

EFFECT OF PHOSPHORUS AND ZINC ON SOYBEAN SUSCEPTIBILITY TO INSECT INFESTATION

BY

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ABSTRACT

A greenhouse was conducted to study the effect of phosphorus and zinc on soybean plant (*Glycin max* L.) susceptibility to some insect infestations. Using different treatments of soybean seeds inoculated with okadin only, okadin in combination with zinc and phosphorus levels of 8 and 40 ppm respectively, also a pots without any treatment used as a control . The previous levels of Zn and P showed lower population density with *Spodoptera littoralis* (Boisd.), *Aphis gossypii* and *Bemisia tabaci* (Genn.) on soybean where the total number of insects were 23, 84 and 29 insect per100 leaves respectively followed by the control as 42, 160 and 53 insect per 100 leaves respectively while the highest level of population density occurred in the pots which seeds inoculated with okadin only 90, 196 and 90 insect per 100 leaves respectively .The least degree of infestation occurred in the soybean plants treated with Zn and P followed by control while the highest level of infestation occurred in the pots which seeds were inoculated with okadin.

The results showed that balanced phosphorus and Zinc nutrition is essential not only for plant growth but also for decreasing the plant susceptibility to insect infestation.

INTRODUCTION

Soybean *Glycin max*. L. (Merr.) is the major semi-arid tropic crop throughout the world. *Spodoptera littoralis* (Boisd.), *Aphis goosypii* and *Bemisia tabaci* (Grenn.) are among the major pests attacking soybean. Chemical analysis of leaves of some plants was determined to show the correlation between these constituents and the resistance of plants to some insect infestations (Taman *et al.*, 1996). They found that the content of protein, N, Zn and Mn were much higher in soybean which was susceptible to *Spodoptera littoralis*, *Aphis* spp, *Empasca* spp. and *Tetranychus* spp., while the concentrations of Cu, Ni, Co and Cd were higher in the resistant plants of mungbean and sesame. Besides, Abdel-Rahman (1995) pointed out that the concentrations of Zn and Mn were much higher in soybean and cotton leaves which were susceptible to the infestation with *S. littoralis* and *Tetranychus* spp. Compared to the resistant varieties. From this point of view, the present work aimed to study the effect of the balance of phosphorus and zinc nutrition on the soybean growth, in addition to their effect on the insect infestation. Nitrogen requirement of this crop is supposed to be through the fixation of atmospheric nitrogen by the plant through symbiosis. Studies on some legume species (Gromeman, 1974; Khare and Rai, 1968; Singh *et al.*, 1968; Abou El-Naga and Ghazal, 1995; Hassan *et al.*, 1997) showed that phosphorus application may enhance nodulation and nitrogen fixation. The nodulation in soybean has been reported to increase with zinc concentration (Gromeman, 1974 and Mahmoud *et al.*, 1996). Studies on phosphorus-zinc relationship showed that their utilization by plant depends upon the available level of both of them in the soil nutrient solution (Brown *et al.*, 1970; Christensen, 1972; Shukla, 1972; Takkar *et al.*, 1976; Negm *et al.*, 1997). However, Yadav (1979) found a considerable influence of phosphorus and zinc interaction on the plant dry matter yield as shown by phosphorus and zinc utilization in soybean. It is, therefore, expected that the magnitude of nodulation and nitrogen fixation in this crop may also be influenced by phosphorus and zinc levels. According to this point of view, the present investigation was undertaken under greenhouse conditions to demonstrate the role of P/Zn ratio and okadine in reflecting the degree of resistance of plants to insect infestations.

MATERIALS AND METHODS

A greenhouse experiment was conducted during summer season 1998 with soya bean C.V. Giza 82 in polythene lined clay pots each of 20 cm diameter.

I- Treatments

Treatments included :

- 1- Seed's inoculation with Okadin .
- 2- Combination of 40 ppm phosphorus as diluted H_3PO_4 and 8 ppm Zinc as $ZnSO_4 \cdot 7H_2O$.

Each treatment was replicated seven times .

