Biology and Impact of a Grass Bug *Labops hesperius* Uhler in Oregon Rangeland

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Highlight: *Wintering eggs of a univoltive plant bug* Labops hesperius *Uhler in rangeland seeded to intermediate wheatgrass hatched in late March. The subsequent nymphs stayed in the litter during the day and crawled on the leaves to feed at night. Adults began to appear in late April. Females had a 2-week preoviposition period and thereafter laid diapausing eggs in dry culms of various grasses. The feeding injury produced by a density of 120 bugs per 0.96 ft² reduced the nutritive value of intermediate wheatgrass about 18% midway through the growing season, but by the time the grass matured, the reduction due to feeding injury was only 2%. However, the impact of feeding injury on rangeland productivity varies with the time of utilization, annual rainfall, and drought. Management practices that reduce the food supply of the bugs and the availability of the straw preferred for oviposition seem a promising method of reducing the impact of feeding injury and the density of bugs.*

Seeding of native rangeland in the semiarid regions of western North America with introduced wheatgrasses has greatly increased forage production during the past 30 years. However, the occurrence and density of populations of *Labops hesperius* Uhler[1] (no approved common name but often referred to as Labops, black grass bug, or wheatgrass bug) in seeded areas has closely paralleled this modification of the rangeland ecosystem (Mills, 1939; Denning, 1948; Armitage, 1952; Knowlton, 1967; Bohning and Currier, 1967). The acreage of rangeland infested with this and other plant bugs is difficult to estimate, but in Utah alone 200,000 acres were damaged in 1965 (Knowlton, 1967). Little is known about the biology of these plant bugs in rangeland other than general observations concerning the seasonal occurrence and the feeding injury caused by the bugs. Nevertheless, the bugs extract the plant sap from the leaves during their feeding activities and may reduce yields 50 to 60% (Bohning and Currier, 1967; Knowlton, 1967).

This investigation was therefore made to study the biology and behavior of *L. hesperius* in Baker County, Oregon. Laboratory and field tests were also conducted to assess the degree of feeding injury produced by the bugs.

Study Areas and General Methods

Two sites with different physical characteristics were used for study. Site I was located on an eastward slope (elevation 3200 ft) that was cleared of sagebrush in 1949 and seeded to intermediate wheatgrass (*Agropyron intermedium* (Host) Beauv.). In 1972, the plant cover was dominated by intermediate wheatgrass with minor amounts of bulbous bluegrass (*Poa bulbosa* L.), Kentucky bluegrass (*Poa pratensis* L.), and scattered plants of big sagebrush (*Artemisia tridentata* Nutt.). Site II was located on rolling terrain close to timberline (elevation 4200 ft). It was seeded with a mixture of grasses in 1959, and by 1972 the plant cover was dominated by intermediate wheatgrass and pubescent wheatgrass (*Agropyron trichophorum* (Link) Richt.) with minor amounts of alfalfa (*Medicago sativa* L.), bulbous bluegrass, and big sagebrush. Both sites are among the more productive improved rangelands in Baker County, which has an annual precipitation of 14 to 20 inches. A 1–2 inch layer of litter was typical of both sites due to light grazing. Daily temperatures were monitored at site I with a thermograph.

The technique for sampling population densities of *L. hesperius* depended on the developmental stage. A 0.96-ft² circular quadrat was used for sampling. Quadrat locations were selected at random. Egg counts were obtained by collecting all straw in the quadrat and splitting the straws to expose the eggs. Counts of nymphs and adults were made by placing an open cylinder of sheet metal over the quadrat and then collecting them with an aspirator. Another sampling method was also used to determine the density of bugs whereby the

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[1] Hemiptera: Miridae.

bugs were collected by sweeping the foliage with a standard 15-inch insect net. The number of bugs per sweep refers to the number collected as the net traveled in a 180° arc.

