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SUPPRESS OF SOYBEAN STEM FLY, *Melanagromyza sojae* (ZEHNT.) BY SPRAYING OF POTASSIUM, MICRONUTRIENTS AND THEIR COMBINATION AS FOLIAR APPLICATION ON FOUR SOYBEAN VARIETIES

Hanan Alfy[1]; Rasha A. El-Hosary[2]; SH.S. Yacoub[1]; A.E. Abd El-All [3] and Mervat, S. AlShaabeny[1]

1- Plant Protection Research Institute, ARC, Giza, Egypt - Hanan_isaac1@yahoo.com

2- Faculty of Agriculture, Plant Protection Department, Benha University

3- Soil, Water and Environment Institute, ARC, Giza, Egypt

ABSTRACT

The present study was carried out at the experimental farm of the Faculty of Agriculture, Benha University, Qalubiya governorate during two successive seasons; 2014 and 2015 to study the influence of potassium, micronutrients and their combinations as foliar application to suppress soybean stem fly, *Melanagromyza sojae* (Zehnt.) (Diptera: Agromyzidae) on four common soybean varieties.

The obtained results showed that treatment of potassium silicate+micronutrients (Fe, Zn and Mn) (P_1M^+) was the least injury for soybean stem fly through injury indicators which were the length of the tunnel and number of larvae inside the plant and there was no significant between varieties. The results also showed in relative increases of seed and stover yield when treated with potassium silicates + micronutrients; the seed yield was 25% and an average per two seasons was 0.30% compared to control. Results also showed an increase in total uptake of potassium with micronutrients for rest of the treatments; especially with potassium silicate that perhaps micronutrients enhanced the potassium absorption that allow the plant to build the restoration after *M. sojae* infection.

Keywords: potassium, micronutrients, soybean, fly *Melanagromyza sojae*

INTRODUCTION

Nowadays, Soybean (*Glycine max* L.) was used as a source of protein; however, in modern agriculture, soybean has dual importance: it is used as a source of oil for human consumption and as a protein source for animal feed. Recently, an upsurge of consumer interest in healthy benefits of soybean and soy products is not only due to its high protein (38%) and oil (18%) content, but also due to presence of physiologically beneficial phytochemicals. Many of the health benefits of soybean are derived from its secondary metabolites (Ajay *et al*., 2011) and (Abdallah *et al.*, 2014). In future; soybean may be an important source of biofuels production (Bourguignon, 2015).

Soybean stem fly *Melaagromyza sojae* (Zehnter) ,(Diptera: Agromyzidae) is a serious pest causing 100% infestation of soybean plants addition to other cultivated legumes that are gaining national importance due to heavy economic losses by this pest. The plant seems yellow from its top especially from the point of ovipostion. The reduced yield reach to 20-30% reductions, especially in the early vegetative state; also, reduce the pod and seed set. If leaves wilt or die during pod fill, the yield losses will occur due to reduced seed size (Abdallah *et al.*, 2014).

Nutrient requirements by soybean crop vary according to soil and climatic conditions, cultivar, yield level, cropping system and management practices. A soybean crop is able to extract 80, 14 and 33 kg/ton, total yield, for N, P_2O_5 and K_2O, respectively and about 366, 90 and 60 gm/ton, for Fe, Mn and Zn, respectively (Andrew *et al.*, 2009). Potassium is one of the principal plant nutrients underpinning crop yield production and quality determination. Potassium and micronutrients not only improve yields but also benefit various aspects of quality (oil & protein contents and seed size). Potassium enhance plant growth under biotic (e.g., pathogens, insects and weeds) and a biotic (e.g., drought, salinity, cold, frost and water logging) stress which causes about 26.3% and 69.3% losses in soybean yield, respectively (Bray *et al*., 2000 and Oerke, 2006).

Foliar fertilization with macro and micronutrients leads usually to considerable growth and development responses. This is mainly due to the face that foliar nutrients application make overcomes limits of soil physiochemical conditions for root nutrient uptake and because of nutrients are directly applied on foliage when demand is particularly high and rapid responses may be desired (Alexander, 1987). Hoeft *et al*., (2000) noted that high potassium will reduce yield by inducing a shortage of magnesium. Meanwhile, Anuradha and Sharma (1995) found that application of potassium increased the chlorophyll content, nitrate reductase activity, seed protein and oil content in soybean.

In general, the recent control strategies must be developed to control the pests of soybean without using the conventional pesticides, there is always need to develop an Integrated Pest Management (IPM) programs (Marlin and Matt, 2007) such select tolerant or resistant varieties as one of the simplest useful tactics in the IPM programs. Therefore, the objective of this study was to investigate the role of potassium, some micronutrients and their combinations as foliar application on vegetative growth of soybean and suppress *M. sojae* on four soybean varieties.

