Planting Date Influence on the Wheat Stem Sawfly (Hymenoptera: Cephidae) in Spring Wheat

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ABSTRACT Wasps of the wheat stem sawfly, Cephus cinctus Norton (Hymenoptera: Cephidae), lay eggs in wheat stems, and larval feeding causes lodging and lower yields. Late-planted spring wheat fields avoid attack if stem elongation begins after termination of the annual oviposition period. Moderate delays of 12–20 days in spring wheat planting trials in 7 years resulted in significantly lower infestation levels in 4 years, and complete avoidance of infestation in 3 years. However, delayed spring planting is known to make less efficient use of critical soil moisture, resulting in lower crop yields. Based on our data, safe planting dates for C. cinctus in spring wheat cannot currently be established because of annual variation in the duration of wasp flights, seasonal plant development, and amount of available moisture. We suggest that fields with a history of heavy infestations should be planted last in producers’ production program.

KEY WORDS Cephidae, cultural control, planting date, sawfly, wheat

Delayed wheat planting to avoid infestation by the Hessian fly (Matetiola destructor (Say) [Diptera: Cecidomyiidae]) is a classic example of applied cultural pest control (Pfadt 1978). Perhaps planting date modification could also be an effective tool for management of other insect pests if the seasonal insect activity and crop phenology were understood.

The wheat stem sawfly, Cephus cinctus Norton (Hymenoptera: Cephidae), has been one of the most destructive chronic pest insects of wheat in the northern Great Plains for many years, and cannot be controlled with conventional methods (Morrill 1995). Larval feeding in stems reduces grain yield and the weakened stems lodge and cause difficulty during harvest (Ainslie 1920, Holmes 1977).

Cephus cinctus oviposition activity must coincide with the seasonal host development, because plants are vulnerable only after stem elongation has begun and before grain begins to fill (Ainslie 1920, Painter 1953). The first specimens of C. cinctus were reared from feral grasses, and the first crop losses occurred in spring planted wheat in Canada (Ainslie 1920, Fletcher 1910, Davis 1948). A comparison of previous and current wasp emergence dates indicated that wasps

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are now emerging earlier, and winter wheat (planted in September) currently is also heavily infested in Montana (Morrill & Kushnak 1996).

Late-planted spring wheat sometimes had lower C. cinctus infestation levels in research trials (Jacobson & Farstad 1952, McNeal et al. 1955, Holmes & Peterson 1963, Weiss et al. 1987). We also recently observed several uninfested late-developing spring wheat fields in regions where C. cinctus consistently occurred (authors, unpublished). Therefore, we conducted field trials to determine infestation levels in spring wheat plots that were planted early during the planting season with those planted a few weeks later.

Materials and Methods

Field trials were conducted 1991–1998 at the Western Triangle Research Center, Pondera County, Montana, where high population levels of C. cinctus consistently occur. The early spring wheat planting dates were selected to coincide with early local planting activity. A second planting was conducted 12–20 days later. Third planting dates in 1991 and 1992 with 37 and 21 day delays, respectively, were established for yield evaluation. Trials were not conducted in 1993 due to budget restrictions. Annual planting dates and cultivars are shown in Table 1.

Table 1. Approximate dates of wheat stem elongation and sawfly wasp flight during the 1991–1998 research period.

<table>
<thead>
<tr>
<th>Year</th>
<th>Crop</th>
<th>Cultivar</th>
<th>Planting date</th>
<th>Initiation of stem elongation</th>
<th>Wasp flight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>Winter wheat</td>
<td>‘Redwin’</td>
<td>Sept. 18</td>
<td>June 20</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Spring wheat</td>
<td>‘Copper’</td>
<td>April 10</td>
<td>July 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spring wheat</td>
<td>‘Copper’</td>
<td>April 23</td>
<td>July 11</td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>Winter wheat</td>
<td>‘Tiber’</td>
<td>Sept. 18</td>
<td>&lt;May 23</td>
<td>May 23–July 1</td>
</tr>
<tr>
<td></td>
<td>Spring wheat</td>
<td>‘Copper’</td>
<td>April 13</td>
<td>June 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spring wheat</td>
<td>‘Copper’</td>
<td>April 28</td>
<td>June 12</td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>Winter wheat</td>
<td>‘Judith’</td>
<td>Sept. 28</td>
<td>&lt;June 3</td>
<td>June 3–July 28</td>
</tr>
<tr>
<td></td>
<td>Spring wheat</td>
<td>‘Newana’</td>
<td>April 19</td>
<td>June 20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spring wheat</td>
<td>‘Newana’</td>
<td>May 3</td>
<td>June 28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spring wheat</td>
<td>‘Newana’</td>
<td>May 3</td>
<td>&lt;June 19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spring wheat</td>
<td>‘Newana’</td>
<td>May 23</td>
<td>July 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spring wheat</td>
<td>‘Copper’</td>
<td>May 1</td>
<td>June 20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spring wheat</td>
<td>‘Copper’</td>
<td>May 13</td>
<td>June 28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spring wheat</td>
<td>‘Copper’</td>
<td>April 15</td>
<td>June 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spring wheat</td>
<td>‘Copper’</td>
<td>May 2</td>
<td>June 26</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spring wheat</td>
<td>‘McNeal’</td>
<td>April 21</td>
<td>June 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spring wheat</td>
<td>‘McNeal’</td>
<td>May 1</td>
<td>June 11</td>
<td></td>
</tr>
</tbody>
</table>
Winter wheat was planted in September of each preceding year, and used as an indicator of local *C. cinctus* activity. Field plots were 6 m long, 6 rows wide, 30 cm apart, and were not irrigated. After winter wheat stem elongation began, sweep net samples (50 or 100 sweeps each) were taken twice weekly in winter and spring wheat plots until wasps were no longer collected. During each sample date, the growth stages as described by the Feekes Scale (Cook & Veseth 1991) were recorded.

