THE HAIRY-VEITCH BRUCHID, BRUCHUS BRACHIALIS FAHRAEUS, IN THE UNITED STATES

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INTRODUCTION

The genus Bruchus was restricted by Schilsky (6) to include only the immediate allies of Bruchus pisorum (L.), the pea weevil, of which he tabulated 24 species known to him. To these may be added others doubtfully distinct, imperfectly known, or more recently described, which increase the nominal species of the genus to a total of about 46. All these species are native to the Palearctic region. Two of them are already well known in the United States as major pests of the plants affected. B. pisorum was the first of the genus and one of the first species of the family to be recognized. It was described in 1752, and was recorded as having destroyed in the 1740's the flourishing colonial American industry of producing dry peas for ships' stores. B. rufiglans Boheman, the broadbean weevil, has now practically destroyed the broadbean industry of California. A third species, B. brachialis Fahraeus, has in recent years gained a foothold in this country, for in 1931 the junior author found it heavily infesting the seeds of vetches growing in New Jersey, Delaware, Maryland, and North Carolina, and in 1932 it was found in Virginia. In view of these facts it seems wise to present a brief summary of the knowledge at present available of the habits of the members of this genus and to point out the increased danger of their establishment in the United States as a result of changed commercial conditions.

FOOD PLANTS OF BRUCHUS (RESTRICTED)

All species of Bruchus of which we have credible records feed as larvae in seeds of plants of the leguminous tribe Vicieae, infesting the pods in the field before they ripen. They are unable to reinfect the seed in storage.

1 Received for publication June 30, 1932; issued May, 1933.
2 Reference is made by number (italic) to Literature Cited, p. 750.
3 Unless otherwise indicated, the records of host plants of the species herein discussed are all based upon determinations, made by the senior author of insects associated with their host seeds contained in the collections of the U. S. National Museum. A large part of this material was obtained in routine inspection work by officers of the Federal Horticultural Board and its successor, the Plant Quarantine and Control Administration (now the Bureau of Plant Quarantine), of the U. S. Department of Agriculture. Much of the seed material was imported by the Division of Foreign Plant Introduction for the experimental work of the Bureau of Plant Industry. The determination of the seeds has been verified by Roland McKee, in charge of investigations of the vetchlike plants, or by H. C. Skeels, in charge of the seed collection of the Division of Foreign Plant Introduction. To both of these men the writers are indebted for assistance in botanical and agricultural matters in the preparation of the present work.
4 Records of species affecting the seeds of Lotus, Ulex, Phaseolus, Oxytropis, and Lupinus are not considered credible. They seem to be based upon visits of adult bruchids to flowers or extrafloral nectaries, upon erroneous identification of seeds affected, or upon mistaken interpretations of the literature.


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The tribe Vicieae includes the genera Vicia, Lathyrus, Lentilla (or Lens), Pisum, Cicer, and Abrus. Cicer (which includes \textit{C. arietinum} L., the chickpea, garbanzo, or gram) and Abrus (including \textit{A. precatorius} L., the rosary-pea) are known to be infested by other Bruchidae, but no species of Bruchus has yet been recorded as affecting either genus. The other host genera all have some species affected; in some instances two or more genera may be attacked by one species of Bruchus. These genera are very closely allied and merge into one another imperceptibly, particularly in the characters of seeds and pods, so that their separation is more or less conventional, being based on usage rather than on sound botanical differences. The seeds of Vicia, Lathyrus, and Pisum are often not easily distinguished as to species, or even as to genus, by botanists familiar with the plants. Hence, many records of host plants of species of Bruchus are indefinite from lack of specific determination of the plants affected or erroneous from misdetermination of the plant. Furthermore, the species of Bruchus are difficult to recognize and frequently have been determined wrongly. The records of attacks upon definite species of Vicieae are surprisingly few, and these few are less to be depended upon than is desirable.

\textit{Lentilla lens} (L.) W. F. Wight (\textit{Lens esculenta} Moensch), the lentil, is affected by \textit{Bruchus lentinis} Froelich, \textit{B. ervi} Froelich, \textit{B. signaticornis} Gyllenhal (\textit{pallidicornis} Boheman), and \textit{B. rufimanus} Boheman. The first two species are not known to affect other host plants. \textit{B. signaticornis} is also found in the lentil-like seeds of \textit{Vicia monanthos} Desfontaines. \textit{B. rufimanus} seems to attack lentils only incidentally. The cultivation of lentils has been repeatedly abandoned in various parts of Europe on account of the attacks of one or another of the lentil bruchids. The writers have found no records of bruchids attacking the seeds of other species of Lentilla than those mentioned.

