Tree Fruit Insect Pest - Codling Moth

Codling moth, Cydia pomonella, was introduced from Europe in colonial times and now occurs throughout North America as well as most of the world, wherever apples are grown.

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The codling moth wing is generally a darker shade of gray near the base, with a dark patch containing coppery scales near the inside wing tip. Photo by G. Krawczyk.

In the past in Pennsylvania, the codling moth was maintained at low population levels by insecticides sprayed to control other pests and usually did not seriously affect apple production in commercial orchards. In the last 10 years the significance of this pest drastically increased mainly due to insecticide resistance. Codling moth has been known to infest 95 percent of the apples in an orchard when control measures were not taken against it. Given this insect's ability to adapt to various fruits (e.g., the ability to coincide with different fruiting times) and to develop resistance to insecticides, fruit growers must continually be on guard against a resurgence of codling moth.

Description and life cycle

The adult female moth is approximately 3/8 inch long and grayish in color. The male is slightly smaller and has a grouping of hairlike scales near the wing base. The wing is generally a darker shade

of gray near the base, with a dark patch containing coppery scales near the inside wing tip. The larvae have a cream to pinkish body and a brown head with dark speckles on the prothoracic shield behind the head. Larvae reach ½ to 5/8 inch long at maturity. Codling moth larvae, are often confused with the Oriental fruit moth larvae, which are smaller, lack spots on the prothoracic shield, and have a comblike structure (anal comb) on the posterior end visible under magnification. Codling moth eggs, laid singly, appear as flat, slightly oval discs. At first translucent, they later become reddish, and finally enter the black head stage just before hatching, when the dark head capsule can be seen.

Codling moth overwinter as full-grown larvae within a cocoon under leaf litter, loose bark scales, or any other sheltered place they may encounter. Pupation occurs at about first pink, with first flight occurring about full bloom, and flight occurring approximately 2 to 8-10 weeks after full bloom. First-generation eggs are laid on leaves near fruit or on the fruit and hatch in about 6 to 10 days. Newly hatched larvae bore through the fruit surface, generally at the side of the fruit, and feed near the surface for a time before boring to the core. Larvae feed on the seeds and surrounding flesh until they are fully grown in 3 to 4 weeks. They then exit the fruit, seek shelter, spin a cocoon, and may or may not pupate. Some first-generation larvae do pupate, emerge as adults in 2 to 3 weeks at about the fourth or fifth cover spray, and produce a second generation. The majority of the second generation overwinter as mature larvae.

First-generation larvae that do not pupate enter a quiet diapausing phase, overwinter as last instar larvae, and become first-generation adults the following year. Some larvae of the second generation may also pupate and produce a third generation at the seventh or eighth cover spray. This generation larvae, which most of the time does not survive the winter, is termed a suicide generation. Individual larvae can, however, inflict additional late season fruit injury.

Damage

Damage to apples may be shown either by a tunnel emanating from the apple side or calyx and extending to the core, or by "stings," small shallow holes the size of pin pricks, with a little dead tissue on the cavity walls. Stings are caused by early instar larvae that have been poisoned and die shortly after puncturing the apple skin. Larvae that feed on the core characteristically leave frass exuding from the point of entry. Stings lower the value of the fruit from fresh market to processing grade apples. Tunneling causes the fruit to be rejected.

Monitoring and management

Pheromone traps for monitoring populations of adult male codling moths should be used to determine if and when controls are necessary. Traps should be placed at a density of at least one trap per 5 acres

(but no less than two traps per block) by the pink stage and situated on the outside of the tree, preferably in the upper fourth of the canopy. The higher the trap placement, the better codling moth is monitored. In the spring, traps should be checked daily until the first adult is caught and then weekly thereafter. In orchards without mating disruption, if the action threshold of five moths per trap per week is exceeded an insecticide application should be made within 5 to 8 days. Repeat applications should be made if the number of captured moths exceeds this threshold 14 days after the insecticide application. In orchards implementing mating disruption for codling moth control, monitoring should be done using high-dose lures (10x) or special CM DA Combo (CM DAC) lures.

