Evaluation of the Resistance of Different Barley Accessions to the Russian Wheat Aphid *Diuraphis noxia*

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ABSTRACT

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This study aimed to assess the natural resistance of 72 barley accessions to the Russian wheat aphid *Diuraphis noxia*. Three parameters were used to evaluate the response of barley accessions (chlorosis, yield and morphological characteristics). A limited chlorosis rate was recorded for the accession 23 (11 to 20% which was associated with important spike weight (3.02 g) and 1000-grain weights (53.84 g)). In spite of its chlorosis rate situated between 31 and 50%, the accession 68 presented a dry weight (6.49 g) and a number of tillers (3) the most important compared to the rest of accessions. In resistant accessions, the high number of hairs on their leaves has probably limited the action of this aphid on yield, especially the weights of the ears and the 1000 grains. The local accession Saida was the most susceptible to the Russian wheat aphid.

Keywords: Aphid, barley, *Diuraphis noxia*, resistance

The Russian wheat aphid *Diuraphis noxia* was reported for the first time in Algeria in May 1938 on samples of wheat harvested near Algiers (Mimeur 1941). In 1989, the area of wheat infested by this aphid in Setif (northeastern Algeria) was estimated to about 200 ha and in the same year it was reported in Sidi Bel Abbes and Tiaret (northwestern Algeria) (Miller et al. 1993). In 1991, it was found in the province of Constantine on *Hordeum vulgare* and *Triticum aestivum* and in 1992 in the Batna region on *Phalaris brachystachys* (Laamari 2004). In a recent study, Laamari et al. (2016) showed that this aphid is present in all semi-arid regions of Algeria where cereals are mainly grown. This aphid receives the attention of farmers through its devastating effect on cereals, particularly in durum wheat and barley. Its toxic saliva produces longitudinal chlorosis on foliage associated with winding, growth retardation, yield drop, deterioration in grain quality and even total drying of the plants. In South Africa, losses caused by *D. noxia* on wheat reached 92% (Calhoun et al. 1991). In the USA, 850 million dollars was spent to fight against this aphid in 1986 (Kiplagat 2005). Phytosanitary control strategies applied to aphids in general attach more importance to chemical control. Nevertheless, there were failures in this choice, notably due to adverse effects on

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the surrounding environment and the emergence of new strains resistant to aphicides. In addition to cultural, biological and chemical methods, the choice of resistant varieties is currently a major component of integrated protection. For its various advantages, several researchers consider that the selection of resistant plants to insects is one of the new perspectives in the field of plant protection. It is in this context that the International Center for Agricultural Research in Dry Areas (ICARDA), in collaboration with the Technical Institute of Field Crops (ITGC, Algeria) at experimental station of Constantine, introduced 71 accessions of barley to assess their level of resistance to the Russian wheat aphid compared to the local variety "Saida". In this study, foliar chlorosis, dry weight of overhead biomass, weight of ears, weight of 1000 grains, and the number of tillers are considered as criteria for the evaluation of the plant resistance. Moreover, the thickness of the epidermis and the number of hairs on the leaves are taken into consideration in order to highlight their contribution to this resistance.

MATERIALS AND METHODS

This work was carried out on 72 accessions of barley (*H. vulgare*). *D. noxia* individuals used for the artificial infestation of the plants are obtained from a strain kept in continuous breeding in the laboratory of plant protection in the Department of Agronomy at the Institute of Veterinary and Agronomic Sciences, University of Batna 1, Algeria. After planting in glasshouses and in plastic bags (30 cm deep and 17 cm in diameter), 5 plants from each accession were artificially infested by 25 adult aphids at the 3-leaf stage (5 aphids per plant). The measured parameters are developed below.

Chlorosis rate.

To evaluate foliar chlorosis, observations were performed at 3-phenological stages. The first one was made at the tillering stage, the second at the elongation stage of the main stem and finally the last at the stage heading-flowering. Depending on the extent of leaf chlorosis, the accessions were ranked based on a 1-6 rating scale (Calhoun et al. 1991):

- Class 1 (highly resistant): chlorosis covering only 0-5% of the leaf surface.
- Class 2 (resistant): chlorosis covering 6-10% of the leaf surface and limited to a few tillers.
- Class 3 (moderately resistant): foliar chlorosis accounts for 11 to 20% on various tillers.
- Class 4 (moderately susceptible): chlorosis occupying 21 to 30% of the leaf surface on various tillers.
- Class 5 (Susceptible): chlorosis extending at 31-50% on various tillers and the leaf tips were necrotic.
- Class 6 (very susceptible): chlorosis exceeding 51% on various tillers and the extension of necroses reaching the whole foliage.