Herbage was clipped at ground level in circular quadrats of 9.6 ft^2, oven dried for 24 hours at 130° F, and then weighed to obtain yield data. Samples were analyzed for the percentage crude protein and ash (Horwitz, 1965), cell-wall constituents (Van Soest and Wine, 1967), and acid-detergent fiber (Van

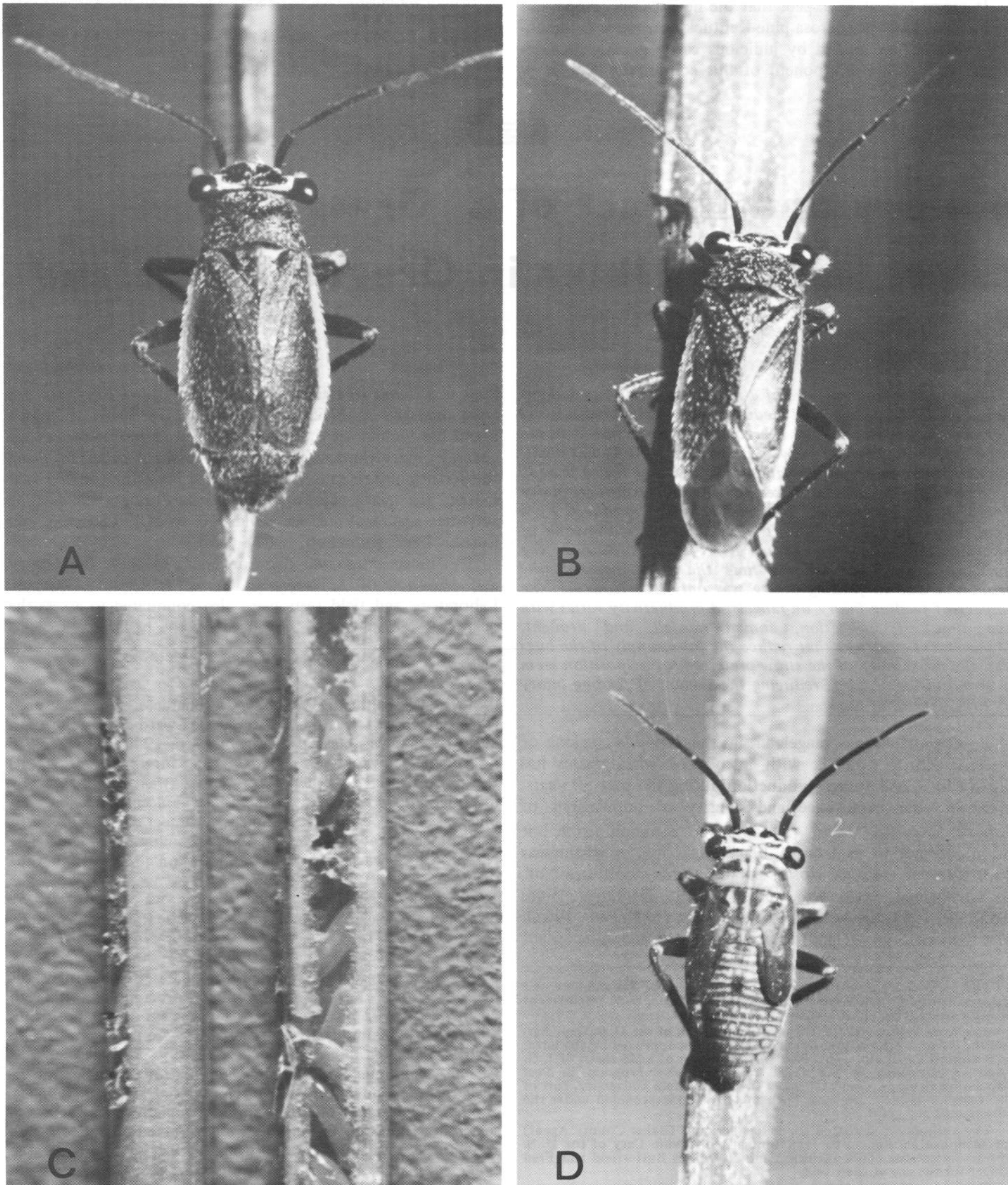

Fig. 1. *Life stages of the* Labops hesperius. *A. Brachypterous female. B. Macropterous female. C. Straw cut in half to show eggs. D. Fifth-instar nymph.*

Soest, 1963) by the Department of Animal Science, Oregon State University. All values are expressed on an oven-dry basis.

