indices of species of this subfamily ranged from 100 (forb feeder) to -100 (grass feeder). Most, however, were classed as forb feeders, mixed feeders, or mixed feeders preferring forbs. Phoetaliotes nebrascensis was the only Cyrtacanthacridinae species consistently classed as a grass feeder.

Some grasshopper species, as evidenced by numbers of individuals collected, had definite preferences for a particular planted pasture habitat. Those species consistently ingesting high proportions of forbs were normally found in far greater numbers at planted pasture collection sites where such forbs were most available. Camptolacantha olivacea was found only at collection sites where western ragweed, the preferred plant, was present. Orophulella speciosa was found at all grasshopper collection sites, but maintained highest populations in overgrazed and moderately grazed smooth brome and western wheatgrass grasshopper collection sites. Ageneotettix deorum was found most abundantly at ungrazed and moderately grazed smooth brome grasshopper collection sites.

Fungus and arthropod parts were commonly found in grasshopper crops; the ingestion rates varying with the grasshopper species. Of these materials, fungi was most often found. In some instances, fungus could be seen inclusive with plant fragments. At other times the crops contained fungus with little plant material present, indicating direct grasshopper feeding upon the fungus. Ingestion of fungus was greatest with early instars, although adults collected during the drought period of 1966 also had ingested large amounts.

Ingestion of arthropod parts also varied with grasshopper species. However, the Oedipodinae and Cyrtacanthacridinae normally showed higher ingestion rates than did the Acridinae. Such arthropod parts were most often fragments of Diptera, Lepidoptera, and Orthoptera. The proportion of arthropod fragment ingestions by many species increased during the drought period of 1966.

Pollen ingestions coincided with the maturity of the plants within the grasshopper collection sites.

A high percentage of first and second instar grasshoppers had empty crops as did the males of several species. The number of specimens with empty crops increased greatly during the drought period of 1966.

Females of Orohulella speciosa and Syrbula admirabilis ingested a greater volume of plant material than did the males. During the 1966 drought period, the volume of plant material ingested by specimens found in overgrazed sites generally declined.

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APPENDIX

Table 1. Scientific names^(a) of grasshopper species included in crop analysis studies.

Acridinae

Aceneotettix deorum deorum (Scudder)
Boopedon gracile Rehn
Boopedon nubilum (Say)
Dichromorpha viridis (Scudder)
Eritettix simplex tricarinatus (Thomas)
Mermiria maculipennis macclunji Rehn
Mermiria neomexicana (Thomas)
Opeia obscura (Scudder)
Orphulella speciosa (Scudder)
Pseudopomala bracyptera (Scudder)
Syrbula admirabilis (Uhler)

Oedipodinae

Arohia conspersa Scudder
Arohia simolex (Scudder)
Arohia xanthoptera (Burneister)
Chortophaga viridifasciata (DeGeer)
Dissosteira carolina (Linnaeus)
Encoptolophus sordidus costalis (Scudder)
Hadrotettix trifasciatus (Say)
Hippiscus rugosus Scudder
Pardalophora apiculata (Harris)
Pardalophora haldemanni (Thomas)

Cyrtacanthacridinae

Campylacantha olivacea olivacea (Scudder)
Hesperotettix speciosa (Scudder)
Hesperotettix viridis pratensis Scudder
Hesperotettix viridis viridis (Thomas)
Melanoplus bivittatus (Say)
Melanoplus confusus Scudder
Melanoplus differentialis (Thomas)
Melanoplus femurrubrum femurrubrum (DeGeer)
Melanoplus keeleri luridus (Dodge)
Melanoplus packardii Scudder
Melanoplus sanguinipes (Fabricius)
Phocetides nebrascensis (Thomas)
Schistocerca lineata Scudder

(a) Following Hebard (1931, 1934) and Coppock (1962).

Table 2. Scientific and common names^(a) of plants ingested by grasshoppers or found in grasshopper collection sites.

