12-1969

Lipid Content and Seasonal Activity of *Odontopus calceatus* (Coleoptera: Curculionidae) Adults

E. A. Heinrichs

Published in *Journal of Economic Entomology* 62:6 (December 1969), pp. 1360–1362;
doi: 10.1093/jee/62.6.1360

Submitted March 3, 1969; published December 1, 1969.

Lipid Content and Seasonal Activity of *Odontopus calceatus* (Coleoptera: Curculionidae) Adults

E. A. Heinrichs

Department of Agricultural Biology, University of Tennessee Agricultural Experiment Station, Knoxville, Tennessee, USA

Abstract
Overwintering *Odontopus calceatus* (Say) adults were first observed feeding on April 10. Weekly collections during the activity period indicated that new-generation adults began emerging June 4. By July 23 they had entered the forest litter for hibernation. Lipid content decreased throughout the hibernation period as the weevils utilized 77% of their total lipid content during this time. The most rapid decrease during hibernation occurred from February to March, just prior to mating and oviposition in the spring. No increase in lipid content occurred during the activity period in spring and summer. A great increase in lipid content did occur within a month after the weevils had entered the litter for hibernation. Only quantitative changes in total lipid content were determined.

Odontopus calceatus (Say) was first reported from yellow-poplar, *Liriodendron tulipifera* L., by Glover in 1870. It was not reported as a serious pest until 1960, when it was reported damaging yellow-poplar in West Virginia (Neel and Gillespie 1966). In addition to yellow-poplar it has been reported feeding on sassafras (Needham et al. 1928) and magnolia (Smith and Weber 1951). In Tennessee yellow-poplar is the most common host.

Russell and Stanley (1967) reported on some aspects of the biology and damage of *O. calceatus* in Tennessee. Burns and Gibson (1968) discussed the distribution, biology, systematics, life history, and damage. Adults overwinter in litter beneath host trees. In early spring adults leave the litter, mate, and begin feeding on buds and leaves. Eggs are deposited in the leaf midribs, and larvae mine the leaves. Adults emerge from the mined leaves in June and begin hibernating shortly thereafter. There is 1 generation annually.

Adult weevils spend about 90% of their life in hibernation. According to Fast (1964) many insects utilize fat as an energy source during quiescence. Smol'yannikov (1955) in a study on the ecology of the noxious little tortoise *Eurygaster integriceps* Puton found a correlation between cold resistance and fat content.

A relationship between fat content and behavior has been demonstrated with the Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins (Atkins 1966). He reported that beetles with higher fat content responded negatively, while those with lower fat content responded positively to the host plant. Nijholt (1967) suggested that since climatic conditions influence the length of the hibernation period and the utilization of stored lipids, the subsequent flight and attack activities might be affected.

Lipid content has been reported also as affecting the susceptibility of insects to insecticides. Munson and Gottlieb (1953) found a high correlation between lipid content and resistance of cockroaches to DDT. Bennett and Thomas (1963) showed that as percent lipid increased with age the alfalfa weevil, *Hypera postica* (Gyllenhal), became more resistant to heptachlor. Moore et al. (1967) reported that. boll weevils, *Anthonomus grandis* Boheman, surviving chemical treatment were larger and contained more fat. However, this relationship does not occur in all species. Fast and Brown (1962) found no significant difference in total fat content between DDT-resistant and susceptible yellow-fever mosquito, *Aedes aegypti* (L.), larvae. According to Moore et al. (1967), except for the solvent effect of chlorinated hydrocarbons in fat, which was demonstrated by Pradham et al. (1952), no conclusive critical role of fat in the tolerance of an insect to a given insecticide has been demonstrated.

Methods and Materials

The study area was situated in Anderson County on University of Tennessee property. Observations on adult activity were conducted weekly during the spring and summer and are expressed as number of beetles on the leaves of 21 approximately 6- to 8-ft yellow-poplar trees. Beetles used for fat determinations were collected from the litter at approximately monthly intervals during the hibernation period and from leaves weekly during the active period.

