Journal of Entomology

ISSN 1812-5670

Academic Journals Inc.

www.academicjournals.com

Journal of Entomology 3 (3): 231-235, 2006
ISSN 1812-5670

Survey of Western Black Flea Beetle, *Phyllotreta pusilla* Horn (Coleoptera: Chrysomelidae) on Cultivated and Non-cultivated Plants Throughout the Growing Season in Colorado

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Abstract: A three-year survey was conducted to evaluate population density of Western Black Flea Beetle (WBFB), *Phyllotreta pusilla* Horn (Coleoptera: Chrysomelidae) and their movement on cultivated crops and non-cultivated habitats throughout the growing season in Colorado (USA). The western black flea beetle was recovered from mid-April to early August during three year sampling periods. Therefore, they have multiple generations in Colorado. The first WBFB populations also appeared winter mustard such as Flixweed, *Descurainia* spp. and moved to canola from wild mustards to caused significant injury during seeding stages of canola. Knowing the population density of WBFB and their movement outsides of canola crops is important to predict their injury to canola plants and for developing new control strategies.

Key words: Western Black Flea Beetle (WBFB), *Phyllotreta pusilla* Horn (Coleoptera: Chrysomelidae), population density, movement cultivated crops and non-cultivated habitats

Introduction

The Western Black Flea Beetle (WBFB), *Phyllotreta pusilla* Horn (Coleoptera: Chrysomelidae), is one of the most important pests on cruciferous plants grown in the Rocky Mountain region in Colorado (Chittenden and Marsh, 1920; Al-Doghairi, 2000; Demirel, 2003; Demirel and Cranshaw, 2005; 2006a, b, c). They have apparently three generations annually in Colorado (Chittenden and Marsh, 1920). Adults overwinters under clods of earth, or under heaps of weeds, dead leaves, or other rubbish (Chittenden and Marsh, 1920).

Primary feeding injury is done by adults, which chew small pits (shotholes) into leaves (Chittenden and Marsh, 1920; Al-Doghairi, 2000; Demirel, 2003). Seedlings are frequently killed or severely stunted by these injuries (Chittenden and Marsh, 1920; Al-Doghairi, 2000; Demirel, 2003) and very high populations can also defoliate established plants (Chittenden and Marsh, 1920; Demirel, 2003). The most important damage to the canola crop occurs within three weeks of germination (Chittenden and Marsh, 1920; Al-Doghairi, 2000; Demirel, 2003). All currently registered varieties of canola (*Brassica napus*) and mustard (*B. juncea* (L.) were reported to be susceptible to attack by *P. pusilla*, although to varying degrees (Demirel, 2003; Demirel and Cranshaw, 2006b). In addition, the first WBFB population appeared outsides of canola crops and later they moved on the canola crops causing significant injury in Colorado (Demirel, 2003).

The purpose of this study was surveying the population density of WBFB outside of canola crops to understand factors contributing to damaging outbreaks and developing new control tactics to prevent their injury on canola crops in Colorado.

Materials and Methods

A total of twenty-two different Colorado sites were sampled during 2000, 2001 and 2002 in Larimer (LC), Western Weld (WWC) countries. Thirteen sites (6 LC, 7 WWC) in 2000, ten sites (5 LC, 5 WWC) in 2001 and thirteen sites (10 LC, 3 WWC) in 2002 were sampled (Table 1). Field sampling involved in using a standard 15-in diameter sweep-net, taking 20 sweep net samples per site for each sampling. Samples were taken from 18 April to 2 August in 2000, 18 April to 14 August in 2001 and 18 April to 13 August in 2002.

Samples were taken from varieties of vegetation types including croplands primarily monocultures of alfalfa (*Medicago sativa* L.), which sometimes infested with flixweed (*Descurainia sophia* (L.) Webb ex Prantl and roadsides containing tansy mustard (*Descurainia pinnata* (Walt.). Having flixweed common throughout the field, alfalfa fields were described as "some flixweed". Fields where flixweed present but uncommon, were described as "little flixweed". All samples were taken between 10 AM to 4 PM to allow warming on the surface of plants. Samples were taken by the same person, usually on a straight line transect across the sampling site. Samples were immediately placed into plastic bags and returned to the lab for counting of western black flea beetle adults.

