Soil Samples for Redbacked Cutworm in Peppermint

The redbacked cutworm, *Euxoa ochrogaster* (Guenee) can be a serious pest on peppermint in central Oregon, particularly in Jefferson and Crook Counties. The larval stage feeds on roots, stems, and leaves, from early May to mid-June, and can do considerable damage to mint before the cutworms are detected. Due to its nocturnal feeding habits and subterranean nature, soil sampling is the most reliable method to determine the presence of this cutworm and the need to treat populations.

Sampling equipment

The equipment for soil sampling is simple to make. It consists of a square-foot sampler, a shovel, and two screens, as shown in the photo. You can make the square-foot sampler from 3/8″ x 2″ x 36″ mild steel. (Because of the trend toward metric figures in modern farming, you may wish to make your sampler 31.6 centimeters (12.5 inches) long on each side, yielding 1,000 square centimeters. This unit can be used throughout this publication as the equivalent for 1 square foot.) Bend this piece into three sides of a square, measuring 12 inches on a side. Sharpen the bottom edge for easy penetration into the soil. Any shovel will do the job, but one with a square point is easier to use for this sampling.

Make two screen frames from four pieces of wood, each 1″ x 4″ x 24″. Screw them together to form two 4″-deep frames, covering the bottom with wire mesh. Cover one with 1/4″ hardware cloth, and the other with 18-mesh fine screen, such as window screen. To separate the redbacked cutworm larvae from the soil and roots, stack and use the two screens together, with the coarse one on top.

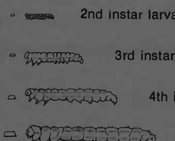
To take a sample, place the square-foot sampler on the ground, sharp edge down, and step on it, pushing it down so the top edge is flush with the soil surface. Use the shovel to remove the dirt and roots within the sampler to a depth of 2 inches. Place this sample on the top, coarse screen and shake the screens to remove excess dirt. Look in the coarse screen first for the large cutworms that didn't fall through, then look carefully for the smaller larvae in the fine screen. The worms are difficult to see, particularly the small ones, because of their drab color. Compare the cutworms with those shown in the accompanying drawing to determine which instars (stages of growth) are present in the field. The illustration is actual size and you can use both overall length and diameter of the worm's head for judging the growth stage.

Soil sampling equipment is inexpensive and easy to make.

Prepared by Elson J. Shields, former Extension pest management specialist, and Ralph E. Berry, professor of entomology, Oregon State University.

The authors are indebted to Stephen D. Danielson, OSU graduate student in entomology, for his development of the redbacked cutworm sequential sampling plans and economic injury levels used in this publication.

Extension Circular 1009 Revised March 1982
Oregon State University Extension Service



2nd instar larva

3rd instar larva

4th instar larva

5th instar larva

The larval instar can be determined by measuring the worm's head capsule over the square at the left, or by matching the worm's length with drawings.

Economic Injury Levels

The economic injury level is the level where enough redbacked cutworms are present in the mint field to cause economic yield loss if uncontrolled. The tolerable level of redbacked cutworms depends on the field age, vigor, oil price, and cost of control.

Baby mint

First-year or row mint is most susceptible to economic damage by redbacked cutworm. Feeding cutworms work their way down the row, destroying top growth as they go. In many cases, root reserves are not sufficient to allow regrowth, resulting in stand thinning. This thinning can carry over into subsequent years before recovering. Research shows that if the redbacked cutworms exceed 0.2 cutworms per square foot (or 1,000 square centimeters) for a field average, significant economic damage will occur, and the field should be treated with an insecticide. If the field average is below 0.2 and the worms are small, resample the field in 7 to 10 days to determine if treatment is necessary.

Well established, vigorous fields

Vigorous mint fields, 2 to 5 years old, can sustain a greater amount of redbacked cutworm damage before economic loss occurs and control measures are necessary. Redbacked cutworm damage occurs early, leaving the plant the entire growing season to recover without yield loss. *Under experimental conditions,* vigorous mint has tolerated up to eight cutworms per square foot without yield loss. Field plots in vigorous commercial fields show that populations of three to five per square foot do not reduce yield. Therefore, well established strong fields should be treated when the average number of redbacked cutworms in a field is more than three to five cutworms per square foot.

Mint fields 6 years and older

Mint fields 6 years and older, or weak, established fields cannot tolerate as much cutworm damage before yield loss as fields 2 to 5 years old. The economic injury level for treatment can be directly related to expected oil price and cost of control. The number of redbacked cutworms that can be tolerated without economic loss for these older and weak fields is shown in Table 2 at the intersection of the cost of treatment with the expected oil price. For example, if the cost of control is $18 per acre and the expected oil price is $12 per pound, then the economic injury level for treatment is 0.39 redbacked cutworms per square foot.