Inoculation of Soybean seeds :

Seeds of soybean C.V. Giza 82 were soaked in water for two hours before inoculation . Inoculation was carried out by mixing the soyabean seeds with a water suspension of arabic gum and the specific okadin inoculum before planting . Okadin is the rhizobia inoculum produced by the bacteriology section , Agricultural Research Center, Ministry of Agriculture, Giza , Egypt .

II- Population density of the insects :

For studing the population density of *S. littoralis*, *A. gossypii* and *B. tabaci* on soybean plants, 100 soyabean leaves were inspected at random on weekly intervals throughout season of 1998 .

III- Infestation caused by insects :

The infestation caused by previous insects was evaluated for each treatment in which 100 soybean leaves were randomly collected. Each leaf was thoroughly inspected and ranked in one of four infestation categories as suggested by Habib and El-Kady (1961) which was slightly modified as follows:- clean (no aphids are visible), slight (1-10% infested leaves), moderate (11-50%) and severe (>50%)> The degree of infestation was estimated according to the following formula:

$$P = \frac{\text{Sum of } n \times v}{ZN} \quad (\text{Kasopers, 1965})$$

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Where P = degree of infestation,
 n = number of leaves in each category,
 v = score of each category,
 Z = score of the highest category (5) and
 N = total number of inspected leaves

IV- Statistical Procedure :

The obtained data were exposed to the proper statistical analysis of variance according to Snedecor and Cochran , 1967

RESULTS AND DISCUSSION

Population density of the *S.littoralis* larvae, *A. gossypii* and *B. tabaci* insects soybean of different treatments (1998 season) :

The population density of *S.littoralis*, *A. gossypii* and *B.tabaci* are shown in Table (1). Analysis of variance of the data obtained during the season 1998 indicated the presence of significant differences between the means (L.S.D.value 5.2, 4.8 and 4.2) for *S.littoralis* , *A.gossypii* and *B.tabaci* respectively). The total number of *S.littoralis* larvae, *A.gossypii* and *B.Tabaci* insects, collected on soybean plants which its seeds inoculation with okadin (90, 196 and 90/100 leaves, respectively) exceeded that collected from control (42, 160 and 53/100 leaves respectively). The least population density showed in Soybean treated with Zn and p (23, 84 and 29 insect/100 leaves respectively). The results indicated that the tested insects exhibited lower population density of previous insects on soybean plants when Zn and P were added in low levels in the soil; these results are in agreement with those obtained by Taman and El-Sebae (1998), Taman *et al.* (1996), and Abdel-Rahman (1995). They pointed out that the concentrations of Zn were much higher in soybean and cotton leaves which were susceptible to the infestation with *S. littoralis*, *A. gossypii*, *E. lybica* and *T. urtica*.

Table (1): Population density of the *S.littoralis* larvae, *A. gossypii* and *B. tabaci* insects on soyabean of different treatments (1998 season)

Date of inspection	<i>S. littoralis</i>			<i>A. gossypii</i>			<i>B. tabaci</i>		
	A	B	C	A	B	C	A	B	C
June 14/6	5	10	2	11	15	--	--	--	--
21/6	10	12	5	15	18	--	--	--	--
30/6	12	23	8	20	25	15	--	--	--
7/7	--	--	--	37	55	25	5	5	--
14/7	7	12	3	32	38	28	5	8	3
21/7	8	18	5	20	20	16	9	12	5
28/7	--	15	--	25	25	--	12	20	6
4/8	--	--	--	--	--	--	12	22	8
11/8	--	--	--	--	--	--	10	23	7
Total	42	90	23	160	196	84	53	90	29
Mean	6	13	3	23	28	12	8	13	4
L.S.D value	5.2*			4.8*			4.2*		

** High significant at 0.05 probability

* Significant at 0.05 probability

A = Control without any treatment

B = seed's inoculation with okadin

C = Combination of 40 ppm phosphorus and 8 ppm zinc

Degree of infestation caused by *S.littoralis*, *A.gossypii* and *B.tabaci* :

The data in Table (2) show the weekly degree of infestations caused by the previous insects in different treatments. They also indicate that higher infestation occurred to soyabean in pots its seed's inoculation with okadin than control without any treatments. Less degree of infestation was observed in pots grown with soybean which its soil treated with phosphorus and zinc.

