Twostriped Grasshopper

Melanoplus bivittatus (Say)

Distribution and Habitat

The twostriped grasshopper, *Melanoplus bivittatus* (Say), occurs widely in North America inhabiting tall, lush, herbaceous vegetation. Dense populations may reside in tallgrass prairie, wet meadows, roadsides, ditch banks, and crop borders.

Economic Importance

The twostriped grasshopper is a major crop pest causing much damage to small grains, alfalfa, and corn. During outbreaks, it may completely destroy crops. A population of 10 adults per square yard in a corn field will defoliate the crop. Sorghum plants over 6 inches tall, however, are nearly immune to attack. Experiments indicate that in feeding on spring wheat the twostriped grasshopper wastes six times as much foliage as it eats. In urban areas the twostriped grasshopper is a common pest of flowers and vegetables. It is a large grasshopper. Collected from a roadside in Platte County, Wyoming, males averaged 549 mg live weight and females 1,086 mg (dry weight: males 166 mg and females 341 mg).

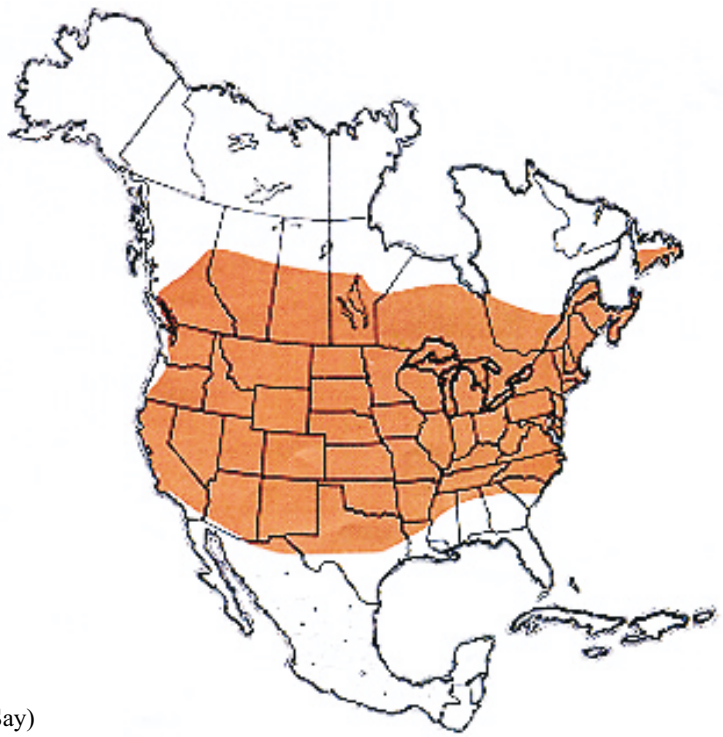
Food Habits

The twostriped grasshopper is a polyphagous species. It feeds on many kinds of plants. Although grasses and cereals are eaten and damaged, rearing experiments show that certain forbs furnish the nymphs with diets that promote high survival, fast growth, and heavy weights. These host plants belong to several plant families. Included are mustards, flixweed and pepperweed; a plantain (broadleaf plantain); legumes (alfalfa and red clover); and composites (greenflower, dandelion, chicory, prickly lettuce, giant ragweed, and arrowleaf butterbur). Microscopic examination of crop contents and field observations indicate that the following species may also be primary host plants: ball mustard, western ragweed, prairie sunflower, perennial sowthistle, kochia, and leadplant. The twostriped grasshopper feeds also on dry litter found on the ground.

A meal for the twostriped grasshopper may be a single species of plant but usually it consists of two or more species. Laboratory rearings demonstrate that a mixed diet is more nutritious than a single plant diet. The diets of particular populations vary depending on the kinds of plants present in their habitats.

