Sources of Resistance in *Triticum* and *Aegilops* Species to Hessian Fly (Diptera: Cecidomyiidae) in Morocco

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Abstract


Hessian fly, *Mayetiola destructor* (Say), is a destructive wheat pest in Morocco. Genetic resistance has been the most practical means of controlling this pest. Twenty-three accessions of *Triticum* and *Aegilops* species were evaluated for Hessian fly resistance in the field and in the greenhouse. One accession of *T. monococcum* subsp. *aegilopoides* and four of *Ae. tauschii* were homogeneously resistant, and two *T. monococcum* subsp. *aegilopoides* accessions showed heterogeneous reaction to this pest. This is the first report of resistance sources to the Moroccan Hessian fly identified in *T. monococcum* subsp. *aegilopoides* and subsp. *monococcum*. Antibiosis is the resistance mechanism in *Ae. tauschii* and *T. monococcum* subsp. *monococcum*, whereas *T. monococcum* subsp. *aegilopoides* seems to be tolerant.

Key words: *Triticum*, *Aegilops*, *Mayetiola destructor*, resistance

Introduction

The Hessian fly, *Mayetiola destructor* (Say), is the most damaging insect pest of wheat in Morocco. Losses were estimated at 42% and 32% for bread wheat (*Triticum aestivum* L. subsp. *aestivum*) and durum wheat (*T. turgidum* L. subsp. *durum* (Desf.) Husn.), respectively (10).

Genetic resistance has been used successfully to control this pest. In the USA, 26 resistance genes designated H1 to H26 have been identified in *Triticum*, *Aegilops* and *Secale* species as effective against this pest (3). Only 10 (H5, H7H8, H11, H13, H14H15, H21, H22, H23, H25 and H26) of these are effective against Moroccan Hessian fly populations (5).

A gene-for-gene relationship has been demonstrated between resistance in wheat and virulence in the Hessian fly (9). As a result of this highly specific relationship, new biotypes of Hessian fly keep evolving as a result of selection pressure exerted by large-scale growing of resistant cultivars with the same genes for resistance, and resistance is overcome by new virulent biotypes (7, 12). Thus, new sources of resistance genes must be sought continuously.

The objective of this study was to evaluate a collection of *Aegilops* and *Triticum* species to identify new sources of resistance to Hessian fly in Morocco.

Material and Methods

The evaluation of *Aegilops* and *Triticum* species was conducted in a greenhouse at the Dry Land Research Center (INRA, Settat) and in a field at Jemaa Shairn experimental station, Morocco.

Greenhouse evaluation: A total of 23 accessions of *Aegilops* and *Triticum* species were screened: 4 *T. monococcum* L. subsp. *aegilopoides* (Link) Thell., 5 *Ae. tauschii* Coss., 1 *Ae. longissima* Schweinf. & Muschl., 3 *T. turgidum* L. subsp. *dicoccoides* (Korn. ex Asch. & Graebn.) Thell., 1 *Ae. biuncialis* Vis., 1 *Ae. kotschyi* Boiss., 3 *T. urartu* Tun. ex. Gandilyan, 1 *Ae. peregrina* (Hack) Maire & Weiller, and 4 *T. monococcum* L. subsp. *monococcum*. Seeds were sown in rows (ca. 20 seeds per row) in a standard greenhouse flat (54 x 36 x 8 cm) containing a mixture of soil, vermiculite and peat. Cultivars ‘Nasma’ and ‘Saada’ were used as susceptible and resistant checks, respectively. The methods of infestation and determination of resistance or susceptibility of individual plants were similar to those used by Cartwright and LaHue (2). Flats containing plants at the one-leaf stage were placed under a cheesecloth tent along with infested plants containing mature Hessian fly pupae. When adults emerged, females were allowed to lay eggs on the seedlings for two days. Plant reactions to larval feeding were determined 20 days after hatching. Susceptible and resistant plants were separated on the basis of symptoms. Susceptible plants were stunted and dark green, whereas resistant plants were not stunted, light green and contained dead first-instar larvae.

Field evaluation: Entries were planted in single rows, 1 m long and 50 cm apart. Saada and Nasma were used as resistant and susceptible checks respectively. When the larvae were in the puparial (flaxseed) stage, all the plants of each entry were collected and taken to the laboratory for examination. The method of evaluation used was similar to that of the greenhouse. Resistant plants were checked for the presence of dead first-instar larvae. The number of live larvae was recorded for five randomly selected susceptible plants.