Sampling Methods

Stratified random sampling

Stratified random sampling plans require the random selection of one sample site for every 1 to 2 acres. For example, take 15 to 30 samples in a 30-acre field. Divide the total number of redbacked cutworm larvae found in a field by the number of samples taken to compute the average cutworm infestation per square foot. Then compare the infestation level with the economic injury level (Table 2) to determine if control measures are warranted. Baby fields are more likely to suffer economic damage than established fields, so it may be preferable to take one sample per acre rather than one sample for every 2 acres, as often practiced in established fields. This will obtain a better estimate of the cutworm population.

Sequential sampling

Sequential sampling plans were developed to reduce sampling time without reducing accuracy. This is accomplished by adjusting the number of samples required to make a control decision based on the number of larvae found. In fields larger than 30 acres, with light or heavy populations of redbacked cutworms, the number of samples required to estimate the population is less than the number of samples required in a stratified random sampling plan. The larger the field, the more time sequential sampling saves. However, in fields with populations below the economic level, the number of samples required to make a control decision may be as many as using stratified random sampling plans. *Sequential sampling plans have been developed for first-year mint fields and mint fields 6 years and older or weak established mint, but not for vigorous fields 2 to 5 years old. The stratified random sampling must be used for strong mint fields 2 to 5 years old.*

Here is how sequential sampling works: The first step is to determine the proper economic injury level (EIL). Regardless of oil price and treatment cost, the EIL for first-year mint is 0.2 cutworms per square foot. The EIL for mint fields 6 years and older (or weak, established fields) is determined from Table 2 by intersecting the cost or treatment per acre with the expected oil price.

The second step is to select the appropriate sequential sampling plan. (Only one sequential sampling plan is necessary for first-year mint. It is found in Table 1.) Mint fields 6 years and older, or weak fields, have several sequential plans, based on the variation of possible EIL's. Select the proper sequential plan by matching the EIL from Table 2 to the proper sequential plan in Table 3, using the range of EIL's listed at the top of each sequential plan. For example, if the cost of control (Table 2) is $18 per acre and the expected oil price is $12 per pound, the EIL is 0.39 cutworms per square foot. This is then matched with Plan B in Table 3, which has an EIL range of 0.30 to 0.39.

Then put the appropriate sequential plan in use. A *minimum* number of 10 samples must be taken, as listed in the first line of Table 3, before a treatment decision can be made. As these samples are being taken, make a running total of the number of larvae found. Compare the total number of larvae found in the 10 samples with the number listed in each of the action columns corresponding to the sample size (10). Using Plan B for example, if after the minimum of 10 samples have been taken from a field and no larvae are found, no further samples are necessary and the field does not need treating. If six larvae have been found in 10 samples, no further samples are necessary and the field needs to be treated. However, if the accumulated number of larvae is from one to five, an additional set of 5 samples is necessary to get a better estimate of the field populations of redbacked cutworms before a treatment decision is made. After completing the 5 additional samples, the accumulated number of larvae is matched with the appropriate column (15 samples) to make a treatment decision as previously discussed. If no treatment decision can be made after 1 sample is taken per acre (30 samples in 30 acres), resample the field in 7 to 10 days.

Table 1. Sequential Sampling Plan for First-Year Fields, Using an Economic Injury Level of 0.2 Larvae per Square Foot.

Number of samples	Action Indicated by accumulated number of larvae found		
	No treat	Continue sampling	Treat
25	0	1 to 6	7 or more
30	1	2 to 7	8 or more
35	2	3 to 8	9 or more
40	3	4 to 9	10 or more
45	4	5 to 10	11 or more
50	5	6 to 11	12 or more
55	6	7 to 12	13 or more
60	7	8 to 13	14 or more

Tips on Locating Redbacked Cutworms

The larvae of the redbacked cutworm cause serious damage during a period from early May to mid-June. The plants usually are cut at or just above the surface and tops of smaller plants are usually entirely consumed. The cutworms come above the surface of the soil at night in search of food, and usually feed above the surface at that time, especially if the soil is not too dry. Sometimes the cutworm burrows beside a plant and cuts it off just below the surface, often dragging the leaves into the soil to feed on them. *Wilted stems and damaged leaves* are indicators of a potential cutworm problem.

Check the areas of the field in which the mint is slow to emerge and slow in growing. Large cutworm populations are more common in unplowed mint. Also, mint growing in fine sandy soil often has more cutworms than in shallow, clay-like soils. Low spots that accumulate sand will tend to have higher levels of cutworms. In addition, parts of the field that have had a history of severe cutworm infestation have a high likelihood of being reinfested. However, check the entire field before making a treatment decision in order to get a total picture of the cutworm's field distribution. If only the highly susceptible areas are sampled larvae counts may be high and the results misleading, and a treatment may not be necessary.