\textit{Pisum sativum} L., the common pea with its varieties, is attacked by \textit{Bruchus pisorum} (L.), \textit{B. emarginatus} Allard, \textit{B. tristiculus} Fahraeus, and perhaps by \textit{B. tristis} Boheman. \textit{B. emarginatus} seems to be the species that attacks the pea in India which has sometimes been determined as \textit{B. affinis} Froelich. It is evidently quite as much a pea pest as the better known \textit{B. pisorum}. \textit{B. tristiculus} is more often found in seeds of Lathyrus. The writers have not been able to verify the records of \textit{B. tristis} attacking the pea, and it is possible that they may be based on misdeterminations of \textit{B. tristiculus}. Peyerimhoff (10, p. 365) has reported the pea weevil breeding in seeds of \textit{P. elatus} Bieberstein, the reputed ancestor of the pea, in northern Africa, and the writers have found it in this species from Tiffis. The writers have discovered no records of the other species of Pisum being attacked by Bruchidae.

The species of the genus Lathyrus are not very familiar to laymen in the United States except \textit{L. odoratus} L., the sweet pea. There is a considerable industry in the production of the seed of this species in California which is definitely threatened by the likelihood that \textit{Bruchus affinis}, \textit{B. tristis}, \textit{B. tristiculus}, and \textit{B. ruifipes} Herbst will

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1 It should not be inferred that species of Bruchus are the only Bruchidae affecting plants of the other genera of the tribe Vicieae. Certain species of Bruchidius and Callosobruchus affect a number of them. Some species of Bruchidius may be as definitely attached to some of them as the pea weevil is to the pea.

2 Since this paragraph was written \textit{Bruchus ruifipes} has been intercepted by inspectors of the Bureau of Plant Quarantine in seeds of sweet pea (\textit{Lathyrus odoratus}), common vetch (\textit{Vicia sativa}), and hairy vetch (\textit{V. villosa}), all of European origin.
be introduced in sweet peas or the seeds of other species of Lathyrus, particularly *L. sativus* L.\(^{9}\) The grass pea (*L. sativus*) is an important food grain in the south of Europe and in India and is also imported into the United States for use as food. The Tangier pea (*L. tingitanus* L.) has been grown experimentally as a forage and green-manure plant, but it has not yet made a place for itself in our agriculture. Other species have also been grown as ornamentals, and still others experimentally as forage crops. *B. venustus* Fahraeus, *B. viciae* Olivier, *B. loti* Paykull, *B. ruifipes*, *B. tristis*, *B. tristiculhus*, *B. affinis*, and *B. atomarius* (L.) are more or less definitely known to breed in seeds of some species of Lathyrus. *B. altaicus* Fahraeus was described from the seeds of *L. tuberosus* L. from the Altai Mountains in central Asia, and the writers have recently determined as this species a bruchid found in the seeds of an undetermined species of Vicia from Turkestan.

Several species of *Vicia* are used for forage, hay, and green-manure plants, and the seeds of some of them are occasionally used for human food. *Vicia faba* L. (the broadbean) is a common food of man. *Bruchus ruifimanus* seems to prefer *V. faba* as host and is principally known as an enemy of that plant. Peyerimhoff (10, p. 365) has recorded it as bred from *V. vestita* Boissier, which is a synonym of *V. lutea* L., in which the present writers have also found it breeding. The writers’ notes also record it from *V. monanthos* Desfontaines, *V. sativa* leucosperma Moench, *V. narbonensis* L., and *Lentilla lens*. *B. dentipes* (Baudi) is reported from *V. faba*, and the writers have determined it from a wild Vicia from Haifa, Palestine. Bekman (4) records *B. dentipes* Baudi from *V. hircana* (=*hircanica* Fischer and Meyer). As before indicated, the writers have determined *B. signaticornis* from seeds of *V. monanthos* from Madrid, Spain. *B. viciae* Olivier, *B. atomarius* (L.), *B. ulicis* Mulsant and Rey, *B. ruifipes* Herbst, *B. griseomaculatus* Gyllenhall, and *B. brachialis* Fahraeus are all recorded as breeding in seeds of species of Vicia.