Components of yield.

At the mature stage, the whole plants were sectioned at the collar level and placed separately in paper bags. Once brought to the laboratory, they were dried in an oven at a temperature of 75°C for 72 h. The parameters measured were the weight of the aboveground biomass, the number of tillers, the weight of the ears and the weight of 1000 grains.

Morphological characteristics of accessions.

In order to evaluate the thickness of the epidermis of the leaves, a scalpel was used to perform 6 very thin transverse sections in the middle of the 3rd leaf of each accession. After thinning and staining, the samples were placed on a micrometer slide, with an accuracy of 0.01 mm, and measured at the microscope. The hair counting was carried out on a surface of 1 mm^2 removed from the upper face of the third leaf of each plant.

Statistical analyses.

To analyze the action of Russian wheat aphid on some of the yield components of 72 barley accessions, statistical analyses were performed using SPSS version 20.0 statistical software. All values given were the mean of five replicates and were expressed as the mean ± standard deviation. Significant differences between the mean values ($P \leq 0.05$) were determined using the Student's test. Correlation analyses (Pearson correlation coefficient) were established between the yield components of these different accessions and their morphological appearance, especially the thickness of the epidermis and the number of hairs on the leaves.

RESULTS

Ranking of accessions based on leaf chlorosis.

At the heading-flowering stage, chlorosis affected at least 21% of the leaf area of all accessions, with the exception of the accession 23 which was found to be moderately resistant (Class 3). Chlorosis affected more than 50% of the leaf area in the accessions 1, 8, 32, 33, 35, 38, and 56 (Table 1).

Ranking of accessions based on yield components.

In addition to its resistance to chlorosis, the accession 23 produced higher aerial biomass (5.49 g), ears weight (3.02 g) and 1000-grain weight (53.84 g) compared to the other accessions (Table 2). Despite its susceptibility to chlorosis, the accession 68 produced a relatively interesting aerial biomass (6.49 g) and three tillers more than all the other accessions. The local variety Saida (accession 1) was found to be the most susceptible to the Russian wheat aphid as it showed the lowest values of aerial biomass (1.77 g), ear weight (0.29 g), weight of 1000 grains (7.51 g) and number of tillers (0.4 tillers).

Morphological traits of tested accessions.

The thickest epidermis was noted in the accessions 4, 7, 9, and 11 (0.040 to 0.043 mm). In the accessions 2, 5, 16, 17, 19, 20, 23, 24, 29, 31, 32, 37, 41, 45, 49, 52, 54, 55, 56, 59, 60, 64, 69 and 70, the thickness of the epidermis did not exceed 0.037 mm. Accessions 1, 3, 10, 13, 22, 34, 57, 61, 63 and 67 were characterized by a very thin epidermis as the noted thickness did not exceed 0.017 mm. Regarding the hair numbers, the accession 23 presented a density of 5.5 hairs/mm^2. Accession 1 (the local variety Saida) was a poorly grain-producing plant and its leaves were covered by only 2 hairs/mm^2. In accessions 2, 5, 12, 15, 16, 20, 25, 28, 49, 50, 61, 63, and 65, the hair density varied between 4 and 6 hairs/mm^2. Leaves of the accession 34 were entirely glabrous. The results obtained revealed no correlation between the thickness of the epidermis and the yield components in the different accessions of barley (Table 3). Conversely, the high density of hairs on the leaves registered in some accessions has probably contributed to their resistance to *D. noxia*.