MATERIALS AND METHODS

Field experiments were carried out at Experimental Farm of the Faculty of Agriculture, Benha

University, Qalubiya Governorate inside the compass, throughout 2014 and 2015 seasons. An area about half feddan was chosen to be sown with four common cultivars. The experimental design was spilt plot arrangement with four replicates. Different fertilizer treatments were randomly distributed. The experimental area was ½ faddan and divided into main plots for cultivars (Crowford, Giza-22, Giza-35 and Giza-111) and sub plots were assigned by eight treatments for foliar application. Each plot equal 1⁄500 faddan. Soybean varieties were seeded on 1st may in the two seasons. The sources of potassium that used as a foliar application were potassium silicates (8.3% K_2O), potassium hydroxide (65% K_2O) and potassium sulphate (50% K_2O) as a rate of 1000 ppm from each potassium source. EDTA cheleated micronutrients (Fe 13%, Zn 13% and Mn 13%) were used with different potassium sources as a foliar application at rate of 1.5 g/L. The suggested treatments were as follows:

1- potassium silicate (P_1)
2- potassium sulphate (P_2)
3- potassium hydroxide (P_3)
4- Micronutrients (Fe, Zn and Mn) (M^+)
5- potassium silicate + micronutrients (Fe, Zn and Mn) (P_1M^+)
6- potassium sulphate + micronutrients (Fe, Zn and Mn) (p_2M^+)
7- potassium hydroxide + micronutrients (Fe, Zn and Mn) (p_3M^+)
8- Control (M_0P_0)

Application of tested materials took place by using hand sprayer (10 liters). The field experiments were left without using any chemical control (pesticides) to determine the percentage of natural infestation of target insect. Spilt plot designs in four replicates; each of treatments was applied two times as a foliar application during the season, the first foliar application at the vegetative growth stage and the second dose at 15 days after the first application. It was emphasized that the spray must be covered to reach all leaves of treated plants and all parts of plants. One row of plants was left untreated between every two plots in order to minimize overlap the drift material. To evaluate the different treatments on soybean stem fly per 10 plants for each variety were chosen randomly and were transferred directly to the laboratory. Data concerning the stem soybean fly numbers of larvae and the length of larval tunnels in the dissected stems were recorded after one week from each spray. Soybean varieties were harvested to chemical analysis at Nubaria Research Station, soil, water and Environment Research Institute, Agriculture Research Center Egypt. Samples of seed and stover were collected from each plot at harvest stage. Each plant sample washed with tap water several times then by distilled water, dried in an oven at 7 ^{0}C for 48 hrs. Dried weights were measured, also; dried plant materials were round in a stainless steel mill and stored in polyethylene bags for analysis. Half gram of the oven-dried plant material was subjected to wet digested with H_2SO_4 and H_2O_2; the concentration of potassium was determined by Flame Photometer and the concentration of Fe Zn and Mn were determined by Atomic Absorption Spectroscopy (Chapman and Pratt, 1961).

The soils used in this work were analyzed according to Page *et al*. (1982) and Klute (1986).

Statically analysis:

Data were analyzed by using of variance for split. Split plot design in randomized complete block arrangement with four replications. The obtained results were statistically analyzed according to Snedecor and Cochran (1967). The treatment means were compared according to L.S.D as prescribed by Steel and Torrie (1960). Finally, simple correlation coefficients among all studied characters were calculated.

RESULTS AND DISCUSSION

Effect of potassium and micronutrients on *M. sojae* infestation.

Stem tunnel lengths.

Evaluation of various foliar components against stem fly revealed that, stem tunnels/10 plants were least in plots treated with P_1M^+ followed by P_2 M^+, P_1, P_3M^+, P_3, P_2 and M_0P_0, respectively at 1st season (2014), as well as 2nd season (2015) as shown in Table (1). There were no significant effects among the four cultivated soybean varieties; also there was is no significant interaction effect between foliar application and cultivated varieties. These trends were seen for all measure parameters in Tables 1, 2, 3, 4, 5, 6, 7 and 8. *M. sojae* numbers.

The second incidence of stem fly is the number of larvae /10 plants. Data in Table (2) revealed that lowest number of larvae were in treated plant with P_1M^+, followed by P_2 M^+, P_1, P_3M^+, P_3, P_2, M^+ and M_0P_0, respectively at 1st season (2014), while; at 2nd season (2015), the values were P_1M^+, P_2, P_2M^+, P_3M^+, P_1, P_3, M^+ and M_0P_0, respectively.

Table (1). Effect of potassium source and micronutrients as foliar fertilizer application on *M. Sojae* infested soybean varieties.

