CABBAGE SEEDPOD WEEVIL, *CEUTORHYNCHUS OBSTRICTUS* (MARSHAM) (COLEOPTERA: CURCULIONIDAE) IN ONTARIO AND QUEBEC

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Abstract *J. ent. Soc. Ont.* 134: 107-113

The cabbage seedpod weevil, *Ceutorhynchus obstrictus* (Marsham) [Coleoptera: Curculionidae] (CSW), is the most significant insect pest of canola in Europe and the US. Since its accidental introduction into Vancouver, Canada in 1931, CSW has been reported in the western and southeastern US (mid 1940s and early1990s, respectively) but only recently has it invaded canola-growing regions in Alberta (1995), British Columbia (1997), Saskatchewan (2000) and Quebec (2000). In Ontario, CSW was found on Brassicaceae, including canola, *Brassica napus* L., and wild mustard, *Sinapis arvensis* L. at 28 and 38% of sites sampled in 2001 and 2002, respectively. In Quebec, CSW was found on three Brassicaceae, including canola, wild mustard, and wild radish, *Raphanus raphanistrum* L. at 66 and 78% of sites sampled in 2001 and 2002, respectively. In 2002, mean numbers of adult CSW collected on canola during flowering were 0.36 per 10 sweeps in Ontario, about 1/20 the number collected in Quebec (6.37 per 10 sweeps). At the pod stage, fewer canola fields were infested in Ontario (44%) than Quebec (72%). In canola fields where CSW occurred, up to 28% of pods were infested in Ontario compared to up to 58% in Quebec, resulting in economic loss in at least two and six fields surveyed, respectively. Numbers of seeds damaged per pod was 4 to7 in Ontario and 1 to 7 in Quebec, typical for CSW. Although population numbers were lower and damage less in Ontario than in Quebec, CSW is clearly established in both provinces and there is potential for significant damage to the canola industry. Alternate host plants such as wild mustard and wild radish serve as reservoirs for CSW populations and will facilitate further dispersal and population increases.

Introduction

The cabbage seedpod weevil, *Ceutorhynchus obstrictus* (Marsham) (Coleoptera: Curculionidae) [CSW] is the most significant insect pest causing yield loss of canola and oilseed rape, *Brassica napus* L. and *B. rapa* L. (Brassicaceae), in the US and Europe (Kuhlmann et al. 2002). Although first reported in the Vancouver area in 1931, CSW has only recently been reported in canola-growing areas of southern Alberta (1995), the interior of British Columbia (1997), Saskatchewan (2000) and southern Quebec (2000) (Philip 2000; Brodeur et al. 2001; Cárcamo et al. 2001; Dosdall et al. 2002). Since its introduction into North America, CSW has dispersed south and east, being reported in the Okanagan and Creston Valleys in British Columbia, the US Pacific Northwest (Washington, Idaho, Oregon) (mid 1940s), California, the southeastern US (Tennessee and Georgia) (early 1990s) (Cárcamo et al. 2001). Damage is caused primarily by larvae feeding on the seeds developing within the pods. About 20-30% of the seeds in a pod can be damaged (Kirk 1992, Cárcamo et al. 2001), and seed weight can be reduced by more than 16% (Buntin et al. 1995; Buntin 1999).

In Ontario, 24,282 ha of canola were planted in 2002 yielding 44,200 tonnes of seed (Canola Council of Canada 2004). Although this represents only approximately 1.1% of Canadian seed production, Ontario is an important area for variety testing and seed production for the industry in western Canada where the majority of canola is grown. Therefore, damage to crops in eastern Canada could have significant impact on the western Canadian canola industry. Further, although Brodeur et al. (2001) concluded that CSW was well established in Quebec, their study was restricted to spring-canola fields in the Quebec City area. Thus, surveys were conducted in southern Ontario and Quebec to determine distribution and abundance of CSW and levels of damage to canola.