Lipid content was determined by drying the beetles in an oven at 70°C for 24 hr and extracting with petroleum ether in a Soxhlet extractor for 10 hr. Samples were replicated 4 times, with each replicate consisting of 10 weevils. Sexes were not determined. Fat was expressed as percent of wet weight. The study indicates only quantitative changes in total lipid content.

Results

Seasonal Activity

In 1968, weevil activity was first observed April 10 (Fig. 1). Two activity peaks are shown. The first is believed to be the overwintering generation and the second the new generation.

By May 20 there were very few unhatched eggs present and most of the overwintering generation had disappeared from the trees. The new generation of adults apparently began emerging between May 28 and June 4 with peak numbers recorded on June 11. The number dropped rapidly thereafter, all the weevils having disappeared from the trees by July 23. The peak number of new generation adults was not so great as for the previous generation. The reason for this was not determined. However, two possible explanations should be mentioned. First, a decrease in the population level may have occurred. Another possible reason is that new-generation adults may emerge over several weeks. If an individual weevil of this generation fed for only a few days before entering hibernation, some of the new-generation weevils would be hibernating before others emerged as adults. Thus the buildup in the number of 2nd generation adults on trees would not be so great as if they were all present simultaneously, as probably occurred in the old generation on April 30.

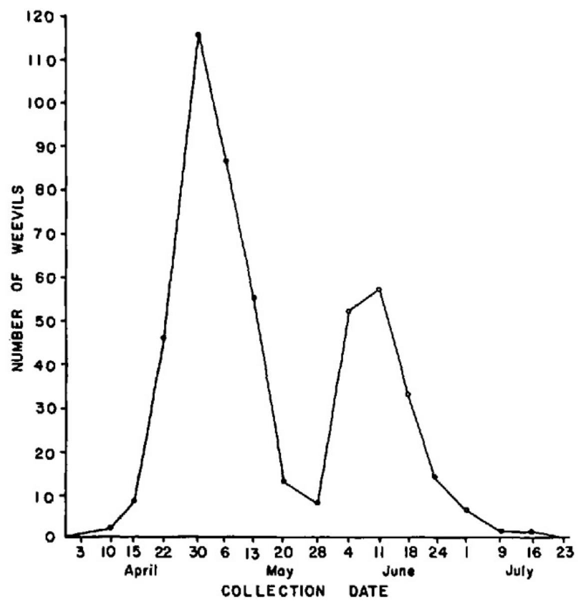

Figure 1. Number of *O. calceatus* adults observed on foliage of twenty-one 6- to 8-ft yellow poplar trees on various dates.

Lipid Content

Lipid content decreased (Table 1) during hibernation from a high of 12.2% on July 24, 1967 (beginning of hibernation), to a low of 2.8% on March 28, 1968 (end of hibernation). The beetles utilized 77% of the lipid reserves during hibernation. A rapid drop occurred between February 13 and March 28, 1968, just prior to emergence. Busnel and Drilhon (1937) recorded a similar occurrence in their studies of the lipid content of the Colorado potato beetle, *Leptinotarsa decemlineata* (Say), during hibernation. They suggest that lipid is utilized in maturation of genital products and in mating. An extended cold spring might have an adverse effect on weevils if lipid content was correlated with cold resistance.

Table 1. Lipid content of *O. calceatus* adults

Date	State of activity	% Lipid of wet weight[a]
1967		
7-24	Hibernation	12.2 e
8-23	"	11.9 e
9-25	"	11.0 e
10-19	"	8.6 d
11-14	"	8.6 d
1968		
2-13	"	7.1 cd
3-28	"	2.8 ab
4-22	Active	4.2 abc
5-1	"	2.5 a
5-6	"	2.4 a
5-13	"	3.3 ab
5-20	"	4.7 abc
5-29	"	3.1 ab
6-4	"	4.4 abc
6-11	"	3.9 ab
6-18	"	4.0 ab
6-24	"	4.9 bc
7-2	"	3.1 ab
7-30	Hibernation	11.6 e

a. Means followed by the same letter are not significantly different at the 0.01 level of probability.

