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New sources of resistance in durum wheat and wild relatives to Russian wheat aphid (Homoptera: Aphididae)

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SUMMARY – Russian wheat aphid (RWA), *Diuraphis noxia* (Mordvilko), is a serious pest of wheat and barley in several parts of the world: North America, North Africa, Ethiopia and South Africa. Very few sources of resistance have been previously identified in durum wheat. For the past four years, thousands of durum wheat lines and wild species were screened for resistance to RWA, both in the field and in the greenhouse under artificial infestation at Tel Hadya, Syria. Eight lines of durum wheat and 19 accessions of wild species were resistant to RWA (score < 3 in Du Toit scale from 1-6). These sources of resistance are being used in the durum wheat breeding program to develop resistant varieties to RWA.

Key words: *Diuraphis noxia,* durum wheat, wild relatives, resistance.

RESUME – *"Nouvelles sources de résistance chez le blé dur et les espèces sauvages apparentées au puceron russe (Homoptera : Aphididae)". Le puceron russe,* Diuraphis noxia *(Mordvilko), est un ravageur important de blé et d'orge dans plusieurs coins du monde: l'Amérique du Nord, le Nord de l'Afrique, l'Ethiopie et l'Afrique du Sud. Très peu de sources de résistance pour le puceron russe ont été trouvées auparavant. Durand les cinq dernières années, plusieurs milliers de lignées de blé dur et d'espèces sauvages ont été évaluées au champ et sous serre à Tel Hadya, Syrie, pour la résistance à ce puceron. Huit lignées de blé dur et 19 accessions d'espèces sauvages se sont montrées résistantes au puceron russe (avaient un score < 3 dans l'échelle Du Toit de 1-6). Ces sources de résistance sont utilisées dans le programme d'amélioration génétique du blé dur pour développer des variétés résistantes au puceron russe.*

Mots-clés : Diuraphis noxia, *blé dur, espèces sauvages, résistance.*

Introduction

Russian wheat aphid (RWA), *Diuraphis noxia* (Mordvilko), is an important insect pest of wheat and barley in many parts of the world particularly in the dry areas. The insect is believed to have its origin in the Caucasus region. However, it has been reported in several countries, USA, Chile, Iran, Canada, Ethiopia, China and most countries bordering the Mediterranean.

RWA causes longitudinal chlorotic streaks, spike deformation, leaf rolling and stunting in the host plant, which results in lower grain yield and poor grain quality. This insect injects phytotoxins during feeding, which cause breakdowns of chloroplast (Fouche *et al.,* 1984).

RWA often causes economic losses in wheat and barley fileds. Miller and Haile (1988) reported 41 to 71% yield loss in barley and 60% yield loss in wheat in Ethiopia. Yield losses between 35 and 60% have been reported in South African wheat (Du Toit and Walters, 1984). Since its introduction to the US in 1986, the cumulative economic losses due to RWA are about 1 $ billion (Vandenberg, 1996).

Host plant resistance has been the most practical and economical means of controlling RWA. Several sources of resistance found in wheat and barley (Du Toit, 1988; Webster *et al.,* 1993). Five resistance genes have been identified and named Dn1-6, and cutlivars carrying some of these genes have already been released in the USA (Ehdaie and Baker, 1999).

In WANA (North Africa and West Asia), very few sources of resistance to RWA have been identified in durum wheat. The objective of this study were to identify sources of resistance to RWA in durum wheat and their wild relatives.

Materials and methods

Plant materials for testing were sown at Tel Hadya farm, on late November. The entries were planted in hill plots, 10 seeds/hill using alpha lattice design with 2 reps. One susceptible check for each crop species was used every 10 entries. This field experiment was infested at tillering stage with about 10 nymphs per plant. The evaluation was done three times at three weeks intervals using DuToit scale (Du Toit, 1987) from 1-6, where 1 = small isolated chlorotic spots on the leaves; 2 = larger chlorotic spots on the leaves; 3 = chlorotic spots tend to become streaky; 4 = mild streaks visible and leaves tend to roll lengthwise; 5 = prominent white/yellow streaks present, leaves tightly rolled; 6 = severe white/yellow streaks, leaves tightly rolled and start to die. The promising lines selected from the field went through two screenings in the greenhouse, initial and advanced. In the initial screening, the material was evaluated in just one rep. The promising lines from this initial screening went through an advanced evaluation (4 reps). The selected entries and a resistant and a susceptible check were seeded in flats, using a randomized complete block design. Five seeds were planted per hill, and upon emergence the number of plants was thinned to three. The method of infestation and evaluation were similar to those described for the field experiment.

Results and discussion

Tables 1 and 2 summarize the screening results. Eight lines of durum wheat and 19 accessions of wild species showed a good level of resistance to RWA (score < 3 in Du Toit scale). Six out of 8 durum wheat lines and 15 others from Tunisia have also been reported resistant against RWA in the US (Formusoh *et al.,* 1992). The 15 lines from Tunisia were susceptible against RWA in Syria which indicates biotypic variation in RWA populations. The 6 lines and the other two from ICARDA (Table 1) are being used in the breeding program to develop resistant varieties to RWA.

Table 1. List of durum wheat entries resistant to Russian wheat aphid, field and greenhouse tests, Tel Hadya, Syria

Entry number/name	Origin
3155 Aouej	Tunisia
3200 Jennah Khetifa	North Africa
3242 Mhmoudi Pubescent	Tunisia
3251 Medea	Tunisia
15465 Frigui	Tunisia
15506 Sinlikat	Tunisia
421 Terbol 97-1	CIMMYT/ICARDA
712 Altar 84/Stn/Wdz-2	CIMMYT/ICARDA

Nineteen accessions of wild relatives are resistant to RWA (Table 2). These four species of wild species and several others (*Aegilops ovata* and *biuncialis*) identified earlier (Ghannoum, 1998) should widen the genetic base of resistance to RWA and provide new resistance genes to use against new biotypes. These latter should be monitored very closely using a set of differentials that will be planted in hot spot areas in the region. All the new sources of resistance should be studied for their mechanisms of resistance. Material with combined mechanisms of resistance should be used in the breeding programs, as this should slow down biotype development.

Table 2. List of wild species accessions resistant to Russian wheat aphid, field and greenhouse tests, Tel Hadya, Syria

Species	Code number	Origin
Triticum monococcum	IC 500134	ICARDA
T. monococcum	IC 500236	ICARDA
T. monococcum	IC 500240	ICARDA
T monococcum	IC 500241	ICARDA
T.monococcum ssp. *vulgare*	6805	Belgium
T. monococcum ssp. *sofianum*	6826	Albania
T. mnococcum ssp. *monococcum*	6832	“
T. monococcum ssp. *monococcum* var. *lact.*	6901	France
T. monococcum ssp. *monococcum* var. *sofianum*	7302	Turkey
T. monococcum ssp. *monococcum* var. *flavesc.*	7401	Albania
T. monococcum	7801	“
T. monococcum	7802	“
T. monococcum	8142	Afghanistan
T. monococcum	TM44	Turkey
T. monococcum	8150	Spain
T. monococcum	9180	France
T. monococcum var. *urartu*	U782	“
T. timopheevii var. *araraticum*	IC 500338	ICARDA
Aegilops kotschyi	IC 400063	“

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