			Average stem tunnel length /10 plants (2014 season)			
Varieties	**Crawford**	**Giza22**	**Giza 35**	**Giza111**	**Mean**	**$LSD_{0.05}$**
P_1	177.0	85.5	93.75	122.8	119.76	
P_2	121.0	113.5	164.5	119.5	129.63	
P_3	135.0	125.5	109.0	124.5	123.50	
M^+	141.3	118.5	117.0	165.5	135.58	
P_1M^+	74.0 l	41.5	41.5	115.5	66.17	147.15
p_2M^+	119.5	91.5	67.0 l	93.5	101.50	
p_3M^+	120.3	105.5	137.0	124.5	121.83	
M_0P_0	237.3	337.0	283.5	269.0	281.70	
Mean	150.20	127.31	135.18	141.85	134.96	
				N.S.		
			Average stem tunnel length /10 plants (2015 season)			
P_1	72.75	116.0	60.0	163.0	102.94	
P_2	99.5	168.0	86.0	89.0	110.63	
P_3	124.5	86.5	135.0	86.0	108.00	
M^+	124.8	146.8	157.0	37.5 l	142.87	
P_1M^+	147.0	121.5	41.0	73.5	95.75	151.41
p_2M^+	143.4	77.0	58.5	114.0	98.23	
p_3M^+	94.0	142.0	66.5	112.5	103.75	
M_0P_0	334.5	319.0	374.5	348.0	344.00	
Mean	142.56	147.10	122.31	140.86	138.27	
			N.S.			

N.S. = no significant

Table (2). Effect of potassium source and micronutrients as foliar fertilizer application on *M. Sojae* larvae infested soybean varieties.

			Mean larval counts / 10 plants (2014 season)			
Varieties	**Crawford**	**Giza22**	**Giza 35**	**Giza111**	**Mean**	**$LSD_{0.05}$**
P_1	8.0	9.0	8.0	13.5	9.63	
P_2	14.0	9.0	14.0	17.5	13.63	
P_3	8.5	11.0	14.5	13.0	11.75	
M^+	17.5	16.0	16.0	7.5	14.25	
P_1M^+	5.0	3.5	4.5	9.5	5.63	8.51
p_2M^+	8.0	12.0	6.0	9.5	8.88	
p_3M^+	11.5	11.5	9.5	6.5	9.75	
M_0P_0	24.0	21.5	20.5	22.5	22.13	
Mean	12.06	11.69	11.63	12.44	11.96	
N.S.						
			Mean larval counts / 10 plants (2015 season)			
P_1	11.0	18.0	11.5	10.5	12.75	
P_2	13.5	11.0	10.0	11.5	11.50	
P_3	10.0	17.0	20.0	4.0	12.75	
M^+	22.0	8.5	13.0	7.5	12.75	
P_1M^+	8.0	6.0	8.5	17.5	10.00	22.10
p_2M^+	17.5	17.5	5.0	9.0	12.25	
p_3M^+	12.0	17.5	7.5	12.5	12.38	
M_0P_0	32.0	30.5	38.0	41.0	35.38	
Mean	15.75	15.75	14.19	14.19	14.97	
			N.S.			

N.S. = no significant

Effect of potassium and micronutrients on soybean yield.

Soybean seed yield.

Data in Table (3) showed that foliar application of different potassium sources with or without micronutrients increased soybean seed yields from 1.10 (M_0P_0) to 1.36 ton /fed (P_1M^+) for the first growing season and the same trend was found for the second growing season from 1.09 to 1.35 ton/fed. Data also showed that no significant differences among the four varieties for the two growing seasons. The relative increases in soybean seed yield about 25 % for the two growing seasons. The highest seed yield were 1.36 and 1.35 ton/fed for the first and second growing seasons, respectively that obtained with treatment of potassium silicates with micronutrients (P_2 M^+), this may be due to the role of silicon to enhance vegetative growth under the biotic stress.

Soybean stover yield.

As a general trend, foliar application of different potassium sources with or without micronutrients had increased the stover yield of cultivated soybean varieties (Crawford, Giza22, Giza35 and Giza111) as shown in Table (4). Mean value soybean stover yields increased from 2.37 to 3.06 ton/fed for M_0P_0 and P_1M^+, respectively for the first growing season (2014) and from 2.41 M_0P_0 to 3.16 ton/fed P_1M^+ for the second growing season (2015). The relative increases in stover yields were 29.11% and 31.12% for the first and second growing seasons, respectively. The highest stover yields were 3.06 and 3.16 ton/fed for the first and second growing seasons, respectively with treatment of P_1M^+ (potassium silicate with micronutrients).

Table (3). Effect of potassium source and micronutrients as foliar fertilizer application on seed yield of soybean varieties.