Optimum timing of insecticide applications based on egg hatch can be determined with the aid of a degree-day model (Table below). First adult capture in a pheromone trap is used as a biofix, and degree-days are accumulated thereafter. Growers wishing to time sprays based on egg development and hatch should make an application of broad-spectrum insecticide at 250-350 degree-days (base 50°F) after the first capture of males in the sex pheromone traps. A second application can be applied 14 to 21 days following the initial application if needed. If insecticides with ovicidal activity are planned for codling moth control, the first application should be performed no later than at about 150 DD after the biofix. Due to frequently extended codling moth flight observed in many orchards, additional insecticide treatments may be necessary after the second application. The delayed timing for initial insecticide application is recommended in orchards where observations from pheromone traps during previous seasons detected extended CM flight, often lasting until end of June.

Mating disruption represents a valuable alternative to insecticide treatment for isolated orchards with a low codling moth population. The hand-applied pheromone dispensers and various forms of sprayable pheromones are commercially available and can be used for codling moth control. If Oriental fruit moth is also a problem in the same block, then select a pheromone to control both species. In orchards with codling moth populations resistant to organophosphate insecticides, a combination of mating disruption and codling moth granulosis virus is recommended to effectively control this pest. Also, the recently registered insecticides with new modes of action are very effective against this pest.

Specific chemical recommendations for home gardeners are in Fruit Production for the Home Gardener , and recommendations for commercial growers are in the Penn State Tree Fruit Production Guide .

Table 2-2. Degree-day look-up table for codling moth (lower threshold 50°F, upper threshold 88°F, horizontal cut off, using sine-wave curve).

To find the total degree-days for a day, locate the minimum and maximum temperatures and follow the rows to where they intersect. For temperatures between those listed, use the nearest shown. Temperatures and degree-days must be determined on a daily basis.

	Minimum temperature																									
	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
50	0	0	0	0	0	0	0	0	0	0	0															
52	0	0	0	0	0	0	0	0	1	1	1	2														
54	1	1	1	1	1	1	1	1	1	2	2	3	4													
56	1	1	1	1	2	2	2	2	2	2	3	4	5	6												

Maximum temperature																												
58	2	2	2	2	2	2	3	3	3	3	4	5	6	7	8													
60	3	3	3	3	3	3	3	4	4	4	5	6	7	8	9	10												
62	3	3	4	4	4	4	4	5	5	5	6	7	8	9	10	11	12											
64	4	4	4	4	5	5	5	5	6	6	7	8	9	10	11	12	13	14										
66	5	5	5	5	6	6	6	6	7	7	8	9	10	11	12	13	14	15	16									
68	6	6	6	6	6	7	7	7	8	8	9	10	11	12	13	14	15	16	17	18								
70	6	7	7	7	7	8	8	8	9	9	10	11	12	13	14	15	16	17	18	19	20							
72	7	7	8	8	8	8	9	9	10	10	11	12	13	14	15	16	17	18	19	20	21	22						
74	8	8	8	9	9	9	10	10	11	11	12	13	14	15	16	17	18	19	20	21	22	23	24					
76	9	9	9	10	10	10	11	11	12	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26				
78	10	10	10	11	11	11	12	12	13	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28			
80	11	11	11	11	12	12	13	13	14	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
82	11	12	12	12	13	13	14	14	15	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
84	12	13	13	13	14	14	15	15	16	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32		
86	13	14	14	14	15	15	15	16	17	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33		
88	14	14	15	15	16	16	16	17	18	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34		
90	15	15	16	16	16	17	17	18	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35		
92	16	16	16	17	17	17	18	18	19	20	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35		
94	16	16	17	17	18	18	18	19	20	20	21	22	23	24	25	26	27	28	29	30	31	32	33	33	34	35		
96	17	17	17	18	18	19	19	20	20	21	22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	35		
98	17	17	18	18	19	19	19	20	21	21	22	23	24	25	26	27	28	29	30	30	31	32	33	34	35	36		
100	18	18	18	19	19	19	20	20	21	22	22	23	24	25	26	27	28	29	30	31	32	32	33	34	35	36		