Results and Discussion

Table 1 summarizes the resistance reaction of *Aegilops* and *Triticum* species to Hessian fly. Four accessions of *Ae. tauschii* (G3402, G3392, G3393, G3395) showed homogeneous resistance reaction. All resistant plants contained dead first-instar larvae, indicating that antibiosis is the resistance mechanism. *Triticum monococcum* subsp. *aegilopoides* accessions G1777 and PI427542 showed respectively homogeneous and heterogeneous resistance reactions. Resistant plants had no dead first instars but only live larvae. However, far fewer larvae survived on resistant plants of this subspecies than that on Nasma, the susceptible check. Two accessions of *T. monococcum* subsp. *monococcum* (G3304, G1471) were moderately resistant. Resistant plants had a mixture of live and dead larvae.

*Aegilops tauschii* has been a good source of resistance to Hessian fly. Several resistance genes (H13, H22, H23, H24, H26) have been identified in this species and transferred to wheat (8, 11, 3). Several other sources of resistance were identified in this species using Morrocan Hessian fly populations (1).
Table 1. Reaction of a collection \(^1\) of *Aegilops* and *Triticum* species for resistance to Hessian fly in Morocco.

<table>
<thead>
<tr>
<th>Species/Accession Number</th>
<th>Greenhouse No. live plants (^2) resistant per plant</th>
<th>No. live larvae per plant</th>
<th>Field No. live plants (^3) resistant per plant</th>
<th>No. live larvae per plant</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>T. m. aegilopoides</em> (PI427542)</td>
<td>30</td>
<td>3</td>
<td>33.3</td>
<td>16.3</td>
</tr>
<tr>
<td><em>T. m. aegilopoides</em> (G1777)</td>
<td>100</td>
<td>1.7</td>
<td>100</td>
<td>6.3</td>
</tr>
<tr>
<td><em>Ae. tauschii</em> (G3402)</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td><em>Ae. tauschii</em> (G3392)</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td><em>Ae. tauschii</em> (G3393)</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td><em>Ae. tauschii</em> (G3395)</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td><em>T. m. monococcum</em> (G3304)</td>
<td>40</td>
<td>3.6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>T. m. monococcum</em> (G1471)</td>
<td>50</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Saada (resist. Check)</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Nasma (susc. check)</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>22</td>
</tr>
</tbody>
</table>

\(^1\) Seeds provided by Dr. H.C. Sharma, Purdue University.

\(^2\) Only those accessions that showed resistance are reported in the table.

\(^3\) Data not available, there was no field germination.

The Hessian-fly resistance identified in *T. monococcum* subspp. *monococcum* is the first record of such resistance in Morocco. It seems that the mechanism responsible for the resistance in *Aegilops* *aegilopoides* is tolerance; resistant plants contained only live larvae. Tolerance has not been reported as a mechanism of resistance to Hessian fly in cultivated wheat. However, genes H1H2, H7H8, and H18 allow for some larval survival on resistant plants (4, 6). Deployment of varieties tolerant to this insect should reduce selection pressure on Hessian fly populations, and thus new biotype development would be slower. The two accessions of *T. monococcum* subspp. *monococcum* that showed a moderate level of resistance to the Moroccan Hessian fly were homogeneously resistant to biotype I in the USA (13).

The resistant *Aegilops* and *Triticum* accessions identified in here represent potentially new sources of resistance and are being used by wheat breeders and geneticists to transfer this resistance to wheat. Embryo-rescue technique was used to produce interspecific hybrids. The resistance in *T. monococcum* subspecies will be most useful in Morocco for improving durum wheat, in which only one source of resistance to Hessian fly has been identified.

الملخص


تعتبر ذباب هين (Mayetiola destructor) من أنواع القمح وصينية الثاني التي تتسبب في مقتل النباتات والأنهار. ومعروف أيضاً أن ذباب هين يثير مرض الذدوبي (T. m. aegilopoides) الذي يشترط من أنواع القمح وصينية الثاني. ويعتبر هذا النوع الأول من مرض الذدوبي من أنواع القمح وصينية الثاني في المغرب. في حين يُذكر أن مجموعة المقاومة في T. m. aegilopoides و A. tauschii في المغرب.

كلمات مفتاحية: القمح، حشانة الماعز (Aegilops)، ذباب هين، مقاومة.

References