Table (2): The degree of infestation caused by *S. littoralis*, *A. gossypii* and *B. tabaci*

Sampling Date	% degree of foliage infestation by								
	<i>S.littoralis</i>			<i>A.gossypii</i>			<i>B.tabaci</i>		
	A	B	C	A	B	C	A	B	C
June 14/6	0.01	0.17	0.01	0.18	0.7	--	--	--	--
21/6	0.18	0.19	0.01	0.51	0.9	--	--	--	--
30/6	0.20	0.30	0.06	0.3	0.3	0.02	--	--	--
7/7	--	--	--	2.9	6.4	0.28	0.01	0.07	--
14/7	0.02	0.20	0.01	1.8	2.8	0.60	0.02	0.10	0.01
21/7	0.06	0.40	0.01	0.3	0.3	0.03	0.09	0.72	0.05
28/7	--	0.50	--	0.3	0.3	--	0.20	0.27	0.07
4/8	--	--	--	--	--	--	0.23	0.30	0.09
11/8	--	--	--	--	--	--	0.18	0.39	0.02
Total	0.47	1.76	0.09	7	11.7	0.93	0.73	1.85	0.24
Mean	0.07	0.25	0.01	0.9	1.7	0.1	0.1	0.3	0.03
L.S.D value	5.112*			4.310*			4.572*		

A = Control without any treatment.

B = seed's inoculation with okadin C = Combination of Zn + P.

The pots were cultivated with soybean which seed's were inoculated with okadin showed almost more infestation with insects . This may be due to the effect of excess nitrogen in plants which leads to the decrease of cellular wall thickness in the plant cells . The chemical changes in sapwater was found to be related to the increase in the susceptibility to the insect pests infestation (Hantour, 1974) .

Therefore, balanced phosphorus and zinc nutrition is essential not only for plant growth but also to get healthy plants and healthy environment where less chemicals are used in addition to the balance between insect pests and their predators and parasite .

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الملخص العربى

تأثير إضافة عناصر الفوسفور والزنك على الإصابة الحشرية
على نبات فول الصويا فى وجود العقدين

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تم تنفيذ التجربة فى صوبة زجاجية لدراسة تأثير إضافة عناصر الفوسفور والزنك بتركيز (٨ ، ٤ جزء فى المليون على التوالى) على الإصابة ببعض الآفات الحشرية لفول الصويا فى وجود العقدين . وقد وجد ان عند هذه التركيزات قلت الإصابة الحشرية بالمقارنة بالكنترول الخالى من العقدين ولكن أظهرت التجربة التى استخدمت فيها بذور فول الصويا المخلوطة بالعقدين فقط أصابة شديدة كما يلى فكان العدد الكلى ليرقات دودة ورق القطن وحشرات المن والذبابة البيضاء فى المعاملة بالزنك والفوسفور فى وجود العقدين ٢٣ ، ٨٤ ، ٢٩ حشرة / ١٠٠ ورقة على التوالى بينما كان أعداد هذه الحشرات فى الكنترول الخالى من هذه المعاملات ٤٢ ، ١٦٠ ، ٥٣/١٠٠ ورقة على التوالى . وقد أظهر خلط العقدين ببذور فول الصويا أعلى إصابة بالحشرات السابقة (٩٠ ، ١٩٦ ، ١٠٠/٩٠ ورقة على التوالى) وذلك فى موسم ١٩٩٨ . وبذلك نجد أن التوازن فى تغذية نبات فول الصويا بكل من الفوسفور والزنك يكون أساسيا ليس فقط فى نمو النبات ولكن أيضا للحصول على أقل إصابة بالآفات الحشرية وان وجود العقدين بمفرده لزيادة العقد البكتيري والمستهولة عن تثبيت النيتروجين أدى إلى زيادة الإصابة الحشرية وقد يرجع ذلك إلى سرعة نمو الخلايا وضعف جدار الخلية مما يؤدى إلى تغيير فى تركيب أنسجة النبات أو فى تركيب العصارة النباتية فيؤثر ذلك على مقاومة النبات للحشرات ويعرضه للإصابة أكثر .