Results

Description of Life Stages

The adult bugs are predominantly black and have a white lateral stripe along the outer margin of the wings. Both sexes have a short, broad head with widely spaced and stalked eyes. Adults are about 1/4 inch long and about 1/16 inch wide. Males are always macropterous, but females may be either macropterous or brachypterous (Fig. 1 A, B). The elongate eggs are circular in cross section, slightly curved longitudinally, with a laterally compressed operculum at one end (Fig. 1 C). The eggs are white when laid but gradually turn light brownish-orange. Nymphs are light grey but have mottled brown and black markings on the legs, thorax, and head, so to the naked eye they appear different shades of greyish-brown (Fig. 1 D). Nymphs pass through five stadia.

Seasonal Development

Wintering eggs of *L. hesperius* began to hatch in late March. The nymphs remained on the ground beneath the straw and litter during the day. They crawled up on the leaves and fed primarily at night (Fig. 2). However, larger nymphs and adults fed both day and night. Bugs at both sites developed rapidly despite the relatively cold temperatures (Fig. 3). The first adults appeared in late April, and the maximum density of adults occurred 2 weeks later (Fig. 3 and 4). The duration of the life cycle at both study sites was essentially the same, except the eggs hatched 1 week later at the higher elevation, probably due to colder temperatures.

The duration of the preovisposition period was determined by dissecting 25 females from each site once a week by using methods previously described (Kamm and Ritcher, 1972). Oocytes were visible as white spots within the follicles of the ovaries after 1 week, but no mature eggs were found until 2 weeks after adult emergence; mating was also observed at this time. Thereafter, ovarian development proceeded rapidly, and the abdomens of females became greatly distended. The number of eggs within the ovaries was maximum in early June but declined thereafter, indicating that oviposition was in progress (Fig. 5). However, the females at site I contained considerably more eggs than the females at site II, which could indicate a difference in fecundity between the populations. Therefore, the straw in five quadrats from each site was dissected to estimate fecundity based on the number of eggs laid in the straw. The results showed that females at site I laid an average 21 eggs compared with 9 eggs per female at site II. We attribute the lower fecundity at site II to a shortage of food, since twice as many bugs were present at site II (Fig. 3 and 4) and feeding injury to the grass was more severe than at site I. No evidence of a second generation was observed at either site.

The phenology of many plant bugs and their host are often synchronized; that is, maturation of the grass coincides with oviposition by the insect. In contrast, *L. hesperius* had completed oviposition when many grasses (including wheatgrasses) were still vegetative, so most straw used for oviposition was one or more years old. Field tests were conducted to determine the species of grass and the portion of

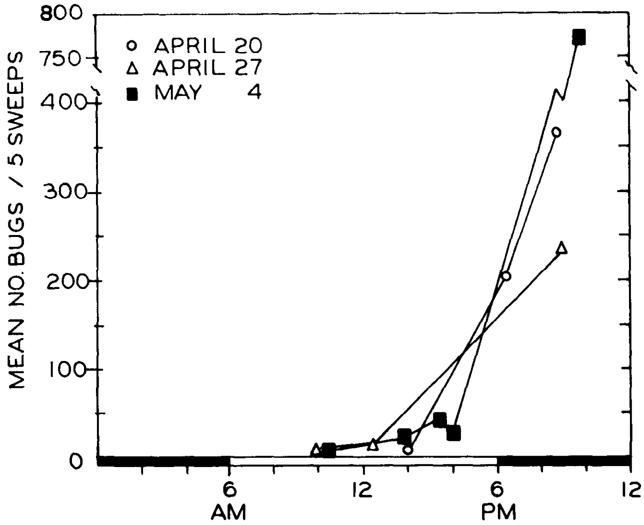

Fig. 2. *Number of nymphs of* Labops hesperius *collected from intermediate wheatgrass at different times of day.*