Methods

To determine CSW distribution, surveys were conducted in 2001 and 2002 in areas where canola was known to be grown and at random sites where flowering Brassicaceae were observed. In Ontario, agricultural fields containing flowering Brassicaceae, including canola, *Brassica napus* L., mustard, *Sinapis alba* L., other crops infested with flowering wild mustard, *S. arvensis* L., and roadside patches of flowering wild mustard were sampled using a sweep net. In July 2001 and 2002, respectively, a total of 14 and 15 canola fields, and 15 and 18 wild mustard stands were sampled. A single mustard field was sampled in 2002. In Quebec, similar surveys were conducted in canola, wild mustard and wild radish, *Raphanus raphanistrum* L. (Brassicaceae). In July 2001 and 2002, respectively, a total of 10 and 3 canola fields, 12 and 13 wild mustard stands and 12 and 8 wild radish stands were sampled. A single stand of volunteer canola was sampled in 2002. In all commercial fields (canola and mustard), and where large patches of wild mustard and wild radish occurred, 100 standard 180° arc sweeps were taken while walking in a straight line; in smaller stands of wild mustard and wild radish as many sweeps as possible (minimum 12) were made. In commercial canola and mustard fields, sweeps were made while walking into the field along one transect beginning at a randomly selected point at the field edge. For volunteer canola, wild mustard and wild radish, sweeps were made where these plants occurred along field margins, roadsides or patches in fields. Sweep samples were placed in a white pan and adult weevils aspirated into vials for identification and processing.

In 2002, to assess abundance and damage additional surveys were done in August in canola fields in the pod stage, north and west of Guelph (Ontario) and south of Quebec City (Quebec). The latter surveys included a 100-sweep sample and collection of 50-pod samples to assess adult densities and seed damage, respectively.

In the laboratory, adult weevils were mounted on points and identified. The identity of CSW was confirmed by Dr. D.E. Bright of the Canadian National Collection of Insects, Arachnids and Nematodes, Agriculture and Agri-Food Canada. For each sample site, total numbers of CSW adults collected were recorded. The 50-pod samples were dissected and numbers of feeding holes, emergence holes, CSW larvae, seeds damaged, and total seeds were recorded.

Results and Discussion

CSW occurred at many but not all of the sites sampled (Figure 1) In Ontario, CSW was found at 8 of 28 (28.6%) of sites sampled in 2001 and 25 of 66 (37.9%) of sites sampled in 2002. Populations were most abundant in the canola growing areas north of Guelph. Although present at some locations, CSW was uncommon at sites from Pickering east to the Ontario/Quebec border. Brassicaceae host plants, particularly *Brassica* spp., *Raphanus* spp. and wild mustard in which larvae develop (Doucette 1947), were not abundant in these areas, which may be a barrier to establishment of CSW. However, canola fields and large stands of wild mustard occur in the eastern Ontario (Trenton - Ottawa - Ontario/Quebec border) area and CSW was not found at any of 12 sites sampled. In Quebec, CSW was found at 21 of 32 (65.6%) of sites sampled in 2001 and 32 of 41 (78.0%) of sites sampled in 2002. Populations were present and very abundant at all but two locations sampled in the canola growing areas south of Quebec City, but scattered and less numerous to the west.