Table 2. Economic Injury Level for Fields 6 Years Old, or in Weak, Established Fields, for Redbacked Cutworm Larvae. Based on Varying Treatment Costs and Anticipated Prices for Peppermint Oil.

Price of peppermint per pound	Cost of treatment per acre																			
	$16	$17	$18	$19	$20	$21	$22	$23	$24	$25	$26	$27	$28	$29	$30	$31	$32	$33	$34	$35
	Average number of larvae per square foot of sample																			
$ 7	0.58	0.62	0.66	0.69	0.73	0.77	0.80	0.84	0.88	0.91	0.95	0.98	1.02	1.06	1.09	1.13	1.17	1.20	1.24	1.28
8	0.51	0.54	0.57	0.61	0.64	0.67	0.70	0.74	0.77	0.80	0.83	0.86	0.89	0.92	0.96	0.99	1.02	1.06	1.09	1.12
9	0.45	0.48	0.51	0.54	0.57	0.59	0.63	0.65	0.68	0.70	0.74	0.77	0.79	0.83	0.85	0.88	0.90	0.94	0.97	0.99
10	0.41	0.43	0.46	0.48	0.51	0.54	0.56	0.58	0.62	0.64	0.66	0.69	0.72	0.74	0.77	0.79	0.81	0.85	0.87	0.89
11	0.37	0.40	0.42	0.44	0.46	0.48	0.51	0.54	0.56	0.58	0.61	0.63	0.65	0.67	0.69	0.72	0.75	0.77	0.78	0.81
12	0.34	0.36	0.39	0.41	0.43	0.45	0.47	0.48	0.51	0.53	0.55	0.57	0.59	0.62	0.64	0.66	0.68	0.70	0.73	0.75
13	0.32	0.33	0.35	0.37	0.40	0.41	0.43	0.45	0.47	0.50	0.51	0.53	0.55	0.57	0.59	0.61	0.63	0.65	0.67	0.68
14	0.30	0.31	0.33	0.34	0.36	0.39	0.40	0.42	0.44	0.45	0.47	0.50	0.51	0.53	0.55	0.56	0.58	0.61	0.62	0.64
15	0.28	0.29	0.31	0.32	0.34	0.35	0.37	0.40	0.41	0.43	0.44	0.46	0.47	0.50	0.51	0.53	0.54	0.56	0.58	0.59
16	0.25	0.28	0.29	0.31	0.32	0.33	0.35	0.36	0.39	0.40	0.42	0.43	0.45	0.46	0.48	0.50	0.51	0.53	0.54	0.56
17	0.24	0.25	0.28	0.27	0.30	0.32	0.33	0.34	0.36	0.37	0.39	0.41	0.42	0.44	0.45	0.46	0.48	0.50	0.51	0.53
18	0.23	0.24	0.25	0.26	0.29	0.30	0.31	0.33	0.34	0.35	0.37	0.39	0.40	0.41	0.43	0.44	0.45	0.47	0.48	0.50
19	0.22	0.23	0.24	0.25	0.26	0.29	0.30	0.31	0.32	0.34	0.35	0.36	0.37	0.39	0.41	0.42	0.43	0.44	0.46	0.47
20	0.21	0.22	0.23	0.24	0.25	0.26	0.29	0.30	0.31	0.32	0.33	0.34	0.35	0.37	0.39	0.40	0.41	0.42	0.43	0.45

Table 3. Sequential Sampling plans for fields 6 *YEARS OR OLDER OR WEAK ESTABLISHED FIELDS* based on the Economic Injury Level (EIL) from Table 2.

Plan A EIL 0.20 – 0.29

Number of samples	Action Indicated by accumulated number of larvae found		
	No treat	Continue sampling	Treat
10	0	1 to 3	4 or more
15	1	2 to 4	5 or more
20	3	4 to 5	6 or more
25	4	5 to 6	7 or more
30	5	6 to 7	8 or more
35	6	7 to 8	9 or more
40	7	8 to 9	10 or more
45	8	9 to 11	12 or more
50	9	10 to 12	13 or more

Plan B EIL 0.30 – 0.39

Number of samples	Action indicated by accumulated number of larvae found		
	No treat	Continue sampling	Treat
10	0	1 to 5	6 or more
15	2	3 to 6	7 or more
20	4	5 to 8	9 or more
25	6	7 to 10	11 or more
30	7	9 to 11	12 or more
35	9	10 to 13	14 or more
40	11	12 to 15	16 or more
45	12	13 to 16	17 or more
50	14	15 to 19	20 or more

Plan C EIL 0.40 – 0.49

Number of samples	Action indicated by accumulated number of larvae found		
	No treat	Continue sampling	Treat
10	1	2 to 6	7 or more
15	3	4 to 9	10 or more
20	5	6 to 11	12 or more
25	7	8 to 13	14 or more
30	10	11 to 15	16 or more
35	12	13 to 18	19 or more
40	14	15 to 20	21 or more
45	16	17 to 22	23 or more
50	19	20 to 24	25 or more

