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Cereal Leaf Beetle (Coleoptera: Chrysomelidae), Incidence at Harvest and Survival in Storage in Montana[1]

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The cereal leaf beetle (CLB) *Oulema melanopus* (L.) (Coleoptera: Chrysomelidae) is a pest of grain crops in Europe (Kadosca, G. 1916. Int. Rev. Sci. Practice Agric. 7: 312-314) and Great Britain (Hodson, E. W. H. 1929. Bull. Entomol. Res. 20: 5-14). It was detected in Michigan in 1962 (Doward, K. 1962. Agric. Chem. 17: 59) and had spread eastward to the Atlantic Ocean by 1972, but westward movement was slower, perhaps due to less favorable environmental conditions (Haynes, D. L. and S. H. Gage. 1981. Ann. Rev. Entomol. 26: 259-287). Isolated populations were found in Utah in 1984 (Karren, J. B. 1989. Utah State Univ. Mim. rept. 4 pp.) and in four counties in Montana in 1989 (Jensen, G. 1990. Mont. Crop Health Rept. 5: 5).

Cereal leaf beetle biology is well known. It is univoltine, with obligatory aestivation-diapause. Adults overwinter in debris in protected areas (Baniecki, J. F. and J. E. Weaver. 1972. W. Va. Univ. Exp. Stn. Current Report. 60: 1-8; Casagrande, R. A., W. G. Ruesink, and D. L. Haynes. 1977. Ann. Entomol. Soc. Amer. 70: 19-30), and become active when spring temperatures reach 13°C. Eggs are deposited on host grasses and larvae feed for 10 to 14 days prior to pupating in the soil. Adults emerge after about 2 weeks (Baniecki and Weaver, ibid) and feed actively on grass or corn for about 3 weeks before becoming quiescent (Connin, R. V. and R. A. Hoopingarner 1971. Ann. Entomol. Soc. Am. 64: 655-660). Extensive dispersal occurs in late summer resulting in relocation to overwintering sites (Koval, C. F. and J. W. Apple. 1965. Proc. North Central Br. Entomol. Soc. Am. 20: 66-67).

Arrival of the CLB in Montana caused considerable concern in the agricultural community by 1990. Therefore, surveys were conducted to determine if larval or adult CLB populations would reach levels which would require treatment. In addition, restrictions on interstate shipment of grain from CLB infested areas to California prompted research on CLB survival in stored grain.

The CLB population density was highest in the Yellowstone Valley (Yellowstone Co.), suggesting this might be the original infestation site in the state. The predominant crops in this area are malting barley, spring wheat, corn, sugar beets, and alfalfa. Most fields are flood irrigated and small grain is swathed prior to combining.

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Preharvest populations. Population densities of CLB larvae in Yellowstone County were estimated by counting larvae on 50 barley plants at 3 weekly intervals in a heavily infested field. Presence or absence of larval feeding damage on individual plants was recorded when plants were beginning to mature.

The maximum larval population was less than two per plant. Feeding damage was found on less than half of the plants. Therefore, the established action level of nine larvae per stem in winter wheat (Webster, J. A. 1983. Crop Prot. 2: 431-6) was not reached. Even at this lower level, growers were considering insecticide applications.

During-harvest populations. Harvest season in this area begins with spring-planted malting barley, followed by spring wheat, and finally corn. Small grains (barley and wheat) harvest lasts for 5 weeks. Cereal leaf beetle adults were sampled at the beginning, midway, and at the end of the small grain harvest season (July 18, Aug. 2, and Aug. 28, respectively). Four samples of 25 sweeps were taken in stubble in 9 to 12 fields on each sample date. Beetles on 6 meter length of unharvested windrow and also on straw (after combining) were counted (six samples per field). Numbers of beetles observed on a 0.9 meter length of stubble were recorded (six samples per field).

Adult CLB infestations averaged about one per sweep in stubble early in the harvest period. In fields which were being harvested, it was possible to count beetles in stubble, on windrows, and on straw during the same day. Many beetles were visible in and on the stubble, and on the straw after passing through the combine (Table 1), indicating that they did not leave the field even though host plants were mature and dry.

Grassy field borders and alfalfa fields were sampled with a sweep net (six samples of 25 sweeps per field). Individual corn plants in fields bordering CLB infested barley were inspected. Numbers of CLB decreased at mid-harvest and after harvest, but adults were plentiful in succulent wild grasses and in late-maturing wheat. Low numbers of CLB captured and lack of feeding damage indicated that alfalfa was not a suitable host. In corn, feeding scars were found, but few adult CLB were seen.

A combine which was operating in a barley field was inspected and many active CLB were found in the hopper and in the grain after it was dumped into a truck. Five 1.5 liter grain samples were taken from the truck and examined in the laboratory. Beetles were separated from the grain by using a wire screen sieve (3 wires per cm). All samples were infested, and there was a mean of 3 CLB per 1.5 liter.

