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EFFECT OF FERTILIZATIONS AND HERBICIDES ON WEEDS, SOIL MICROORGANISMS AND SOYBEAN PRODUCTION

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ABSTRACT

The present work was conducted to investigate the effect of fertilizers {mineral fertilizers (NPK) and organic fertilizer (FYM) and some herbicides (Pendimethalin at the rate of 1.7 l/fed, Prometryn at the rate of 1.0 l/ fed, Metolachlor at the rate of 1.0 l/ fed, Metribuzin at the rate of 300 g/ fed and untreated) on weeds, bacterial nodulation and soil microorganisms associated soybean crop during 2012 and 2013 summer seasons.

The results showed that FYM fertilizer significantly increased the dry weight of grassy and broad-leaved weeds (g/ m^2) after 30 days from sowing. Also, it increased the number and dry weight of nodules/plant, the number of soil microorganisms, pod number /plant, pod weight /plant (g), seeds weight / plant (g), seed yield (ton/ fed.) and NPK seed contents % compared to no fertilizer. This was true in both seasons. All the studied herbicides significantly decreased the dry weight of grassy, broad-leaved weeds and decreased number and dry weight of nodules / plant, number of soil microorganisms and increased pods number /plant, pods weight /plant (g), seeds weight /plant (g), seed yield (ton/fed.) and NPK seed contents % compared to untreated treatment.

It can be concluded from this study that application of Pendimethalin at the rate of 1.7 l/ fed and Metribuzin at the rate of 300 g/ fed. with FYM fertilizer were the best for weed control and gave the highest soybean yield.

***Key words**: herbicides, microorganisms, nodulation.*

1. INTRODUCTION

Microorganisms usually occupy a volume of less than 0.1 % of the soil, but are responsible for numerous transformations that cycle elements and energy in nature. The biomass of microorganisms/hectar may reach several tonnes (Torstensson, 1980). The susceptibility of *Rhizobium spp*. to herbicides has been investigated by a variety of methods, ranging from plate counts of *Rhizobium* cells to examination of nodulation of legumes (Anderson,1978). Greaves and Malkomes (1980) indicated that the susceptibility of the host plant to herbicides is generally greater than that of the bacterium. Reductions in nodulation and nitrogen- fixation are usually ascribed to plant damage rather than to direct effects of the herbicide on the microorganisms. Kravchenko *et al*. (2013) revealed that the bacterial populations in the rhizosphere were significantly affected by inoculation. Some undefined bacterial lineages were also found, indicating that soybean rhizosphere may be an important source for the isolation of novel nitrogen-fixing bacteria.

Mclaron and Peterson (1967) pointed out that organic matter plays an essential part in securing soil structure and high fertility. It also acts as a major source of nutrients and energy for the soil microflora.

Hernot and Robertson (1994) stated that soil microbial biomass is a source and sink of soil nutrients, which may be influenced by the N transformation in soil systems. Soliman *et al*. (1995) noted that nodulation of soybean was enhanced by inoculation and the highest nodule numbers and fresh mass were obtained with 200 kgN/fed.. Mohamed and Ezzat (1996) showed that nodule number, nodule weight/plant, straw and seed yields were significantly increased by increasing phosphate rate and inoculation. Zayed (2003) noted that straw, seed yield, 100-seed weight, nodule fresh weights and nodule numbers were significantly increased by inoculation with Rizobia and Phosphate solubilizing bacteria than uninoculated seeds.Gawronska (1997) showed that mineral fertilization also strongly affects a number of microorganisms and qualitative selection of whole communities of soil microorganisms. Sarathchandra *et al*. (2001) reported that nitrogen and phosphate fertilizers had no significant effects on soil microbial populations and N application reduced the functional microbial diversity in pasture soils. Barabasz *et al*. (2002) showed that mineral fertilization of arable land increased the biological productivity of various ecosystems as well as the microbial activity in the soil. Agha *et al.* (2004) stated that 50 kg N/ha + inoculation of *Rizobia japonicum* increased nodule numbers, number of pods per plant, number of seeds per pod, seed weight per plant, seed index, number of nodules per plant and seed yield. Lv *et al*. (2005) indicated that in addition to providing necessary nutrients for crops and improving soil physico-chemical properties, organic fertilizer is able to enhance soil microbial activity of soil, such as improving the activity of soil enzymes and increasing soil microbial biomass. Cong *et al*. (2006) showed that microbial biomass and microbial activity were generally higher in organically than conventionally managed soils. Huda (2009) revealed that Rhizobacterien and Phosphorin significantly increased plant height, pod numbers /plant, seed number /pod, seed weight /plant, 100-seed weight, seed yield /fed, nitrate reductive activity, protein and oil % in soybean. Kelly *et al*. (2010) found that all inorganic N forms led to a net reduction in microbial respiration, and the magnitude of the observed response (up to 60 % reduction) was consistent across all soils and negatively correlated with N concentration. Janssens *et al*. (2010) found that microbial response is a direct effect of the increase in N availability and if adding different forms of N would yield a similar response.

Although herbicides are applied to plants and soils to control weeds, they may also affect soil properties, microorganisms. Examinations of herbicide effectes on legume nodulation and growth are important. At present, it seems that the most valuable information comes from measurement of plant growth rather than from more specilized measurements of Rhizobium populations (Greaves and Malkomes, 1980). Zhang *et al*. (2009) stated that the mineral fertilizer application (N, NP and NPK) did not significantly affect the N mineralization and soil microbial biomass compared with the CK under current fertilization conditions.

Miloševic and Govedarica (2002) showed that *Azotobacter* is the most sensitive to herbicide application. The numbers of this group of nitrogen-fixing bacteria decrease considerably in the period of 7—14 days after herbicide application. Simultaneously, the numbers of *Actinomycetes* and less so of fungi increase, indicating that these microorganisms use herbicides as sources of biogenous elements. Scholter *et al.* (2003) noted that many studies have reported the negative as well as the positive effects of the herbicides on soil microbial biomass and soil microorganisms. Khuntia *et al*. (2013) found that all the herbicides significantly reduced the microbial population up to 15 days after application but recovered later on.

Thus, the present study was designed to investigate the effects of fertilizers and some herbicides on nodules, weeds and soil microorganisms associated soybean crop.

2. MATERIALS AND METHODS

This experimental work was carried out during 2013 and 2014 summer seasons in Shandaweel Research Station (Sohag Governorate, Egypt) to investigate the effect of fertilization and some herbicides on weeds, nodules, microorganisms, yield and yield components of soybean (*Glycine max* L., cv. Giza 111).

After soil preparation, the experiment area was divided into 10.5 m^2 sub plots consisted of five rows (3.5 m long and 0.6 m apart). Seeds were planted after inoculation with the appropriate treatments. Seeds were planted in 10 and 15 June in the two seasons, respectively**.** Table (1) shows some characteristics of the experimental site. Also Table (2) shows the Trade, common and chemical names of the herbicides. A split plot design with three replications was used in both seasons. The treatments were arranged as follows:

2.1. Fertilizers were allocated in the main plots which were:

2.1.1. NPK (mineral fertilizer) at rate 30 kg N (urea 46.5% N), 22.5 kg P_2O_5 (superphosphate 15.5% P_2O_5) and 24 kg K (potassium sulfate 48% K_2O) / feddan..