Table 1. Classification of tested barley accessions based on chlorosis severity noted at three phenological stages

*** Classes**	**Class 1**	**Class 2**	**Class 3**	**Class 4**	**Class 5**	**Class 6**
Chlorosis (%) Stage	**0-5%**	**6- 10%**	**11- 20%**	**21- 30%**	**31- 50%**	**> 51%**
Tillering	2, 3, 4, 5, 6, 13, 14, 15, 16, 17, 20, 21, 22, 23, 24, 25, 26, 27, 37, 44, 45, 47, 48, 49, 51, 52, 53, 55, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72.	7, 8, 10, 18, 19, 28, 29, 30, 31, 35, 36, 38, 40, 46, 50, 56.	1*, 9, 11, 12, 33, 34, 39, 41, 42, 43, 54.	32		
Total	**44**	**16**	**11**	**1**	**0**	**0**
Elongation	2, 4, 5, 6, 13, 16, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 44, 45, 47, 48, 50, 51, 52 53, 55, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70	3, 14, 15, 17, 30, 31, 41, 46, 49, 57, 58, 59, 60, 71, 72	7, 8, 9, 10, 11, 12, 19, 32, 33, 34, 35, 36, 37, 38, 39, 40, 42, 43, 56	1, 54		
Total	**36**	**15**	**19**	**2**	**0**	**0**
Heading-Flowering			23	2, 5, 12, 15, 16, 20, 21, 25, 28, 49, 50, 61, 63, 65	3, 4, 6, 7, 9, 10, 11, 13, 14, 17, 18, 19, 22, 24, 26, 27, 29, 30, 31, 34, 36, 37, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 51, 52, 53, 54, 55, 57, 58, 59, 60, 62, 46, 66, 67, 68, 69, 70, 71, 72	**1**, 8, 32, 33, 35, 38, 56
Total		**0**	**1**	**14**	**50**	**7**

* Class 1: Highly resistant, Class 2: Resistant, Class 3: Moderately resistant, Class 4: Moderately susceptible, Class 5: Susceptible, Class 6: Very susceptible. (**1**: Local accession Saida).

Table 2. The values of certain performance components estimated in tested barley accessions

