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SUSCEPTIBILITY OF THREE MAIZE CULTIVARS TO APHID INFESTATION AND EFFECT OF POTASSIUM FERTILIZER LEVELS ON APHID

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ABSTRACT

Susceptibility of the three maize cultivars (Cross 10, Bashair 13 and Watania 4) to aphid infestation was evaluated at El-Mansoura district, Dakahlia Governorate throughout 2002 and 2003 seasons. The obtained results cleared that the population of cereal (*Rhopalosiphum maidis* (Fitch) and *Rhopalosiphum padi* L.) and cotton (*Aphis gossypii* (Glover)) aphids on each cultivar recorded one peak during each season of study. The initial infestation and population density of aphids were varied according to aphid species. However, *R. maidis* infestation started earlier in comparison with *R. padi* and *A. gossypii*, respectively.

The Cross 10 cultivar was comparatively susceptible to aphid infestation and harboured high numbers of *R. maidis* followed by Bashair 13 and Watania4 cultivars during the two study seasons. In case of *R. padi* the same trend was found where Cross 10 harboured higher numbers of 733 and 759 individuals during the two study seasons. On the contrary, *A. gossypii* recorded differed result where the highest number of 386 individuals found on Bashair cultivar during 2003 season.

The potassium fertilization significantly influenced aphid populations. However, the highest aphid numbers (143.9 and 66.4 individuals) recorded at zero level of potassium, while the lowest numbers (70.9 and 25.07 individuals) recorded at higher potassium level 150 kg/fadd. for *R. maidis* and *R. padi*. Host preferability may be due to the variance in epidermal cells thickness which varied from 5.29 to 6.14 micron as response to the variance on potassium levels from zero to 150 kg/fadd.

INTRODUCTION

The maize crop is one of the most important gramineae crop used as human and animal feed all over the world. The cereal aphids (*R. maidis*, *R. padi*) and cotton aphid, *A. gossypii* are considered as main and serous pests of maize plants. The aphid species are of great economic importance pests which cause serious damage directly by sucking plant juce and indirect damage by transmission virus disease. Serini and Lozzio (1996), Hance (1997), Jauset *et al.* (1998), Abd El-Samed (1999) and Hegab-Ola (2001).

Maize varieties exhibited different susceptibility to aphid infestation (Hegab-Ola, 2001). So, the resistance varieties could be used as an item in integrated pest management programs. On the other hand, fertilization had an important role on aphid infestation; however, the high rate of potassium fertilization reduced the population density of many aphid species (Hegab-Ola, 2001 and El-Gindy, 2002).

So, the present work aimed to evaluate susceptibility of three maize cultivars to aphid infestation and the relation between aphid infestation and the thickness of plant epidermal thickness in response to potassium fertilization levels.

MATERIALS AND METHODS

These experiments were carried out at El-Mansoura district, Dakahlia Governorate throughout 2002 and 2003 seasons.

1- Susceptibility of maize cultivars to aphid infestation and seasonal abundance of aphid species infested maize plants:

The experimental area about three feddans was divided into 9 plots presented three replicates of each maize cultivar in completely randomized block design.

The three maize cultivars examined for its susceptibility to aphid infestation were, Cross 10, Bashair 13 and Watania 4. The examined cultivars were sown through the 3rd week of May during the two study seasons.

After four weeks of planting date, weekly samples were collected randomly from each variety till the tassels emergence. Each sample consists of 30 leaves or inch of tassels on the main stem treatment.
The collected samples were placed in paper bags and transmitted to the laboratory for investigation by using a binocular stereomicroscope. The total number of each aphid species were counted and recorded.

2- Effect of potassium fertilizer on aphid populations:

The experimental area (0.5 faddan) was divided into 12 plots arranged as completely randomized block design. Four levels of potassium sulphate (48.0 % K_2O) of 0, 50, 100 and 150 kg/fadd. were tested. Each treatment was replicated three times.

The phosphorus fertilizer as calcium super phosphate 15 % was applied at 200 kg/fadd. with tillage, whereas nitrogen fertilizer as urea 46.5 % was applied at 120 unite/fadd in two equal portions at the first and second irrigations as recommended practices as well as other agriculture practices, while potassium sulphate was applied at the second irrigation. All treatments were kept free from insecticides application.
Weekly samples were collected and investigated as mentioned above.