Lipid content fluctuated little throughout the adult activity period (Table 1). The only significant difference in lipid content during this period was June 24, which was significantly higher than May 1 or May 6. No apparent buildup in lipid content of the new generation during the active period was detected. Lipid content on July 2, 1968, the last collection date for active weevils, was 3.1%. On July 30, 1968, the lipid content of the hibernating weevils was 11.6%. The increase in lipid content apparently occurred after the weevils had entered the litter and occurred over a period of a month or less. Busnel and Drilhon (1937) found that the lipid content of the Colorado potato beetle during hibernation rose from 2.65% in September to 12.6% in November.

This study indicates there is a significant change in lipid content during adulthood. The importance of lipid content in the behavior or physiology of the adult was not determined.

References Cited

Atkins, M. D. 1966. Laboratory studies on the behavior of the Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins. Can. Entomol. 98: 953–91.

Bennett, S. E., and C. A. Thomas, Jr. 1963. The correlation between lipid content and percent mortality of the alfalfa weevil to heptachlor and malathion. Econ. Entomol. 56: 239–40.

Burns, D. P., and L. P. Gibson. 1968. The leaf-mining weevil of yellow-poplar. Can. Entomol. 100: 421–29.

Busnel, R. G., and A. Drilhon. 1937. Étude biochimique du *Leptinotarsa decemlineata* Say pendant l'hivernation. C. R. Soc. Biol. 124: 916–17.

Fast, P. G. 1964. Insect lipids: A review. Memo. Entomol. Soc. Can. 37.

Fast, P. G., and A. W. A. Brown. 1962. Lipids of DDT-resistant and susceptible larvae of *Aedes aegypti*. Ann. Entomol. Soc. Amer. 55: 663–72.

Glover, T. 1870. *In* Report of the U.S. Commissioner of Agriculture for the year of 1870, p. 68. Government Printing Office, Washington, D.C.

Moore, R. F., Jr., A. R. Hopkins, H. M. Taft, and L. L. Anderson. 1967. Fatty acids in total lipid extracts of insecticide-treated boll weevils that survived or died. J. Econ. Entomol. 60: 64–68.

Munson, S. C., and M. I. Gottlieb. 1953. The differences between male and female American roaches in total lipid content and in susceptibility to DDT. Ibid. 46: 798–802.

Needham, J. G., S. W. Frost, and B. H. Tothill. 1928. Leaf-Mining Insects. Williams & Wilkins, Baltimore, Md. 351 p.

Neel, W. W., and W. H. Gillespie. 1966. Leaf-mining weevil damage on the tuliptree in West Virginia. Entomol. News 139–142.

Nijholt, W. W. 1967. Moisture and fat content during the adult life of the Ambrosia beetle *Trypodendron lineatum* (Oliv.). J. Entomol. Soc. Brit. Columbia 64: 51–55.

Pradham, S., M. R. K. Nair, and S. Krishnaswami. 1952. Lipid solubility as a factor in the toxicity of contact insecticides. Nature 170: 619–20.

Russell, W. G., and W. W. Stanley. 1967. Observations of *Odontopus calceatus* (Coleoptera: Curculionidae), a leaf miner damaging yellow-poplar. J. Tenn. Acad. Sci. 42: 93–96.

Smith, C. E., and J. C. Weber. 1951. Magnolia leafminer. La. Exp. Sta. Annu. Rep., p. 80–81.

Smol'yannikov, V. V. 1955. Data on the ecology of the noxious little tortoise—*Eurygaster integriceps* Put. (Hemiptera-Heteroptera-, Pentatomidae) in Ciscaucasia. Entomol. Obozrenie 34: 88–95. [Original not seen.]