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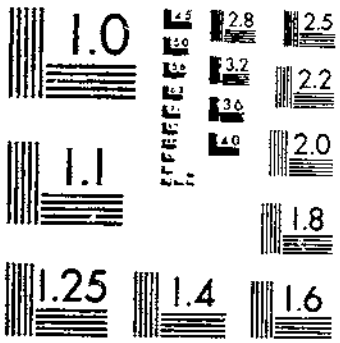


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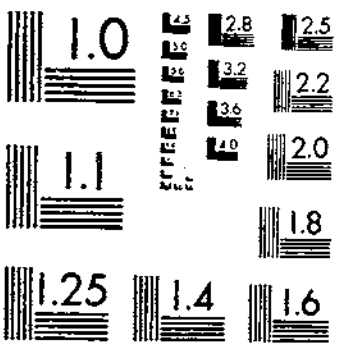


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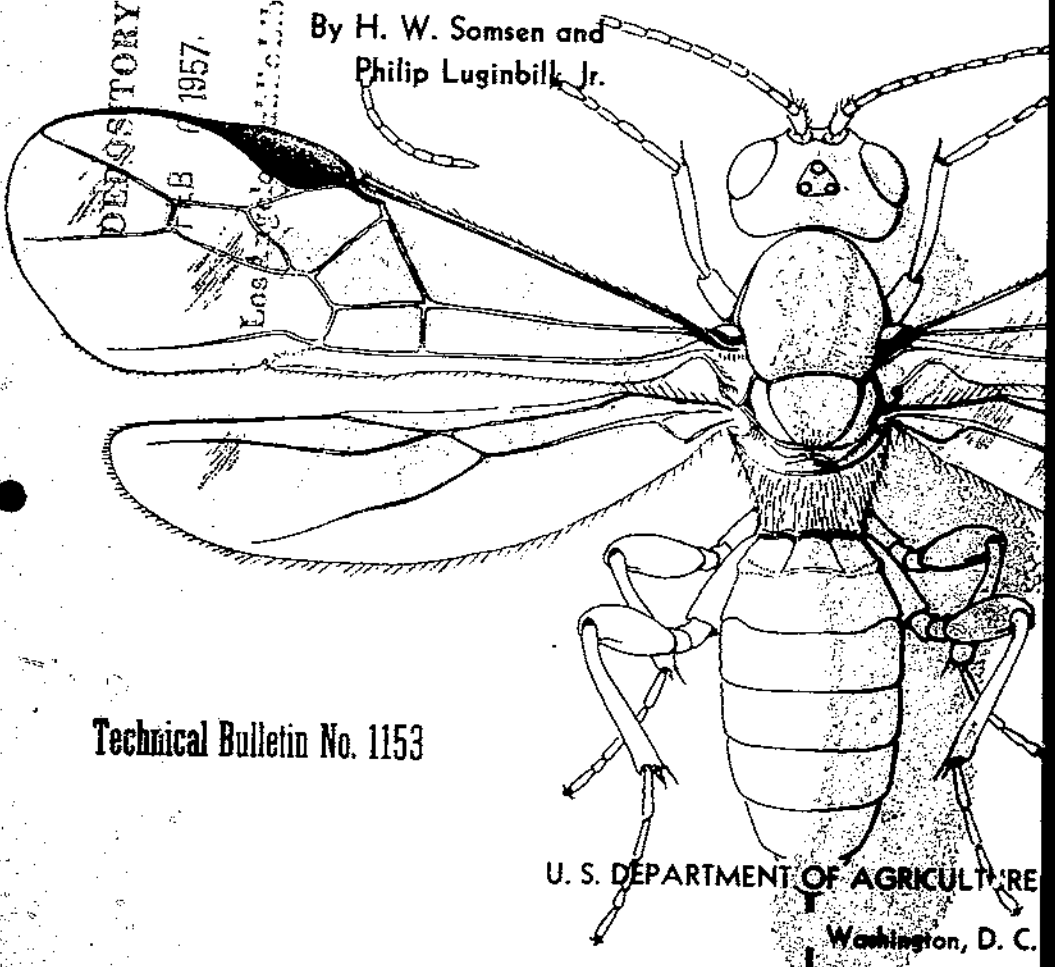
# BRACON LISSOGASTER MUES.

## A PARASITE OF THE WHEAT STEM SAWFLY



By H. W. Somsen and
Philip Luginbill, Jr.