Infestation levels of *C. cinctus* larvae were estimated by evaluation of at least 75 randomly selected mature stems from each plot, but in 1998, plants from all replications were mistakenly combined and could not be evaluated separately. Care was taken to ensure that the lower sawfly-cut “stubs” were included in the samples. Plant samples were taken to the laboratory where each stem was dissected to determine if it was infested and had been cut by larvae. Annual mean infestation levels and standard errors are shown graphically (SigmaPlot, Jandel Scientific, San Rafael, California) (Charland 1995).

Fig. 1. Wheat stem sawfly infestation levels in spring wheat, late-planted spring wheat, and winter wheat in Montana. Data for 1993 were not obtained.
Yields were estimated in 1991 and 1992 by harvesting the center two rows of each plot. Means were compared with Student’s t test (SigmaStat, Jandel Scientific, San Rafael, California).

Results and Discussion

Producers’ spring wheat planting dates in Montana ranged April 7–June 9, based on a five-year average (Peck & Bay 1996). Our annual planting dates of April 10–May 23, were within this range.

Initiation of winter wheat stem elongation consistently occurred before wasp flights began. However, spring wheat stem elongation lagged behind winter wheat by several weeks, and during some years, did not occur until after wasp flights terminated (Table 1). However, late planted spring wheat development occurred at a faster rate. For example, in 1991, a 13 day planting delay resulted in a 9 day difference in beginning of stem elongation, supporting the findings of Manupeerapan & Pearson (1993).

Late–planted spring wheat consistently had lower levels of *C. cinctus* infestation, and completely avoided attack in 1994, 1995, and 1997 (Fig. 1). During these years, stem elongation began after the last wasp was captured (Table 1). Number of days of susceptibility and percent infestation for 1992, 1996, and 1998 were 18

![Fig. 2. Regression of yield and planting date of spring wheat. R = 0.93, 0.87, P = 0.93, 0.96, df = 14, 14 for 1991 and 1992, respectively. Data were collected in research plots near Conrad, Montana.](image-url)
days and 11% infestation, 8 days and 3% infestation, and 15 days and 13% infestation, respectively (Table 1).

Infestation levels in winter wheat were consistently higher (45–95%) than in the early planted spring wheat (12–52%). Annual fluctuations probably were influenced by two species of larval parasitoids (Morrill et al. 1994, 1998).

The annual duration of wasp flights varied considerably, ranging 9–34 days between the first sampling period until the last wasp was collected. The emergence and subsequent flight periods sometimes were extended by cool wet weather. Wasps were present in spring wheat later in the season than in winter wheat.

Planting dates may also affect susceptibility of winter wheat to C. cinctus. Early-planted, early-maturing varieties may be less vulnerable because senescence may occur before sawfly larval development is complete (Holmes & Peterson 1960, Holmes 1982, authors unpublished).

Yield data in 1991–1992 indicated that a 14–15 day planting delay did not statistically significantly reduce yield (Fig. 2) (Student’s t, P < 0.05). Yield loss is due to less efficient use of critical spring soil moisture, and is more pronounced when precipitation is marginal during the growing season (Briggs & Aytenfisu 1979, Connor et al. 1992).

Our results indicate that a moderate delay in spring wheat planting can reduce the risk of infestation by C. cinctus. Conversely, wheat producers are aware that this practice may result in loss of critical early-season soil moisture needed for germination and plant growth. Therefore, we suggest that individual fields with a history of heaviest infestation sawfly be planted last.

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References Cited


