EVALUATION OF AEGILOPS AND TRITICUM SPECI ES FOR RESISTANCE TO THE MOROCCAN HESSIAN FLY (DIPTERA : CECIDOMYIIDAE)

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INTRODUCTION

Infestations of the Hessian fly, **Mayetiola destructor** (Say) cause serious damage each year to bread wheat (**Triticum aestivum** L.) and durum wheat (**Triticum turgidum** L. var. durum) in Morocco. In the United States, the use of genetic resistance has protected common wheat from Hessian fly for the last 40 years (HATCHETT, 1986).

Introgression of genes from various species of **Aegilops**, **Triticum**, **Agropyron**, and **Secale** into wheat has had a prominent role in the development of pest resistant wheat cultivars (AMRI 1989, DVORAK 1977, KNOTT et al. 1977, RAI 1983, SHARMA and GILL 1983, STALKER 1980, WAINES 1983,

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ZELLER and KSAM 1983). A recent litterature review listed several examples of successful transfer of genes for pest resistance from **Aegilops** species into common wheat (SEARS 1983). GILL et al. (1985), found a high frequency of resistance to leaf rust, powdery mildew, greenbug and Hessian fly, among **Aegilops** species. They also found that some accessions of **Ae. caudata**, **Ae. longissima**, **Ae. speltoides,** and **Ae. variabilis** were resistant to the foliar diseases as well as to the Hessian fly. GILL et al. (1986) also found that **Ae. squarrosa** had resistance to leaf rust, powdery mildew, greenbug and Hessian fly.

GILL et al. (1985), and PASQUINI (1980), suggested that genes for pest resistance in **Aegilops** species having the S or D genomes could easily be exploited in wheat improvement programs. Genes for pest resistance could be transferred into wheat by direct introgression using the embryo rescue technique (GILL and RAUPP 1987). Many genes for Hessian fly resistance, including H13, have been transferred using this technique. However, Tegyey (1967) was unsuccessful in his attempts to transfer the factor for resistance present in **T. timopheevi** into durum wheat.

The objective of the present study was to evaluate a collection of **Aegilops** and **Triticum** species for resistance to a Morroccan population of Hessian fly.

MATERIAL AND METHODS

One hundred and sixty-five accessions of **Aegilops** and **Triticum** species were tested for Hessian fly resistance in Morocco. Ten to twenty seeds of each accession were planted in 10 cm rows in a standard greenhouse flat (54 x 28 x8 cm), containing soil. Plants were infested at the one leaf stage with Hessian fly collected at Sidi El Aidi Experiment Station, near Settat, Morocco. Two susceptible cultivars, 'Nesma' and 'Newton' and two resistant cultivars, 'Saada' (H5) and KSH8998 (H13), were planted as checks in the middle four rows of each flat. The plants were grown at a temperature of 20 ± 3°C and were evaluated 20 days after infestation. Susceptible plants were dark green in color, stunted and contained live larvae, whereas the resistant plants were light green in color, not stunted and contained dead larvae. Large numbers of flies were used in the case of **Aegilops** and **Triticum** species to assure infestation in spite of any differences in oviposition preference. Eggs were observed on all species tested. The number and percentage of resistant accessions are reported for each species that included more than two accessions.

At Sidi El Aidi Experiment Station 80 accessions of North African durum wheat land races from Tunisia and Morocco were tested. The susceptible bread wheat cultivar 'Nesma' was planted after each ten accessions, to assess the Hessian fly infestation and the relative tolerance of durum wheat. Ten plants per entry were observed for presence of live or dead larvae. Tolerance was scored visually based on the number of productive spikes produced by each entry relative to the susceptible check.

At Jemaa Shaim Experiment Station 1400 accessions of **T. diccocoides** were tested using procedures described above for testing durum wheats.