Results and Discussion

A significant high WBFB numbers were recovered on 18 April in 2000 and 2001 sampling seasons comparing with in 2002 sampling (Table 2-4). The first western black flea beetle was collected on mid-April samples in all three seasons. This is consistent with the early season movement of adults reported by Chittenden and Marsh (1920). It was found at the sample sites throughout the season in all years. The greatest numbers were recovered in 2000 with total capture 10 times and 1.6 times greater than in 2001 and 2002, respectively (Table 2-4). There were multiple population peaks observed in sampling years; on 30 May, 21 June in 2000, 18 April, 3, 29 May and 27 June in 2001,

Table 1: Sites used in surveys of western black flea beetle, *Phyllotreta pusilla*, on different habitats at Larimer (LC) and Western Weld County (WWC) in Colorado in 2000, 2001 and 2002

Site	Location	Predominant vegetation[1]
ARDEC A	Colorado State Agricultural Development and Education Center	Flixweed
ARDEC B	ARDEC	Flixweed
ARDEC C	Immediately west of ARDEC A	Alfalfa with some flixweed
ARDEC D	Southwest of ARDEC along CR 56	Alfalfa with little flixweed
ARDEC E	ARDEC	Alfalfa with little flixweed
ARDEC F	ARDEC	Alfalfa with some flixweed
Bay farm A	CSU Bay farm	Alfalfa field
Bay farm B	CSU Bay farm	Alfalfa field
CSFS nursery	CSFS Nursery	Alfalfa field
CR15 A	Weld County Rd 15, 1.5 miles to East 14	Roadside weeds, predominantly grasses
CR15 B	Weld County Rd 15, 2 miles to East 14	Roadside weeds, predominantly flixweed
CR15 C	Weld County Rd 15, intersection of Hwy 86	Alfalfa with some flixweed
EI25	One half mile east of I25, on right of Strauss Cabin Rd	Alfalfa with some flixweed
Hort farm	Colorado State Horticulture Research Farm	Alfalfa with little flixweed
H257 A	Southeast corner, Hwy 257 and 14-intersection	Alfalfa with some flixweed
H257 B	Weld County Hwy 257, 2 miles south of Hwy 14	Flixweed
H257 C	Weld County Hwy 257 intersection at CR 80	Alfalfa with little flixweed
North Budweiser	Larimer County Rd 54, north of Budweiser Plant	Alfalfa with little flixweed
Mountain vista	Corner of Mountain Vista Rd and Timberline Rd	Alfalfa with little flixweed
Severance A	Two blocks NW of downtown Severance center	Garden with flixweed
Severance B	Adjacent to above Severance site	Alfalfa with some flixweed
W. Cargill	Cargill Oilseed Research Center, Ft. Collins	Alfalfa with some flixweed

[1]Flixweed at H257 B was predominantly the native species, *Descurainia pinnata* (Walt.) Britt. Flixweed at all other sites was predominantly the introduced European species, *Descurainia sophia* (L.) Webb. ex Prantl

Table 2: Weekly samples of western black flea beetle, *Phyllotreta pusilla*, on different crops at LC and WWC in Colorado in 2000

Site	18-Apr	25-Apr	2-May	9-May	16-May	23-May	30-May	7-June
ARDEC A	25	35	14	75	75	35	511	9
ARDEC B	14	16	65	33	61	87	270	18
ARDEC C	44	88	30	18	99	0	1	3
Hort farm	19	10	73	27	96	86	227	34
CR15 A	21	12	12	21	30	0	6	0
CR15 B	65	10	115	44	148	115	137	36
CR15 C	24	25	13	19	4	25	0	17
H257 A	10	10	4	75	8	37	180	0
H257 B	11	10	11	14	32	313	315	33
Severance A	10	4	25	0	4	50	77	35
Severance B	9	0	0	18	4	16	73	18
EI25	0	10	14	18	24	4	645	16
W. Cargill	5	12	4	13	24	3	832	35
	247	242	380	375	609	771	3274	254