			Seed yield (ton/fed.), season 2014				
Varieties	**Crawford**	**Giza22**	**Giza 35**	**Giza111**	**Mean**	**$LSD_{0.05}$**	**Relative increase %**
P_1	1.25	1.21	1.42	1.13	1.25		
P_2	1.3	1.19	1.16	1.13	1.20		
P_3	1.09	1.12	1.2	1.18	1.15		
M^+	1.08	1.1	1.12	1.11	1.10		
P_1M^+	1.32	1.36	1.45	1.3	1.36	0.17	25
p_2M^+	1.37	1.25	1.22	1.18	1.26		
p_3M^+	1.19	1.1	1.09	1.17	1.14		
M_0P_0	1.12	0.98	1.09	1.21	1.10		
Mean	1.22	1.16	1.22	1.18	1.195		
N.S.							
			Seed yield (ton/fed.), season 2015				
P_1	1.35	1.14	1.16	1.25	1.23		
P_2	1.18	1.11	1.15	1.13	1.14		
P_3	1.15	1.12	1.2	1.18	1.16		
M^+	1.11	1.19	1.07	1.17	1.14		
P_1M^+	1.3	1.4	1.41	1.28	1.35	0.15	25
p_2M^+	1.33	1.08	1.36	1.29	1.27		
p_3M^+	1.22	1.13	1.15	1.21	1.18		
M_0P_0	1.03	1.11	1.1	1.12	1.09		
Mean	1.21	1.16	1.20	1.20	1.195		
			N.S.				

N.S. = no significant

Table (4). Effect of potassium source and micronutrients as foliar fertilizer application on stover yield of soybean varieties.

			Stover yield (ton/fed.), season 2014				
Varieties	**Crawford**	**Giza22**	**Giza 35**	**Giza111**	**Mean**	**$LSD_{0.05}$**	**Relative increase %**
P_1	3.08	2.82	2.75	2.66	2.83		
P_2	2.93	2.69	2.62	2.54	2.70		
P_3	2.55	2.51	2.51	2.5	2.52		
M^+	2.6	2.54	2.57	2.83	2.64		
P_1M^+	2.99	3.05	3.27	2.93	3.06	0.21	29.11
p_2M^+	2.82	2.73	3.22	2.52	2.82		
p_3M^+	2.66	2.57	2.49	2.9	2.66		
M_0P_0	2.46	2.29	2.25	2.49	2.37		
Mean	2.76	2.65	2.71	2.67	2.7		
N.S.							
			Stover yield (ton/fed.), season 2015				
P_1	3.27	2.77	2.8	3.03	2.97		
P_2	2.86	2.7	2.79	2.74	2.77		
P_3	2.748	2.616	2.616	2.88	2.72		
M^+	2.5	2.69	2.66	2.71	2.64		
P_1M^+	3.04	3.29	3.31	3	3.16	0.33	31.12
p_2M^+	3.05	2.5	3.12	2.97	2.91		
p_3M^+	2.77	2.5	2.54	2.68	2.62		
M_0P_0	2.41	2.22	2.4	2.62	2.41		
Mean	2.83	2.66	2.78	2.83	2.78		
			N.S.				

N.S. = no significant

Effect of potassium and micronutrients on element uptakes in soybean.

Potassium uptake.

Data presented in Table (5) showed that foliar applications of different potassium sources with or without micronutrients had increased from potassium uptake in soybean plants. Total potassium uptake (seed potassium uptake+stover potassium uptake) had increased with foliar application, from 31.90 (P_0M_0) to 50.96 kg/fed (P_1M^+) for the first growing season (2014) and from 33.77 (P_0M_0) to 53.40 kg/fed (P_1M^+) for the second growing season (2015) for P_0M_0 and P_1M^+, respectively. The increases in potassium uptakes were nearly two fold by foliar application that may be due to increase in the ability of root to absorb the nutrients that enhanced by high nutrient value that add as foliar application especially P_1M^+. It's clear that foliar application treatments with micronutrients (P_1M^+, P_2M^+ and P_3M^+) were higher in potassium uptake for soybean varieties than foliar application without micronutrients (P_1, P_2 and P_3).

Table (5). Effect of potassium source and micronutrients as foliar application on potassium uptake for soybean varieties.

			Potassium uptake (kg/fed) season 2014			
Varieties	**Crawford**	**Giza22**	**Giza 35**	**Giza111**	**Mean**	**$LSD_{0.05}$**
P_1	45.44	42.99	43.02	41.85	43.33	
P_2	54.16	50.93	48.79	48.07	50.49	
P_3	44.39	45.21	47.00	47.09	45.92	
M^+	36.38	36.17	38.01	41.90	38.12	
P_1M^+	48.01	49.92	55.06	50.84	50.96	11.00
p_2M^+	40.66	39.79	45.76	38.87	41.27	
p_3M^+	37.52	36.30	34.68	40.60	37.28	
M_0P_0	31.74	29.73	31.09	35.03	31.90	
Mean	42.29	41.38	42.93	43.03	42.41	
N.S.						
			Potassium uptake (kg/fed) season 2015			
P_1	51.59	44.97	44.25	50.01	47.70	
P_2	50.23	51.63	55.32	48.47	51.41	
P_3	48.64	48.80	47.39	53.92	49.69	
M^+	34.80	37.06	37.06	37.45	36.59	
P_1M^+	53.46	53.00	52.31	54.81	53.40	12.50
p_2M^+	47.51	39.13	48.91	47.34	45.72	
p_3M^+	40.66	37.05	37.94	40.47	39.03	
M_0P_0	33.07	30.97	34.08	36.96	33.77	
Mean	45.00	42.83	44.66	46.18	44.66	
			N.S.			