Anatomical issue:

To measure the epidermal cell thickness, the examined plants were cleaned with tap water and cut to suitable parts. After that, they were fixed in formalin, acetic acid, alcohol solution for at least 36 hours, dehydrated with n-butyl alcohol, infiltrated and embedded in pure paraffin wax (M. P56- 58 °C) Johansen (1940). Sectioning at thickness of 14 micron was performed by using a rotatery microtome. Paraffin ribbons were mounted on this slides and stained with safranin and light green, then the sections covered by Canada balsam and examined microscopically by using micrometer ocular to measure the epidermal cell thickness.

Statistical analysis was done by using a one way ANOVA and the correlation and regression analysis were done.

RESULTS AND DISSUASION

I- Seasonal abundance of aphid populations on the tested maize cultivars:

The obtained results in Table (1) cleared that there were three aphids species infested maize cultivars, i.e. corn leaf aphid, *R. maidis*; oat aphid, *R. padi* and cotton aphid, *A. gossypii*. The aphid infestation was varied according to starting time and population density from maize cultivar to another and from aphid species to another as follows:

The aphid infestation on all tested maize cultivars indicated that *R. maidis* infestation started earlier (in the first half of July) in comparison with *R. padi* (approximately in the mid July) and *A. gossypii* (in the second half of July) (Table, 1).

As shown in Table (1) obviously cleared that aphid population recording one peak during each season. *R. maidis* exhibited the highest peak on Cross 10 cultivar (571 and 612 individuals) at the 1st and 2nd week of August followed by Bashair 13 (481 and 510 individuals) at the 2nd and 3rd week of August, while Watania 4 cultivar had lowest peaks (372 and 406 individuals) at the 1st and 3rd week of August during the first and second season. *R. padi* exhibited its highest peaks on Cross 10 cultivar (220 and 169 individuals) at the 3rd and 4th week of August followed by Watania 4 (162 and 173 individuals) at the 3rd week of August and 1st week of September, while Bashair 13 cultivar had lowest peaks (372 and 406 individuals) at the 1st and 3rd week of August during the first and second season.

The two peaks of *A. gossypii* in the two seasons were recorded at the 1st week of September (66 individuals) and 3rd week of August (79 individuals) on Cross 10 cultivar, while on Bashair 13 cultivar exhibited its peaks (61 and 103 individuals) at the 1st week of September and 4th week of August. On Watania 4 the aphid peaks (74 and 92 individuals) were noticed at the 2nd and 3rd week of August, during the first and second seasons.

Generally, it could be concluded that the starting of infestation were varied from aphid species to other and from season to other. The corn leaf aphid, *R. maidis* population recorded approximately higher numbers and longer infestation periods followed by oat aphid, *R. padi*; while cotton aphid, *A. gossypii* recorded comparative lower numbers and short infestation period.

These results are found in agreement with those of El-Saadany (1965), Abd-Allah (1985), Hegab *et al.* (1988), Abd-El-Samed (1999) and Farag *et al.* (1992). They reported that the number of corn leaf aphid raised on maize from end of July and early of August, the highest infestation percentage were recorded at August and the numbers decreased gradually tell it disappeared in the second week of September. On contrary, the obtained results not confirm with El-Naggar (2000) results. He maintained that *R. maidis* had two peaks on maize plants. These differences may be attributed to ecological variations as the crop species or natural enemies' activity.

Table (1): Seasonal abundance of the three cereal aphid populations (*R. maidis*, *R. padi* and *A. gossypii*) on certain maize cultivars (Cross 10, Bashair 13 and Watania 4) at El-Mansoura district, Dakahlia Governorate during 2002 and 2003 seasons.