2.1.2. Farm Yard Manure (FYM fertilizer) at the rate 40 m^3/feddan.

2.1.3. Control (Un- fertilizer plots.)

2.2. Weed control treatments in the sub plots were:

Table (1): Soil characterization of the experimental sites.

Year	Texture	$CaCO_3$%	Soil pH	O.M%	Available nutrients in soil (ppm)		
					N	P	K
2013	Sandy loam	7.57	7.8	0.7	14	19	12
2014	Sandy loam	7.52	7.6	0.8	15	18	13

Table (2): Trade, common and chemical names of the herbicides used in this study.

Trade name	Common name	Chemical name
Stomp Extra	Pendimethalin	N-(1-ethylepropyl)-3,4-di-methyl-2,6-dinitrobenzene-amine
Gesagard	Prometryn	N^2,N^4-di-isopropyl-6-methylthio-1,3,5-triazine-2,4-diamine
Dual Gold	S-Metolachlor	2-chloro-6'-ethyl-*N*-(2-methoxy-1-methylethyl)aceto-*o*-toluidide
Sencor	Metribuzin	4-Amino-6-(1,1-dimethylethyl)-3-(methylthio)-1, 2, 4-triazin-5(4*H*)-one. . .

2.2.1. Stomp extra 45.5 CS % at rate of 1.5 l/fed. as pre-emergence
2.2.2. Gesagard 50% SC at rate of 1.0 l/fed. as pre-emergence
2.2.3. Dual Gold 96% EC at rate of 1.0 l/fed. as pre-emergence
2.2.4. Sencor 70 WP % at rate of 300 g/fed. as pre-emergence
2.2.5. Unweeded treatment.

Farm Yard Manure (FYM) was added as organic fertilizer at soil preparing.

Phosphorus (15.5% P_2O_5) was added before sowing, both urea (46.5% N) and potassium (48% K_2O) was added in one dose before the first irrigation.

Herbicides were sprayed on the soil surface immediately before irrigation as pre-emergence. Using Knapsack sprayer with one nozzle boom and 200 liters water $fed.^{-1}$ as carrier.

The single inoculation was carried out by mixing the bacterial inoculums with soybean seeds; for the combined bacterial inoculations, equal amounts of each inoculums were mixed with soybean seeds. The recommended agricultural practices were carried out throughout the two growing seasons.

2.3. Recorded data

2.3. 1. Weed survey

Weeds were hand pulled from 1.0 m^2 in each subplot after 30 days from sowing. Weeds were identified and classified to grassy and broad-leaved weeds to record: dry weight of grassy weed (*Echinochola colonum* L.) and broad leaved weeds (*Xanthium spinosum* L., *Portulaca oleracea* L., *Euphorbia peplus* L., *Corchorus olitorius* L. and *Amaranthus hybridus* L.) g / m^2. Weeds were air-dried for seven days and then oven-dried at 70 C° for 24 hours until a constant weight.

2.3. 2. Nodulation

Sixty days after planting, soybean root samples were collected and washed from the soil particles on 1 mm sieve holes. Nodules were counted and the number of nodules/plant, fresh weight active nodules/plant (g) were estimated.

2.3.3. Microorganisms

2.3.3.1.Sampling of soybean rhizosphere microflora

Root systems of soybean plants, including any adhering soil, were carefully collected at 20, 40 and 60 days after planting. In each plot, two plants were collected randomly at 20, 40 and 60 days after planting. Samples were transported to the laboratory on ice in plastic bags and processed within 4 h. The roots from each sample were gently removed from the surrounding soil with forceps and any adherent soil was considered part of the rhizosphere. Roots with adherent soil from each sample were cut to pieces then were weighed and placed in 250 or 500 ml flasks containing sterile 1.2 mm phosphate buffer (pH= 7). This was a 1:10 (root and soil to buffer solution ratio) as determined on an oven dry weight basis. The flasks were put on a rotary shaker for 30 min and used as stuck suspensions for microbial analysis per gram soil.

2.3.3.2. Media used

Different semi-solid media were used for the isolation and estimtion of microorganisms from rhizosphere of soybean plants. Peptone-Rose Bengal agar medium (Martin,1950) supplemented with 40 mg streptomycin sulphate/100 ml medium was used for isolating and estimting fungi, whereas nutrient agar (NA) medium was used for bacteria, Ken Knight's agar medium for *Actinomycetes* (Anarson,1970) and Ashby's mannitol agar medium for *Azotobacter* estimation (Monkiedje *et al*. 2002).

2.3.3. 3. Microbial analysis by serial dilution and pour plate method

Serial dilution technique and pour plate method described by Dhingra and Sinclair (1995) were used for estimating the total count of isolated bacteria (*Azotobacter* and A*ctinomycetes*) and fungi associated with soybean roots after application of agrochemicals in treated plots. Serial dilutions of water suspensions were prepared and 1 ml from each stuck suspension of soil rhizosphere was used for isolating microorganisms. Using a fresh sterile micro pipette, 1 ml from each appropriate dilution factor was placed into each of the three Petri dishes. Then approx, 20 ml of molten medium were poured in each plate. After pouring, the plates were immediately gently moved in a whirling motion to mix the contents, left until solidification of the medium and then incubated at 28±5ºC in inverted position. After appropriate incubation period, the number of colonies per plate was recorded and the number of colony forming unit (CFU) was counted. Total viable counts are calculated from the following formula.

Total viable count = Average number of colonies × size of aliquot × dilution factor.

2.3. 4. NPK contents (%)

Plant materials (wet seeds) were digested using a mixture of concentrated sulphuric acid and hydrogen peroxides (Jackson,1958). Phosphorus was determined using chlorostannous reduced molybdophosphoric blue color method in H_2SO_4 system and color metrically determined following the method introduced by Jackson (1967). Potassium was photometrically determined using a flame photometer as described by Jackson (1958).

2.3. 5. Yield and yield components

At harvest, plant height (cm), number of branches /plant, number of pods/plant, weight of pods /plant (g), weight of seeds /plant (g) and number of seed /plant were determined in a sample of 10 random guarded plants from each sub plot. Seed yield (ton /fed) was calculated on plot basis.

2.3. 6. Statistical analyses

The collected data were subjected to statisticall analysis of variance (ANOVA) as split-plot design. The treatment means were compared using the least significant differences (LSD) mentioned by Gomez and Gomez (1984).

3. RESULTS AND DISCUSSION

3.1. Effect of fertilization and weed control treatments on

3.1. 1. Weeds

The major weeds present in both experimental sites were cocklebur (*Xanthium strumarium* L.), common purslane (*Portulaca oleracea* L.), leafy spurge (Euphorbia peplus L.), nalta jute (*Corchorus olitorius* L.) and pig weed (*Amaranthus hybridus* L.) as annual broadleaf weeds and branyardgrass (*Echinochola colonum* L. Link) as annual grassy weed.