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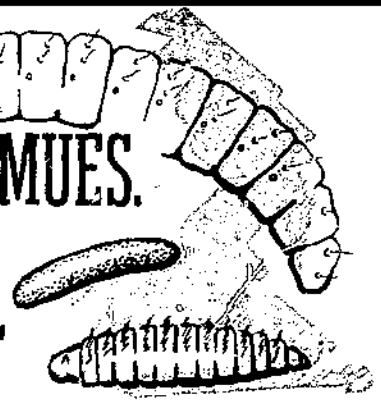
# BRACON LISSOGASTER MUES.

## A PARASITE OF THE WHEAT STEM SAWFLY[1]



By H. W. Somsen and Philip Luginbill, Jr., *entomologists, Entomology Research Branch, Agricultural Research Service*[2]

The wheat stem sawfly (*Cephus cinctus* Nort.) originally lived in native grasses and still infests a number of them. However, it has now spread to wheat (*Triticum aestivum* L.) and has become one of the most important insect pests of that crop in the northern Great Plains. Several million bushels of wheat are lost annually in Montana and North Dakota because of wheat stem sawfly damage.

In 1949 a new parasite of the wheat stem sawfly was discovered at Choteau, Mont., by H. W. Somsen. This parasite has been described and named *Bracon lissogaster* Mues.[3] by C. F. W. Muesebeck (*3*).[4]

### ECONOMIC IMPORTANCE OF PARASITES

Parasites of the wheat stem sawfly play an important role in reducing the sawfly in grasses, but their effectiveness against the pest in wheat has been limited. In Manitoba, Canada, Criddle (*2*) found *Plewrotropis utahensis* Cwfd. common in grass but not in wheat. Ainslie (*1*) reported that from some localities in Bottineau County, N. Dak., *utahensis* controlled as high as 50 percent of the sawflies in *Bromus* and *Phleum*.

*Collyria calcitrator* (Grav.), a European parasite, was introduced into Canada in 1930 to aid in controlling the wheat stem sawfly. Smith (*4*) in a fall survey the year of release estimated that it parasitized from 2 to 9 percent of the sawfly population. There are no records since 1930, however, to indicate that this parasite has been able to maintain itself.

*B. lissogaster* is strictly an ectoparasite of *C. cinctus* and may be either solitary or gregarious. It is not uncommon to find 3 or 4 parasites per host. It will parasitize larvae in wheat under some conditions, but it has not to date adapted itself to wheat grown under regular farm practices in the sawfly area. In 1951 it heavily parasitized the sawfly in small experimental plots of spring wheat seeded

[1] Submitted for publication May 29, 1956.

[2] The writers express their appreciation to K. B. Maughan, of the former Bureau of Entomology and Plant Quarantine, for much of the material herein reported; and to E. G. Davis and A. M. Vance, Entomology Research Branch, and J. A. Callenbach, head of the Department of Entomology, North Dakota Agricultural Experiment Station, for their helpful suggestions.

[3] Order Hymenoptera, family Braconidae.

[4] Italic numbers in parentheses refer to Literature Cited, p. 7.

in an uncultivated field containing mostly *Agropyron* grasses. The average parasitization in Supreme, Thatcher, Ceres, and Rescue varieties grown in these plots was 28.9 percent. In 1953 near Choteau sawfly larvae in volunteer wheat growing in a barleyfield were parasitized 85 percent. However, in large fields of wheat never more than a fraction of 1 percent have been parasitized.

## DISTRIBUTION AND HOST PLANTS

*B. lissogaster* has been found in Cascade, Chouteau, Glacier, Hill, Liberty, Pondera, Teton, and Toole Counties in north-central Montana. It has been reared from sawflies infesting the wild grasses *Agropyron smithii* Rydb., *trachycaulum* Malte, and *Stipa viridula* Trin., as well as wheat and barley (*Hordeum vulgare* L.). However, no sawfly parasitism was observed in the grasses *Hordeum jubatum* L., *Bromus inermis* Leyss., *Phleum pratense* L., and *Elymus canadensis* L., which were often heavily infested with the sawfly during the observations reported here.

## SEASONAL HISTORY

The parasite has two complete generations a year in the vicinity of Choteau, Mont. The winter is passed as larvae enclosed in silken cocoons within the wheat stems. Pupation takes place the following spring. Adults of the first generation begin to emerge during the latter part of June and are most abundant in the field late in July. Adults of the second generation appear about the middle of August and are most abundant 2 weeks later. First-generation adults do not oviposit until 6 to 8 days after emergence, but those of the second generation lay their eggs almost immediately.