Scientific name	Common name
Perennial Grasses	
<u>Agropyron smithii</u> Rydb.	western wheatgrass
<u>Andropogon gerardi</u> Vitman	big bluestem
<u>Andropogon scoparius</u> Michx.	little bluestem
<u>Bouteloua curtipendula</u> (Michx.) Torr.	sideoats grama
<u>Bromus inermis</u> Leyss.	smooth brome
<u>Chloris verticillata</u> Nutt.	windmillgrass
<u>Eragrostis spectabilis</u> (Pursh) Steud.	purple lovegrass
<u>Festuca arundinacea</u> Schreb.	tall fescue
<u>Panicum scribnerianum</u> Nash	scribner panicum
<u>Panicum virgatum</u> L.	switchgrass
<u>Phalaris arundinacea</u> L.	reed canarygrass
<u>Poa pratensis</u> L.	Kentucky bluegrass
<u>Schedonnardus paniculatus</u> (Nutt.) Trel.	tumblegrass
<u>Sorochastrum nutans</u> (L.) Nash	indiangrass
<u>Spartina pectinata</u> Link	prairie cordgrass
<u>Sporobolus asper</u> (Michx.) Kunth	tall dropseed
<u>Sporobolus cryptandrus</u> (Torr.) A. Gray	sand dropseed
<u>Tridens flavus</u> (L.) Hitchc.	purpletop
Annual Grasses	
<u>Aristida oligantha</u> Michx.	prairie threeawn
<u>Bromus japonicus</u> Thunb.	Japanese brome
<u>Bromus tectorum</u> L.	downy brome
<u>Dicitararia sanguinalis</u> (L.) Scop.	crabgrass
<u>Eragrostis ciliaris</u> (All.) Lutati	stinkgrass
<u>Hordeum pusillum</u> Nutt.	little barley
<u>Setaria lutescens</u> (Weigel) Hubb.	yellow bristlegrass
<u>Setaria viridis</u> (L.) Beauv.	green bristlegrass
Grass-like Plants	
<u>Carex</u> spp. L.	sedge
<u>Typha latifolia</u> L.	common cattail
Perennial Forbs	
<u>Achillea millefolium</u> var. <u>lanulosa</u> (Nutt.) Piper	western yarrow
<u>Ambrosia psilostachya</u> DC. (<u>A. coronopifolia</u> T. and G.)	western ragweed

Table 2. (cont.)

Scientific name	Common name
Perennial Forbs	
<u>Ampelamus albidus</u> (Nutt.) Britt. (<u>Gonolobus laevis</u> of manuals, not Michx.)	climbingmilkweed
<u>Antennaria neglecta</u> Green (incl. <u>A. campestis</u> Rydb. and <u>A. longifolia</u> (Green))	field pussytoes
<u>Artemisia ludoviciana</u> Nutt. (incl. var. <u>cnacholodes</u> (Nutt.) T. and G.)	common sagewort
<u>Asclepias sylvantii</u> Engelm.	sullivant milkweed
<u>Asclepias tuberosa</u> L.	butterfly milkweed
<u>Asclepiodora viridis</u> (Walt.) Gray (<u>Asclepias v.</u> Walt.)	green antelopehorn
<u>Aster ericoides</u> L.	heath aster
<u>Astragalus caryocarpus</u> Ker. (<u>A. crass-icarpus</u> Nutt.)	groundplum milkvetch
<u>Callirhoe involucrata</u> (T. and G.) Gray	purple poppymallow
<u>Convolvulus arvensis</u> L.	bindweed
<u>Desmanthus illinoensis</u> (Michx.) MacM.	Illinois bundleflower
<u>Helianthus maximiliani</u> Schrad.	maximilian sunflower
<u>Kuhnia eupatorioides</u> L. (<u>K. suaveolens</u> Fresin; <u>K. hitchcockii</u> A. Nels.)	falseboneset
<u>Lespedeza capitata</u> Michx.	roundhead lespedeza
<u>Medicago sativa</u> L.	alfalfa
<u>Melilotus alba</u> Desr.	white sweetclover
<u>Melilotus officinalis</u> (L.) Lam.	yellow sweetclover
<u>Oxalis stricta</u> L.	common yellow oxalis
<u>Petalostemum multiflorum</u> Nutt.	roundheaded prairie-clover
<u>Physalis</u> spp. L.	groundcherry
<u>Polygonum pennsylvanicum</u> L. (incl. <u>P. omisum</u> Greene)	Pennsylvania smartweed
<u>Ruellia humilis</u> Nutt. (<u>R. ciliosa</u> , in part; <u>R. caroliniensis</u> , in part.)	fringeleaf ruellia
<u>Rumex crispus</u> L.	curled dock
<u>Sagittaria latifolia</u> Willd. (including <u>S. esculenta</u> Howell)	common arrowhead
<u>Salvia azurea</u> Lam. var. <u>grandiflora</u> Benth. (<u>S. pitcheri</u> Torr.)	pitcher sage
<u>Schrankia nuttalli</u> (DC.) Standl. (<u>S. uncinata</u> of manuals, not Willd.)	catclaw sensitivebriar
<u>Solidago missouriensis</u> Nutt. (incl. <u>S. glaberrima</u> Martens and <u>S. moritura</u> Steele)	Missouri goldenrod
<u>Taraxacum officinale</u> Weber (<u>T. vulgare</u> Lam.)	common dandelion
<u>Vernonia altissima</u> Nutt.	tall ironweed
<u>Vernonia baldwini</u> var. <u>baldwini</u> Torr.	baldwin ironweed
<u>Verbena stricta</u> Vent.	woolly vervain