Results presented in Table (3) cleared that the

Table(3): Effect of fertilizations and herbicides on the dry weight of grassy, broad and total weeds in 2012 and 2013 summer seasons.

Treatments	Grassy weeds		Broad-leaved weeds		Total weeds	
	2012	2013	2012	2013	2012	2013
Fertilizers						
NPK fertilizer	79.2	143.5	200.9	302.5	280.1	446.0
FYM fertilizer	161.7	192.0	301.8	338.6	463.5	530.6
Un-fertilized	78.7	116.7	200.7	242.5	279.4	359.1
L.S.D at 5%.	14.0	23.8	28.4	35.2	24.3	13.7
Weed control treatments						
Pendimethalin at 1.7 cm^3/fed	66.2	121.0	217.2	245.6	283.4	366.6
Prometryn at 1.0 l/fed	70.7	112.2	204.3	256.3	275.0	368.6
Metolachlor at 1.0 l/fed	87.7	136.1	210.8	271.6	298.4	407.7
Metribuzin at 300 cm^3/fed	105.7	140.4	179.2	277.6	284.9	418.0
Unweeded treatment	202.7	243.8	360.7	421.7	563.3	665.4
L.S.D at 5%.	22.1	22.8	34.0	27.2	36.0	34.9

effect of fertilizations and herbicides were significantly reduced in the two categories of the annual weeds (dry weight g/m^2).

FYM fertilizer increased the dry weight of grassy, broad-leaved and total weeds by 105.5, 50.4 and 65.9 % in the first season, respectively, and by 64.5, 39.6 and 47.8 % in second season, respectively, compared with unfertilized treatment. The reduction in the dry weight of the above mentioned weeds in soybean fields might be due to increasing the vegetative growth of soybean plants, which subsequently inhibited the weeds growth. Similar results were obtained by Salas *et al*. (1997) who indicated that increasing nitrogen increased the dry weight of weeds. Weed population decreased by more than 50% by applying the bioactive organic fertilizer on soil surface (Hui-lian *et al*. 2009).

Pendimethalin (1.7 l/fed), Prometryn (1.0 l /fed), Metolachlor (1.0 l /fed.) followed by Metribuzin (300 g /fed.) significantly reduced dry weight of grassy weeds by 67.3, 65.1, 56.7 and 47.9 % in the first season , respectively, and 50.4, 54.0, 44.2 and 42.4 % in the second season, repetitively. While, Metribuzin, prometryn, Metolachlor and Pendimethalin reduced the dry weight of broadleaf weeds by 50.3, 43.4, 41.6 and 39.8 and % in the first season, respectively. Meanwhile, Pendimethalin, Prometryn, Metolachlor and Metribuzin decreased the same weeds by 41.8, 39.2, 35.6 and 34.2 % in the second season, respectively.

Prometryn, Pendimethalin , Metribuzin and Metolachlor reduced the total weeds percentage by 51.2, 49.7, 49.4 and 47.0 % in 1st season, respectively. While, Pendimethalin,Prometryn, Metolachlor and Metribuzin decreased the total weeds by 44.9, 44.6, 38.7 and 37.2 % in the 2nd season, respectively. These findings are consistent with those obtained by Sha *et al.*(2004).

3.1. 2. Nodulation

Results presented in Table (4) show that application of FYM and NPK fertilizers significantly increased the number and dry weight of active nodules/ plant compared to unfertilized treatment. Increases in the number and dry weight of active nodules/ plant by FYM were 25.4, and 13.7 %, respectively, and by NPK fertilizers were 30.1 and 14.3% in the first season, respectively, compared with nonweeded treatment.

The same trend was observed in the second season which were 41.1 and 27.0, respectively, with FYM and 36.4 and 13.6 %, respectively, with NPK fertilizers. Similar results were obtained by Soliman *et al*. (1995), Mohamed and Ezzat (1996), Zayed (2003) and Agha *et al.* (2004).

Number of active nodules significantly decreased with the application of prometryn, Pendimethalin, Metolachlor and Metribuzin treatments. These reductions were 21.3, 19.3, 18.2 and 129 % in the first season, respectively, compared with unweeded treatments. In the second season, application of Metolachlor, Prometryn, Metribuzin and Pendimethalin decreased the number of active nodules by 24.4, 20.9, 18.7 and 18.4 %, respectively, compared with unweeded. The same trend was found in decreasing the active nodules and dry weight per plant with the application of Prometryn, Pendimethalin , Metolachlor and Metribuzin by 17.9, 17.9, 14.3 and 10.7 % in the first season, respectively compared with unnweeded. While, application of Pendimethalin, Metribuzin , Metolachlor and Prometryn decreased the active nodules and dry weight per plant by 14.3, 10.7, 10.7 and 7.1 % in the second season, respectively compared with unweeded.

These results indicated that nodulation of soybean plants is sensitive to the four tested herbicides, as confirmed by González *et al.*, (1996) who reported that the risk of herbicide toxicity to microorganisms may be higher since the metabolism products can inhibit biochemical processes related to symbiosis between plants and microorganisms. Bollich *et al.* (1985) reported that Metribuzin reduced soybean nodulation and N2 fixation rate by 50%.

3.1. 3. Microorganisms

The results in Tables (5& 6) and Figs (1-8) showed that application of FYM and NPK fertilizers significantly increased the microbial populations (Bacterial, Actinomycetes, Azotobacter and fungal). In contrast, application of all herbicides significantly decreased the previous traits.

FYM and NPK fertilizers significantly increased bacterial population (10^6 cfu/g soil) by 37.8 and 16.8 % at 20 DAT by 32.9 and 12.7 % at 40 DAT and 26.8 and 15.6 % at 60 DAT in the first season, respectively, compared to the control (no fertilizer). In the second season, FYM and NPK fertilizers significantly increased the bacterial population (10^6 cfu/g soil) by 17.0 and 11.4 % at 20 DAT by 26.0 and 13.3 %, at 40 DAT and 18.8 and 10.6 %, at 60 DAT, respectively compared to the control.

The present results in Table(5) showed that

Table (4): Effect of fertilizers and herbicides on the active nodules/ plant at 60 days after sowing in 2012 and 2013 seasons.

Treatments	Number of active nodules/ plant		Weight of active nodules /plant	
	2012	2013	2012	2013
Fertilizers				
NPK fertilizer	50.6	50.4	2.4	2.5
FYM fertilizer	55.8	56.0	2.9	3.0
Un-fertilized	44.5	39.7	2.1	2.2
L.S.D at 0.05	**3.57**	**6.23**	**0.13**	**0.19**
Weed control treatments				
Pendimethalin at 1.7 cm^3/fed.	47.4	47.6	2.3	2.4
Prometryn at 1.0 l/fed.	46.2	46.1	2.3	2.6
Metolachlor at 1.0 l/fed.	48.0	44.1	2.4	2.5
Metribuzin at 300 cm^3/fed.	51.1	47.3	2.5	2.5
Unweeded treatment	58.7	58.3	2.8	2.8
L.S.D at 0.05	**5.33**	**9.13**	**0.23**	**0.25**

Table (5): Effect of fertilizer and herbicides on the total bacterial, and actinomycetes populations.

