

INSECTS

That damage White Oak acorns

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TO GROW OAK trees—either in forests or for shade trees—crops of good acorns are needed. Yet in some places and at some times, acorn crops are destroyed or badly damaged by insects. To prevent this we need to know, first of all, which insects do the damage.

In 1960-64, we made a study of white oak (*Quercus alba* L.) in Ohio to estimate the amount of damage done to acorn crops and to identify the insects that did it. In 1962 and 1963, we studied damage to acorns in other states throughout the range of white oak.

Our studies showed that the damage is great and that it is caused by several species of weevils, moths, wasps, and flies.

METHODS

Acorns—submitted by various collectors or collected by me—were placed in emergence chambers; and the emergent larvae were sorted, counted, and placed in rearing containers. After most of the larvae had emerged, 1 quart of acorns from each collection was opened and examined to determine viability and the distribution of damage from all causes. The emergent larvae and those still in the acorns were combined to determine the total infestation.

The percentage distribution of individual species of *Conotrachelus* and *Curculio* was based on the number of emergent adults.

RESULTS AND DISCUSSION

Many species of insects are found in acorns. Most of these are secondary invaders—parasites, predators, casual visitors, or scavengers. Most are in the larval or adult stages. All life stages of the destructive insects may be found in or on the acorn.

Weevils of the genera *Curculio* and *Conotrachelus* caused most of the damage to acorns. *Curculio* varied from 1 to 7 per infested nut and *Conotrachelus* from 1 to 24 per infested nut. As many as seven holes were made in some acorns by emerging larvae. All *Conotrachelus* larvae usually exited through a single hole, but each *Curculio* larva usually chewed its own exit hole through the nutshell.

Light crops were usually more heavily infested than heavy crops. This agrees with the observations made by Beal (1952), but is contrary to the observations on bur oak (Gibson 1971). The degree of infestation depends upon the weevil population as well as the acorn crop. Heavy acorn crops occurring the year after a year of high weevil population are likely to be infested at a higher rate than light crops occurring after a couple of cropless years.

Seven species of *Curculio* have been reared from acorns of white oak. Of these, *C. iowensis* (Casey) and *C. orthorhynchus* (Chttn.) are rare. Of the other five species reared from the 1962, 1963, and 1964 crops, *C. pardalis* (Chttn.) made up 85.60 percent of the total; *C. sulcatulus* (Casey) made up 7.47 percent; *C. confusor* (Ham.) made up 3.66 percent; *C. proboscideus* Fab. made up 2.53 percent; and *C. strictus* (Casey) made up 0.74 percent. All *Curculio* species names conform to the recent revision (Gibson 1969).

Three species of *Conotrachelus* infest white oak acorns: *C. naso* LeConte, *C. posticatus* Boheman, and *C. carinifer* Casey. *C. carinifer* is found in the southeastern and southern parts of the United States (Gibson 1964); it is a minor portion of the *Conotrachelus* present in *Quercus alba*. *C. posticatus* usually make up a small portion of the total, but in three collections they made up 62.5 percent, 66 percent, and 100 percent. Thus they sometimes are the major portion of *Conotrachelus* in a particular area. A total of all samples submitted in 1962 from various parts of the range of *Q. alba* showed that 93 percent of the *Conotrachelus* were *C. naso*.

The moth *Melissopus latiferranus* (Wlsm.) usually oviposits through the bottom of the cup while the nut is still forming. The resultant larva will completely consume the nutmeat and may move to adjacent nuts before completing its growth. Pupation normally takes place in the leaves and other debris on the ground. This moth usually infests less than 10 percent of the mature crop, but may infest as much as 32 percent in some collections. The degree of damage to the immature acorns has not been determined for white oak, but has been high in collections of *Quercus velutina*.

The moth *Valentinia glandulella* (Riley) is a scavenger. It lays its eggs in the oviposition hole or exit hole of another insect or in a mechanical wound. It frequently pupates in the nut after feeding on the frass and detritus left by weevils or by *M. latiferranus*. *V. glandulella* in some instances may be detrimental to the acorn crop. Though nuts infested by *Curculio* may not be completely eaten and thus may be

still viable and capable of producing a seedling, the moth larva, in its foraging, will usually consume the remaining nutmeat, rendering the nut unviable.

The Cynipid wasps lay eggs in the pistillate flowers, which causes galls to develop in the acorn or on the acorn cup. The gall wasp *Cynips glandulosus* Beutm. produces growths resembling small acorns on the side of the acorn cup. These galls do not affect acorn viability unless they are abundant enough to cause premature abscission.

The wasp galls normally found inside the acorn are caused by species of *Callirhytis*. They form as a group of separate but closely appressed cells imbedded in but separate from the flesh of the cotyledon. They do not damage the viability of the acorn unless they form in the germ area.

Other Hymenoptera reared from acorns are parasites of the Cynipid wasps or of the moths. The parasites of the Cynipids belong to the superfamily Chalcidoidea, and the parasites of the Lepidoptera belong to the superfamily Ichneumonoidea.