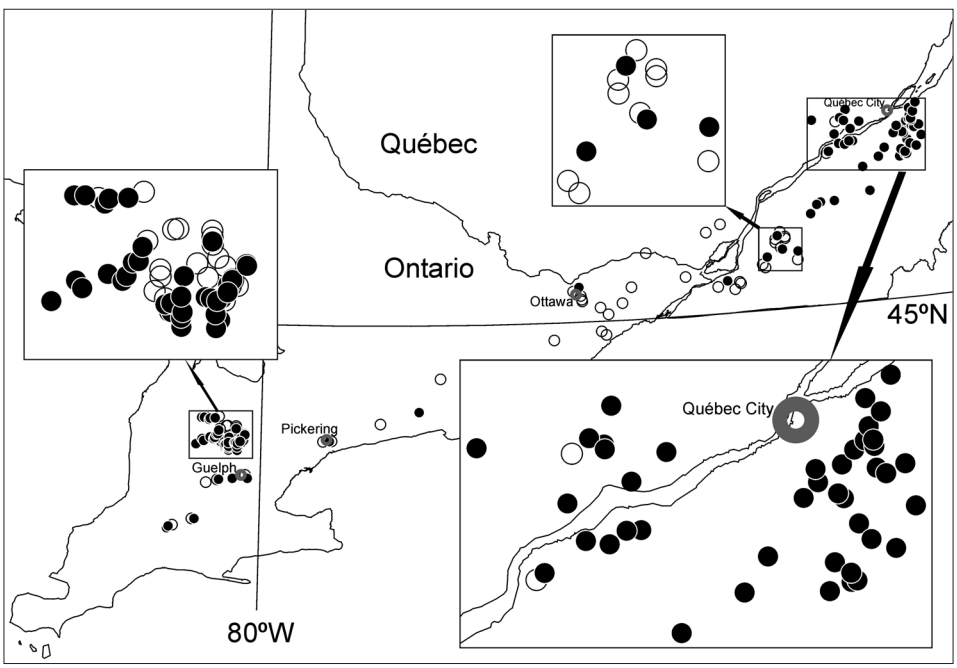

FIGURE 1. *Ceutorhynchus obstrictus* (Coleoptera: Curculionidae) distribution in southern Ontario and southwestern Quebec: locations where CSW was present (•) and locations sampled but where CSW was not present (o).

CSW adults were collected from all plant species surveyed in July of both years (Table I). Wild radish, although present in scattered locations in southern and eastern areas (Alex 1998), was not encountered during our surveys in Ontario. Mean numbers of adult CSW were approximately 20 times greater in southern Quebec compared to Ontario. According to Doucett (1947) CSW does not develop on commercial mustard, *S. alba*, in Washington state. This may explain the low numbers of adult CSW collected (0.05/10 sweeps) in mustard in Ontario despite being in close proximity to a canola field where 2.1 weevils/10 sweeps were collected. The abundance of CSW on wild mustard and wild radish indicates that management strategies that include crop rotations when canola is not planted may have little effect on reducing CSW populations. Further, spread of CSW in Ontario will be facilitated by presence of these preferred non-crop hosts.

TABLE I. Mean numbers of adult cabbage seedpod weevil, *Ceutorhynchus obstrictus* (Coleoptera: Curculionidae), collected on host plants in the family Brassicaceae in Ontario and Quebec in July 2002.

	Adult *C. obstrictus* (per 10 sweeps) ±SE (n)	
Host Plant	Ontario	Quebec
canola, *Brassica napus* L.	0.36 ±0.14 (15)	6.37 ±4.67 (3)
volunteer canola, *B. napus*	–*	5.43 ±4.18 (2)
mustard, *Sinapis alba* L.	0.05 (1)	–
wild mustard, *S. arvensis* L.	0.27 ±0.23 (18)	4.50 ±3.37 (11)
wild radish, *Raphanus raphanistrum* L.	–	6.56 ±5.86 (6)
mixed stands of wild mustard and wild radish	–	1.50 ±0.50 (2)

* no samples

Fewer canola fields were infested in Ontario (43.8%, n=32) than in southern Quebec (72.2%, n=18). Percent of pods infested by CSW varied considerably between fields in both regions (Tables II & III). In Ontario, where CSW occurred, up to 28% of pods (n =50) were infested whereas in southern Quebec up to 58% of pods (n =50) were infested (5 of 14 fields had more than 30% of pods infested). Brodeur et al. (2001) reported that percent pods infested ranged from 5.0 to 75.9% in four fields south of Quebec City in 2000. In our surveys, the wide variation in percent pods infested suggests that CSW infestations are not uniformly distributed, thus monitoring may be required on an individual field rather than an area-wide scale. Mean numbers of damaged seeds per infested pod were similar in both regions, ranging from 4.0 to 6.9 in Ontario and from 1.2 to 7.0 in southern Quebec. Brodeur et al. (2001) sampled 4 fields in southern Quebec and found that the mean number of seeds damaged per infested pod ranged from 5.2 to 9.2. Other studies have shown that larvae will consume 4-6 seeds during development (McCaffrey et al. 1986; Homan and McCaffrey 1993). Depending on insecticide costs and commodity price, yield losses occur when more than 26 to 40% of pods are infested (Buntin 1999). In our study, the number of damaged seeds ranged from about 6 to 41% and 15 to 34% of the total seeds per pod in Ontario and Quebec, respectively (Tables II & III). Thus, economic losses likely occurred in 2002 in at least two fields surveyed in Ontario and six in southern Quebec.

Pod sampling was done relatively late in the season (7-8 August in Ontario and 14-15 August in Quebec. Due to the wet spring there was a wide range of planting dates and a range of plant

TABLE II. Extent of damage and mean numbers of adult cabbage seedpod weevil, *Ceutorhynchus obstrictus* (Coleoptera: Curculionidae), in commercial canola, *Brassica napus* (Brassicaceae), crops in southern Ontario during August 2002.