## SPECIES DESCRIPTION

The original description of the species by Muesebeck (*3*), based on a study of 17 females and 28 males reared from *C. cinctus* in Choteau, Mont., is as follows:

Most similar to *B. connecticutorum* (Vier.), but differing from that species in having the abdomen entirely smooth and polished, the notaulices less hairy, and the second abscissa of cubitus only half as long as the recurrent vein.

*Female.*—Length about 3.5 mm. Head, including face and frons, smooth and polished; transverse diameter of opening between clypeus and mandibles slightly longer than distance from opening to eye. Antennae 27- to 31-segmented, shorter than body, the first two flagellar segments about twice as long as broad, the rest shorter. Thorax smooth and polished. Notaulices weak, not strongly hairy. Propodeum without even a suggestion of a median longitudinal carina at apex. Radius arising from before middle of stigma; first abscissa two-thirds as long as, second abscissa only slightly longer than, first intercubitus, which is strongly oblique. Second cubital cell about three-fourths as long as third measured on cubitus. Abdomen entirely smooth and polished. Second suture fine, nearly straight and not foveolate. Ovipositor sheaths extending less than half the length of abdomen beyond last segment.

Usually mostly testaceous, with head, including antennae and palpi, pro- and mesopectus, apices of all tibiae, and all tarsi entirely, black; wings somewhat infumated; stigma and veins dark brown. In some of the female paratypes the thorax and legs are more extensively black.

*Male.*—More slender than the female. Antennae as long as body, 33- to 39-segmented. Head and thorax entirely black. Legs brownish to piceous, with coxae largely black.

## LABORATORY REARING

*B. lissogaster* eggs were hatched in deep-well slides covered with cover slips. A small drop of water added to each well raised the humidity and prevented the eggs from desiccating. The larvae hatching from the eggs were transferred to second- and third-stage larvae of the sawfly and confined in transparent cellophane straws, 3 inches long, with moist cotton plugs inserted in each end. Here they were allowed to mature, pupate, and emerge as adults.

Two types of cages were used to observe parasitism of the sawfly larvae. One was made by taping five 1-gallon ice-cream cartons end to end, with the bottoms and covers removed, and installing a cellophane observation window, 4 by 24 inches, in the side of this container. The other type was made by covering one end of a clear plastic tube, 2½ inches in diameter, with 56-mesh plastic screen. The plastic-tube cage was more satisfactory. When the cage of ice-cream cartons was used, the parasites tended to congregate on the observation window; in the plastic cage they rested on the wheat stems close to the sawfly larvae.

Succulent *A. smithii*, *trachycaulum*, and *T. aestivum* stems, infested by introducing mature sawfly larvae through a one-fourth-inch slit, were placed in each observation cage. Adult parasites were fed honey and sugar mixed with agar to increase their life span.

## OVIPOSITION

To locate a larva for oviposition, the female *B. lissogaster* walks up and down the wheat stem, occasionally touching the stem with her antennae. When the larva is located she stops, raises her body to leg's length, and stands perfectly rigid as if listening or feeling for larval movement. Before ovipositing, her abdomen is tipped slightly forward so that the ovipositor is perpendicular to the stem. It is very common for her to remain in this position for several hours. As the ovipositor is inserted into the stem and larva, it is guided by a pair of black pads. After penetration, the ovipositor is withdrawn almost out of the stem and then driven back with a pumping motion. The host larva is paralyzed to some degree in this manner before oviposition takes place.

Eggs are deposited on or near the sawfly host larva. If the larva is not completely paralyzed and continues to crawl, the eggs, being sticky, adhere to the integument of the larva. One to four eggs are laid by each female before she moves to another stem. After completing oviposition the parasite either remains on the same stem and preens herself, or she flies to another stem and oviposits again.

The egg (fig. 1, *A*) is 0.74 mm. long and from 0.09 to 0.12 mm. wide. It is almost cylindrical and is elongate and slightly curved. The chorion is smooth, glistening, and light gray.

## LARVAL GROWTH AND PUPATION

*B. lissogaster* eggs hatch in 66 hours at 23° C. and 78-percent relative humidity. The larva escapes from the egg by splitting the cephalic end. Immediately after hatching it crawls about over its host until it finds a suitable place to feed. It feeds at the outer sur-

