

(*Diuraphis nexia* (Morduilko))

* (*Triticum turgidum* var. durum)

**Genetic study of resistance to Russian Wheat Aphid (*Diuraphis nexia* (Morduilko))
in advanced durum wheat (*Triticum turgidum* var. durum) lines**

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(*Diuraphis nexia* (Morduilko))

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(*Triticum turgidum* var. durum)

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PI 225262

PI 222668

(Haley *et al.*, 2002)

(*Diuraphis noxia* (Mordvilko))

(Assad and Dorry, 2001)

Shz.W-104 Shz.W-102

(Najafi Mirak, 2003)

Shz.W-101

Shz.W-103

(Assad, 2002)

(Najafi Mirak, 2003)

(Lage *et al.*, 2004)

T. dicoccum *Ae. Tauschii*

(Hawley *et al.*, 2003)

T. dicoccum

B A

(Anderson *et al.*, 2002)

D

(Najafi Mirak, 2003)

(Miller *et al.*, 2001)

Dn6 (Saidi and Quick, 1996)

Dn9 *Dn8*

PI 243781

PI 220127

Dnx

PI294994

(Liu *et al.*, 2001)

Dn7

(Randolph *et al.*, 2005)

1RS

Dn4

Dn6

(Anderson *et al.*, 2003)

(Dong and Quick, 1995)

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$$\left(\frac{\quad}{\quad} \right)$$

(Najafi Mirak, 2003)

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(Najafi Mirak, 2003)

() DW13

$$\left(\quad \right)$$

() DW6 DW1 () DW11

() DW4 DW2

F₁

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(Nkongolo *et al.*, 1989)

F₁

(Najafi Mirak, 2003)

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B

(Griffing, 1956)

() (Jinks and Hayman, 1953)

DW1×DW2 Ungrouped D₂

DW2×DW6

(Mather and Jinks, 1982)

DW4 DW2 DW1 ()

(F₁)

DW4 (/) ()

DW2×DW4 DW1×DW11 DW1×DW2
 DW6×DW13 DW4×DW11 DW2×DW13 (GCA)
 DW11×DW13 (SCA)

%

DW2×DW6
 (/)
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W_r

V_r

() () DW6 DW4 DW2 DW1
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DW2

(Najafi Mirak, 2003)

(/)

DW2
 DW4×DW11 DW1×DW11 DW1×DW4 DW1×
 DW6×DW13 DW6×DW11 DW4×DW13
 DW11×DW13

(Najafi Mirak, 2003)

Table 1. Analysis of variance for leaf chlorosis and leaf rolling traits in durum wheat lines under artificial infection with Russian Wheat Aphid

S.O.V.	df	M.S.	
		(%) Leaf chlorosis (%)	(%) Leaf rolling (%)
Block	2	0.004 ^{ns}	0.037 ^{ns}
Treatment	20	27.034 ^{**}	29.29 ^{**}
Error	40	0.183	0.043

** : Significant at the 1% level of probability. % :**
 ns: Non-Significant. :ns

Table 2. Analysis of variance for general and specific combining abilities (GCA and SCA) for leaf chlorosis and leaf rolling traits in durum wheat lines under artificial infection with Russian wheat aphid

S.O.V.	df	M.S.	
		(%) Leaf chlorosis (%)	(%) Leaf rolling (%)
GCA	5	28.813 ^{**}	29.307 ^{**}
SCA	15	2.411 ^{**}	3.249 ^{**}
Error	40	0.061	0.014

** : Significant at the 1% level of probability. % :**

$$\text{Leaf chlorosis: } \frac{V_{GCA}}{V_{SCA}} = 11.951^{**}$$

$$\text{Leaf rolling: } \frac{V_{GCA}}{V_{SCA}} = 9.020^{**}$$

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Table 3. Estimation of general combining ability (on the main diameter) and specific combining ability effects (above the main diameter) of durum wheat lines for leaf chlorosis under artificial infection with Russian wheat aphid

	aphid					
	DW1	DW2	DW4	DW6	DW11	DW13
DW1	-1.590 ^{**}	-2.375 ^{**}	-0.561 ^{**}	0.742 ^{**}	-0.927 ^{**}	0.726 ^{**}
DW2		-1.910 ^{**}	0.792 ^{**}	1.823 ^{**}	0.353 ^{ns}	0.817 ^{**}
DW4			-0.995 ^{**}	1.570 ^{**}	-0.620 ^{**}	-1.90 ^{**}
DW6				-0.023 ^{ns}	-0.864 ^{**}	-1.54 ^{**}
DW11					2.822 ^{**}	-1.90 ^{**}
DW13						1.696 ^{**}