Post-harvest populations. Ten 2-liter samples of malting barley were collected from grain in a local elevator as it was brought from farms. Each sample was placed in a plastic container and sealed with a tight lid to prevent escape or entrance of CLB. Beetles were separated from grain in the laboratory. Eight of the 10 samples were infested. The highest infestation was 2.5 CLB per liter.

Survival in stored grain. It was clear that CLB's were present in fields during harvest, and that they were being carried from the field in harvested grain. No information on CLB survival in stored grain was available. Laboratory trials were conducted to determine if beetles would survive the expected temperature fluctations.

Table 1. Incidence of cereal leaf beetle adults during and after harvest in Yellowstone Co., MT, 1990.

Crop	Stage	Sampling method	No. CLB mean, SD	Samples/ field	No. fields sampled
		Early harvest, July 18			
Barley	Stubble*	Sweep net	33.33 ± 3.56	5	3
Barley	Stubble†	Visual	1.86 ± 0.27	20	3
Barley	Straw‡	Visual	2.40 ± 0.52	10	1
Barley	Windrow§	Visual	7.32 ± 1.32	10	2
		Midharvest, August 2			
Barley	Stubble	Sweep net	6.33 ± 1.33	10	3
Barley	Windrow	Visual	2.80 ± 0.61	10	2
Oats	Stubble	Sweep net	9.00 ± 2.60	10	1
Oats	Windrow	Visual	1.22 ± 0.32	10	1
Wheat	Stubble	Sweep net	21.20 ± 4.64	10	1
Alfalfa	Standing¶	Sweep net	0	2	1
Alfalfa	Stubble	Sweep net	0.03 ± 0.15	10	1
Alfalfa	Windrow	Visual	0.45 ± 0.69	10	1
Border	Standing**	Sweep net	33.55 ± 20.60	2	5
		Postharvest, August 28			
Wheat	Stubble	Sweep net	0	2	1
Barley	Stubble	Sweep net	0.33 ± 0.49	2	6
Barley	Straw§§	Visual	0.50 ± 0.50	2	2
Corn	Standing§§§	Visual	0.50 ± 0.50	10	2
Alfalfa	Standing¶¶	Sweep net	0	2	1
Border	Standing**	Sweep net	0	2	4

* Crop was winrowed (cut), all samples were 25 sweeps.
† CLB visible in 0.9 meter length of row.
‡ CLB visible on 6 meter length of straw windrow which had been combined.
§ CLB visible on 6 meter length of windrow before combining.
¶ Alfalfa was 75 cm tall, early bud stage.
** Mixed species of plants in field border, uncut.
§§ Clumps of straw residue not removed during baling.
¶¶ CLB visible on a single corn plant in the milk stage.

Adult CLB used in the stored grain trials were field collected with sweep nets. They were held on wild oat plants in the laboratory for 2 days to eliminate beetles which were damaged during collecting.

The low temperature trial was conducted at 18 ± 2°C and 24 hr D photoperiod. Ten CLB were placed on the surface of 600 g of freshly harvested 'Morex' barley (13% moisture) in 5 cm dia × 40 cm containers. There were 9 containers (replications). For a comparison, four replicates of ten 0 to 3 day-old lesser grain borers (LGB), *Rhyzophertha dominica* (F.), were held in similar conditions. We also caged 211 adult CLB on wild oats at room temperatures and recorded survival for 8 weeks.

Insects were counted at 7 day intervals to determine survival. A mean of 17.8% (SD=1.8) of the CLB survived for 7 days, and none survived for 14 days. Over 77% of the control insects (LGB) survived for 21 days. There was 92% survival of beetles caged on wild oat plants after 8 weeks.

The high temperature experiment was conducted at 28 ± 1°C, with 12L : 12D photoperiod. Cereal leaf beetles were held in 1 liter glass jars on 800 grams of barley as previously described. There were 10 CLB per container with 10 replications. Lesser grain borers were again maintained similarly as a check.

There was 42% (SD = 14.8) and 32% (SD = 10.6) survival of CLB at 7 and 14 days, respectively. None survived for 21 days. Cereal leaf beetles are too large to fit into spaces between barley grains, and it is likely that they would be crushed or be held immobile in grain bins. Cereal leaf beetles are not known to feed on mature grain (Gray, H. E., R. G. Howe, E. M. Lutz, and W. K. Whitney. 1964. Down to Earth. 20: 8-12). Also, beetles continued to feed in the field after harvest, and food reserves from this period may be important to long term survival.

Initiation of dispersal activity was apparent by behavior of beetles in sweep nets. Those which were captured late in the season were very active, and were difficult to capture with an aspirator when nets were checked.

Collection of CLB in grain which is entering elevators is of special interest for concern exists for the possible spread of CLB through grain transport. No surviving beetles were found in samples which were collected in the elevator. Even under optimal conditions (being placed on the surface of the grain mass) CLB survival was less than 3 weeks. Mortality of CLB in storage should be a factor in determining quarantine regulations for states which are importing grain from infested areas.

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