Plan D EIL 0.50 – 0.59

Number of samples	Action indicated by accumulated number of larvae found		
	No treat	Continue sampling	Treat
10	1	2 to 8	9 or more
15	3	4 to 10	11 or more
20	6	7 to 13	14 or more
25	9	10 to 16	17 or more
30	11	12 to 18	19 or more
35	14	15 to 21	22 or more
40	17	18 to 24	25 or more
45	19	20 to 26	27 or more
50	22	23 to 29	30 or more

Plan E EIL 0.60 – 0.69

Number of samples	Action Indicated by accumulated number of larvae found		
	No treat	Continue sampling	Treat
10	1	2 to 9	10 or more
15	4	5 to 12	13 or more
20	7	8 to 16	17 or more
25	10	11 to 19	20 or more
30	13	14 to 22	23 or more
35	17	18 to 25	26 or more
40	20	21 to 28	29 or more
45	23	24 to 32	33 or more
50	26	27 to 35	36 or more

Plan F EIL 0.70 – 0.79

Number of samples	Action Indicated by accumulated number of larvae found		
	No treat	Continue sampling	Treat
10	1	2 to 11	12 or more
15	5	6 to 15	16 or more
20	8	9 to 19	20 or more
25	12	13 to 23	24 or more
30	16	17 to 27	28 or more
35	20	21 to 31	32 or more
40	24	25 to 34	35 or more
45	27	28 to 38	39 or more
50	31	32 to 42	43 or more

Plan G EIL 0.80 – 0.89

Number of samples	Action indicated by accumulated number of larvae found		
	No treat	Continue sampling	Treat
10	1	2 to 13	14 or more
15	6	7 to 17	18 or more
20	10	11 to 21	22 or more
25	14	15 to 25	26 or more
30	19	20 to 29	30 or more
35	23	24 to 33	34 or more
40	27	28 to 37	38 or more
45	32	33 to 41	42 or more
50	36	37 to 46	47 or more

Plan H EIL 0.90 – 0.99

Number of samples	Action indicated by accumulated number of larvae found		
	No treat	Continue sampling	Treat
10	1	2 to 15	16 or more
15	6	7 to 19	20 or more
20	11	12 to 24	25 or more
25	16	17 to 29	30 or more
30	20	21 to 33	34 or more
35	25	26 to 38	39 or more
40	30	31 to 43	44 or more
45	35	36 to 48	49 or more
50	39	40 to 52	53 or more

Plan I EIL 1.00 – 1.09

Number of samples	Action indicated by accumulated number of larvae found: No treat	Continue sampling	Treat
10	1	2 to 16	17 or more
15	7	8 to 21	22 or more
20	12	13 to 27	28 or more
25	17	18 to 32	33 or more
30	22	23 to 37	38 or more
35	27	28 to 42	43 or more
40	32	33 to 48	49 or more
45	37	38 to 53	54 or more
50	43	44 to 59	60 or more

Plan J EIL 1.10 – 1.19

Number of samples	Action indicated by accumulated number of larvae found: No treat	Continue sampling	Treat
10	1	2 to 18	19 or more
15	7	8 to 24	25 or more
20	13	14 to 29	30 or more
25	19	20 to 35	36 or more
30	25	26 to 41	42 or more
35	30	31 to 46	47 or more
40	36	37 to 52	53 or more
45	42	43 to 58	59 or more
50	48	49 to 64	65 or more

Plan K EIL 1.20 – 1.29

Number of samples	Action indicated by accumulated number of larvae found: No treat	Continue sampling	Treat
10	2	3 to 19	20 or more
15	8	9 to 25	26 or more
20	13	14 to 30	31 or more
25	19	20 to 36	37 or more
30	26	27 to 42	43 or more
35	31	32 to 48	49 or more
40	37	38 to 54	55 or more
45	43	44 to 60	61 or more
50	49	50 to 66	67 or more

For Further Information

Berry, R. E., 1977. Insects on Mint. Pacific Northwest Cooperative Extension Publication 182. 14 pp.

Berry, R. E., 1978. Insects and Mites of Economic Importance in the Northwest. Oregon State Bookstore, Inc. 189 pp.

Danielson, S. D. and R. E. Berry, 1978. Redbacked Cutworm: Sequential Sampling Plans in Peppermint. J. Econ. Ent. 71:323-8.

OREGON STATE UNIVERSITY EXTENSION SERVICE

Extension Service, Oregon State University, Henry A. Wadsworth, director. Produced and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. Extension work is a cooperative program of Oregon State University, the U. S. Department of Agriculture, and Oregon counties. Extension invites participation in its programs and offers them equally to all people.