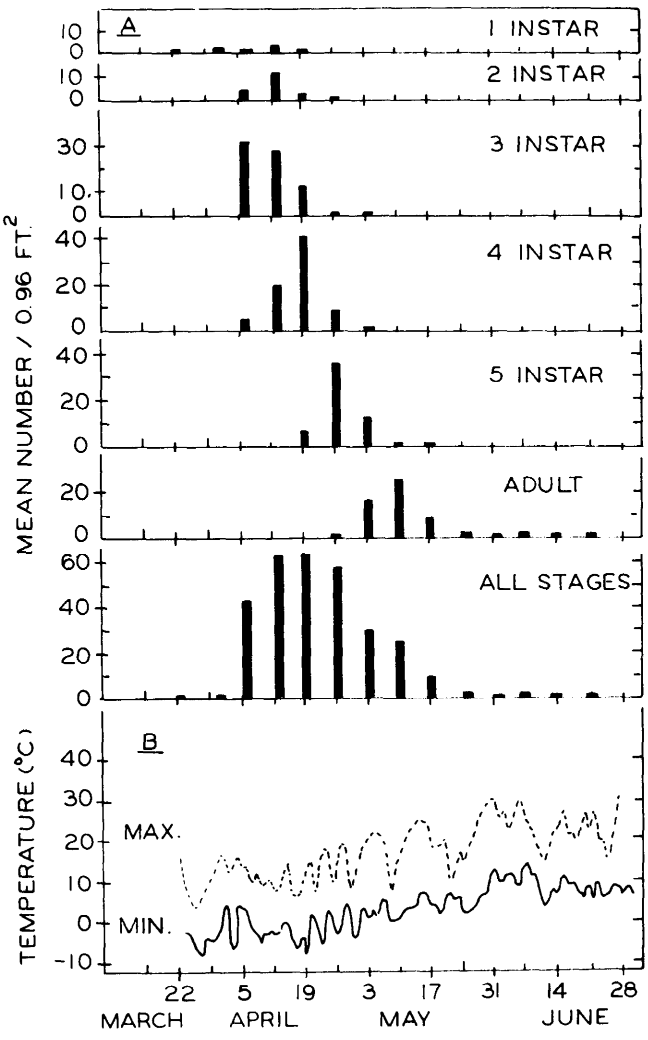

Fig. 3. *A. Seasonal occurrence and density of life stages of* Labops hesperius *at site 1 (5 samples per collection date). B. Daily temperature.*

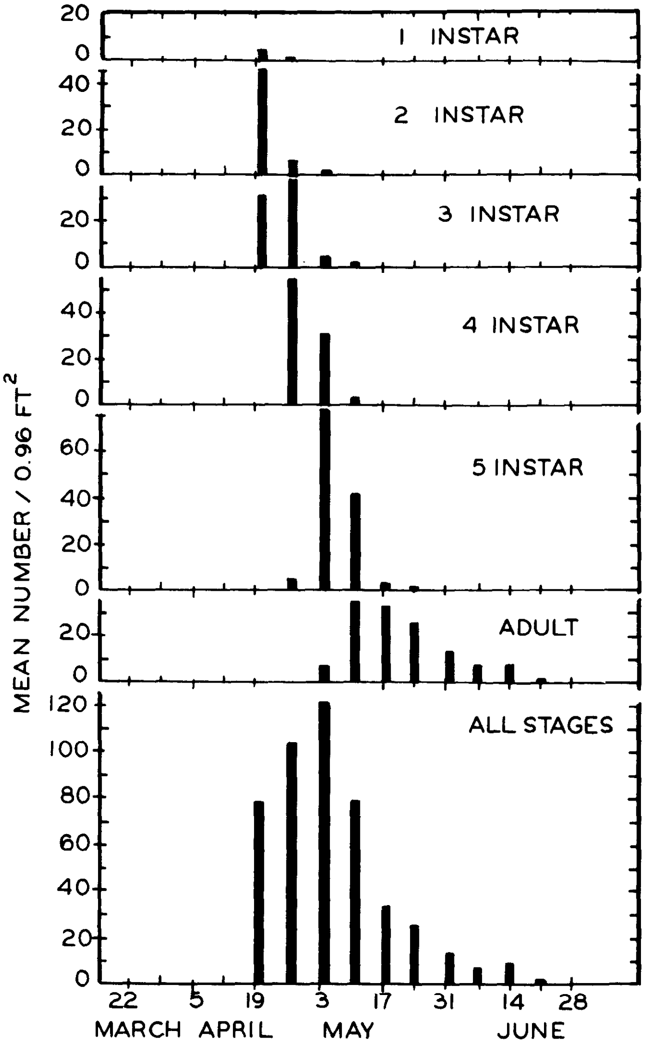

Fig. 4. *Seasonal occurrence and density of life stages of* Labops hesperius *at site 2 (5 samples per collection date).*