**COMMERCIAL CONDITIONS AFFECTING THE DISTRIBUTION OF BRUCHIDAE**

The establishment of *Bruchus brachialis* in the eastern part of the United States is the result of a post-war speeding up of agricultural commerce which has increased the chances of introducing exotic Bruchidae into this country. Formerly commercial operations were so slow that seeds were not distributed in this country until a year or more after they were harvested. The bruchids in them therefore had time to emerge and if they were unable to reinfest the seed they died before they were scattered over the country. Within the last 20 years the principal shipping points of hairy-vetch seed imported into the United States have been changed from Baltic to Adriatic ports, where the earlier season makes it possible for the seed to be ready for market in the same season in which it is harvested. It is also much more certainly infested by *B. brachialis* in southern Europe than in the more northerly regions.

During the last three years several lots of living bruchids have been noticed in seeds imported under regular trade conditions, whereas in previous consignments the insects in the seeds examined were dead. *Bruchus brachialis* is the seventh species of Bruchidae known to have been accidentally established in continental United States.

\(^{9}\) See note on page 740.
HISTORY OF BRUCHUS BRACHIALIS

*Bruchus brachialis* was described by Fahraeus (13, p. 79) from specimens sent to Schoenherr for description by Chevrolat, the material coming from Tours, France.

Mulsant and Rey (8, p. 33) described the male of *brachialis* as *pal-lidicornis* Schoenherr, and gave the first description of its distinctive sexual characters.

Allard (1) renamed *pallidicornis* Mulsant and Rey (not Gyllenhal) as *ruficornis*, and added Sicily to France as its habitat.

Perris (9, p. 237) records that in September, 1874:

I fanned some wheat ***, under the fan the seeds of vetch and the *Bruchus* from them had accumulated in such numbers as to cover the ground. I noticed many *Bruchus pisi* [pisorum] and *granarius* [atomarius] with which I was not concerned, and persuaded myself the rest were *nubilus* [rufipes]. Entirely by chance, I picked up a few of them and saw that *nubilus* was in a very small minority and that the rest belonged to one or two species unfamiliar to me, though I might have mistaken them for *sertatus* [ervi] or *pallidicornis* [signicornis], if I did not know that those species live in lentils. To have some for study when not too much pressed for time I collected some hundreds of them and found the two species to be *brachialis* Fah. and *ruficornis* All., which according to Mr. Allard himself is only the male of *brachialis*.

Here then is an insect which, judged by catalogues of rich collections, which I had run through recently, my colleagues do not have, which I did not myself possess, and of which, doubtless, I may take thousands more, for there are always, to nourish them, enough vetches among the wheat.

Baudi (2, p. 13, 16) described the species, placed it in *Mylabris*, and extended its range to include “all Italy and its Islands, Dalmatia, France, Spain, and Algeria.”

Bedel (3, p. 357) placed it in *Laria*, gave its range in France as south of the Loire River, and added the record of its occurrence in Asia Minor.

Marchal (7) gives an account so pertinent to the present occasion that it is quoted in its entirety. Now, after nearly 30 years, his prediction of its establishment in this country has been fulfilled. The account is as follows:

Perris has already indicated the presence of *Laria brachialis* Fahraeus in the seeds of vetches growing in fields of wheat. He found it there in quantity, associated with some other species, in seeds of *Vicia* accumulated under a fan which had just been used for cleaning wheat. The specific name of the plant was not definitely indicated by the author.

Examination of a package received through Mr. Hariot, preparator at the Museum, results in finding this insect attacking the seeds of vetches cultivated as forage plants and notably those of *Vicia villosa*. The seeds of this plant sent to me were strongly infested by *Laria brachialis*, each seed attacked containing one of these insects.

It should be noted that *Vicia villosa* is a plant of northern, eastern, and central Europe and does not grow wild in France. It has, however, for some years been cultivated frequently as a forage plant. On the other hand, *Laria brachialis* is a species belonging in the south of Europe and [according to Bedel] does not reach above the Loire in France except accidently. Apparently, then, it is only recently that this insect has adapted itself to *Vicia villosa*. [This inference may be doubted.]