Acc.	Dry weight (g)	Ear weight (g)	Weight of 1000 gains (g)	Number of tillers	Acc.	Dry weight (g)	Ear weight (g)	Weight 1000 gains (g)	Number of tillers
1*	1.77 ± 0.96 d	0.29 ± 0.58 d	7.51 ± 15.21 f	0.4 ± 0.5 e	**37**	4.64 ± 0.85 bc	1.92 ± 0.57 c	39.71 ± 1.06 c	2.0 ± 0.1 d
2	5.52 ± 1.11 b	2.59 ± 0.44 bc	48.77 ± 4.14 b	2.4 ± 0.9 c	**38**	2.87 ± 0.45 d	0.51 ± 0.16 d	15.92 ± 4.40 e	1.2 ± 1.2 e
3	4.78± 0.74 bc	2.29 ± 0.30 c	49.25 ± 4.21 b	1.2 ± 0.4 e	**39**	3.98 ± 1.34 c	1.65 ± 0.72 cd	45.91 ± 3.57 c	1.6 ± 0.6 e
4	**6.37 ± 0.88 a**	2.58 ± 0.24 bc	**53.42 ± 6.12 a**	2.0 ± 0.1 d	**40**	4.20 ± 0.73 c	1.66 ± 0.63 cd	35.45 ± 2.63 cd	1.4 ± 0.5 e
5	4.74 ± 0.52 bc	2.94 ± 0.45 ab	51.85 ± 3.06 ab	1.4 ± 0.5 e	**41**	4.31 ± 0.86 c	2.04 ± 0.60 c	45.53 ± 16.16 c	1.4 ± 0.5 e
6	5.54 ± 1.27 b	2.34 ± 0.74 c	48.68 ± 2.72 b	1.8 ± 0.5 d	**42**	3.94 ± 1.91 c	2.36 ± 0.33 c	29.21 ± 9.31 d	1.2 ± 0.5 e
7	3.93 ± 0.41 c	1.98 ± 0.48 c	43.03 ± 6.08 c	1.0 ± 0.1 e	**43**	4.03 ± 0.69 c	1.05 ± 0.42 d	26.08 ± 3.81 d	2.0 ± 0.1 d
8	1.43 ± 0.26 d	0.21 ± 0.29 d	6.742 ± 1.29 f	0.4 ± 0.6 e	**44**	4.12 ± 0.85 c	1.59 ± 0.39 cd	29.09 ± 1.05 d	1.2 ± 0.5 e
9	4.72 ± 0.89 bc	2.38 ± 0.50 c	37.67 ± 4.45 cd	2.2 ± 0.4 d	**45**	4.57 ± 1.61 c	2.08 ± 0.71 c	34.12 ± 16.65 cd	1.8 ± 0.6 d
10	4.69 ± 1.10 bc	2.53 ± 0.62 bc	47.28 ± 5.89 b	1.2 ± 0.4 e	**46**	4.27 ± 1.88 c	1.55 ± 1.16 cd	28.03 ± 4.2 d	1.8 ± 0.8 d
11	5.24 ± 1.54 b	2.65 ± 0.95 bc	40.02 ± 7.41 c	2.2 ± 0.4 d	**47**	5.92 ± 0.29 b	**3.12 ± 0.30 a**	35.26 ± 3.82 cd	2.0 ± 0.1 d
12	5.22± 0.45 b	2.85 ± 0.47 ab	**56.24 ± 9.20 a**	1.0 ± 0.1 e	**48**	5.41 ± 0.99 b	2.77 ± 0.67 b	38.74 ± 8.88 c	1.4 ± 0.6 e
13	4.59 ± 1.21 c	2.32 ± 0.95 c	48.01 ± 6.86 b	2.0 ± 0.1 d	**49**	4.94 ± 1.40 bc	2.14 ± 1.01 c	27.63 ± 4.36 d	1.2 ± 0.4 e
14	4.27 ± 0.71 c	2.20 ± 0.48 c	34.05 ± 5.09 cd	2.4 ± 0.6 c	**50**	**6.18 ± 1.05 a**	2.58 ± 0.43 bc	35.14 ± 5.11 cd	2.2 ± 0.7 d
15	5.11± 0.51 b	2.54 ± 0.36 bc	39.53 ± 5.67 c	2.0 ± 0.1 d	**51**	5.80 ± 2.11 b	2.76 ± 1.24 b	29.63 ± 5.63 d	**3.0 ± 0.8 a**
16	5.82 ± 0.46 b	**3.38 ± 0.27 a**	50.86 ± 3.07 ab	**3.0 ± 0.7 a**	**52**	5.37 ± 1.43 b	2.48 ± 0.90 c	31.44 ± 7.70 d	1.8 ± 0.4 d
17	3.95 ± 0.46 c	1.84 ± 0.11 c	34.02 ± 1.89 cd	1.0 ± 0.5 e	**53**	4.97 ± 0.76 bc	2.34 ± 0.65 c	31.68 ± 5.69 d	1.6 ± 0.6 e