Table 2. (cont.)

Scientific name	Common name
Biennial Forbs	
<u>Cirsium altissimum</u> (L.) Spreng.	tall thistle
<u>Cirsium undulatum</u> (Nutt.) Spreng.	wavyleaf thistle
<u>Gaura parviflora</u> Dougl.	smallflower gaura
<u>Grindelia squarrosa</u> (Pursh) Dunal	curlycup gumweed
<u>Verbascum thapsus</u> L.	flannel mullein
Annual Forbs	
<u>Amaranthus retroflexus</u> L.	rough pigweed
<u>Ambrosia artemisiifolia</u> L. (<u>A. elatior</u> L.)	common ragweed
<u>Chenopodium album</u> L.	lambsquarters
<u>Conyza canadensis</u> (L.) Cron. (<u>Erigeron c.</u> L., <u>Leontodon c.</u> (L.) Britt)	horseweed
<u>Croton</u> spp. L.	Croton
<u>Erigeron strigosus</u> (Muhl.) (<u>E. ramosus</u> (Walt.))	daisy fleabane
<u>Euphorbia macrinata</u> Pursh	snow-on-the-mountain
<u>Euphorbia</u> spp. L. (incl. <u>Tithymalus</u> (Tourn.) Adans. and <u>Chamaesyce</u> Small)	matforming spurge
<u>Euphorbia serotens</u> HBK	serpent euphorbia
<u>Hibiscus trionum</u> L.	flowerofanhour
<u>Kochia scoparia</u> (L.) Roth	kochia
<u>Lactuca scariola</u> L. (<u>L. serriola</u> L.; L. <u>cirosa</u> of manuals, not L.)	prickly lettuce
<u>Lepidium densiflorum</u> Schrad.	peppergrass
<u>Lespedeza stipulacea</u> Maxim.	Korean lespedeza
<u>Solanum carolinense</u> L.	poisonberry
<u>Solanum rostratum</u> Dunal	burning bush nightshade
<u>Tribulus terrestris</u> L.	puncturevine
Woody Plants	
<u>Amorpha fruticosa</u> L.	indigobush amorpha
<u>Populus</u> spp. L.	cottonwood
<u>Rhus radicans</u> L. (<u>R. toxicodendron</u> , of manuals, in part, not L.)	poisonivy
<u>Rosa arkansana</u> Porter var. <u>suffulta</u> (Greene) Cockerell (<u>R. suffulta</u> Greene)	Arkansas rose
<u>Salix</u> spp. L.	willow
<u>Sambucus canadensis</u> L.	American elderberry
<u>Symphoricarpos orbiculatus</u> Moench	buckbrush
<u>Vitis vulpina</u> L.	wild grape

(a) Following Anderson, K. L. (1961), Fernald (1950), and Stevens (1950).

Table 3. United States Weather Bureau climatological data from the Kansas State University Agronomy Farm recording station, Manhattan, Kansas.