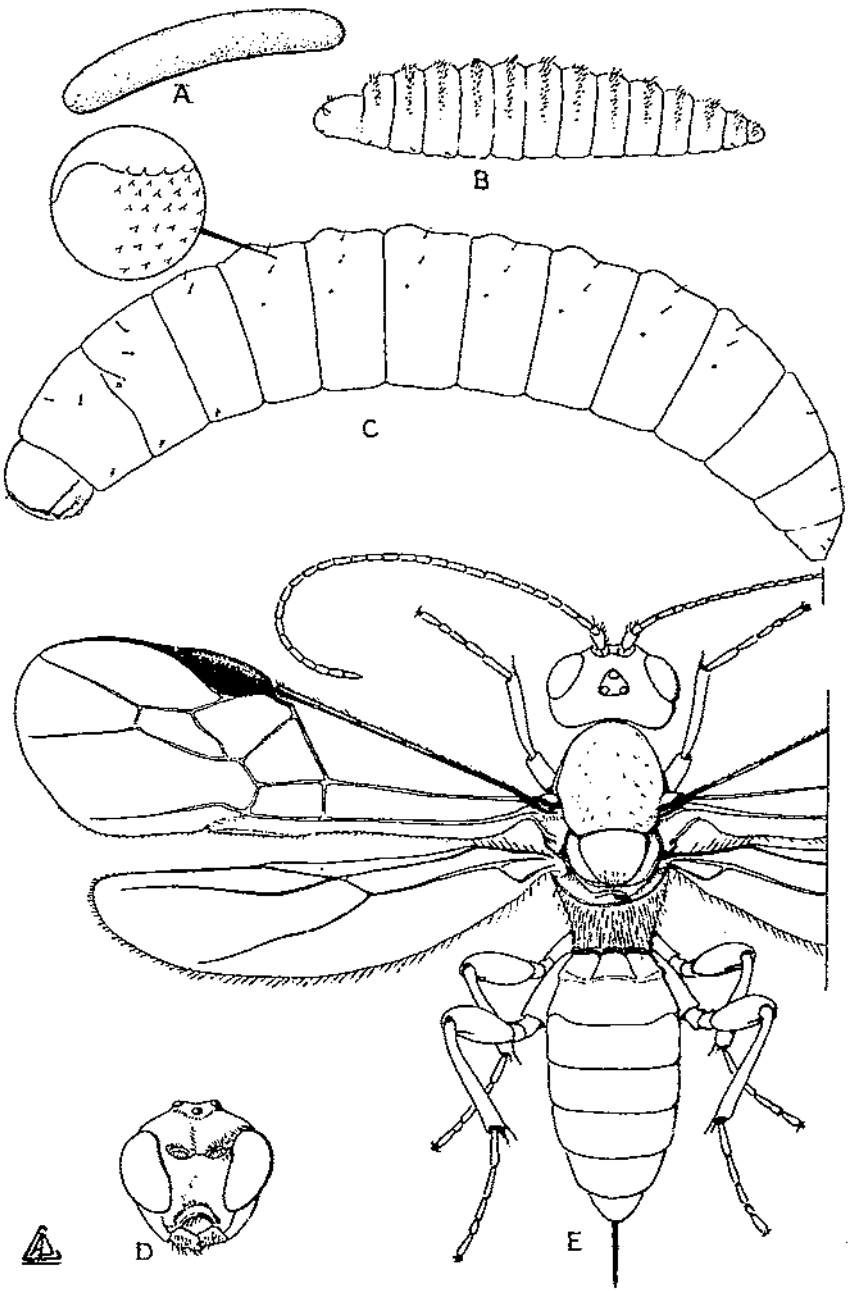



FIGURE 1.—*Bracon lissogaster*: *A*, Egg; *B*, late first-stage larva; *C*, last-stage larva; *D*, front view of head of adult; *E*, adult. (Much enlarged.)

face, sucking juices from the body of the host larva through minute lacerations made with its mandibles. As the larva feeds it moves from one location to another. It is not uncommon for the host larva to move about slightly for 2 or 3 days while the parasite larva feeds.

The first-stage larva on hatching is 0.6 mm. long. The head is large in proportion to its overall size, and its body tapers to a point at the caudal end. This larva usually lies in a hooked position when newly hatched, but as it feeds the body lengthens and fills out. At the end of this stage of development (fig. 1, *B*) it has doubled in size, and most of the body segments are larger than the head. A few setae are found on the body segments. A pair of short stout antennae are present. The mouth parts are not sclerotized.

Near the end of the second stage the larva is 2.5 mm. long. Little change in shape takes place during this stage. The head is more pointed than in the first stage. The mouth parts show some sclerotization. Setae are predominantly scattered over all body segments. Groups of 4 or 5 setae are usually found on the dorsolateral aspect of each body segment.