Not only in France is this plant menaced by this insect, which like all bruchids attacking plants under cultivation doubtless will not delay becoming cosmopolitan. The seeds sent to me had, indeed, been supplied by a French seed house and forwarded to Canada, whence they had been returned to France for examination of the insects contained in them. The approaching naturalization of *Laria brachialis* in America is an event to be foreseen.
Schilsky (6, No. 29) placed the species in Bruchus as restricted by himself and gave the most recent and most careful description of the species, a translation of which follows:

*Bruchus brachialis* Fahraeus. Ovate, black, covered with sparse fuscous pubescence beneath, sides of breast and venter whitish-maculate; pronotum and elytra whitish-variegated; pygidium covered with whitish-cinereous pubescence; prothorax almost twice as broad as long, sides parallel behind, dentate in the middle, hind angles rectangular; elytra short; front legs rufotestaceous, hind femora strongly dentate, hind tibiae ending in two spines at apex beneath. Length, 3-3.5 mm.

Male. Antennae rufotestaceous, joints 6 to 10 depressed, strongly transverse; front tibiae stout, compressed, slightly arculate; middle tibiae curved, armed at apex with a truncate mucro.

Female. Antennae a little less depressed, black, first four or five joints and the last (and the front legs also) rufotestaceous; front femora black at base; front tibiae linear.

Variety a [male] with antennae infuscate in the middle; variety b [male], front femora black; variety c [female], front femora and last joint of antennae black; variety d [female], two joints of antennae rufous or ferruginous; variety e [female], antennae rufotestaceous, joints 6–7 or 6–9 infuscate; variety f [male], antennae bright rufotestaceous (Erivan); variety g [female], last joint of antennae black, middle tarsi rufescents. Nyons (from Baudi).

[Bibliography omitted.]

Antennae differing in color in the sexes as in *Br. pallidicornis*; front tibiae of male in both species widened but the fasciate markings of elytra lacking [in *hrachialis*]; middle tibiae and tarsal black, the middle tibiae of males have very different characters. Body black, oval, similar to *atomarius*, sparse very short pubescence beneath, sides of breast and sternites with usual brighter maculae, brownish and dirty white variegated above, indefinite white markings of elytra not distinctly transverse-fasciate; scutellum and a macula in front of it whitish pubescent; pygidium evenly cinereous, generally with two small indistinct spots; pronotum almost twice as broad as long, densely rugosely punctured, the sides parallel behind, a small denticle in the middle, hind angles right angles, sides not emarginate in front of the angles; elytra short, oval, the striae fine, almost impunctate; hind femora strongly toothed, hind tibiae within with two equal very short spinules at apex.

Male. Antennae yellow, rarely infuscate in the middle (variety a), compressed, joints 2 to 4 fully as long as broad, or shorter, 5 considerably broader, the following joints very strongly transverse, emarginate at apex; front legs reddish yellow, their tibiae broad, compressed, parallel-sided, hence not arcuately expanded on the outer side [as t is in *signaticornis*, the other common species with broad front tibiae in the male]; middle tibiae curved downward, with a black, truncate plate at apex directed backward. In one male from Dalmatia (von Heyden collection) the middle tarsi are red.

Female. Antennae narrower, black; the 4 or 5 basal joints and the last, rarely the last two (variety d), reddish yellow; rarely [are] the antennae redish yellow infuscate in the middle (variety e); base of the yellow front femora generally black to the middle, rarely entirely black (variety b); in some cases the last joint of the antennae is also black (variety c).

In central and southern Europe, in Asia Minor (Erivan, Anatolia), in Algeria.

**SYNOPTIC TABLE OF THE NEAREST ALLIES OF BRUCHUS BRACHIALIS**

According to Schilsky (6, No. 12), *Bruchus hamatus* Miller (12, p. 228) from Greece and Asia Minor is very closely allied to *B. brachialis*, but the pronotum is much less transverse and the pale dots on the elytra are arranged in two indistinct fasciae. The male *hamatus* has the secondary sexual characters of *brachialis*, but the fifth joint of the antennae is produced into a tooth or spine such that if the following joints were modified in the same manner the antennae would be pectinate. This is a rare species and its food plants are unknown.
*Bruchus venustus* Fahraeus (13, p. 75) is also closely allied to *brachialis*, but it has the hind femora with a small subbasal denticle beneath instead of the usual subapical tooth. It is found in the Caucasus, Hungary, and southern France and is considered a rare species.