Date	*R. maidis*						*R. padi*						*A. gossypii*					
	Cross 10		Bashair13		Watania 4		Cross 10		Bashair13		Watania 4		Cross 10		Bashair13		Watania 4	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Jun-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
July-1	11	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
2	26	17	6	0	22	0	8	0	0	1	0	0	0	0	0	0	0	0
3	97	39	14	8	46	4	19	11	3	5	0	12	0	5	0	0	6	8
4	220	110	72	27	103	42	51	48	11	16	3	18	3	15	0	3	15	15
Aug.-1	571	253	182	89	372	57	96	54	33	45	29	36	38	29	2	13	36	18
2	374	612	481	197	321	117	112	72	64	83	53	71	21	56	6	46	74	48
3	230	390	346	510	209	406	220	94	81	117	162	85	45	79	15	51	58	92
4	145	263	234	367	120	358	98	169	57	193	98	112	63	53	40	103	32	66
Sept.-1	98	186	155	241	52	225	62	117	32	90	76	173	66	39	61	73	22	43
2	47	137	63	163	5	144	44	83	17	69	70	56	27	27	33	36	20	32
3	0	68	21	39	0	68	23	72	9	45	10	37	16	12	10	12	0	21
4	0	0	0	0	0	0	0	39	6	21	0	16	0	0	0	0	0	0
Total	1819	2075	1674	1641	1253	1421	733	759	313	685	501	606	249	315	167	386	263	344

II- Susceptibility of maize cultivars to aphid infestations:

1- Corn leaf aphid, *R. maidis*:

Significant differences were observed between mean numbers of aphid species infested maize cultivars, where the Cross 10 cultivar was more susceptible to *R. maidis*, however, it harboured 1819 and 2075 individuals; followed by Bashair 13 harboured 1674 and 1641 individuals; while the comparative low numbers 1253 and 1421 individuals were recorded on Watania 4 cultivar during the two seasons of 2002 and 2003 (Table, 2).

2- Oat aphid, *R. padi*:

Data in Table (2) clear that the numbers of aphids on tested cultivars were varied significantly where the relatively high numbers 733 and 759 individuals were recorded in the Cross 10 which considered more susceptible cultivar during 2002 and 2003 seasons. The second cultivar, Bashair 13 harboured by relatively low numbers of 313 and 685 individuals during 2002 and 2003 seasons, respectively; while the last cultivar, Watania 4 harboured relatively moderate numbers of 501 and 616 individuals during the two studied seasons. Statistical analysis showed significant differences between the first and the third cultivar while highly significant differences were found between the second and third cultivars.

3- Cotton aphid, *A. gossypii*:

Data in Table (2) clear that the *A. gossypii* recorded the same trend of preferability to maize cultivars. Cross 10 cultivar was tended to be susceptible to this aphids species as it harboured 249 and 315 individuals, and Bashair 13 harboured 167 and 386 individuals, while Watania 4 harboured 263 and 344 individuals with highly significant differences between cultivars during 2002 and 2003 seasons, respectively.

Table (2); Comparative susceptibility of the three maize cultivars to three species of cereal aphids at El-Mansoura district, Dakahlia Governorate during 2002 and 2003 seasons.

Cultivars	Rh. maidis		Rh. padi		Aphis gossypii	
	2002	2003	2002	2003	2002	2003
Cross 10	*1819 a	2075 a	733 a	759 a	249 b	315 c
Bashair13	1674 b	1641 b	313 c	685 b	167 c	386 a
Watania 4	1253 c	1421 c	501 b	616 c	263 a	344 b
L.S.D.	8.15	5.99	5.02	13.75	13.59	10.12

* Total harboured numbers

III- Effect of different potassium fertilization levels on aphid infestations :

Data recorded in Table (3) show the significant differences between population density of *R. maidis, R. padi* under the four tested potassium fertilization levels.

1- Corn leaf aphid, *R. maidis*:

Data given in Table (3) show that the highest mean number of *R. maidis*, 127.7 and 143.9 individuals/sample occurred on zero level of potassium fertilization during 2002 and 2003 seasons. Whereas the lowest mean numbers were recorded with the level of 150 kg potassium/fadd. (70.9

and 84.5 individual/sample) during the two season. In addition to correlation analysis indicated that, there are negative correlations between aphid populations and potassium fertilization levels (r-values were -0.998** and -0.996** for the first and second seasons).