Location	Infested Pods (%)	n	# damaged seeds ±SE	%# damaged seeds ±SE	*C. obstrictus* adults / 10 sweeps
Kinburn (44°05.287'N 80°48.004'W)	12	6	4.7 ±0.4	19.9 ±1.5	12.4
Yeoville (44°04.519'N 80°42.503'W)	28	14	3.6 ±0.4	15.7 ±1.5	16.6
Maple Lane (44°05.131'N 80°37.268'W)	6	3	5.7 ±1.7	40.9 ±12.0	13.1
Conn 1 (43°59.160'N 80°33.973'W)	4	1	6	27.3	0
Conn 2 (40°58.888'N 80°34.165'W)	10	5	5.4 ±0.5	28.4 ±3.5	NA*
Kenilworth (43°54.332'N 80°37.268'W)	6	2	1.5 ±1.5	6.3 ±6.3	0.2
Farewell (43°54.866'N 80°41.306'W)	4	2	5.5 ±0.5	19.3 ±0.7	6.4
Glenlee 1 (43°52.849'N 80°46.483'W)	28	13	5.1 ±0.6	34.3 ±6.7	18.6
Glenlee 2 (43°52.880'N 80°46.755'W)	6	3	1.3 ±1.3	8.9 ±8.9	20.7
Palmerston (43°50.987'N 80°52.516'W)	2	1	7	25	6.1
Arthur (43°50.004'N 80°28.341'W)	12	4	5.0 ±1.8	25.2 ±10.2	4.3
Metz (43°49.391'N 80°26.250'W)	2	1	3	25	1.8
Luther March (43°54.906'N 80°21.564'W)	10	5	1.2 ±0.2	5.7 ±0.9	0

* data not available, adults collected but not counted

stages encountered during sampling, sometimes even in one field. In Ontario, plant stages from the end of flowering, when seeds are enlarging in the lower pods (stage 4.4 of Harper and Berenkamp [1975]), to the end of ripening when seeds in all pods are brown and the plants are senescent (stages 5.5) were encountered, with stage 5.2 (green seeds in the lower pods) being the most common. In southern Quebec, only ripening plants (stages 5.1-5.5) were found, with stage 5.2 also being the most common. Incidence of CSW larvae was low. Exit holes made by mature larvae provided an additional measure of infestation. No more than a single larva occurred in pods where larvae were found, contrasting with Brodeur et al. (2001), who found up to 3 larvae per pod. Adult CSW were collected at most fields, 20 of 31 (64.5%) in Ontario and 18 of 19 (94.7%) in southern Quebec. Adults were found in some fields in which pods were not infested. Because adults were common (up to 20.7 and 27.5 per 10 sweeps in Ontario and southern Quebec, respectively), we suspect that the new overwintering generation was emerging and dispersing.

In Ontario, CSW has established, although perhaps more recently than in southern Quebec, and some economic losses may have occurred in 2002. The source of these populations is not known and further studies may clarify this. Damage in infested fields is typical to that in other areas where CSW is established. The presence of alternate host plants, such as wild mustard and wild radish, provide reservoirs in which CSW populations can maintain and increase their numbers and facilitate further dispersal.

TABLE III. Extent of damage and mean numbers of adult cabbage seedpod weevil, *Ceutorhynchus obstrictus* (Coleoptera: Curculionidae), in commercial canola, *Brassica napus* (Brassicaceae), crops in southern Quebec during August 2002.