*Bruchus terminatus* Wollaston (14, p. 381) from Tenerife is apparently near *brachialis*, but it is more elongate and has more pale pubescence. The description of the subbifid spine at the apex of the middle tibiae would seem to refer to a truncate lamella such as occurs in *brachialis, venustus, ulicis, hamatus, and signaticornis*. The following outline should differentiate the males of this group:

1. Middle tibiae with acute tooth above apical lamella, front tibiae incrassate, antennae usually pale.
   - *signaticornis*
   - Middle tibiae without tooth above apical lamella
   - *ulicis*
2. Front tibiae incrassate.
   - *ulicis*
   - Front tibiae simple, antennae dark except at base
   - *hamatus*
3. Antennae pale, joint 5 produced into a tooth, middle femora triangularly widened, front legs only pale
   - *venustus*
4. Hind femora with small denticle near base, without subapical tooth, front legs only pale, antennae with joints 1 to 8 pale, 9 to 11 dark
   - *brachialis*
5. Antennae dark, front legs and middle tarsi pale
   - *terminatus*

It is not possible at present to differentiate the females of these species or either sex of some other species which are as yet imperfectly known.

The hairy-vetch bruchid may be distinguished readily from the other two species of *Bruchus* now known to be established in the United States by its smaller size, much more transverse pronotum, greatly reduced pale pubescence, particularly on the elytra, and the coloration of the antennae, pale in the male, basal joints and terminal joint pale in the female. These three species may be distinguished from other North American Bruchidae by the emarginate lateral margin of the pronotum with a small distinct tooth before the emargination.

**BRUCHUS BRACHIALIS IN THE NATIONAL MUSEUM**

*Bruchus brachialis* has been recorded from no host plant other than *Vicia villosa* Roth. In addition to recently collected material from the eastern part of the United States, it is represented in the National Museum by three lots of adults with which are preserved seeds of *V. villosa* from which they had emerged. The first is from the Chitten-den collection and was secured from the French exhibit in the Paris Exposition of 1889. The second was secured by the senior author in December, 1921, from seeds of *V. villosa* imported by a seed firm in Baltimore. Finding the seeds infested, this firm had brought the matter to the attention of the United States Department of Agriculture. The beetles contained in this lot were all dead when examined. The seeds were very lightly infested, much less than 1 per cent showing the work of *B. brachialis*. The third lot was submitted to the senior writer in September, 1930, by the manager of a seed-testing laboratory in Washington, D. C. The insects had been found living in samples of *V. villosa* seed submitted for testing by a Hungarian seed firm which proposed marketing the seeds in the United States. These
samples also showed less than 1 per cent infestation. After all the emerged bruchids had been removed, the seeds were kept under rigorous quarantine conditions at room temperature through the following winter, but no additional adults emerged. This suggests that at room temperature all the larvae transform and emerge in the fall or die before spring.

**LIFE HISTORY OF BRUCHUS BRACHIALIS UNDER CONDITIONS PREVAILING IN NEW JERSEY**

Adults of *Bruchus brachialis* were taken by sweeping in a fallow field near Haddon Heights, N. J., on June 12, 1931. On June 17, this field was again visited and many adults were collected. At this time eggs were being deposited in large numbers on the pods of the hairy vetch. Some preliminary observations made by the junior writer on the habits of the insect in this and in other patches of vetch are given here.

**THE EGG**

The egg is about 0.6 mm long, 0.2 mm wide at the widest point, which is near the anterior end, and 0.2 mm high. Viewed from above, it is more or less oblong in outline, with the ends rounded and the sides straight, or nearly so, and converging somewhat toward the posterior end. The outline is similar when viewed from the side, and from the end it appears nearly circular. The egg is glued lengthwise to the outer surface of the pod. The exposed surface is finely wrinkled. The freshly deposited egg is a pale yellowish green. The hatched egg appears whitish or straw colored, owing to the débris with which the shell is filled by the larva in gaining entrance into the pod. In the field many of the eggs darken.

Eggs are deposited on the immature pod after it has attained a width of about one-fourth inch. Most of the eggs are placed near and parallel to the margins of the pod, with the posterior ends directed toward the apex of the latter. Twenty-five or more eggs were seen attached to a single pod, but the usual number was between 3 and 10. With the exception of those developed from late flowers, few pods escaped attack.

**THE LARVA**

The young larva gains entrance to its host by gnawing a hole through the broader end of the chorion of the egg and through the thin valve of the legume to which it is attached. It then turns toward the center of the pod in search of a seed. A few larvae do not find the seeds and therefore die within the pod. The larva may enter the seed at any point, the hilum being often preferred. In the ripe seed the entrance hole of the larva may be seen under low magnification as a small circular hole filled with frass. As many as seven entrance holes have been noted in a single seed, but rarely does more than one larva develop.