18	**6.12 ± 1.17 a**	**2.99 ± 0.68 a**	38.04 ± 4.77 cd	2.4 ± 0.7 c	**54**	4.20 ± 0.64 c	1.88 ± 0.62 c	42.94 ± 2.79 c	1.2 ± 0.4 e
19	5.31 ± 0.43 b	2.70 ± 0.41 b	33.64 ± 11.67cd	2.2 ± 0.4 d	**55**	5.19 ± 1.46 b	2.70 ± 0.95 b	36.65 ± 7.78 cd	1.4 ± 0.5 e
20	5.20 ± 0.71 b	2.75 ± 0.47 b	49.21 ± 3.20 b	1.8 ± 0.4 d	**56**	2.04 ± 0.63 d	0.16 ± 0.09 d	2.60 ± 3.03 g	0.4 ± 0.5 e
21	5.32 ± 2.14 b	2.65 ± 1.09 bc	47.83 ± 3.71 b	1.8 ± 0.4 d	**57**	4.07 ± 0.94 c	1.94 ± 0.60 c	33.68 ± 5.94 cd	1.0 ± 0.1 e
22	**6.28 ± 0.85 a**	**3.09 ± 0.39 a**	39.66 ± 6.53 c	2.2 ± 1.0 d	**58**	3.65 ± 1.02 c	1.61 ± 0.51 cd	35.41 ± 1.80 cd	1.6 ± 0.5 e
23	5.49 ± 0.26 b	**3.02 ± 0.31 a**	**53.84 ± 5.23 a**	1.8 ± 0.4 d	**59**	5.14 ± 0.62 b	2.23 ± 0.50 c	36.04 ± 6.82 cd	2.0 ± 0.7 d
24	4.73 ± 0.85 bc	2.35 ± 0.45 c	42,32 ± 4,79 c	1,6 ± 0,5 e	**60**	4,91 ± 1,03 bc	2,46 ± 0,95 c	41,22 ± 5,91 c	1,6 ± 0,5 e
25	4.69 ± 1.77 bc	2.12 ± 1.23 c	41.16 ± 23.14c	1.6 ± 0.9 e	**61**	5.82 ± 1.04 b	2.84 ± 0.69 ab	40.07 ± 3.70 c	2.6 ± 0.5 e
26	4.99 ± 0.49 bc	1.96 ± 0.13 c	**54.37 ± 3.22 a**	1.6 ± 0.6 e	**62**	5.07 ± 0.36 b	2.75 ± 0.26 b	45.96 ± 10.88 c	1.8 ± 0.4 d
27	4.93 ± 1.20 bc	1.86 ± 0.66 c	42.97 ± 7.69 c	1.8 ± 0.4 d	**63**	4.62 ± 1.04 bc	2.55 ± 0.80 bc	41.91 ± 2.83 c	1.6 ± 0.6 e
28	5.25 ± 0.95 b	2.35 ± 0.34 c	49.65 ±7.03 ab	1.6 ± 0.6 e	**64**	5.71 ± 1.09 b	**3.25 ± 0.80 a**	45.25 ± 7.41 c	2.4 ± 0.6 c
29	4.48 ± 0.53 c	2.13 ± 0.24 c	**54.32 ± 7.43 a**	1.2 ± 0.4 e	**65**	5.24 ± 0.62 b	2.84 ± 0.43 ab	41.43 ± 10.30 c	2.0 ± 0.1 d
30	5.40 ± 1.23 b	2.58 ± 0.41 bc	50.57 ± 5.63 ab	1.6 ± 0.5 e	**66**	4.46 ± 1.53 c	2.53 ± 0.36 bc	28.37 ± 10.19 d	1.6 ± 0.9 e
31	4.59 ± 1.61 c	1.89 ± 1.13 c	33.78 ± 18.81 cd	1.2 ± 0.8 e	**67**	5.43 ± 0.36 b	2.77 ± 0.38 b	34.10 ± 4.27 cd	2.6 ± 0.5 b
32	2.96 ± 0.60 d	0.96 ± 0.60 d	20.37 ± 1.73 e	1.2 ± 0.6 e	**68**	**6.49 ± 0.55 a**	**3.22 ± 0.26 a**	39.88 ± 15.29 c	**3.0 ± 0.1 a**
33	3.39 ± 0.94 d	1.59 ± 0.70 cd	28.15 ± 2.05 d	1.2 ± 0.5 e	**69**	5.54 ± 0.53 b	2.75 ± 0.31 b	42.17 ± 3.31 c	1.8 ± 0.5 d
34	5.16 ± 1.04 b	2.01 ± 0.84 c	28.93 ± 10.08 d	2.2 ± 0.4 d	**70**	4.13 ± 0.62 c	1.98 ± 0.45 c	42.20 ± 3.57 c	2.0 ± 0.6 d
35	3.37 ± 0.67 d	1.09 ± 0.15 d	19.07 ± 15.21 e	1.2 ± 0.5 e	**71**	4.33 ± 1.33 c	1.78 ± 0.47 c	31.44 ± 2.38 d	1.6 ± 0.5 e
36	4.30 ± 0.40 c	2.31 ± 0.46 c	51.72 ± 4.14 ab	1.0 ± 0.1 e	**72**	3.82 ± 0.62 c	1.25 ± 0.23 d	34.23 ± 8.92 cd	1.2 ± 0.4 e