Table 2: Continued

Site	14-June	21-June	29-June	5-Jul	11-Jul	18-Jul	28-Jul	2-Aug
ARDEC A	444	26	506	395	0	0	0	0
ARDEC B	300	775	166	206	0	0	0	0
ARDEC C	52	0	3	14	0	0	0	0
Hort farm	16	0	1	1	17	4	4	0
CR15 A	0	0	0	0	0	0	0	0
CR15 B	28	72	51	1	0	0	0	0
CR15 C	145	0	9	9	11	0	9	2
H257 A	1	1	16	2	0	0	0	0
H257 B	24	1	1	0	0	0	0	0
Severance A	144	933	653	153	70	16	4	14
Severance B	48	8	131	6	0	0	0	0
EI25	0	1	6	32	16	3	2	16
W. Cargill	47	229	38	42	16	0	4	9
	1249	2046	1581	861	130	23	23	41

Table 3: Weekly samples of western black flea beetle, *Phyllotreta pusilla*, on different crops at LC and WWC in Colorado in 2001

Site	18-Apr	25-Apr	3-May	8-May	23-May	29-May	7-June	12-June
ARDEC E	0	2	48	34	0	1	1	6
ARDEC F	0	0	25	4	0	33	3	7
Hortfarm	0	0	5	1	9	9	0	2
CR15 C	0	5	3	14	4	20	2	5
W. Cargill	0	3	17	4	2	35	1	0
H257 B	2	4	6	10	7	2	10	3
H257 C	4	2	6	10	7	2	10	3
Severance A	92	4	4	29	3	36	24	10
Severance B	69	17	29	13	2	16	9	8
EI25	31	4	4	2	0	39	0	2
	198	41	148	115	29	203	51	60

Table 3: Continued

Site	19-June	27-June	3-Jul	12-Jul	21-Jul	25-Jul	7-Aug	14-Aug
ARDEC E	0	19	0	2	2	0	1	1
ARDEC F	0	0	3	2	0	0	1	0
Hort farm	0	1	11	14	0	0	0	0
CR15 C	1	6	14	2	0	0	2	0
W. Cargill	1	0	4	0	0	0	1	1
H257 B	4	5	0	4	0	0	0	0
H257 C	4	5	0	4	0	0	0	0
Severance A	19	6	3	0	0	0	11	3
Severance B	2	4	5	2	2	0	0	0
EI25	0	2	2	4	0	0	0	1
	27	120	117	30	4	0	16	6

Table 4: Weekly samples of western black flea beetle, *Phyllotreta pusilla*, on different crops at LC and WWC in Colorado in 2002

Site	18-Apr	25-Apr	2-May	8-May	18-May	27-May	4-June
ARDEC C	0	0	0	0	0	119	97
ARDEC D	1	0	2	38	1566	9	16
Hortfarm	0	0	0	193	4	1322	1310
N. bud	0	0	0	14	2	0	0
Mon. vista	0	0	0	1	31	3	20
CR15 C	1	0	0	78	1770	267	216
H257 C	0	0	0	10	6	42	0
Severance A	0	0	0	38	2	77	0
EI25	1	0	3	17	13	2	0
W. Cargill	0	0	0	6	2	34	0
Bay farm A	0	0	0	23	0	19	6
Bay farmI B	1	0	0	13	2	42	0
CSFS nursery	0	0	1	5	4	4	0
	4	0	6	436	3402	1940	1665