N.S. = no significant

Fe uptake.

The resulted obtained in Table (6) indicated that foliar applications had increased the amount of Fe uptake by soybean plants, from 658.52 (P_0M_0) to 1546.87 g/fed (P_1M^+) for the first growing season (2014) and from 763.09 (P_0M_0) to 1676.87 kg/fed (P_1M^+) for the second growing season (2015).

Zn uptake.

Data arranged in Table (7) showed that applications of micronutrients and different sources of potassium as foliar application treatments (P_1M^+, P_2M^+ and P_3M^+) were higher in Zn uptake in soybean plants than foliar application without potassium sources (P_1, P_2 and P_3). These may be that potassium application increased Zn uptake from the soil.

Table (6). Effect of potassium source and micronutrients as foliar application on Fe uptake for soybean varieties.

Varieties	Crawford	Giza22	Giza 35	Giza111	Mean	$LSD_{0.05}$
			Fe uptake (g/fed) season 2014			
P_1	1142.03	918.72	1089.62	1084.25	1058.66	
P_2	1050.66	781.57	914.94	958.45	926.41	
P_3	860.16	729.06	812.46	779.17	795.21	
M^+	1388.71	1231.78	1161.31	1550.69	1333.12	
P_1M^+	1635.20	1402.18	1634.75	1515.34	1546.87	342.21
p_2M^+	1452.06	1255.90	1399.36	1545.59	1413.23	
p_3M^+	1449.39	1248.06	1448.97	1237.03	1345.86	
M_0P_0	754.76	593.03	532.84	753.45	658.52	
Mean	1216.62	1020.04	1124.28	1178.00	1134.47	
N.S.						
			Fe uptake (g/fed) season 2015			
P_1	1248.99	962.05	1124.05	1375.74	1177.71	
P_2	1064.53	813.10	1010.17	1125.55	1003.34	
P_3	972.58	791.97	874.49	979.10	904.54	
M^+	1496.34	1407.29	1474.81	1579.75	1489.55	
P_1M^+	1744.63	1574.93	1725.17	1662.75	1676.87	285.12
p_2M^+	1636.23	1205.91	1522.13	1520.04	1471.08	
p_3M^+	1516.13	1276.63	1251.48	1534.75	1394.75	
M_0P_0	767.52	644.24	827.77	812.81	763.09	
Mean	1305.87	1084.52	1226.26	1323.81	1235.12	
			N.S.			

N.S. = no significant

Table (7). Effect of potassium source and micronutrients as foliar applications on Zn uptake for soybean varieties.

Varieties	Crawford	Giza22	Giza 35	Giza111	Mean	$LSD_{0.05}$
			Zn uptake (g/fed) season 2014			
P_1	297.14	254.14	247.74	269.61	267.16	
P_2	251.32	195.13	228.48	196.24	217.79	
P_3	206.75	182.36	203.39	177.37	192.47	
M^+	278.86	249.91	315.61	250.60	273.75	
P_1M^+	368.73	340.87	428.19	322.82	365.15	125.34
p_2M^+	313.13	290.16	310.78	354.77	317.21	
p_3M^+	283.86	265.74	267.30	318.19	283.77	
M_0P_0	171.54	134.55	121.30	171.46	149.71	
Mean	271.42	239.11	265.35	257.63	258.38	
N.S.						
			Zn uptake (g/fed) season 2015			
P_1	290.23	296.96	297.14	342.68	306.75	
P_2	254.61	243.47	275.93	272.33	261.59	
P_3	235.93	222.96	250.20	278.29	246.85	
M^+	340.06	300.60	277.84	378.66	324.29	
P_1M^+	416.08	324.06	464.36	443.92	412.11	152.40
p_2M^+	304.06	323.19	391.06	327.60	336.48	
p_3M^+	336.65	313.24	336.42	381.06	341.84	
M_0P_0	181.94	165.39	187.62	216.24	187.80	
Mean	294.95	273.73	310.07	330.10	302.21	
			N.S.			

N.S. = no significant

Mn uptake.

Data arranged in Table (8) indicated that amount of Mn uptake by soybean plants, as a mean value Mn uptake increased from 134.71 (P_0M_0) to 374.94 g/fed (P_1M^+) for the first growing season (2014) and from 147.08 (P_0M_0) to 414.46 g/fed (P_1M^+) for the second growing season (2015).