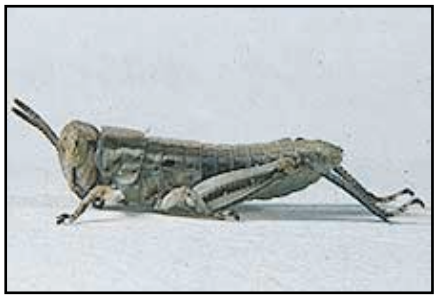
Migratory Habits

The twostriped grasshopper exhibits migratory behavior during both nymphal and adult stages. At high densities nymphs move in bands when they reach the third and older instars. Populations invade crops from crop borders and roadsides where eggs are concentrated and nymphs reach densities as great as 500 per square yard. Nymphs start migration around 10 a.m. when skies are clear and temperature has risen to 75°F. This activity may



Geographic range of
Melanoplus bivittatus (Say)

Instar 1



1. BL 5-6.6 mm FL 2.7-3 mm AS 12-13.

Instar 2

2. BL 7.4-10.4 mm FL 3.9-4.3 mm AS 17-18.

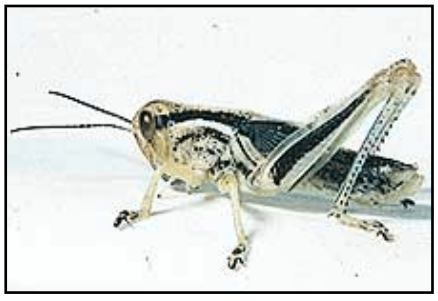
Instar 3

3. BL 9-14 mm FL 5.7-8.4 mm AS 19-22.

Instar 4

4. BL 15-21 mm FL 8.5-12 mm AS 23-24.

Instar 5



5. BL 20-27 mm FL 12-14 mm AS 24-26.

Figures 1-5. Appearance of the five nymphal instars of *M. bivittatus* - their sizes, structures, and color patterns. Notice progressive development of the wing pads. BL = body length, FL = hind femur length, AS = antennal segments number.

occur through the day until 6 p.m. Wind has little effect on movement.

Adults begin flying when temperatures reach 86° to 90°F. Flying with the wind at heights of 600 to 1,400 ft above ground level, they may travel long distances. Swarms of adults also move upwind by low, short flights in search of green food. At high densities, twostriped grasshoppers develop longer wings and slimmer bodies and are more adapted to flight than are low density, solitary individuals.

Identification

The twostriped grasshopper is one of the two largest species in the genus *Melanoplus*. The other is the differential grasshopper, *M. differentialis* (Thomas). Both species are often found together in the same habitat.

The nymphs of the twostriped grasshopper (Fig. 1-5) are identifiable by their spots, stripes, and color patterns:

(1) Compound eye brown with many light tan spots and no dark bands.

(2) Front of head tan or green with dark spots; line of dark spots on carinae (ridges) of frontal costa.

(3) Pronotum with light, horizontal stripe at top of lateral lobe; above the stripe a fuscous or brown band at the edge of pronotal disk.

(4) Gena colored tan or green and spotted, without light crescent below compound eye.

(5) Hind femur with black stripe entire, not interrupted by pale band. Stripe fills upper medial area of hind femur except at proximal end and encroaches slightly on the lower medial area.

(6) Hind tibia green or buff with spines or tips of spines black. Front (anterior edge) of tibia fuscous.

(7) General color green or tan.

The adult male (Fig. 6) is easily identified by the shape of the cercus (Fig. 9). Both the male and the female (Fig. 7) have two distinctive light yellow stripes running down the dorsum of the head, pronotum, and tegmina (Fig. 8). The stripes come together posteriorly on the tegmina forming a triangle.

Hatching

The twostriped grasshopper is an early-hatching species. It is one of the first species to appear in habitats of roadsides and field borders. Eggs (Fig. 10) begin embryonic growth in the summer of deposition and attain 60 to 80 percent development before they go into diapause for the winter. When soil temperatures rise in spring, the

Figures 6-10. Appearance of the adult male and female of *M. bivittatus*, two diagnostic characters, and the egg pod and several loose eggs.

embryos complete development and hatching begins. Eggs start to hatch eight to ten days ahead of those of the migratory grasshopper, *Melanoplus sanguinipes* (F.) The hatching period may last from four to six weeks depending mainly on soil temperatures in spring. Hatching may come in two or more bursts following rain and warm temperatures.