Treatments	Bacterial population (10^6 cfu/g soil)						Actinomycetes population (in 10^4 cfu/g soil)					
	20 days		40 days		60 days		20 days		40 days		60 days	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Fertilizers												
NPK fertilizer	22.9	30.2	26.7	34.0	42.2	37.7	8.6	5.7	6.1	6.9	5.1	4.1
FYM fertilizer	27.0	31.7	31.5	37.8	46.3	40.5	10.1	7.0	7.8	7.3	5.3	5.1
Un-fertilized	19.6	27.1	23.7	30.0	36.5	34.1	6.7	4.7	5.7	4.9	4.5	3.7
L.S.D at 0.05	**3.25**	**n.s**	**3.02**	**2.04**	**4.43**	**1.86**	**0.31**	**1.25**	**0.98**	**1.10**	**n.s**	**0.26**
Herbicides												
Pendimethalin at 1.7 cm^3/fed.	22.0	30.2	30.1	38.2	42.2	42.3	8.8	4.7	5.1	6.3	3.9	2.4
Prometryn at 1.0 l/fed.	14.6	20.3	19.3	24.2	33.9	29.6	6.6	4.2	4.6	4.4	2.7	2.0
Metolachlor at 1.0 l/fed.	16.7	25.6	20.1	28.1	43.2	30.4	8.3	5.6	6.0	5.0	3.6	2.9
Metribuzin at 300 cm^3/fed.	18.1	23.7	19.7	27.4	42.6	31.2	8.1	6.2	5.4	5.6	3.8	3.0
Un-weeded treatment	44.4	48.6	47.3	51.7	46.6	53.7	10.7	7.9	11.6	10.4	10.9	11.3
L.S.D at 0.05	**3.20**	**2.38**	**3.03**	**2.30**	**5.01**	**1.93**	**1.22**	**1.92**	**1.05**	**1.17**	**1.22**	**1.37**

the application of Prometryn, Metolachlor, Metribuzin e and Pendimethalin significantly reduced the total bacterial population (10^6 cfu/g soil) in the soil at 20 DAT by 67.1, 62.4, 59.2 and 50.5 %, respectively, in the first season compared to the untreated. Thus, Prometryn, Metribuzin, Metolachlor and Pendimethalin treatments caused a reduction in the total bacterial population which were 58.2, 51.2, 47.3 and 37.9 % in the second season, respectively compared to the untreated. The same trend was observed at 40 and 60 DAT in both seasons.

FYM organic fertilizer increased significantly the actinomycetes population (10^4 cfu /g soil) by 50.7, 36.8 and 17.8 %, at 20, 40 and 60 DAT in the first season, respectively, and by 48.9, 49.0 and 37.8 %, at 20, 40 and 60 DAT, respectively, in the second one. Whilst, NPK mineral fertilizers increased significantly the actinomycetes population (10^4 cfu /g soil) by 28.4, 7.0 and 13.3 %, at 20, 40 and 60 DAT in the first season, respectively, and by 21.3, 40.8 and 10.8 %, at 20, 40 and 60 DAT in the second season, respectively as compared to control.

Application of herbicides decreased the numbers of actinomycetes compared to the control. The reduction in the actinomycete populations was slight at 20 DAT and increased at 40 and 60 DAT. Prometryn, Metribuzin, Metolachlor and Pendimethalin significantly reduced actinomycetes population (10^4 cfu/g soil) at 20 DAT by 38.3, 24.3, 22.4 and 17.8 %

Table (6): Effect of fertilizers and herbicides on azotobacter and fungal populations.

Treatments	Azotobacter population (in 106 cfu/g soil)						Fungal population (in 103 cfu/g soil)					
	20 days		40 days		60 days		20 days		40 days		60 days	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Fertilizers												
NPK fertilizer	20.2	23.3	25.0	25.3	34.8	28.5	3.8	8.2	7.3	11.1	11.1	14.5
FYM fertilizer	24.0	25.5	27.4	27.5	38.8	33.1	5.1	10.4	8.7	12.9	13.7	16.2
Un-fertilized	17.5	20.7	20.6	22.3	32.4	26.7	2.9	7.1	7.0	9.0	9.8	12.3
L.S.D at 0.05	1.65	3.37	2.67	2.90	2.74	0.88	0.71	1.29	0.86	2.50	2.08	2.51
Herbicides												
Pendimethalin at 1.7 cm3/fed.	24.6	25.4	33.0	24.2	36.8	32.2	3.1	4.4	7.0	10.2	10.3	14.3
Prometryn at 1.0 l/fed.	15.0	15.7	15.4	17.7	26.2	20.0	2.8	6.3	5.6	7.9	10.1	10.9
Metolachlor at 1.0 l/fed.	13.9	15.9	16.8	18.1	35.2	22.8	3.6	8.1	6.7	10.4	12.6	13.9
Metribuzin at 300 cm3/fed.	15.2	19.1	17.3	19.2	36.9	21.9	3.9	8.8	8.0	11.4	10.8	15.2
Un-weeded treatment	34.1	38.9	39.1	46.0	41.0	50.2	6.4	11.1	11.1	15.1	13.9	17.3
L.S.D at 0.05	2.01	1.69	2.24	2.24	2.62	2.48	0.73	1.72	1.16	1.72	2.15	2.30

in the first season, respectively, compared to the untreated. Meanwhile,Prometryn,Pendimethalin, Metolachlor and Metribuzin treatments reduced actinomycetes population by 46.8, 40.5, 29.1 and 21.5 % in the second season, respectively, compared to the control. The same trend was observed at 40 and 60 DAT in both seasons.

The present results showed that Prometryn herbicide, had an inhibitory effect on the numbers of actinomycete populations compared to other herbicides and the control. FYM and NPK fertilizers significantly increased the azotobacter population (10^6 cfu /g soil) by 37.1 and 15.4 % at 20 DAT, respectively, 33.0 and 21.4, % at 40 DAT, respectively, and 19.8 and 7.4 % at 60 DAT, respectively, compared to control in the first season. In the second season, FYM and NPK fertilizers significantly increased azotobacter population (10^6 cfu /g soil) by 23.2 and 12.6 % at 20 DAT, respectively 23.3 and 13.5 %, at 40 DAT and 24.0 and 6.7 %, at 60 DAT, respectively, compared to control.

The results in Table (6) idicate that the application of Metolachlor, Prometryn, Metribuzin and Pendimethalin caused greater reduction in azotobacter population (10^6 cfu/g soil) present in the soil at 20 DAT, by 59.2, 56.0, 55.4 and 27.9% in the first season, respectively, compared with the untreated. Thus, Prometryn, Metolachlor, Metribuzin and Pendimethalin treatments reduced azotobacter population by 59.6, 59.1, 50.9 and 34.7 % in the second season , respectively compared to the untreated. The same trend was observed at 40 and 60 DAT in both seasons.

Results in Table (6) showed that the application of FYM and NPK fertilizers significantly increased the population of soil fungi at 20 DAT by 75.9 and 31.0 %, by 24.3 and 4.3 %, at 40 DAT and by 39.8 and 13.3 %, at 60 DAT in the first season**,** respectively. Meanwhile, the prevoius fertilizers increased the population of soil fungi by 46.5 and 15.5 % at 20 DAT, respectively, 43.3 and 23.3 %, at 40 DAT respectively, and 31.7 and 17.9 %, at 60 DAT**,** respectively in the second season compared with control.