the culm used for oviposition. First, the fallen straw was removed leaving only the green leaves of intermediate wheatgrass and negligible amounts of short pieces of straw produced the previous year. Then 500 adults (sex ratio was 1.8 females to 1 male) were introduced into each of six cages and provided with dry whole culms of a single species of grass. In addition, 500 adults were confined with only whole green culms, and another 500 adults were caged on only stubble and short broken straws (1-3 inches) of intermediate wheatgrass. Egg counts were made from a sample of straw taken from each cage after the adults had died (Table 1).

The dry culms of crested wheatgrass (*Agropyron desertorum* (Fisch.) Schult.), bluebunch wheatgrass (*Agropyron spicatum* (Pursh) Scribn. and Smith), intermediate wheatgrass, and bulbous bluegrass were readily used for oviposition, and most eggs were laid between the inflorescence and the distal node. No eggs were laid in green culms and relatively few were laid in the stubble and broken culms of intermediate wheatgrass. Since many eggs were laid in bulbous bluegrass we decided to determine the preferred oviposition host in a field situation. At the time of this test, the wheatgrass was still vegetative, but the bulbous bluegrass had produced dry, mature culms that were available for oviposition. The culms in 30 quadrats were collected at random from site II; 99.5% were intermediate wheatgrass and 0.5% were bulbous bluegrass. However, 27% of the 3,152 eggs recovered were found in bulbous bluegrass. Clearly, the early maturing bulbous bluegrass was preferred for oviposition despite the great abundance of old straw of intermediate wheatgrass.

Habitat and Host Range

L. hesperius was found in habitats that varied from the native sagebrush-grass communities of the high desert to mountain parks near the timberline. Populations of bugs were relatively sparse in areas of native vegetation, but dense populations were invariably associated with modified rangeland reseeded to wheatgrasses. Bugs were observed to feed on the following plants: crested wheatgrass, intermediate wheatgrass, pubescent wheatgrass, bulbous bluegrass, Kentucky bluegrass, cheatgrass (*Bromus tectorum* L.), quackgrass (*Agropyron repens* (L) Beauv.), bluebunch wheatgrass, California brome (*Bromus carinatus* Hook and Arn.), orchardgrass (*Dactylis glomerata* L.), Idaho fescue (*Festuca idahoensis* Elmer), barley (*Hordeum vulgare* L.), Junegrass (*Koeleria cristata* (L) Pers.), Sandberg bluegrass (*Poa secunda* Presl), rye (*Secale cereale* L.), and Lemmon's needlegrass (*Stipa lemmonii* (Vasey) Scribn.). The degree of feeding injury varied among species, and the list is probably

Table 1. Number of eggs laid by *Labops hesperius* in 100 culms of each of 6 species of grass.

		Number of eggs between:			
Plant species	Straws with eggs (%)	Inflorescence and distal node	Distal node and penultimate node	Penultimate node and base of plant	Total
Crested wheatgrass: whole culm	11	121	39	0	160
Bluebunch wheatgrass: whole culm	19	204	0	0	204
Cheatgrass: whole culm	2	0	14	0	14 [a]
Idaho fescue: whole culm	2	18	0	0	18 [a]
Bulbous bluegrass: whole culm	64	4508	1160	0	5768 [b]
Intermediate wheatgrass:					
Whole culm (dry)	30	336	40	0	376
Stubble (1-3")	3				32
Broken straw	7				52
Whole culm (green)	0				0

[a]Calculated from a sample of 50 straws.
[b]Calculated from a sample of 25 straws.