Figures (1,2,3 and 4) illustrated that strength of correlation between nutrients uptake and infestation degree of stem fly. It's clear that there are a high negative correlation between the amount of K, Fe, Zn and Mn with average of stem tunnel length /10 plants for the cultivated soybean varieties. The correlation was high for the second growing season (2015), than the first growing season (2014). Correlation coefficient were

0.95, 0.62, 0.77 and 0.82 for the first growing season and were 0.55, 0.40, 0.59 and 0.67 for the second growing season for K, Fe, Zn, and Mn, respectively.

Table (8). Effect of potassium source and micronutrients as foliar application on Mn uptake for soybean varieties.

Varieties	Crawford	Giza22	Giza 35	Giza111	Mean	$LSD_{0.05}$
		Mn uptake (g/fed) season 2014				
P_1	254.76	242.35	223.79	203.43	231.08	
P_2	225.97	219.18	206.21	176.61	206.99	
P_3	185.95	180.52	183.12	159.44	177.26	
M^+	226.46	239.17	207.71	254.69	232.01	
P_1M^+	345.44	377.77	442.01	334.52	374.94	115.24
P_2M^+	303.53	337.65	352.82	285.00	319.75	
P_3M^+	264.83	244.11	233.45	294.83	259.31	
M_0P_0	154.38	121.32	109.01	154.13	134.71	
Mean	245.17	245.26	244.77	232.83	242.01	
N.S.						
			Mn uptake (g/fed) season 2015			
P_1	239.02	269.50	230.42	280.73	254.92	
P_2	246.33	248.81	259.91	229.10	246.04	
P_3	219.72	213.43	221.00	258.17	228.08	
M^+	287.35	268.80	246.20	275.00	269.34	
P_1M^+	374.02	428.37	482.12	373.32	414.46	144.05
P_2M^+	347.72	324.31	362.52	353.55	347.03	
P_3M^+	291.49	254.15	263.90	296.04	276.40	
M_0P_0	158.54	139.86	122.01	167.90	147.08	
Mean	270.52	268.40	273.51	279.23	272.92	
			N.S.			

N.S. = no significant

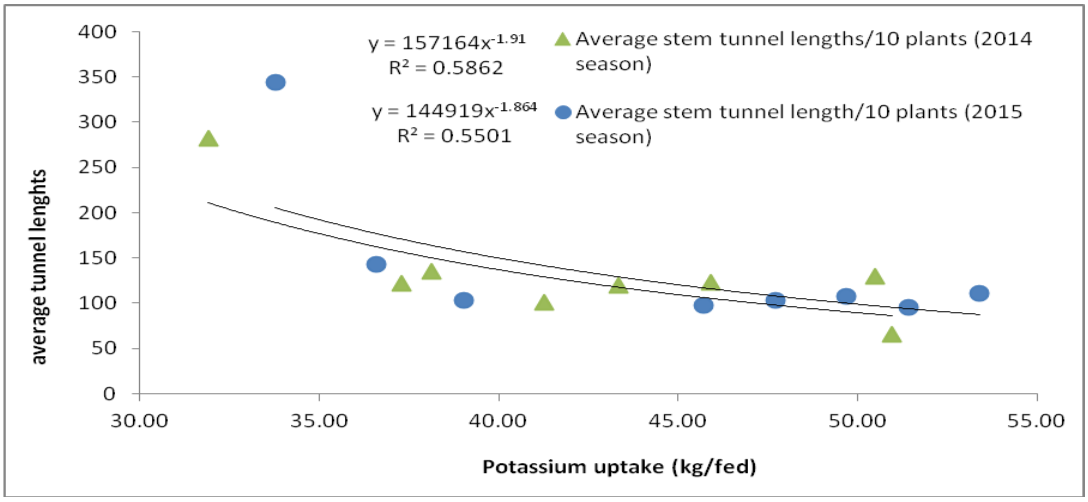

Figure (1). Regression between total potassium uptake and tunnel lengths of two growing seasons.