The last-stage larva (fig. 1, *C*) at the end of feeding is 4.2 by 1 mm. At maturity it is light yellow with brown facial rods. It is plump, elongate, and slightly curved. The head measures 0.39 mm. in diameter and the anal segment 0.45 mm. Thirteen conspicuous segments, in addition to the head, are present. The dorsal and lateral surfaces of the body are evenly covered with short delicate setae. A few longer setae are scattered dorsally on the body segments. The mouth parts, especially the mandibles, are heavily sclerotized. This last larval stage is completed in 2 or 3 days.

A parasite larva completes its development in 6 to 8 days. When 3 or 4 feed upon the same host larva, the feeding and developing period is slightly shorter, probably because of the limited amount of food available to each parasite larva. Larvae developing under crowded conditions are normal and completely developed, but they are usually slightly smaller than those that feed solitarily. No cannibalism was observed among *B. lissogaster* larvae.

After the parasite larva has finished feeding, it spins a cocoon, about 6.1 by 1.9 mm., very close to the remains of the host. As it spins it weaves its head and thorax from side to side, exuding a delicate white thread from its silk glands. After completing half of the cocoon, the larva turns around and spins the remainder. Approximately 36 hours is required for the construction of each overwintering cocoon.

The first-generation larva makes a loose, lightly woven cocoon, consisting mainly of 2 well-padded ends attached firmly to the inside walls of the wheat stem. This cocoon is light brown. The second-generation larva constructs a tightly woven, elongate, cylindrical cocoon, which is dull white.

One of the first signs of pupal development is a lateral constriction between the abdomen and the thorax. The pupa contained within the silken cocoon is of the free or exarate type. It is motionless and enclosed within a thin, transparent membrane. It is 4.0 by 1 mm. in size. When first formed the pupa is glistening white and has a pair of compound eyes. Three small ocelli, located near the vertex, appear later and are light reddish brown. The antennae are the first appendages to become distinct. They lie ventrally and extend about

three-fourths the length of the body in the female and the full length or slightly longer in the male. The 3 pairs of legs appear next. Wings, which develop last, extend 0.5 mm. beyond the propodeum when fully formed. As further development takes place, the pupa gradually assumes the black color of the adult. Similar to the wheat stem sawfly, *B. lissogaster* pupates with its head at the upper end of the cocoon. The pupal stage lasts from 7 to 9 days at 23° C. and 78-percent relative humidity.

## ADULT ACTIVITY

The adult parasite (fig. 1, *D* and *E*) escapes by cutting a circular hole in the cephalic end of the cocoon and in the side of the host plant.

The sex ratio appears to be 2 males to 1 female. Mating is not necessary for the production of normal, healthy progeny by the female, but it does play a definite role in determining the sex. Adults developing from unfertilized eggs are all males, whereas those from mated females are both males and females in about equal proportion. However, this phenomenon is not unusual, as several braconid parasites produce male progeny from unfertilized eggs.

Laboratory-reared adults of *B. lissogaster* had an average life span of 2½ days and a maximum of 6 when given neither food nor water. When they were given only water, the average was increased to 9½ days and the maximum to 21. When the adults were fed on a solution of honey or sugar and water, the average life span was 19 days and the maximum was increased to 35.

Adults are most active in sunny weather, but like their host *C. cinctus* they may seek shade in the heat of the day. They are weak fliers and do not fly long distances. They hover in flight, and after landing they frequently preen themselves carefully.

## SUMMARY

*Bracon lissogaster* Mues., a new parasite of the wheat stem sawfly (*Cephus cinctus* Nort.), was first found at Choteau, Mont., in 1949, and subsequently it was reported from 8 counties in north-central Montana. This parasite has been reared from sawflies infesting several native and cultivated grasses growing voluntarily or under experimental conditions, but few have been found in wheat grown under regular farm practices in the sawfly area.

*B. lissogaster* was described by C. F. W. Muesebeck in 1953 as a new species, being most similar to *B. connecticutorum* (Vier.), but differing from it in having the abdomen entirely smooth and polished, the notaulices less hairy, and the second abscissa of cubitus only half as long as the recurrent vein.

*B. lissogaster* is an ectoparasite and may be either solitary or gregarious. There are two complete generations a year. The winter is passed as a larva. First-generation adults are most abundant late in July, and those of the second generation appear in mid-August. Adult braconids paralyze the sawfly larvae before laying eggs on or near them, and hatching larvae feed on the host larvae through minute lacerations made with their mandibles. There are three larval stages. The pupae are of the exarate type. First-generation cocoons are

very loosely woven; those of the second generation are tightly woven. After pupation the adults escape by cutting a circular hole in the host plant.

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