The results in Table (6) showed that all the used herbicides decreased the population of soil fungi compared with the control. Application of Prometryn, Pendimethalin , Metolachlor and Metribuzin caused a greater reduction in soil fungi population (10^3 cfu /g soil) at 20 DAT by 56.3, 51.6, 43.8 and 39.1% in the first season, respectively compared to the untreated. Thus, Pendimethalin , Prometryn, Metolachlor and Metribuzin reduced soil fungi population by 60.4, 43.2, 27.0 and 20.7 %, respectively, in the second season compared to the untreated. The same trend was observed at 40 and 60 DAT in both seasons. The present results are in agreement with those reported by Gawronska (1997), Barabasz *et al*. (2002), Miloševic and Govedarica (2002), Scholter *et al*. (2003), Lv *et al*. (2005), Cong *et al*. (2006), Janssens *et al*. (2010) and Khuntia *et al* (2013) .

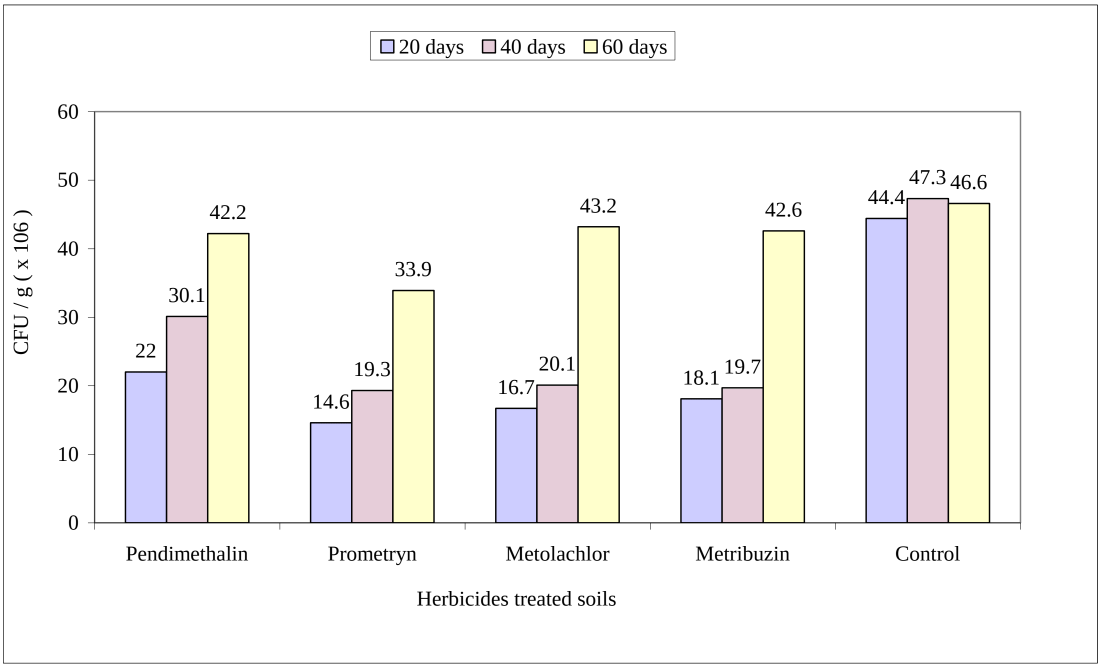

Fig. (1): Effect of herbicides on soil bacterial populations in 2012 season.

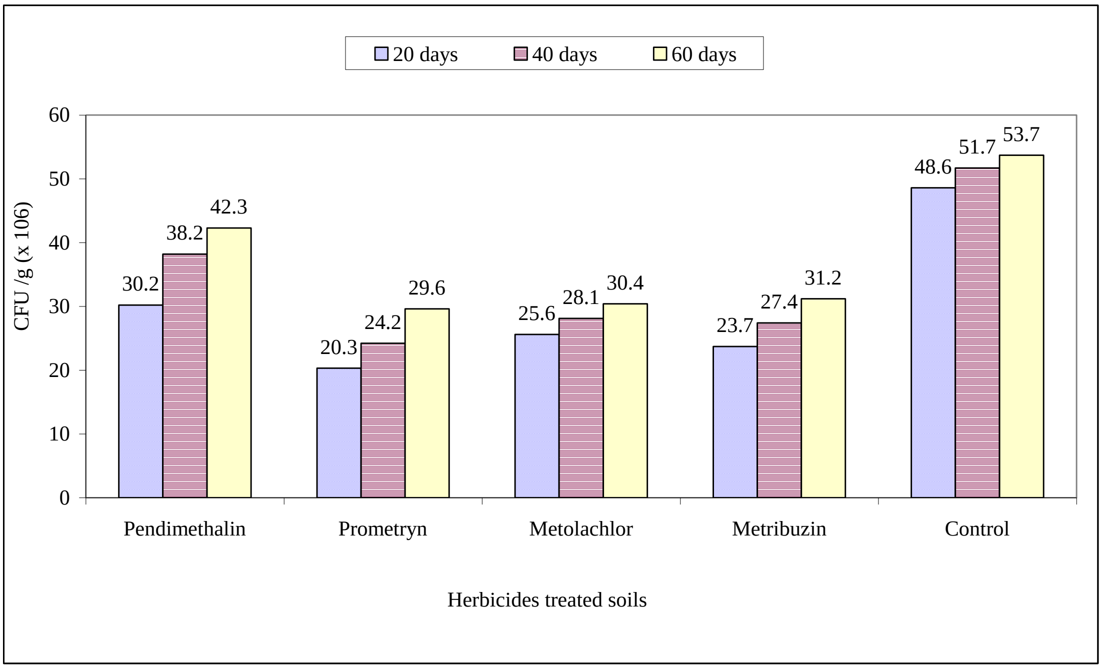

Fig. (2): Effect of herbicides on soil bacterial populations in 2013 season.