Location	Infested Pods (%)	n	# damaged seeds ±SE	%# damaged seeds ±SE	*C. obstrictus* adults / 10 sweeps
Ste-Marie (46°26.982'N 71°06.126'W)	34	17	6.9 ±0.9	34.47 ±5.8	2.1
St-Raymond (46°52.898'N 71°50.269'W)	10	5	5.8 ±0.8	33.45 ±4.4	2.8
St-Charles de Bellechasse 1 (46°49.893'N 70°56.116'W)	20	9	5.1 ±0.7	20.69 ±3.1	0.8
Honfleur (46°39.974'N 70°55.381'W)	34	17	5.6 ±0.5	28.71 ±2.7	3.2
Bèlval (46°33.207'N 70°48.945'W)	4	1	4	15.4	21.7
Ste-Hénédine (46°31.785'N 71°00.603'W)	24	9	4.3 ±0.7	17.8 ±3.2	0.4
Quatre Chemin (46°35.108'N 71°03.914'W)	58	23	6.8 ±0.7	22.8 ±2.4	7.6
St-Elzéar (46°23.155'N 71°02.320'W)	6	2	4.0 ±1.0	22.2 ±9.1	17.5
Leclercville (46°33.643'N 71°58.645'W)	14	5	4.2 ±1.2	16.6 ±3.9	0.1
St-Charles de Bellechasse 2 (46°43.950'N 70°57.077'W)	8	2	3.5 ±2.5	14.8 ±3.7	0.6
St-Charles de Bellechasse 3 (46°45.165'N 70°56.435'W)	28	11	4.3 ±0.3	22.6 ±2.8	1
St-Charles de Bellechasse 4 (46°47.739'N 70°53.922'W)	10	4	4.3 ±1.0	21.4 ±1.6	9
St-Charles de Bellechasse 5 (46°42.658'N 70°55.826'W)	52	23	4.4 ±0.3	29.3 ±3.2	27.5
St-Charles de Bellechasse 6 (46°43.942'N 70°55.381'W)	42	19	5.4 ±0.7	28.9 ±3.8	16.2

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References

Alex, J.F. 1998. Ontario Weeds. Ontario Ministry of Agriculture, Food and Rural Affairs Publication No. 505: 88.

Brodeur, J., L. Leclerc, M. Fournier, and M. Roy. 2001. Cabbage seedpod weevil (Coleoptera: Curculionidae): new pest of canola in northeastern North America. The Canadian Entomologist, 133: 709-711.

Buntin, G.D. 1999. Damage loss assessment and control of the cabbage seedpod weevil (Coleoptera: Curculionidae) in winter canola using insecticides. Journal of Economic Entomology, 92: 220-227.

Buntin, G.D., J.P. McCaffrey, P.L. Raymer, and J. Romero. 1995. Quality and germination of rapeseed and canola seed damaged by adult cabbage seedpod weevil, *Ceutorhynchus assimilis* (Paykull) [Coleropera: Curculionidae]. Canadian Journal of Plant Science, 75: 539-541.

Canola Council of Canada. 2004. http://www.canola-council.org/markets/acreage-productionandyield.html. February 23, 2004.

Cárcamo, H.A., L. Dosdall, M. Dolinski, O. Olfert , and J.R. Byers. 2001. The cabbage seedpod weevil, *Ceutorhynchus obstrictus* (Coleoptera: Curculionidae) - a review. Journal of the Entomological Society of British Columbia, 98: 201-210.

Dosdall, L.M., R.M.Weiss, O. Olfert, and H.A. Cárcamo. 2002. Temporal and geographical distribution patterns of cabbage seedpod weevil (Coleoptera: Curculionidae) in canola. The Canadian Entomologist, 134: 403-418.

Doucette, C.F. 1947. Host plants of the cabbage seedpod weevil. Journal of Economic Entomology, 40: 838-840.

Harper, F.R. and B. Berenkamp. 1975. Revised growth-stage key for *Brassica campestris* and *B. napus*. Canadian Journal of Plant Science, 55: 657-658.

Homan, H.W. and J.P. McCaffrey. 1993. Insect pests of spring-planted canola. University of Idaho, Cooperative Extension System Publication No. 982: 2.

Kirk, W.D.J. 1992. Insects on Cabbages and Oilseed Rape. Naturalists' Handbooks 18, Richmond Publishing Co. Ltd., Slough, England, 66 pp.

Kuhlmann, U., L.M. Dosdall and P.G. Mason. 2002. *Ceutorhynchus obstrictus* (Marsham), Cabbage Seedpod Weevil (Coleoptera: Curculionidae). pp. 52-58 *In* P.G. Mason and J.T. Huber (eds.) Biological Control Programmes in Canada 1981-2000. CABI Publishers, Wallingford, UK, 583 pp.

McCaffrey, J.P., L.E. O'Keeffe, and H.W. Homan. 1986. Cabbage seedpod weevil control in winter rapeseed. University of Idaho, Cooperative Extension Service, Current Information Series No. 782: 1-7.

Philip, H. 2000. Minutes of the 40th Annual Meeting of the Western Committee on Crop Pests. October 16th, 2000. Moose Jaw, Saskatchewan, p. 5.