The flies are represented by parasites of moths and by secondary invaders such as Drosophilidae (fruit flies) and Mycetophilidae (fungus gnats), which feed on the decaying fungus-infected nut or on the residue of frass and detritus left by the moths and weevils. A few fly species may damage the acorns, but are not considered damaging to seed viability.

The degree of infestation varies from year to year and from tree to tree in the same area as well as throughout the range of white oak. Therefore the data presented in tables 1 and 2 actually indicate only the infestation of each tree. But they do give an indication of the density and diversity of insect damage to white oak acorns.

By combining the infestation for the two moth species, the *Conotrachelus* species, and the *Curculio* species, the total infestation by each of the three groups and the actual total damage to white oak crops for each area sample and for each year can be calculated (tables 1 and 2). A sample from

Table 1.—Conditions of Ohio white oak acorns

Year and county	Sound	Insect-damaged	Rotten	Mal-formed	Sample size
1961:	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>
Union	4.0	80.7	8.9	6.4	201
Morgan	46.5	53.0	0	.5	419
Sandusky	25.1	43.6	2.5	28.8	398
1962:					
Union	13.8	42.9	41.9	1.4	210
Delaware	11.0	63.1	23.7	2.2	181
Marion	—	54.9	—	—	219
Clinton	0	93.8	3.1	3.1	65
Trumbull	0	100.0	0	0	181
Auglaize	0	99.2	.8	0	121
Mercer	15.1	65.9	17.3	1.7	179
Ottawa	14.6	56.7	28.1	.6	178
Sandusky	—	78.0	—	—	200
1963:					
Marion	47.0	13.5	39.0	.5	875
Auglaize	1.0	20.0	79.0	0	909
Delaware	0	50.0	50.0	0	600
Hocking	22.0	21.0	57.0	0	1,369
Sandusky	17.0	13.0	69.0	.1	1,000
1964:					
Union	33.0	62.0	4.5	.5	1,417
Marion	64.0	32.0	4.0	0	636
Clinton	4.0	86.0	6.0	4.0	600
Trumbull	2.0	87.0	11.0	0	374
Auglaize	70.0	29.0	1.0	0	804
Clermont	4.0	87.0	3.0	6.0	208
Delaware	37.0	54.0	9.0	0	724
Morrow	18.0	50.0	32.0	0	300
Sandusky	48.0	44.0	8.0	0	650

Table 2.—Conditions of white oak acorns

Year, county, and state	Sound	Insect- damaged	Rotten	Mal- formed	Sample size
	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>No.</i>
1962:					
LaCrosse, Wisc.	—	17.1	—	—	380
Clinton, Mich.	—	48.7	—	—	402
New Haven, Conn.	—	32.1	—	—	443
Laurel, Ky.	—	51.0	—	—	1,035
Franklin, Tenn.	8.8	85.0	6.2	—	581
Boone, Ark.	9.7	89.8	.6	—	528
Lee, Ala.	—	50.3	—	—	480
Warren, Miss.	—	44.0	—	—	454
Clarke, Ga.	56.6	29.6	13.8	0	422
Lamar, Ga.	—	52.6	—	—	1,450
Jackson, Fla.	—	57.3	—	—	300
1963:					
Dane, Wisc.	0	87.0	13.0	0	487
Oceana, Mich.	14.0	47.0	33.0	4.0	98
Iowa, Iowa	0	81.0	19.0	0	549
Hardin, Ill.	0	76.0	23.0	1.0	325
DuPage, Ill.	2.0	13.0	85.0	0	330
Bartholomew, Ind.	0	66.0	33.0	1.0	497
Madison, Ky.	0	51.0	49.0	0	387
Franklin, Tenn.	4.0	74.0	19.0	3.0	415
New Castle, Del.	9.0	65.0	26.0	0	313
Middlesex, N. J.	1.0	14.0	83.0	2.0	359
D. C.	1.0	10.0	89.0	0	521
Buckingham, Va.	0	78.0	17.0	5.0	382
Franklin, N. C.	34.0	51.0	6.0	9.0	100
Orange, N. C.	34.0	10.0	56.0	0	599
Berkeley, S. C.	2.0	33.0	65.0	0	303
Harris, Ga.	49.0	38.0	12.0	1.0	308

the 1960 Ohio white oak acorn crop was 58 percent sound and 42 percent insect-damaged.

Acorn samples gathered from three Ohio locations in 1961 were from 4.0 to 46.5 percent sound and from 43.6 to 80.7 percent insect-damaged. The infestation consisted of 79.1 *Curculio* spp., 15.1 percent *Conotrachelus* spp., 5.7 percent moths, and 0.1 percent galls.

Acorn samples gathered from throughout the range of white oak in 1962 were from 0 to 56.6 percent sound and from 17.1 to 100 percent insect-damaged. The infestation consisted of 59.5 percent *Curculio* spp., 38.0 percent *Conotrachelus* spp., 2.5 percent moths, and less than 0.1 percent galls.

Acorn samples gathered from throughout the range of white oak in 1963 varied from 0 to 49 percent sound and from 10 to 87 percent insect-damaged. The infestation consisted of 57.5 percent *Curculio* spp., 37.8 percent *Conotrachelus* spp., and 4.7 percent moths.

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