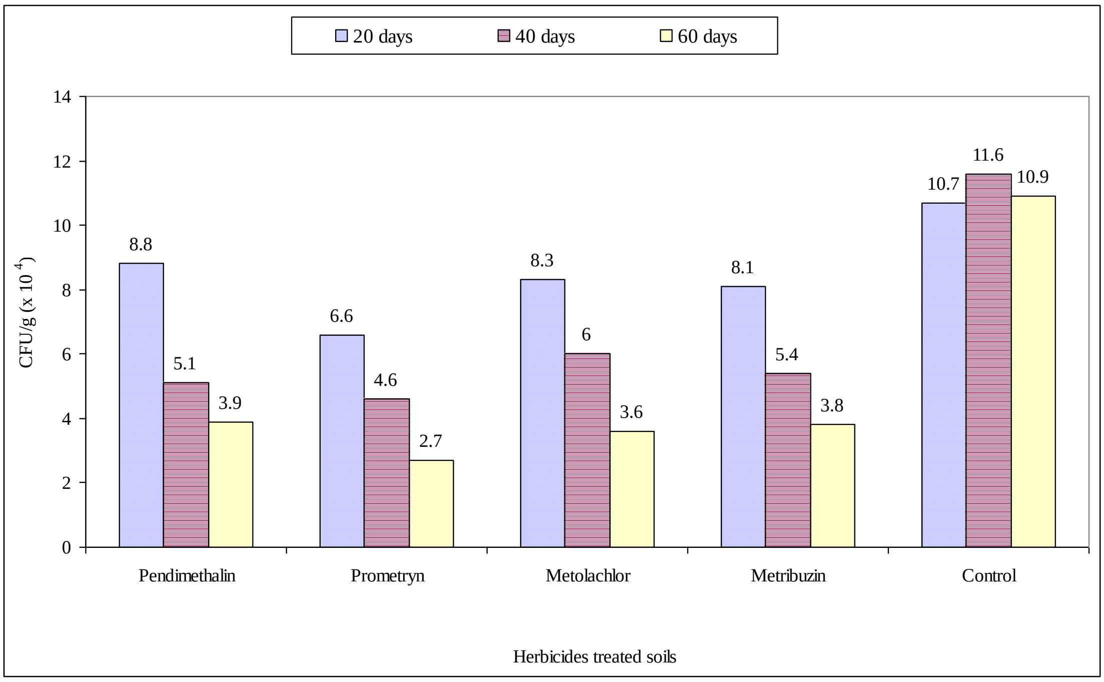

Fig. (3): Effect of herbicides on soil actinomyces populations in 2012 season.

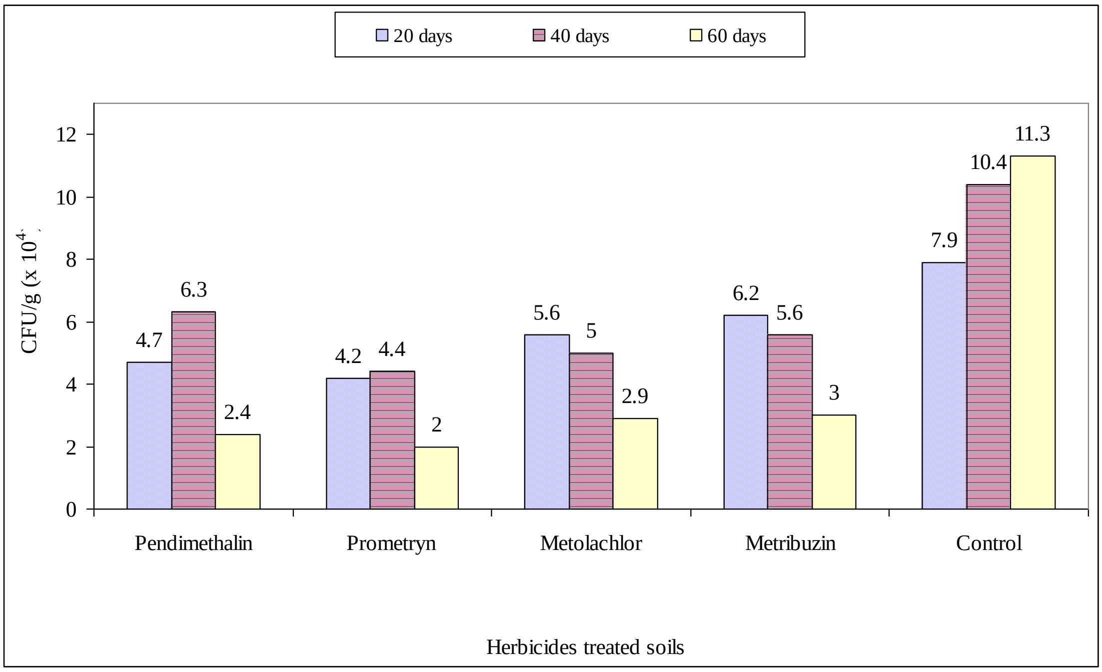

Fig. (4): Effect of herbicides on soil actinomyces populations in 2013 season.

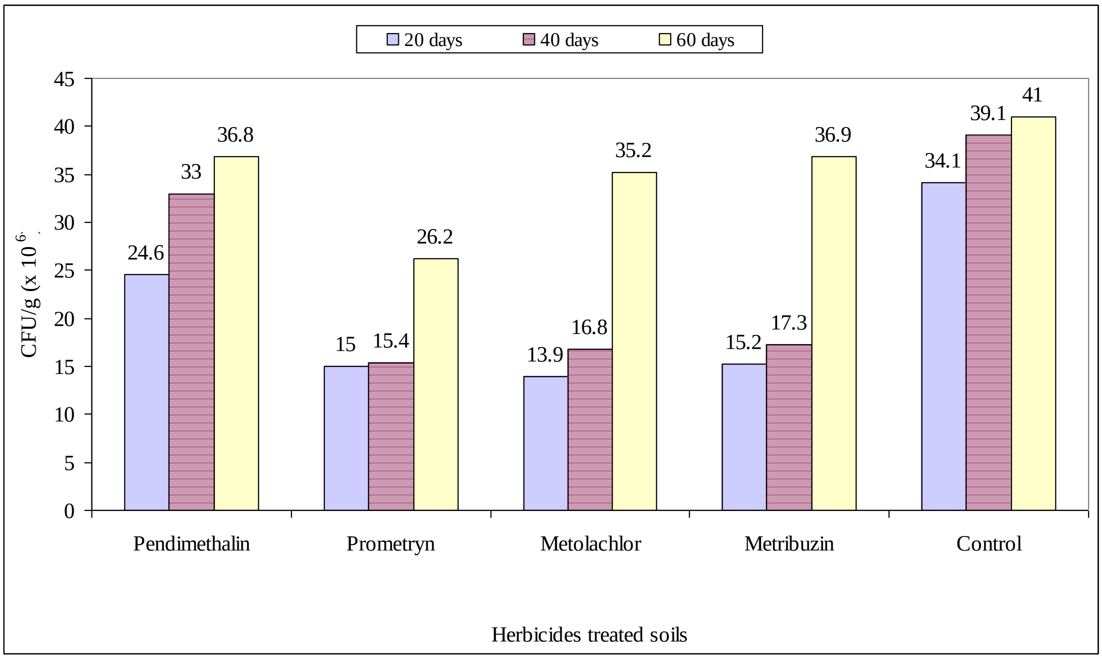

Fig. (5): Effect of herbicides on soil azotobacter populations in 2012 season.