Once inside the seed, the larva develops rapidly, feeding upon the seed content. During growth the body of the larva is surrounded by dry frass, and when full grown it packs this loose material against the sides of the cavity made in feeding, to form the oval pupal chamber in which it is to transform. The frass is held in place by a thin cement substance, which upon drying hardens into a fibrous cocoon.
very resistant to solvents. The full-grown larva often narrowly thins the margin of the circular area of the outer seed coat which forms the cephalic end of the cell. From the outside this thinned area appears as a narrow ring of pale olive green and is rather conspicuous against the darker color of the seed. The ring marks the area or "cap" which the adult cuts out in emerging. The middle of the cap is often thinned, giving it the lighter color.

The full-grown larva is a distinct yellow in color, and in outline resembles the larva of the common bean weevil (Mylabris) Acanthoscelides obtectus (Say) (5). After the larva has finished feeding and has the inside of the cap properly thinned and the cell lined, it is ready to pupate. Before pupating, however, it passes through a prepupal stage during which the shape of the pupa is gradually assumed, the body becoming less curved with a distinct constriction at the neck. This change takes place in about two days.

THE PUPA

The pupal stage lasts from 5 to 5 1/2 days. During the first 3 days there is no change in the pale yellow color except in the eyes. Soon after pupation minute reddish spots appear along the hind margin of the eye. As these spots enlarge and darken, others gradually appear toward the front of the eye, the apex of the upper lobe being the last area to show the coloring. Each spot occupies the center of a facet, the interspaces being the pale body color until the fourth day, when the eye has become a uniform dark reddish brown. About this time a curved brownish line inside the hind coxal cavity appears and the mandibles start to become brown at the apex. The fifth day brings considerable change in color, the tarsal claws becoming fuscous at the base, and the body, except the abdomen, becoming various shades of pale reddish brown, the color being darkest at the articulations of the legs.

THE ADULT

The adult at first resembles the last stage of the pupa, but in less than 12 hours it has become normal in color. The wings remain exposed beyond the apex of the elytra for a day or two. The abdomen is much distended at first and about four days are required for it to contract to normal form. The adult is then thoroughly hardened and quite active.

Soon after it is fully hardened the adult cuts around the circular cap, pushes it away, and leaves the seed. The exit hole is located opposite to or near one end of the seed scar, but does not include any part of the scar. The first emergence from caged material collected June 17 took place about July 15, and during the rest of July adults emerged in enormous numbers from all collections. In the field on July 22 many emergences had already taken place and adults were numerous in unopened pods. The adult is unable to cut its way through the valve of the pod and depends upon the dehiscence of the pod for its escape.

Late pods in condition for oviposition on July 22 were without eggs and no recently deposited eggs were seen on any pods, indicating that the egg-laying season of the overwintering females had been ended for some time and that the newly emerged females were not depositing eggs.
The life history of *Bruchus brachialis*, therefore, may be briefly stated as follows: The overwintering females deposit eggs on immature pods of vetch in June, and the new generation of adults emerges from the seeds during the latter half of July and the first part of August but does not deposit eggs until the following June. It has not been ascertained that any individuals overwinter in the seeds.

**QUANTITY OF FOOD CONSUMED AND EXTENT OF INFESTATION**

As the larva does not migrate from one seed to another, the quantity of food consumed depends largely upon the size of the seed. This often directly affects the size of the adult, for small, poorly developed seeds produced adults 2 mm in length while the normal individual is 3 to 3.5 mm long. The entire content of the smaller seed is eaten, but the larger seed contains more food than is required by the larva. It is unlikely that a seed in which a larva has developed would be able to germinate.

A small representative sample of hairy-vetch seed from the first pods to ripen at Haddon Heights, N. J., was examined and the infestation noted. Of 785 seeds, 15 were not at all developed and are not considered. Of the remaining 770 seeds, 591 (76.7 per cent) produced adults or had pupae or full-grown larvae when opened, 32 (4.2 per cent) contained larvae that had died soon after entering the seed, and 147 (19.1 per cent) were not infested. This gives a total infestation of 80.9 per cent. One hundred of the uninfested seeds weighed 2.1 grams. Thus 1 pound would contain about 21,600 seeds, which would theoretically produce more than 17,000 bruchids.

**PARASITES**

The common bruchid egg parasite, *Uschina semijumipennis* Girault, was not noted to attack the eggs of *Bruchus brachialis*, but it should be expected to do so.