RESULTS AND DISCUSSIONS

No resistance was recorded among the 80 accessions of durum wheat land races, nor among the 35 accessions of **T. monococcum**, nor among the 9 accessions of **T. boeoticum**, nor among the 1400 accessions of **T. diccocoides** (AMRI 1989, Appendix III). In contrast, sixty-five percent of durum cutivars and 98 percent of the **T. boeoticum** accessions were found to have plants resistant to biotype D Hessian fly in the U.S. (unpublished data).

Table 1 : **Evaluation of accessions of Aegilops species for resistance to a Moroccan population of Hessian fly**.

Species and genome	Total accessions tested	Number of resistant & heterogeneous accessions
Ae. squarrosa (D)	41	33
Ae. speltoides (S)	4	0
Ae. triaristata (UM or UMu)	18	2
Ae. triuncialis (UC)	30	6
Ae. ovata (UM)	9	4
Ae. ventricosa (DUn)	4	3
Ae. cylindrica (CD)	10	8
Ae. kotshvi (US)	3	0
Ae. juvenalis (DMU)	2	0

( ) genome symbol.

Among the **Aegilops** species, all accessions of **Ae. speltoides**, believed to be most probable donor of the B genome of bread and durum wheat, were susceptible. Other species of **Aegilops** had high frequencies of resistant plants: **Ae. squarrosa** had 80%, **Ae. cylindrica** had 80%, **Ae. ventricosa** had 75%, and **Ae. ovata** had 66%, **Ae. kotshyi** had 20% and **Ae. triaristata** had 10% (Tables 1 and 2). The single accessions of **Ae. uniaristata**, **Ae. crassa**, and **Ae. comosa**

Table 2 : **List of Aegilops accessions resistant to the Moroccan population of Hessian fly.**

Ae. squarrosa		
CI 000008	TA 1667	CI 170197
CI 000009	TA 1668	CI 173615
CI 000017	TA 1669	CI 226819
CI 000018	TA 1671	CI 344789
CI 000019	TA 1677	CI 344794
CI 000024	TA 1678	CI 374353
CI 000025	TA 1987	**Ae. triaristata**
CI 000027	TA 1691	CI 170191
CI 000028	TA 1695	CI 374364
CI 000051	TA 1707	**Ae. ovata**
CI 000072	TA 1715	CI 000054
PI 431602	**Ae. cylindrica**	CI 000063
PI 276976	CI 172357	CI 369576
TA 1642	CI 172358	CI 369578
TA 1644	CI 374318	**Ae. conosa**
TA 1645	CI 374345	CI 376970
TA 1647	CI 374353	**Ae. crassa**
TA 1651	CI 428560	CI 276972
TA 1656	**Ae triuncialis**	**Ae. unaristata**
TA 1664	CI 170192	CI 276995
TA 1665		

were resistant, but the single accession of **Ae. columnaris**, and **Ae. longissima** were susceptible.

Aegilops species, that have the D genome, are good sources of resistance to the Hessian fly in Morocco. Resistance genes on the D genome can be transferred into bread wheat by direct introgression as has been done in the case of **Ae. squarrosa** (GILL and RAUPP 1987).

In the field experiment at Sidi El Aidi, the Hessian fly pressure was so severe that the bread wheat check, 'Nesma', as well as all the adjacent bread wheat breeding lines, were completely destroyed. In spite of this Hessian fly pressure, the durum land races developed many productive tillers. These observations support the prevailling understanding in Morocco that durum land races are more tolerant to the Hessian fly than bread wheats. However, durum wheats still suffer severe yield losses despite their relative tolerance.

The susceptibility of all species having the A, B or S genomes demonstrates the diffficulty of finding genes for resistance to the Hessian fly that can be introgressed directly into durum wheat. Some sources of resistance could be transferred from **T. timopheevi** as reported by TEGYEY (1967). For the near future, the only way to protect durum wheats is to transfer effective genes located in the A or B genomes of bread wheat into durum wheat cultivars. More elaborate techniques such as induction of homeologous pairing or translocations could also be used to transfer genes found in the more distantly related species into wheat.

We should continue to explore the existing genetic variability in durum wheat for effective resistance to the Moroccan Hessian fly. We should also try to improve the tolerance of durum wheat to the Hessian fly.