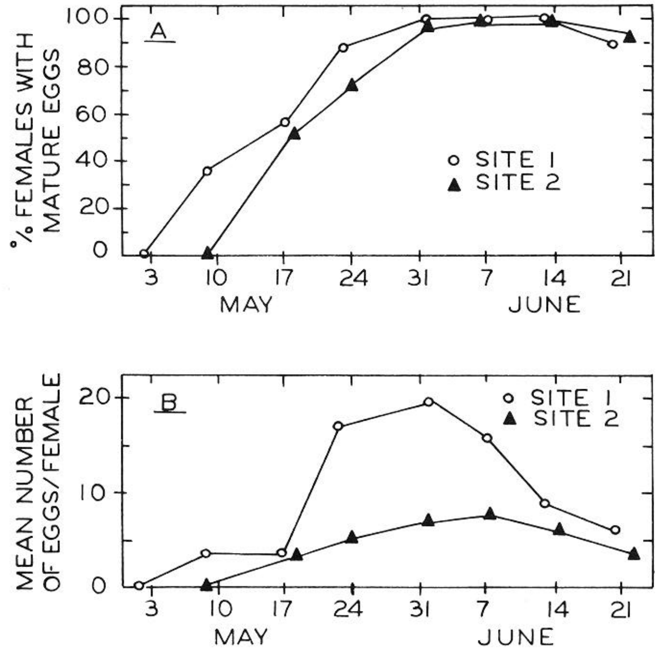

Fig. 5. *A. Cumulative percentage of females that had ovaries with mature eggs. B. Mean number of eggs per female (from dissection of ovaries).*

incomplete. Many grasses are satisfactory as food in early season; but thereafter grasses, such as wheatgrass, which remain green during oviposition are essential to meet the food requirements of the adults.

Feeding Injury

Nymphs and adults of *L. hesperius* sucked plant juices from the leaves and thereby produced small irregular white spots. When such feeding punctures were numerous, the leaves gradually turned yellow and then white around the feeding punctures. The impact of feeding injury on the yield and nutritional value of the forage was assessed in a block of field plots, half of which were sprayed with insecticide[2] (Cygon®, 1 lb/acre) April 26. Forage samples were removed from both sprayed and unsprayed plots on May 22, when the contrast in feeding injury between plots was greatest (Fig. 6). By May 22, the feeding injury in the unsprayed plots reduced the dry weight yield 13% but increased crude protein 2%, cell-wall constituents 6%, acid-detergent fiber 5%, and ash 0.5% (Table 2). This increase in the cell-wall constituents reflects an equivalent decrease of 6% in the cell contents. Since the estimated digestibility of the cell-wall constituents of grasses is 25% and that of the cell contents is 98% (Van Soest and Moore, 1965), the 6% decrease in cell contents represents an approximated decrease in digestibility of about 5%. However, the acid-detergent fiber is part of the cell-wall constituents, so the 5% increase was, in fact, a relative increase due to the removal of the cell contents by the bugs. Similarly, the increase of ash was a relative increase due to the removal of the cell contents. The 2% increase of crude protein may also be relative, but we are not certain because the crude protein includes portions of both the cell contents and cell-wall

[2] Mention of a pesticide does not constitute recommendation or endorsement by the U. S. Department of Agriculture.

Table 2. Dry weight (g/9.6 ft^2) and chemical constituents (%) of intermediate wheatgrass injured by feeding of *Labops hesperius* at site II, Baker, Oregon.

Date sampled and treatment	Dry weight	Chemical constituents: Crude protein	Cell-wall constituents	Acid detergent fiber	Ash
May 22, 1972					
Sprayed	99*	11.28*	62.08*	34.80*	10.84*
Unsprayed	86	12.87	68.33	39.38	11.22
July 31, 1972					
Sprayed	247	4.37	60.85*		
Unsprayed	244	4.55	62.39		

*Significantly different at $P < 0.05$.

constituents (Van Soest and Moore, 1965). Rautapaa (1970) reported a similar increase in protein of wheat due to the feeding injury of the plant bug *Leptopterna dolobrata* (L.). We estimate the combined effects of the decrease in yield and the reduction in percent cell contents to represent a loss of forage value of about 18% midway in the growing season.