Six species of native American Chalcidoidea usually affecting coleopterous larvae and pupae in similar habitats were found parasitizing *Bruchus brachialis* in *Vicia villosa* at Haddon Heights late in July and in August, 1931. These species, kindly determined for the writers by A. B. Gahan, of the Bureau of Entomology, are *Eupelmus cyaniceps amicus* Gir., *Eupelminus saltator* (Lindemann), *Microdon-tomerus anthonomi* (Crawford), *Zatropis incertus* (Ashm.), *Habrocytus* sp., and *Eurytoma tylodermatis* Ashm. These species, except *E. saltator*, have been previously recorded as enemies of Bruchidae, but, as suggested, they are not in any peculiar sense bruchid parasites.

**PRESENT DISTRIBUTION IN THE UNITED STATES**

*Bruchus brachialis* is thus far known from five States—New Jersey, Delaware, Maryland, North Carolina, and Virginia. Numerous infestations in New Jersey were found, involving Camden, Burlington, Atlantic, and Cape May Counties, all in the southern part of the State. The junior writer reared numbers of the bruchid from vetch pods collected by D. P. Perry at Felton, Kent County, Del., July 1, 1931, and at Salisbury, Wicomico County, on the Eastern Shore of Maryland July 15, 1931. In September, 1931, a small sample of vetch seed was received at Haddon Heights, N. J., for experimental planting from
Roland McKee, of the Bureau of Plant Industry, United States Department of Agriculture. This lot of seed originated in the vicinity of Woodleaf, Rowan County, in the western part of North Carolina, where the smooth variety has been grown for several years. Several dead adults of *B. brachialis* were taken from seeds in this lot and a number of seeds with emergence holes were also obtained, showing that the insect is established in that State. During June, 1932, the junior author found this species in additional localities in Maryland, in the District of Columbia, and in adjacent Virginia.

HOST PLANTS OF *BRUCHUS BRACHIALIS*

*Vicia villosa* is the only previously recorded host of *Bruchus brachialis* and is the species involved in the foregoing records. At Haddon Heights, Camden County, N. J., *V. cracca* L. was found to be lightly infested with this species of Bruchus. Normal emergence from the seeds was obtained during the first part of August from material collected July 11 and 23, 1931. The habits of the bruchid in these hosts, so far as known, are the same as in *V. villosa*.

During 1932 the junior author found *Bruchus brachialis* attacking the woolly-pot vetch (*Vicia dasycarpa* Ten.) and the Hungarian vetch (*V. pannonica* Crantz) in experimental plantings. *Vicia angustifolia* Roth growing abundantly in a field with *V. villosa* was not found to be infested.

ECONOMIC RELATIONS OF *BRUCHUS BRACHIALIS*

The hairy vetch (*Vicia villosa*) is an exceedingly adaptable forage and green-manure plant highly recommended by the United States Department of Agriculture for cultivation in this country in sections not favorable for the cultivation of alfalfa, red clover, or crimson clover. Its cultivation has been gradually increasing, particularly on the Atlantic seaboard from Washington south. The planting requirements in recent years have called for about 2,000,000 pounds of seed, of which about one half has been produced in this country and the remainder imported from Europe.

*Vicia cracca* is a circumpolar species extending from Europe across northern Asia and America to the Northeastern States, growing wild in sections north of those adapted to hairy vetch. It has not been found sufficiently useful in cultivation to compete with red clover and is of little commercial importance although it has most of the good qualities of hairy vetch. There is no production of its seed for commercial purposes. Hungarian vetch (*V. pannonica*) serves the same uses as the hairy vetch and the common vetch and recently has partly

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7 Since this paper was submitted for publication, notes have been received from G. W. Underhill, associate entomologist of the Virginia Agricultural Experiment Station, on the oviposition of *Bruchus brachialis* on the pods of hairy vetch near Richmond, Va., in 1931 and 1932. On 40 pods examined in late July, 1931, an average of 26 eggs per pod were found, with a maximum of 48 and a minimum of 11. The first emergence from the seed was noted on July 27, and a weevil emerged from almost every seed. Freshly laid eggs were observed on May 23, 1932, and were abundant in early June. Larvae hatched from the eggs of May 23 on May 27 and 28. In neither year were adults observed to cut their way out of the pods. A vetch not identified by Underhill, but certainly *Vicia angustifolia*, was abundantly associated with *V. villosa* but was not attacked by *B. brachialis*. Underhill believes that he found *B. brachialis* in small numbers in 1930 at Richmond, and the junior author certainly did at Haddon Heights, N. J. It is probable that the infestations in both places are recent. In New Jersey, at Richmond, Va., and in North Carolina *B. brachialis* was noticeably more abundant in 1932 than in 1931. Underhill's notes indicate that the season for *B. brachialis* at Richmond is three weeks or more earlier than at Haddon Heights. A thorough survey of the eastern part of the United States may show the bruchid to be established elsewhere.
superseded *V. sativa* in the vetch-growing sections of Oregon, where there is now a considerable commercial production of its seed.