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ABSTRACT

A limited number of sources of resistance to the Hessian fly, **Mayetiola destructor** (Say), are available to protect wheats (**Triticum aestivum** L.) in Morocco. The objective of this study was to evaluate a collection of **Aegilops** and **Triticum** species for resistance to the Moroccan Hessian fly. No resistance was recorded among the 80 accessions of North African durum wheat (**Triticum turgidum** L. var. **durum**) land races, nor among the 1400 accessions of **T. diccocoides**. All accessions of **T. monococcum**, **T. boeoticum**, **Aegilops speltiodes**, **Ae. columnaris** and **Ae. longissima** tested were susceptible.

Among the other **Aegilops** species tested, 80% of **Ae. squarrosa**, 80% of **Ae. cylindrica**, 75% of **Ae. ventricosa**, 66% of **Ae. ovata**, 20% of **Ae. kotshvi** and 10% of **Ae. triaristata** accessions had resistance to the Hessian fly. The single accessions of **Ae. comosa**, **Ae. crassa**, and **Ae. uniaristata** tested were also resistant. **Aegilops** species carrying the D genome are good sources of resistance against the Moroccan Hessian fly.

KEY WORDS : **Aegilops**, **Triticum**, Cecidomyiidae, **Mayetiola destructor**, wheat, Resistance.

RESUME

Peu de sources de résistance sont actuellement disponibles pour protéger les blés au Maroc contre la mouche de Hesse, **Mayetiola destructor** (Say). Pour le blé dur aucune source de résistance n'a été trouvée, mais cette espèce apparait en général plus tolérante que le blé tendre. Cent soixante cinq accessions, respectivement des espèces sauvages **Triticum** et **Aegilops** ont été évaluées en serre sous infestation artificielle, et 80 variétés du blé dur et 1400 accessions appartenant à l'espèce **T. diccocoides** ont été testées au champs à Sidi El Aidi et à Jemaa Shaim, respectivement. Les résultats montrent que toutes les accessions appartenant aux espèces **Triticum** et **Aegilops** ayant les génomes A, B ou S ont été sensibles aux populations de Cécidomyie utilisées. Toutes les variétés de blé dur ont montré des symptômes d'attaque mais certaines d'entre elles se sont avérées plus tolérantes. Aucune des 1400 accessions de T. diccocoides testées à Jemaa Shaim ne s'est montrée résistante. Par contre, les espèces d'**Aegilops** ayant le génome D dans leur composition ont plusieurs accessions résistantes à la cécidomyie.

MOTS CLES : **Aegilops**, **Triticum**, Cecidomyiidae, **Mayetiola destructor** Blé, Resistance.

ملخص

يوجد بالمغرب عدد قليل من مصادر وراثية للحد من خسائر القمح الناتجة عن الإصابة بدودة هس .إن الهدف من هذه الدراسة هو تقييم مجموعة من أصناف Aegelops و Triticum من حيث مقاومتها لذبابة هس.

تبين النتائج انعدام مصادر المقاومة في 80 سلالة من القمح الصلب المنحدر من شمال افريقيا، وكذلك في 1400 سلالة من T.diccocoides: كل السلالات المختبرة من الأنواع التالية: Aegelops Aspeltiodes, T. boeoticum, T. Monococum بينت حساسيتها لهذه الحشرة Aegelops longissima, Aegelops Columnaris . أما بالنسبة للأنواع الأخرى فأن 80٪ من Ae. squarrosa و80٪ Ae. cylin-drica 75٪ من Ae. ventricosa و 66٪ من Ae. ovata و 20٪ من Ae. kot-shyi و 10٪ triaristata من السلالات المختبرة برهنت على مقاومتها للحشرة كما هو الحال بالنسبة للأصناف Ae. Comosa ، Ae. Uniaristata إن السلالات الحاملة لمجموعة جينات genonme D تشكل مصادر لمقاومة دودة هس ويمكن نقلها إلى القمح الطري عن طريق التهجين.

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