Table 4: Continued

Site	12-June	18-June	28-June	5-Jul	12-Jul	22-Jul	5-Aug	13-Aug
ARDEC C	6	9	0	2	0	0	4	25
ARDEC D	0	0	0	2	0	0	5	19
Hortfarm	4	10	2	4	0	2	2	13
N. bud	4	10	0	0	0	0	3	16
Mon. vista	2	0	0	2	0	0	0	0
CR15 C	0	5	2	2	0	0	0	13
H257 C	6	2	0	5	0	0	0	4
Severance A	18	0	0	0	0	0	0	2
EI25	0	0	0	0	0	0	0	10
W. Cargill	12	2	0	3	0	0	0	8
Bay farm A	0	2	0	3	0	0	0	1
Bay farmI B	0	0	0	4	0	0	0	2
CSFS nursery	0	0	0	12	0	0	3	6
	52	40	4	39	0	2	17	119

18, 27 May and 4 June in 2002, respectively (Table 2-4). The western black flea beetle is reported to have up to three generations per year in Colorado (Chittenden, 1909; Chittenden and Marsh, 1920). The documentation of sustained adult activity over the four-month period of these studies would be consistent with such a life cycle, although larval stages were not sampled.

A significant WBFB number declined suddenly in 2002 sampling comparing with 2000 and 2001 samplings due to the first cutting alfalfa field occurring on 23 May at ARDEC C; 7 June at H257 A; 14 June at Hortfarm; Severance B, EI25, W. Cargill and 21 June at CR15 C in 2000 (Table 2). In addition, the first cutting of alfalfa occurred between the first week and third week of June in 2001 (Table 3). Moreover, the first alfalfa cutting occurred the second week on June 2002 (Table 4).

The sites dominated by flixweed, both *D. sophia* and *D. pinnata*, supported large early season WBFB populations, suggesting that this winter annual mustard can be an important host plant for WBFB. For example, the sides of ARDEC A, B and Severance A had predominantly annual mustard that kept the population density of WBFB more continently comparing with mixtures with alfalfa field (Table 2). Chittenden and Marsh (1920) reported on winter annual weeds as early season hosts for WBFB. In addition, where flixweed occurred in alfalfa, cutting of the crop appear to trigger migration. After cutting alfalfa and wild mustard, the western black flea beetle moved on canola field and caused significant injury within three weeks of germination (Chittenden and Marsh, 1920; Al-Doghairi, 2000; Demirel, 2003). Most of currently registered varieties of canola (*Brassica napus*) were reported to be susceptible to attack by *P. pusilla*, although to varying degrees (Demirel, 2003; Demirel and Cranshaw, 2006b). The spring canola (CO1) was significantly more attractive and susceptible for the WBFB. In addition, the spring canola (Helios) sustained relatively high plant injury with WBFB and plant had low population density and suggestion in tolerance to WBFB injury (Demirel, 2003; Demirel and Cranshaw, 2006b).

In order to decrease significant WBFB injury on canola crops can be useful some of the cultural control methods. For example, the wild mustard is significant food sources for this canola pest species and cleaning them caused to decrease their population density. In addition, controlling wild mustard in the alfalfa crops can be also decreased the population density of WBFB on canola crops in Colorado. Furthermore, previous reported by Demirel (2003) and Demirel and Cranshaw (2006b) indicated that the spring mustard (ZEM1) and winter mustard (Debut) were significantly attractive and more susceptible for the WBFB. Those crops might be used as traps crops to decrease the population density of WBFB on canola. In addition, the spring mustard (W1-23) was less susceptibility to WBFB and suggests possible source of reduced susceptibility in oilseed mustard (Demirel, 2003; Demirel and Cranshaw, 2006b).

In conclusion, the western black flea beetle had consistent population during three year sampling periods. Therefore, the surveys supported previous reports that they have multiple generations in Colorado. The first WBFB population appeared winter mustard and moved to canola from them to cause significant injury during seeding stages of canola.

Acknowledgements

I would like to give so special thanks to all the farmers and the Cargill Oilseed Research Center (CORC) who gave me permission to take samples in their field. This project was supported by Colorado Agricultural Experiment Station. ND was supported by the Ministry of National Education of Republic of Turkey.

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