After the adult *L. hesperius* had laid eggs and died, summer rainfall produced a lush growth of grass, so another series of forage samples was taken to determine the impact of feeding injury on forage production at the end of the growing season. Only the dry weight yield, crude protein, and cell-wall contents were determined at this sampling. The yield for July 31 was more than that for May 22, but no significant difference was found between sprayed and unsprayed plots (Table 2). The crude protein was about the same in both treatments, but the cell-wall constituents were 2% greater in the untreated plots. Thus, our estimate of the total loss of nutritive value of the forage was about 2% when the grass was mature.

Aspects of Cultural Control

In our first tests *L. hesperius* was observed to oviposit in the upper portions of culms; relatively few eggs were laid in the stubble and broken culms of intermediate wheatgrass (Table 1). We therefore evaluated removal of straw as a method of reducing the density of bugs. In July 1971, a hay

Fig. 6. *Intermediate wheatgrass with feeding injury by* Labops hesperius *(left) and no injury (right). May 18, 1972.*

crop was removed from a 40-acre field of intermediate wheatgrass adjacent to site II, which was left undisturbed. The management practices on these field was the same prior to 1971. Both fields were sampled along parallel transects on May 20, 1972, to estimate the number of adults and again on June 14 to estimate the number of eggs laid by these adults. In the field where the hay was removed, a mean density of 20 adults produced a mean of 45 eggs per quadrat; in the undisturbed field, 44 bugs produced a mean of 230 eggs per quadrat. Analysis of the data with the Wilcoxon two-sample test indicated that significantly fewer adults ($P < 0.05$) were present in the field that produced the crop of hay, but the number of eggs in the two fields was not significantly different. However, the outcome may have been different in the absence of bulbous bluegrass because nearly half the eggs in the field used for hay production were in straws of bluegrass produced the season after the hay was removed.

In yet another test, burning of grass litter to destroy wintering eggs and nymphs was evaluated by burning randomly selected portions of a field of wheatgrass in early April. On May 4 the burned and unburned plots had an average of 7 and 92 nymphs per sample, respectively, and the number of eggs laid in the burned and unburned plots by June 30 was 2 and 30 eggs per sample, respectively. Clearly, burning had destroyed the spring population and also eliminated most of the straw used for oviposition. In fact, the only eggs found in the burned area were in straw of bulbous bluegrass that grew after the field was burned.

Discussion

Dense infestations of the univoltive plant bug, *L. hesperius*, were usually associated with established seedings of crested and intermediate wheatgrass. However, the feeding injury produced by a maximum density of 120 bugs per quadrat (0.96^2 ft) reduced the nutritive value of intermediate wheatgrass about 18% midway in the growing season but only 2% by the time the grass was matured and dry. In other words more than half the forage produced during the 1972 season grew after the bugs had died, so the impact of the feeding injury was less than 9% for the season. Thereafter the nutritive components decreased 7% further during normal curing of the grass and thus, at maturity, only a 2% loss was attributable to feeding injury of the bugs. We are aware of the accuracy and limitations of the analytical techniques used to determine forage quality and the assumptions made in assessing our data in practical terms. Nevertheless in terms of forage utilization, yield would have been reduced 9% when used for spring pasture but only 2% when reserved for fall pasture. However, in years of scant rainfall, the grasses make little or no growth after the bugs die. Then the loss would be close to 18%, assuming utilization as spring pasture. The impact of feeding injury of *L. hesperius* on rangeland productivity, therefore, varies with time of utilization, annual rainfall, and drought. In fact even greater losses may occur in years of acute drought.

The forage loss attributed to the feeding activity of *L. hesperius* often does not justify the use of insecticide. However, cultural or management practices designed to reduce the straw preferred for oviposition may prove useful in reducing population densities the following year. Certainly in some rangeland the presence of early maturing grasses such as bulbous or Sandberg bluegrass may reduce or prevent an effective management program, but these grasses are not present in all seedings of wheatgrass. The practice of rotation grazing whereby a pasture is grazed one year and rested the next may increase the population of bugs by allowing the accumulation of the straw used for oviposition. We believe that grazing trials should be explored as a management practice to reduce the food supply of the bugs and the straw available for oviposition.

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