Data are mean values of five replicates ± SD (standard deviation). Confidence intervals were calculated at the threshold of 5%. Acc: Accessions (1: Local variety Saida). Values within each column followed by the same letter are not significantly different according to Student-Newman Keuls test at $P < 0.05$.

Table 3. Matrix of the correlation coefficients of the parameters measured in the different accessions

Parameter	Dry weight (g)	Ear eight (g)	Tillers number	Weight of 1000 grains (g)
Epidermis thickness (mm)	0.091 ns	0.089 ns	0.104 ns	0.107 ns
Hair number	0.224 ns	0.268*	-0.007 ns	0.323*

ns: Not significant, *: Significant at $P \leq 0.05$.

DISCUSSION

In all tested barley accessions, the prolonged infestation with *D. noxia* caused a progression of chlorosis on leaves. It has been observed that the toxic saliva injected by the Russian wheat aphid at the time of feeding was responsible for the appearance of longitudinal chlorotic lines on leaves (Kiplagat 2005). In susceptible accessions, this leaf chlorosis evolves into necroses and the plants desiccate very early. This is the case of accessions 1 (the local variety Saida), 8, 32, 33, 35, 38, and 56 whose leaves were completely necrotic and desiccated. Studies have shown that this chlorosis can cause loss of photosynthetic pigments (chlorophyll a, chlorophyll b and carotene) due to the activity of degradation enzymes secreted by the aphid in the damaged parts of susceptible wheat accessions (Ni et al. 2002). However, in the resistant accessions, the high concentration of certain dissuasive substances (phenols) in the cells surrounding the stylet gives the sap a disagreeable taste (Belefant-Miller et al. 1994). In this study, the results showed that some accessions produced sterile ears, especially the accession 51. This phenomenon was explained by the imprisonment of the ears in the leaf sheath of the last leaf (Kiplagat 2005). As a result, the development of pollen grains cannot be accomplished. This sterility is frequently manifested by an abortion of stamens or grains of pollen, a delayed emergence of the ears and their deformation (Kiplagat 2005). Furthermore, the low grain production recorded in certain accessions can be explained, according to Gallais and Bannerot (1992), by the reduction of photosynthesis after flowering. These authors add that the last formed leaves participate with more than 50% in the filling of the grains. This is the case for accessions 1, 8, 32, 33, 35, 38, and 56 where the recorded low production in vegetative mass and in grain yield can be attributed to chlorosis which has affected more than 50% of their leaf area at the flowering stages. The resistance of plants to insects can be also attributed to the morphological traits of their leaves, in particular the epidermis thickness and the density of hairs. This study showed that, in general, the thickness of the epidermis was not correlated with the yield components (Table 3), whereas the high density of the hairs on the leaves has contributed to a certain level in the resistance to this aphid infestation. According to Andres and Connor (2003), the presence of hairs on the plant increases the time required for aphid feeding and reproduction. Other studies have pointed out that the strong presence of hairs on the leaves of certain accessions of wheat delays the movement of aphids compared with smooth leaf accessions (Lage et al. 2004). This is the case with accession 34 which is characterized by glabrous leaves on which the Russian wheat aphid moves easily.

The current study revealed the resistance of certain accessions of barley to *D. noxia*. In addition to its resistance to chlorosis compared to other accessions, the yield of accession 23 in aerial biomass and grain was higher. Despite their susceptibility to chlorosis, production of accessions 16 and 68 in aerial biomass, weight of 1000 grains and number of tillers, was important. The accessions 1, 8, 32, 33, 35, 38, and 56, exhibiting the severest chlorosis symptoms, showed the lowest yield components. As for the epidermis thickness of leaves, no correlation between this morphological trait and yield components but interestingly, the hair density has limited the action of this aphid on weight of the ears and the weight of 1000 grains.

RESUME

Laamari M. et Benyahia L. 2018. Evaluation de la résistance de différentes accessions d'orge à l'égard du puceron russe du blé *Diuraphis noxia*. Tunisian Journal of Plant Protection 13 (si): 99-106.

L'étude menée a pour objet l'évaluation du niveau de résistance de 72 accessions d'orge au puceron russe du blé *Diuraphis noxia.* En plus du taux de chlorose limitée (11 à 20 %) enregistré chez l'accession 23, son poids d'épis (3,02 g) et son poids de 1000 grains (53,84 g) sont importants. Malgré le taux de chlorose compris entre 31 et 50 % noté sur son feuillage, la variété 68, a présenté un poids sec total (6,49 g) et un nombre de talles (3 talles) élevés comparativement au reste des accessions. Chez les accessions d'orge résistantes, la densité élevée des poils sur leurs feuilles a contribué à un certain niveau dans la réduction de l'action de ce puceron sur certaines composantes du rendement, en particulier, le poids des épis et le poids de 1000 grains. La variété locale « Saida » s'est révélée être la plus sensible au puceron russe du blé.