The woolly-pod vetch (*Vicia dasycarpa*) seems to serve the same uses, but has not become as popular as some of the other vetches, and there is little or no commercial production of its seed in this country. *Bruchus brachialis* is important only in its relation to the production of the seeds of the vetches attacked by it. To what extent it will affect the production of hairy-vetch seed in Oregon, Indiana, Michigan, Ohio, New York, and the Carolinas, and of Hungarian-vetch seed in Oregon can not be predicted, but the North Carolina growers are already aware of increasing losses from it.

Whether the present species will also affect the common vetch (*Vicia sativa*) is entirely problematic. While no records have been encountered of attacks on other species of vetch, this must be considered of little significance until comprehensive studies have been made on the biology of this and other species of *Bruchus*. Several other species of *Bruchus*, however, attack *V. sativa* in Europe.

**TWO OTHER SPECIES OF BRUCHUS FROM VETCHES**

The bitter vetch (*Vicia ervilia* (L.) Willdenow) is another green-manure plant from the Old World occasionally cultivated experimentally in the United States, but it is still uncertain whether it will find an important place in American agriculture. Under certain commercial conditions the seeds of this species are imported and ground for mixed poultry feeds. The National Museum contains about 10 lots of *Bruchus ulicis* with notes indicating that the beetles were bred from seed of *V. ervilia* of European origin. Whether this insect affects other species of vetches is not a matter of record.

A sample of the seed of *Vicia cracca* introduced from Japan under the name *V. gemella* Crantz by the Office of Foreign Plant Introduction in 1903 was recently examined and a single female *Bruchus* found in it which agrees with the description of *Bruchus maculatipes* Pic (11). This vetch is so similar to *V. villosa* that it is almost certain that this species would be able to utilize the hairy vetch.

In May, 1932, individuals of the same species were sent by S. I. Kuwana to the Bureau of Entomology for determination, having been taken from among seeds in storage at Kyoto, Japan. Two males among these make it possible to recognize its close relationship with *Bruchus ruhipes*, the main difference in *B. maculatipes* consisting in the almost complete suppression of the pale pubescent pattern of the pronotum and elytra.

**SUMMARY**

The hairy-vetch bruchid (*Bruchus brachialis* Fahraeus) is now established in the United States. In 1932 it was known to occur in New Jersey, Delaware, Maryland, the District of Columbia, Virginia, and North Carolina. It affects the seeds of the cultivated forage plants hairy vetch, woolly-pod vetch, Hungarian vetch, and the wild *Vicia cracca*. It is of economic significance because it destroys the seeds of its host plants.

The insect belongs to the restricted genus *Bruchus*. All the members of this genus deposit their eggs upon the green pods of the host plants. Their larvae feed within the seeds and transform there.
The adults emerge from the ripe seeds and can not reinfest them. *Bruchus brachialis* seems always to transform and leave the seeds in summer and hibernate elsewhere as an adult.

The adult is described and characters are pointed out to distinguish *Bruchus brachialis* from the closely allied European species of *Bruchus* and from all other American Bruchidae.

Notes on the life history and habits of *Bruchus brachialis* in New Jersey are recorded. In Haddon Heights, N. J., about 80 per cent of the seeds of volunteer plants of the hairy vetch produced during the egg-laying period of the bruchid were destroyed by it. Six species of native American Chalcidoidea were found parasitizing it.

The incidence of the different species of *Bruchus* upon seeds of the leguminous tribe Vicieae, including numerous important economic plants, is summarized, the records being based mainly upon interceptions made in the course of the work of the Department of Agriculture. Changed commercial conditions in handling these seeds have led to the establishment of *Bruchus brachialis* and make probable the establishment in the United States of other destructive species affecting plants upon which agricultural industries are based.

**LITERATURE CITED**


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(12) Reitter, E., with the assistance of Dr. Eppelsheim, Kratz, G., Miller, L., and Wachtl, Jr.

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(14) Wollaston, T. V.