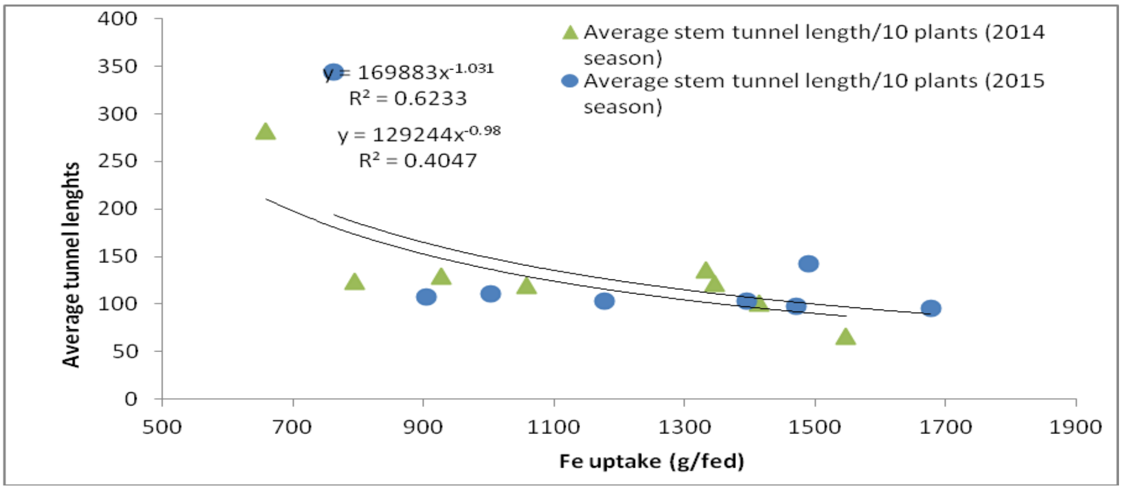

Figure (2). Regression between total Fe uptake and average tunnel lengths of two growing seasons.

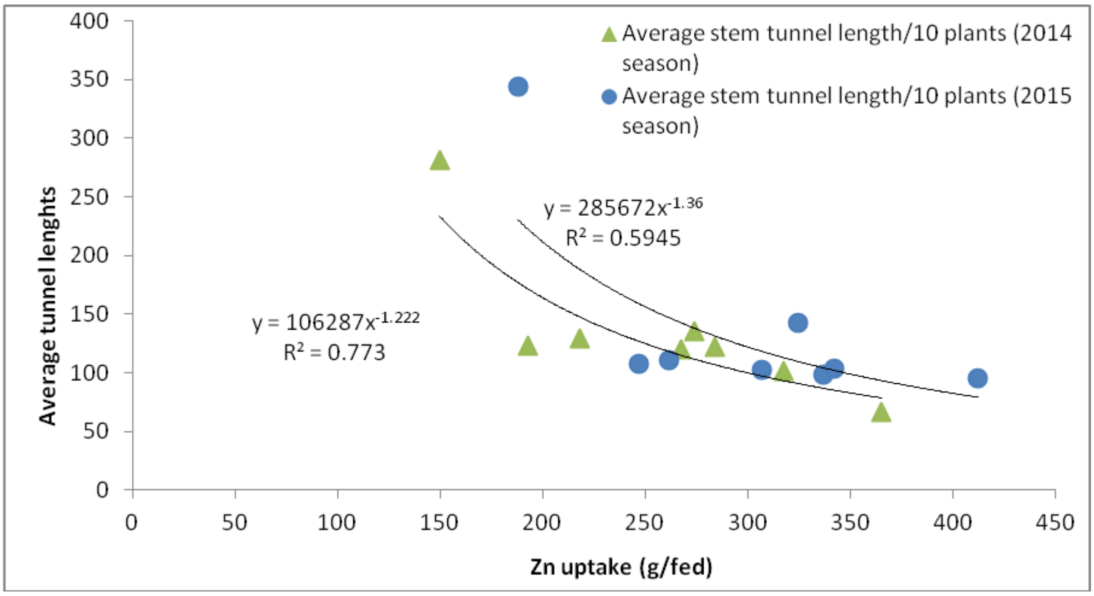

Figure (3). Regression between total Zn uptake and tunnel lengths of two growing seasons.