Mots clés: *Diuraphis noxia*, orge, puceron, résistance

ملخص

لعماري، مالك ولطفي بنيحي. 2018. تقييم مقاومة سلالات مختلفة من الشعير لمن القمح الروسي *Diuraphis noxia*. Tunisian Journal of Plant Protection 13 (si): 99-106.

أجريت هذه التجربة لتقييم مدى تأثير تواجد حشرات المنّ الروسي *Diuraphis noxia* على إنتاج 72 سلالة من الشعير. بينت النتائج أن السلالة 23 هي الأكثر مقاومة لاصفرار الأوراق والأكثر إنتاجية من حيث وزن 1000 حبة (53.84 غ) ووزن السنابل (3.02 غ). بالرغم من أن نسبة الاصفرار المسجلة عند السلالة 68 كانت من 31 إلى 50 %، إلا أن معدل وزنها الجاف (6.49 غ) وعدد السنابل التي أنتجتها (3) كانا مرتفعين مقارنة بباقي السلالات. أظهرت الدراسة عند هذه السلالات من الشعير أن كل زيادة في معدلات الأوبار التي تغطي الأوراق تقابلها زيادة نسبية في بعض عناصر الانتاج، خاصة وزن السنابل ووزن 1000 حبة. لوحظ أيضا أن الصنف المحلي "سعيدة" كان حساسا جدا لهذا النوع من المن.

كلمات مفتاحية: شعير، مقاومة، منّ، *Diuraphis noxia*

LITERATURE CITED

Andres, M.R., and Connor, E.F. 2003. The community-wide and guild-specific effects of pubescence on the folivorous insects of manzanitas *Arctostaphylos* spp. Ecological Entomology 28: 383-396.

Belefant-Miller, H., Porter, D.R., Piece, M.L., and Mort, A.J. 1994. An early indicator of resistance in barley to Russian wheat aphid. Plant Physiology 105: 1289-1294.

Calhoun, D.S., Burnett, P.A., Robinson, J., and Vivar, H.E. 1991. Field resistance to Russian wheat aphid in barley. Crop Science 31: 1464-1467.

Gallais, A. and Bannerot, H. 1992. Amélioration des espèces végétales cultivées. Editions INRA, France, 767 pp.

Kiplagat, O.K. 2005. The Russian wheat aphid (*Diuraphis noxia* Mord.), damage on Kenyan wheat *(Triticum aestivum* L.) accessions and possible control through resistance breeding. Doctorate Thesis in Agronomy Sciences, University Aula of Wageningen, Nederlands, 141 pp.

Laamari, M. 2004. Etude éco-biologique des pucerons des cultures dans quelques localités de l'Est Algérien. Thèse de Doctorat en Sciences Agronomiques, Institut National Agronomique d'El Harrach, Algérie, 204 pp.

Laamari, M., Boughida, S., and Merouani, H. 2016. Distribution, parasitoids and cyclic appearance of Russian wheat aphid *Diuraphis noxia* (Mordvilko, 1913) (Hemiptera, Aphididae) in Algeria. European Journal of Environmental Sciences 6: 103-107

Lage, J., Skovmand, B., and Andersen, S.B. 2004. Resistance categories of synthetic hexaploid wheats resistant to the Russian wheat aphid (*Diuraphis noxia*). Euphytica 136: 291-296.

Miller, R.H., Tangohi, L.K., Bushman, L.L., and Kornosor, S. 1993. Distribution and ecology of Russian wheat aphid, *Diuraphis noxia* Mordvilko (Homoptera: Aphididae) in western Asia and northern Africa. Arab Journal of Plant Protection 11: 45-52.

Mimeur, J.M. 1941. Aphididae Nord Africains. Bulletin de la Société des Sciences Naturelles du Maroc 21: 67-70.

Ni, X., Quisenberry, S.S., Heng-Moss, T., Markwell, J., Higley, L., Baxendale, F., Sarath, G., and Klucas, R. 2002. Dynamic change in photosynthetic pigments and chlorophyll degradation elicited by cereal aphid feeding. Entomologia Experimentalis et Applicata 105: 43-53.