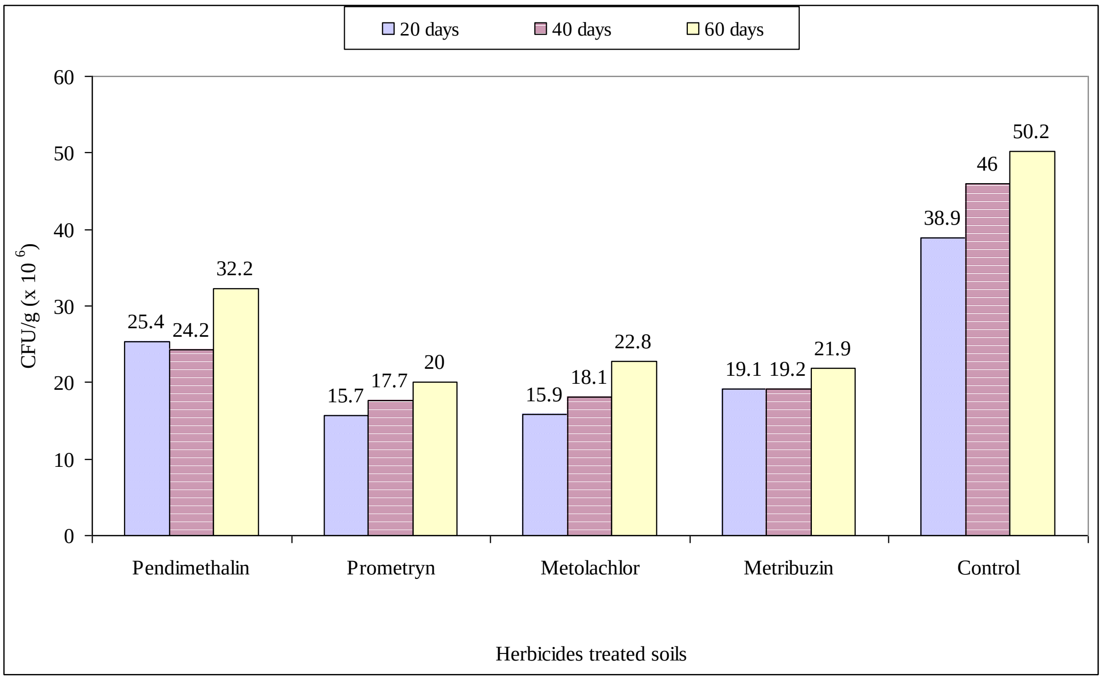

Fig. (6): Effect of herbicides on soil azotobacter populations in 2013 season.

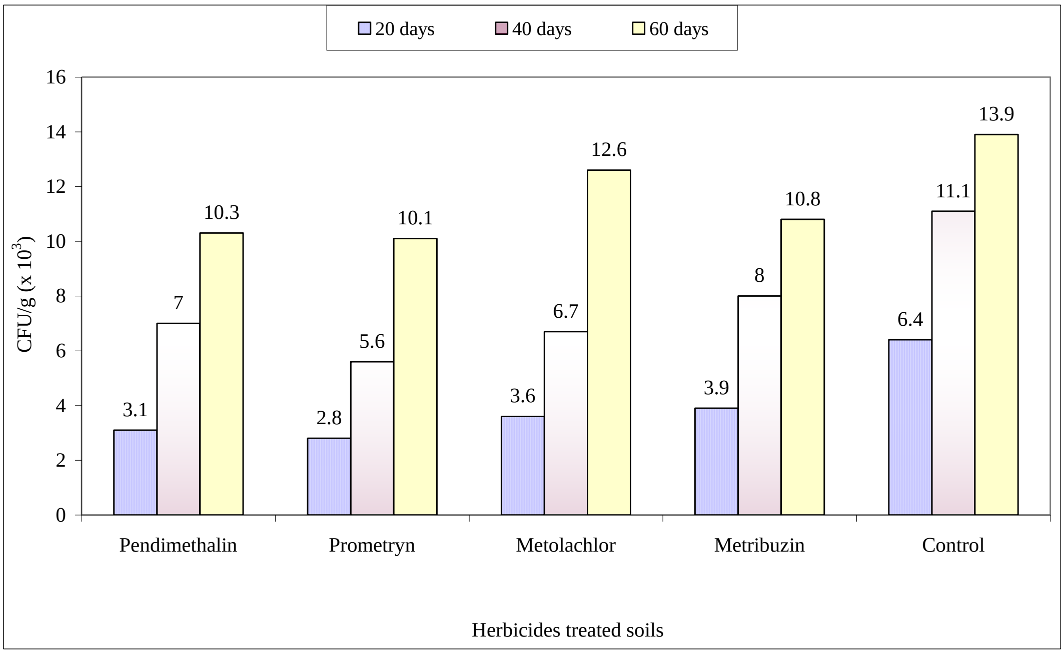

Fig. (7): Effect of herbicides on soil fungal populations in 2012 season.

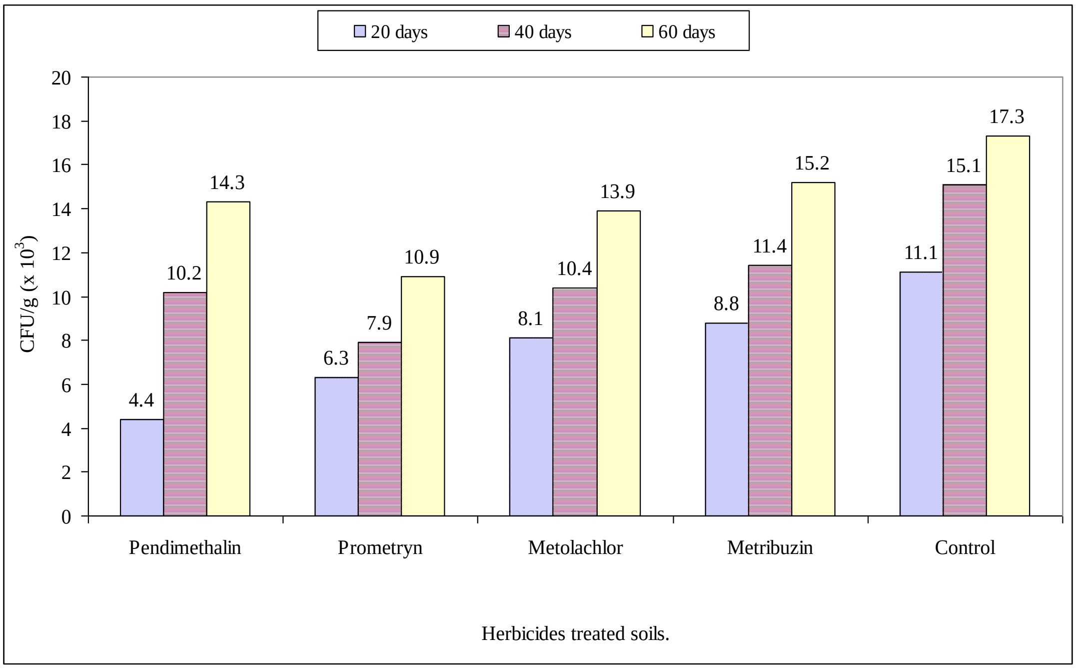

Fig. (8): Effect of herbicides on soil fungal populations in 2013 season.