() S.E.(GCA) = 0.080 S.E.(SCA) = 0.181
 (%) C.D. 5% = 0.162 C.D. 5% = 0.366
 (%) C.D. 1% = 0.216 C.D. 1% = 0.489

** : Significant at the 1% level of probability. % :**
 ns: Non-Significant. :ns

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Table 4. Estimation of general combining ability (on the main diameter) and specific combining ability effects (above the main diameter) of durum wheat lines for leaf rolling under artificial infection with Russian wheat

aphid						
	DW1	DW2	DW4	DW6	DW11	DW13
DW1	-1.341**	-0.181*	0.833**	1.612**	-1.269**	+2.585**
DW2		-1.292**	-0.332**	2.737**	0.349**	-0.280**
DW4			-2.024**	1.495**	-1.256**	0.481**
DW6				0.024 ^{ns}	2.039**	-1.070**
DW11					2.218**	-1.641**
DW13						2.415**
	() S.E.(GCA)=0.039			S.E.(SCA)=0.087		
	(%) C.D. 5%=0.079			C.D. 5% =0.176		
	(%) C.D. 1% =0.105			C.D. 1% =0.235		

** : Significant at the 1% level of probability.

ns: Non-Significant.

%

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ns

DW2 DW6

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D

H₂ H₁

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DW2

DW6

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(Ehdaie and Baker, 1999)

(Najafi Mirak, 2003)

G5864

PI 294994

(Zhang *et al.*, 1998)

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E

(Najafi Mirak, 2003)

DW13

F

DW1

$$\left(\sqrt{\frac{H_1}{D}}\right)$$

(D)

()

(H₂ H₁)

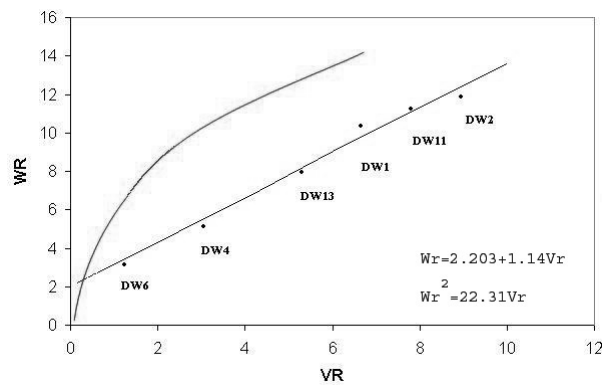
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V_r W_r

Table 5. Estimation of intercept and slope of regression of W_r on V_r for leaf chlorosis and leaf rolling of durum wheat under artificial infection with Russian wheat aphid

Parameter	Leaf chlorosis	Leaf rolling
a	2.203*	3.017**
b	1.14**	0.84**
1-b	-0.14 ^{n.s}	-0.16 ^{n.s}

* and **: Significant at the 5% and 1% probability levels, respectively. % % **: *
 ns: Non-Significant. :ns



W_r² V_r W_r

Fig.1. Regression line of W_r on V_r and parabola of W_r² for leaf chlorosis of durum wheat under artificial infection with Russian Wheat Aphid

% %
 % %

V_r W_r

(Najafi Mirak, 2003)

H₂ H₁ D

ML₁-ML₀

(Najafi Mirak, 2003)

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W_r+V_r

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.(Hayman, 1954)

Table 6. Estimation of genetical variance components for leaf rolling and leaf chlorosis of durum wheat under artificial infection with Russian wheat aphid

