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

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Abstract

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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. *monococcum* accessions showed heterogeneous reaction to this pest. This is the first report of resistance sources to the Moroccan Hessian fly identified in *T. monococcum* subs. *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 avirulence 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 Shaim 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* Tum. 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 Ddiscussion

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 Moroccan Hessian fly populations (1).

Table 1. Reaction of a collection[1] of *Aegilops* and *Triticum* species for resistance to Hessian fly in Morocco.

Species/ Accession Number	Greenhouse		Field	
	% resistant plants[2]	No. live larvae per plant	% resistant plants	No. live larvae per plant
T.m.aegilopoides (PI427542)	30	3	33.3	16.3
T.m.aegilopoides (G1777)	100	1.7	100	6.3
Ae.tauschii (G3402)	100	0	100	0
Ae.tauschii (G3392)	100	0	100	0
Ae.tauschii (G3393)	100	0	100	0
Ae.tauschii (G3395)	100	0	100	0
T.m.monococcum (G3304)	40	3.6	-[3]	-
T.m.monococcu m (G1471)	50	2	-	-
Saada (resist. Check)	100	0	100	0
Nasma (susc. check)	0	10	0	22

[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. monoccocum* subspecies is the first record of such resistance in Morocco. It seems that the mechanism responsible for the resistance in Subsp. *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* subsp. *monococcum* that showed a moderate level of resistance to the Moroccan Hessian fly were homogeneously resistant to biotype L 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 the 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

البوحسيني، مصطفى، ع. بن لحبيب، أ. بنتيكا، ح.س. شارما و سعدية لحلوي. 1997. مصدر المقاومة في أنواع القمح (*Triticum*) وحشيشة الماعز (*Aegilops*) لذبابة هس في الغرب. مجلة وقاية النبات العربية. 15(2): 126-128.

تعتبر ذبابة هس، *Mayetiola destructor* (Say) آفة مدمرة على القمح في المغرب. وتعتبر المقاومة الوراثية أكثر الطرائق العملية لمكافحتها وقد تم تقويم 23 مدخلا من أنواع القمح وحشيشة الماعز لمعرفة مدى مقاومتها للذبابة تحت ظروف الحقل والدفيئة. ووجد مدخل واحد من *Triticum monococcum* ssp. وأربعة مدخلات من *Aegilops tauschii* مقاومة على نحو متجانس وراثيا ، كما أظهر مدخل من *T. monococcum* spp. *monococcum* تفاعلا غير متجانس وراثيا للآفة. ويعتبر هذا التسجيل الأول لمصادر مقاومة لذبابة هس في *T.m.* spp. *monococcum* و *T. m.* spp. *aegilopoides*. ويبدو أن التضاد الحيوي Antibiosis هو آلية المقاومة في *Ae. tauschii* و *T. m.* spp. *monococum* في حين يبدو أن *T. m.* spp. *aegilopoides* متحملا للإصابة.

كلمات مفتاحية: القمح، حشيشة الماعز *(Aegilops)*، ذبابة هس، مقاومة.

References

1. **Amri, A., M. El Bouhssini, M. Jlibene, T.S. Cox and J.H. Hatchett.** 1992. Evaluation of *Aegilos* and *Triticum* species for resistance to the Moroccan Hessian fly (Diptera: Cecidomyiidae). Al Awamia 77:109-118.
2. **Cartwright, W.B. and D.W. LaHue.** 1944. Testing wheats in the greenhouse for Hessian fly resistance. J. Econ. Entomol. 37:385-387.
3. **Cox, T.S. and J.H. Hatchett.** 1994. Hessian fly-resistance gene H26 transferred from *Triticum tauschii* to common wheat. Crop Sci. 34:958-960.
4. **El Bouhssini, M.** 1992. Genetic interactions among resistance genes in wheat (*Triticum aestivum* L.) and virulence genes in the Hessian fly (*Mayetiola destructor* (Say)) in North America and Morocco. PhD dissertation, Entomology Department, Kansas State University, 119pp.
5. **El Bouhssini, M., S. Lhaloui, J.H. Hatchett and N. Naber**. 1996. Nouveaux gènes de résistance efficaces contre la mouche de Hesse (Diptère: Cécidomyiidae) au Maroc. Al Awamia (in press).
6. **El Bouhssini, M., J.H. Hatchett and S. Lhaloui.** 1996. Larval survival on wheat plants carrying resistance genes to Hessian fly (Diptera: Cecidomyiidae) in Morocco. Arab J. Plant Prot. 13(2):103-105.
7. **Gallun, R.L**. 1977. Genetic basis of Hessian fly epidemics. Ann. New York Acad. Sci. 287: 223-229.
8. **Gill, B.S., J.H. Hatchett and W.J. Raupp**. 1987. Chromosomal mapping of Hessian fly resistance gene H13 in the D genome of wheat. J. Hered. 78:97-100.
9. **Hatchett, J.H. and R.L. Gallun.** 1970. Genetics of the ability of the Hessian fly, *Mayetiola destructor* (Say), to survive on wheats having different genes for resistance. Ann. Entomol. Soc. Am. 63:1400-1407.
10. **Lhaloui, S., L. Buschman, M. El Bouhssini, A. Amri, J.H. Hatchett, D. Keith, K. Starks and K. El Houssaini.** 1992. Control of Mayetiola species

(Diptera: Cecidomyiidae) with carbofuran in bread wheat, durum wheat and barley with yield loss assessment and its economic analysis. Al Awamia 77:55-73.

11. **Raupp, W.J., A. Amri, J.H. Hatchett, B.S. Gill, D.L. Wilson and T.S. Cox.** 1993. Chromosomal location of Hessian fly-resistance genes H22, H23, and H24 derived from *Triticum tauschii* in the D genome of wheat. J. hered. 84:142-145.

12. **Sosa, O., Jr.** 1981. Biotypes J and L of Hessian fly discovered in an Indiana wheat field. J. Econ. Entomol. 74:180-182.

13. **Sharma, H.C., J.E. Foster, H.W. Ohm and F.L. Patterson.** 1992. A note on resistance to Hessian fly (*Mayetiola destructor*) [Diptera: Cecidomyiidae] biotype L in tribe Triticeae. Phytoprotection 73(2):79-82.