Table (3): Effect of potassium fertilization levels on the epidermal thickness and aphid population on Cross 10 cultivar.

Potassium levels (Kg.)	R. maidis		R. padi		Epidermal thickness (micron)
	2002	2003	2002	2003	
0	127.7	143.9	54.4	66.4	5.29
50	109.6	128.6	49.9	61.07	5.57
100	86.6	104.1	34.8	44.5	5.88
150	70.9	84.5	25.07	33.8	6.14

2- **Oat aphid, *R. padi*:**

Also, in respect to *R. padi* population (Table, 3), it exhibited the lowest occurrence at the highest level of potassium fertilization. However, as the potassium fertilization increase the aphid population decrease. There was a negative correlation between aphid populations and potassium fertilization levels in the first and second seasons as r-values were -0.982** and -0.984**. As shown in Table (3), the highest population of *R. maidis* or *R. padi* was recorded on the lowest epidermal thickness. There is a negative correlation between *R. maidis* population size and plant leaf thickness, however r-values were -0.999** and -0.997** in the first and second season. Also, there is a negative correlation between *R. padi* population size and plant leaf thickness, however r-values were -0.984** and -0.986** in the first and second season.

The simple regression for the effect of epidermal thickness on *R. maidis* population revealed a negatively high significant effect during the two seasons (b = -0.01). Also, the simple regression for the effect of epidermal thickness on *R. padi* population revealed a negatively high significant during the two seasons (b= -0.03 and -0.02).

These results are in agreement with finding of Hegab-ola (2001) and El-Gindy (2002), Megahed and Hashem (2004); they found that the potassium fertilization suppressed the aphid infestation on cereal and legumes plants.

It could be concluded that using potassium fertilization increase the thickness of epidermal leaves consequently suppressed the ability of aphids' mouth part to piercing the leaves cells of maize plants to feed. Therefore, the potassium fertilization could be recommended as agent of integrated pest management of against aphids.

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حساسية ثلاث أصناف من نباتات الذرة للإصابة بحشرات المن وتأثير التسميد البوتاسى على تعداد المن

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أجريت هذه الدراسة لتقييم حساسية ثلاثة اصناف من الذرة المنزرعة فى منطقة المنصورة بمحافظة الدقهلية وهى هجين فردى ١٠ وبشاير ١٣ ووطنية ٤ وذلك خلال الموسمين ٢٠٠٢ و ٢٠٠٣. واظهرت النتائج ان لكل من الذرة ومن الشوفان ومن القطن ذروة عددية واحدة خلال كل موسم من موسمى الدراسة. وتباينت بدية الاصابة وكثافة التعداد بناءا على نوع المن ؛ حيث بدأت الاصابة بمن الذرة مبكرا تلاها الاصابة بمن الشوفان ثم من القطن على الترتيب .

كان الصنف هجين فردى ١٠ أعلى الاصناف حساسية للاصابة بالمن مسجلا اعلى تعداد لمن الذرة ثم بشاير ١٣ يليهما وطنية ٤ خلال موسمي الدراسة ، وكذلك فى حالة من الشوفان سجل اعلى تعداد على الصنف هجين فردى ١٠ (٧٣٣ & ٧٥٩ فرد) خلال موسمي الدراسة . وعلى النقيض سجل من القطن نتيجة مختلفة حيث كان اعلى تعداد (٣٨٦ فرد) على الصنف بشاير ١٣ خلال موسم ٢٠٠٣ .

ادى التسميد البوتاسي الى اختلاف معنوى فى تعداد المن حيث سجل اعلى متوسط تعداد (١٤٣,٩ & ٦٦,٤ فرد) لمن الذرة ومن الشوفان عند مستوى صفر من التسميد البوتاسي ؛ بينما كان اقل تعداد (٧٠,٩ & ٢٥,٠٧ فرد) عند مستوى ١٥٠ كجم للفدان . وهذا التفضيل ربما يرجع الى تباين سمك طبقة البشرة (الابيديرم) من ٥,٢٩ الى ٦,١٤ ميكرون نتيجة التباين فى مستويات التسميد البوتاسي من صفر الى ١٥٠ كجم للفدان.