Genetical components	Estimated values	
	Leaf chlorosis	Leaf rolling
D ± S.E.(D)	22.251 ± 0.503 ^{**}	22.387 ± 0.321 ^{**}
H ₁ ± S.E.(H ₁)	10.498 ± 1.278 ^{**}	13.965 ± 0.815 ^{**}
H ₂ ± S.E.(H ₂)	7.745 ± 1.141 ^{**}	10.036 ± 0.728 ^{**}
F ± S.E.(F)	12.553 ± 1.229 ^{**}	13.267 ± 0.784 ^{**}
E ± S.E.(E)	0.058 ± 0.190 ^{ns}	0.014 ± 0.121 ^{ns}
$\sqrt{H_1 / D}$	0.687	0.790
r(Pr, Wr+Vr)	0.11	-0.44
ML ₁ -ML ₀	-0.751	1.186
H _{bs}	0.58	0.86
H _{ns}	0.45	0.62

** : Significant at the 1% level of probability.

ns: Non-Significant.

0.058 ± 0.190^{ns}

0.014 ± 0.121^{ns}

(Additive variance)

(Mean non-additive variance of the arrays)

(Adjusted mean non-additive variance of the arrays)

(Mean covariance of additive and non-additive effects of the arrays)

(Environmental variance)

(Average degree of dominance)

(Parental mean – Overall means of progeny): Dominance direction

(Broad sense heritability)

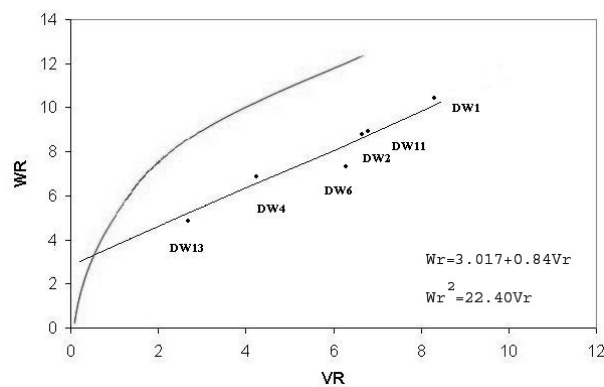
(Narrow sense heritability)

$\sqrt{H_1 / D}$

ML₁-ML₀

H_{bs}

H_{ns}



Wr² Vr Wr

Fig.2. Regression line of Wr on Vr and parabola of Wr² for leaf rolling of durum wheat under artificial infection with Russian Wheat Aphid .

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Wr + Vr

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() (Assad and Dorry, 2001)

V_r W_r

W_r+V_r

(Najafi Mirak, 2003)

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Genetic study of resistance to Russian Wheat Aphid (*Diuraphis nexia* (Morduilko)) in advanced durum wheat (*Triticum turgidum* var. durum) lines

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ABSTRACT

Nourbakhsh, A. H., A. A. Zali, A. Hosseinzadeh and T. Najafi Mirak. Genetic study of resistance to Russian wheat aphid (*Diuraphis nexia* (Morduilko)) in advanced durum wheat (*Triticum turgidum* var. durum) lines. **Iranian Journal of Crop Sciences. 10(2):125-135.**

Six advanced durum wheat lines with different levels of resistance to Russian wheat aphid (RWA) were crossed in half-diallel method. Seedlings of F1 and their parents were grown in greenhouse and artificially infected with RWA. Analysis of variance and diallel analysis using Griffing, and Jinks and Hayman methods were performed for leaf rolling and chlorosis (percentage of leaf rolling and chlorosis) traits. General and specific combining abilities for resistance to Russian Wheat Aphid were significant for both traits indicating the role of additive and non-additive gene effects in controlling these traits. Jinks and Hayman analysis revealed higher additive gene effect as compared to non-additive gene effects. Non-additive gene effects were of partial dominance type for both traits. Less leaf rolling and chlorosis (greater resistance) were under control of recessive and dominant alleles, respectively. Broad and narrow sense heritability for resistance to RWA based on leaf chlorosis damage were 58 and 45 percent and for leaf rolling were 86 and 62 percent, respectively implying potential for improving resistance to RWA based on leaf rolling as compared to leaf chlorosis trait.

Key words: Durum wheat, Russian Wheat Aphid, Resistance, Diallel analysis, Leaf chlorosis, Leaf rolling.

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