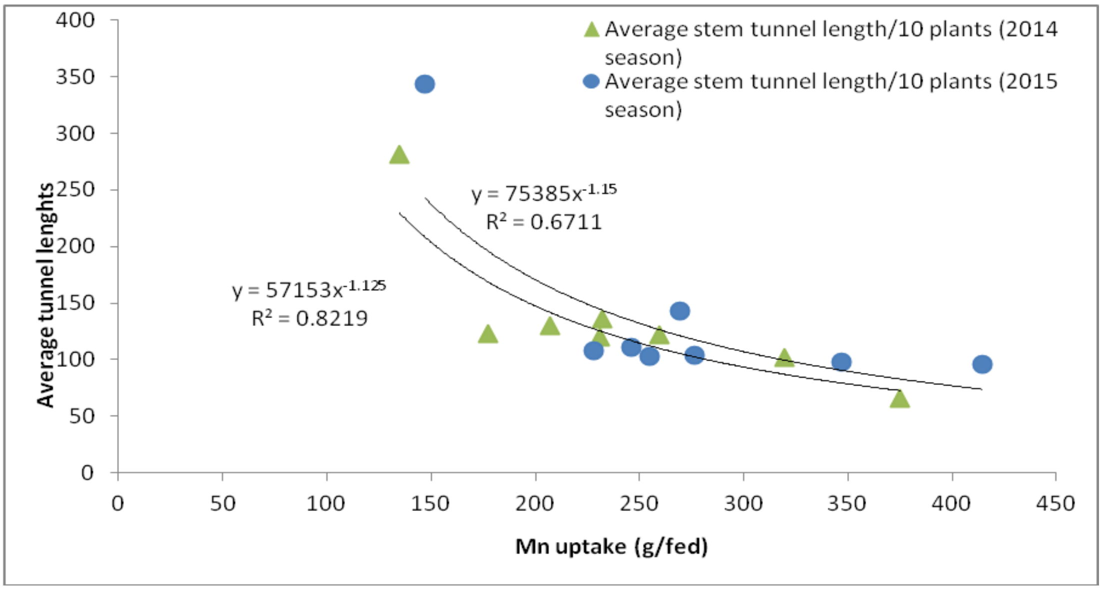

Figure (4). Regression between total Mn uptake and tunnel lengths of two growing seasons.

Main physical and chemical properties were shown in Table (9).

Table (9). Physical and chemical properties of experimental soil.

Soil characteristics	Average of two growing seasons
Sand	13.00
Silt	30.20
Clay	56.80
Texture	Clayey
PH (1:2.5 soil :water suspension)	8.13
EC dS m^{-1} (saturation paste extract)	1.10
CaCO3 (g kg^{-1})	23.14
OM (g kg^{-1})	12.35
Available N (mg kg^{-1})	43.10
Available P (mg kg^{-1})	6.22
Available K (mg kg^{-1})	168
DTPA-extractable Fe (mg kg^{-1})	2.51
DTPA-extractable Zn(mg kg^{-1})	1.75
DTPA-extractable Mn(mg kg^{-1})	10.9

Generally, data showed that foliar applications of potassium and micronutrients had positive effect in decreasing the damage occurred by stem fly and can be an active tool to enhance soybean crop yield under these biotic stress. These were clearly noticed in the field that had plots received foliar applications of potassium sources with or without micronutrients on soybean plants have the ability to restore their growth after the infestation of stem fly, especially the potassium silicate with micronutrients. Also, the micronutrient application increased K uptake from the soil that may be due to enhance root growth and increased the ability of roots to absorb and transported of K.

These data agree with Mortezaiefard (2010) who assured that young plants that infested cut flower, *Gerbera jamesonii* (stanza) sprayed with three different potassium salts including KNo_3, K_2Sio_3 and K_2So_4 two times during the trail. All K treatments increased the potassium leaf content, yield significant and among of them.

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الحد من الضرر الناتج عن ذبابة ساق فول الصويا برش البوتاسيوم والعناصر الصغرى والدمج بينهما كمغذيات ورقية على أربعة أصناف من فول الصويا

حنان ألفى صادق[١] ، رشا علي الحصرى[٢] ، شنودة سيد يعقوب[١] ، أحمد اسماعيل عبد العال[٣] و ميرفت صالح عبد الرحمن الشعبينى[١]

١- معهد بحوث وقاية النبات - مركز البحوث الزراعية
٢- كلية زراعة مشتهر - قسم وقاية النبات - جامعة بنها
٣- معهد بحوث الاراضى والمياه والبيئة - مركز البحوث الزراعية

أجريت هذه التجربة على فول الصويا بمزرعة كلية الزراعة – جامعة بنها – محافظة القليوبية خلال الموسمين ٢٠١٤ و ٢٠١٥م وذلك بهدف معرفة تأثيرالرش الورقى بايون البوتاسيوم فى صوره المختلفة وبعض العناصر الصغرى بالاضافة للدمج بينهم على الاصابة بذبابة ساق فول الصويا لأربعة اصناف من فول الصويا .

أظهرت النتائج أن معاملة سليكات البوتاسيوم وخليط العناصر الصغرى كانت أقل المعاملات إصابة بذبابة ساق فول الصويا من خلال مؤشرات الإصابة وهى طول النفق وعدد اليرقات داخل النبات وذلك بدون معنوية بين الأصناف. كما أظهرت النتائج زيادة محصول البذور و القش عند المعاملة بسليكات البوتاسيوم والعناصر الصغرى معا بنسبة ٢٥% لمحصول البذرة و ٣٠% لمحصول القش كمتوسط للموسمين مقارنة بالكنترول . كما أوضحت النتائج زيادة فى إمتصاص البوتاسيوم الكلى عند المعاملة بأيون البوتاسيوم مع العناصر الصغرى عن باقى المعاملات وبالأخص مع سليكات البوتاسيوم وربما يرجع السبب فى ذلك الى أن العناصر الصغرى تحفزالنبات على زيادة إمتصاص البوتاسيوم مما يتيح للنبات استعادة بنائه بعد الإصابة .