Year	Precipitation in inches					Average temperature in °F						
	April	May	June	July	Aug.	Sept.	April	May	June	July	Aug.	Sept.
1957	3.63	3.74	7.07	3.32	2.02	5.25	49.7	61.31	71.2	81.05	78.45	64.0
1958	1.48	2.17	7.57	12.39	3.91	7.56	50.8	64.85	72.05	74.75	75.85	68.4
1959	1.42	8.30	1.97	2.64	2.58	3.97	51.7	65.6	74.7	74.3	82.1	68.3
1960	2.94	2.77	4.17	5.35	5.76	2.83	55.9	61.8	71.3	75.3	77.2	70.5
1961	2.51	7.28	4.19	3.17	1.76	7.82	48.4	59.3	71.6	77.9	75.4	63.7
1962	1.14	5.98	4.40	2.86	4.50	4.56	51.0	72.95	71.85	75.85	76.85	64.45
1963	1.47	2.06	2.53	1.15	2.01	2.09	56.4	64.5	77.1	82.1	79.9	71.6
1964	4.41	2.52	5.12	3.64	3.22	2.03	54.9	68.0	72.1	72.3	74.2	68.6
1965	1.48	1.93	11.27	3.66	2.95	8.47	55.16	69.1	72.2	76.61	76.3	65.11
1966	1.83	1.65	1.62	2.41	3.67	.57	50.2	63.4	73.7	83.5	73.5	66.2
Normals(a)	2.65	4.49	5.09	3.65	4.26	3.64	55.7	64.8	75.6	81.2	79.6	70.8

(a) Normals are climatological standard normals based on the 1931-1960 period.

FOOD PLANT PREFERENCES OF
GRASSHOPPERS (ORTHOPTERA:
ACRIDIDAE) OF SELECTED
PLANTED PASTURES IN
EASTERN KANSAS

by

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ABSTRACT

An investigation to determine the feeding and behavioral habits of grasshoppers in planted (tame) pastures of eastern Kansas was conducted during the frost-free seasons of 1965 and 1966. Emphasis was placed on the food preferences of the more common grasshopper species.

Grasshopper collection sites were selected primarily with regard to vegetation type; each consisting of one or more planted forage species not native to eastern Kansas. Collection sites selected were of (1) western wheatgrass (Acrocyron smithii)-Korean lespedeza (Lespedeza stipulacea), (2) smooth brome (Bromus inermis)-sweetclover (Medicago spp.), (3) Kentucky bluegrass (Poa pratensis), (4) overgrazed smooth brome, (5) moderately grazed smooth brome, and (6) reed canarygrass (Phalaris arundinacea)-smooth brome.

Plant species making up the vegetation of each site were identified and given a numerical relative abundance rating. Such ratings denoted both numbers and relative availability of a plant species to the grasshopper.

Grasshopper collections were made at weekly intervals at each collection site throughout the growing season.

Grasshopper food ingestions were determined by analysis of the crop contents. Findings were then I. B. M. data-processed and data were converted to tabular form giving: the total number of specimens of each life stage of a grasshopper species collected per site; percentage of the total numbers of each specific life stage of a grasshopper species having ingested a particular plant species in each site; percentage of each life stage with empty crops or with pollen, fungus, or arthropod parts ingested. Also, each species was given a grass-forb index number obtained by subtracting the

total percent of individuals of a species ingesting grasses from the total percent ingesting forbs. Grasshopper species whose ratings were 100 to 76 were classified as forb feeders; 75 to 26, mixed feeders preferring forbs; 25 to -25, mixed feeders; -26 to -75, mixed feeders preferring grasses, and; -76 to -100, grass feeders.

Crop content analyses indicated that grasshoppers, in general, are selective in their choice of food plants; the degree of selectivity varying with the grasshopper species. No significant changes in food plant preferences during various stages of the life cycles of the species studied were noted. Most Acridinae species were classified as grass feeders; grass ingestion percentages often ranking closely with relative abundance of grass species present. Oedipodinae species were normally classed as grass feeders or mixed feeders preferring grasses. Cyrtacanthacridinae species had more diverse feeding habits, but were usually classed as forb feeders, mixed feeders, or mixed feeders preferring forbs.

Some grasshopper species showed definite preferences for a particular planted pasture habitat, being found only or most abundantly at collection sites where the preferred food plant was available.

Fungus and arthropod parts were commonly found in the grasshopper crops; the ingestion rates varying with the grasshopper species. Ingestions of these materials greatly increased during the drought period of 1966.

A high percentage of first and second instar grasshoppers had empty crops as did the males of several species. The numbers of specimens with empty crops increased greatly during the drought period of 1966.