Nymphal Development

Nymphs develop and grow in spring when vegetation is young and green. It takes around 40 days for them to reach the adult stage. Dense populations of nymphs do much shifting about and often migrate into crops, particularly barley and wheat. Because of an extended period of hatching, nymphs may be present in the habitat for as long as 75 days.

Adults and Reproduction

Although the exact date of adult emergence may vary annually by as much as 50 days, this event usually occurs in the first part of summer. Grasshoppers that have moved into crops return to crop borders and roadside habitats for reproduction. Without signaling, a male will stealthily approach a female and make a copulatory leap. After mounting and while attaching his genitalia, the male performs a courtship ritual by shaking his hind femora for three or four seconds. Females have a preoviposition period of one to two weeks before depositing their first clutch of eggs. Favored sites for oviposition are ditch banks that face south and crop borders with compact drift soil. The females select crowns of grass or roots of weeds on which to deposit their clutch. Pods may contain from 50 to 108 eggs. Pods are curved, one and one-eighth to one and one-half inches inches long and one-quarter inch in diameter (Fig. 10) They are delicate and easily broken in sifting them from the soil. Eggs are olive and 5.1 to 5.3 mm long. Fed a nutritious diet of radish leaves, caged grasshoppers have averaged 450 eggs per female. The average number of pods and eggs produced in nature is unknown.

Most populations of the twostriped grasshopper have a one-year life cycle, but in mountain parks of British Columbia at altitudes above 3,000 feet, populations take two years to complete a life cycle. A two-year life cycle may also occur among populations inhabiting meadows of the Rocky Mountains.

Population Ecology

The twostriped grasshopper became a pest when agricultural development in the West fostered large populations of the insect. Early settlers unwittingly sowed

Male

6. BL 28-30 mm FL 15-16.5 mm AS 26-27.

Female

7. BL 36-41 mm FL 18.5-20.5 mm AS 27-28.

Note Two Stripes

8. Dorsal view of twostriped grasshopper.

Note Cercus

9. Side view end of male abdomen.

Egg pod

10. Egg pod and several loose eggs.

seeds of various weeds along with their crops, thus introducing nutritious new host plants for this grasshopper. The weeds also grew luxuriantly along crop borders, road sides, and ditch banks. This environment provided essential habitats, while south-facing ditch banks and compact drift soil at field margins furnished ideal egg laying sites.

These factors and favorable weather over a few consecutive years allow populations to irrupt. In eastern North and South Dakota such favorable conditions combined to precipitate one of the worst outbreaks of the twostriped grasshopper and differential grasshopper in agricultural history. Populations increased slowly for three years, 1928 to 1930. Both species reached phenomenal numbers in 1931 and 1932. They devastated fields of alfalfa, small grains, corn, vegetables, and a variety of fruit and shelterbelt trees. In 1933 and 1934 a severe drought not only ruined crops and other vegetation but also terminated the grasshopper outbreak.

Daily Activity

The twostriped grasshopper is a diurnal insect. Its activities occur during the daylight hours when weather is warm and the skies are clear (Table 1).

The tall vegetation of its habitat influences its behavior. In the evening before sunset as temperatures cool, both nymphs and adults climb the plants and rest, moving from halfway up to nearly the top of the vegetation. In these positions they rest through the night. Shortly after sunrise, the grasshoppers are warmed by the rays of the sun and begin to descend from their overnight perches. On the ground they may continue sunning themselves or begin to feed and then to migrate. Nymphs are usually on the ground from 6 to 11 a.m.

Table 1. Activity of nymphs and adults of the twostriped grasshopper, *Melanoplus bivittatus* (Say) correlated with air and soil temperatures (after Parker and Shotwell 1932)

Name of activity	Description	Average temperature °F			
		Nymphs		Adults	
		Air	Soil	Air	Soil
Beginning of activity	Start of descent from plants	65		65	
Beginning of normal activity	Start of feeding	68		68	70
	Start of migration	75		78	
	Start of oviposition			70	
Beginning of escape from heat	Climbing and seeking shade on plants	90	112	90	112
	Flying in circle or flying with wind			90	112

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