3.1. 4. Soybean yield, yield components

Results presented in Tables (7) and (8) showed that the application of fertilizers and herbicides significantly affect the soybean yield and its attributes. FYM fertilizers effect on soybean yield and its attributes was significant in both seasons except with plant height in the first season. Application of FYM gave the superior values for all the studied characteristics. In regard to seed yield (ton /fed.) in both seasons, the higher values (37.9 and 40.9 %) were obtained by FYM fertilizers compared to nofertilizer in both seasons, respectively. This in turn, accelerated the vegetative growth, enhances the photosynthetic activity which eventually form the carbohydrate pools, yield and yield components were subsequently increased. The results are also in good agreement with those obtained by Mohamed and Ezzat (1996), Agha *et al.* (2004), Hoda (2009) and Janssens *et al*. (2010).

Table (7): Effect of fertilizers and herbicides on yield components of soybean

Treatments	Plant height (cm)		Pods number /plant		Pods weight /plant (g)		Seeds weight /plant (g)		100 Seed Weight (g)	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Fertilizers										
NPK fertilizer	97.6	90.0	63.3	62.2	92.4	84.1	79.1	71.5	21.3	21.7
FYM fertilizer	100.8	100.8	70.5	72.1	101.7	92.2	87.9	80.2	22.5	23.1
Un-fertilized	97.4	89.7	44.7	44.0	79.0	69.1	66.3	57.1	19.5	19.6
L.S.D at 0.05	**n.s**	**9.21**	**2.7**	**8.39**	**9.7**	**3.53**	**14.5**	**4.63**	**0.59**	**0.44**
Herbicides										
Pendimethalin at 1.7 cm^3/fed.	100.6	93.4	63.1	60.2	93.4	76.8	80.7	65.4	21.5	21.7
Prometryn at 1.0 l/fed.	94.6	94.9	59.1	64.0	96.6	86.0	83.1	75.4	21.7	22.0
Metolachlor at 1.0 l/fed.	100.8	93.6	59.3	65.0	96.9	78.9	84.7	67.7	21.4	21.7
Metribuzin at 300 cm^3/fed.	102.4	93.1	61.8	61.7	97.0	80.2	84.1	67.7	21.5	21.5
Unweeded treatment	94.7	92.5	54.1	46.3	71.2	87.1	56.2	71.9	19.5	20.2
L.S.D at 0.05	**n.s**	**n.s**	**n.s**	**7.36**	**8.6**	**n.s**	**9.0**	**n.s**	**0.76**	**0.68**

Table (8) : Effect of fertilizers and herbicides on soybean yield and NPK seed contents.

Treatments	Seed yield ton/fed		Seed contents %					
			N		P		K	
	2012	2013	2012	2013	2012	2013	2012	2013
	Fertilizers							
NPK fertilizer	2.15	2.25	5.48	5.45	0.343	0.336	3.04	3.18
FYM fertilizer	2.69	2.79	5.64	5.72	0.357	0.369	3.39	3.55
Un-fertilized	1.95	1.98	4.77	4.45	0.284	0.262	2.68	2.72
L.S.D at 0.05	**0.08**	**0.24**	**0.33**	**0.24**	**0.01**	**0.01**	**0.27**	**0.16**
	Herbicides							
Pendimethalin at1.7 cm^3/fed.	2.30	2.56	5.47	5.43	0.346	0.349	3.24	3.30
Prometryn at 1.0 l/fed.	2.27	2.25	5.64	5.56	0.344	0.346	3.36	3.34
Metolachlor at 1.0 l/fed.	2.29	2.40	5.52	5.33	0.335	0.331	3.06	3.11
Metribuzin at 300 cm^3/fed.	2.41	2.37	5.52	5.20	0.334	0.314	3.00	3.20
Un-weeded treatment	2.06	2.12	4.77	4.52	0.281	0.272	2.53	2.82
L.S.D at 0.05	**0.17**	**0.21**	**0.17**	**0.20**	**0.02**	**0.02**	**0.16**	**0.17**

It can be seen in Tables (7&8) that all herbicides significantly increased growth characteristics and yield of soybean except plant height, pods number in the first season and plant height, pods weight per plant^{-1} and seed weight per plant^{-1} in the second one. All herbicides gave the superior values for all studied characteristics compared to un-weeded treatment in both seasons.

In addition, application of Prometryn was the best treatment to increase 100-seed weight compared to un-weeded treatment in both seasons. On the other hand, Metribuzin, Pendimethalin and Metolachlor treatments had the highest seed yield (ton/ fed.$^{-1}$) in the first season and Pendimethalin , Metolachlor and Metribuzin in the second season compared with the un-weeded treatment. These treatments increased seed yield over un-weeded treatment by 17.0, 11.7 and 11.2 % in the first season, respectively, and by 20.8, 13.2 and 11.8 % in the second one, respectively. Superiority of these treatments is correlated with their efficiency for controlling soybean associated weeds, limiting weeds infestation and minimizing weed competition.

FYM and NPK fertilizers caused significant increase in the NPK contents in the seeds compared with unfertilized treatments in both seasons (Table 8). FYM fertilizer gave the highest values of NPK contents in the seeds followed by NPK fertilizer compared with the unfertilized treatments in both seasons.

Results presented in Table (8) showed that weed control treatments increased the mean value of NPK contents (%) in seeds in both seasons. Application of Prometryn gave the highest values of N content (%) in the seeds by 18.2 and 23.0 % in both seasons, respectively and Pendimethalin for P content (%) in the seeds (23.1 and 28.3 %) in both seasons, respectively. Application of Prometryn gave the highest values of K content (%) in seeds (32.8 and 18.4 %) in both seasons, respectively, compared with un-weeded treatment. Weed control chemically may be increased amount of nutrients absorbed by the roots which resulted in increased NPK contents in soybean seeds. Weed control mechanically or chemically may be increased amount of nutrients absorbed by the roots which resulted in increased NPK contents in soybean seeds.

3.2. Interaction between fertilization and weed control treatments

All interactions effects between fertilizers and weed control treatments on all characteristic study were significant at (0.05) level on the population of soil fungi at 20 and 40 DAT in the first season, dry weight of broad-leaf, total weeds and N content % in the seeds in the second season, meaning that the two factors act independently and their data were excluded (Table 9). All herbicides gave the highest reduction on dry weight of broad-leaf and total weeds under non- fertilizing (control).

Results in Table (9) showed that all interactions between non-fertilizing and prometryn, Pendimethalin, Metolachlor and Metribuzin gave the highest reduction in dry weight of broad-leaf by 62.2, 58.8, 55.8 and 52.7% and total weeds by 67.7, 63.0, 59.7 and 56.4 %, respectively compared to FYM fertilizers with un- treated.

Interactions between FYM fertilizers with the un-treated gave the highest values of soil fungi

Table(9): Effect of the interaction between fertilization and weed control treatments on the number and weight of nodules/plant in 2012 season and broad leaf, total weeds (g/m^2) and N seed content % in 2013 season.

Fertilization	Weed control	2012 season		2013 season		
		Fungal population (in 10^3 cfu/g soil)		Broad-leaf weeds (g/m^2)	Total Weeds (g/m^2)	N Seed contents %
		20 days	40 days			
NPK	Pendimethalin at 1.7 cm^3/fed.	3.00	5.0	264.0	378.7	5.630
	Prometryn at 1.0 l/fed.	2.67	6.0	264.3	383.0	5.730
	Metolachlor at 1.0 l/fed.	3.33	6.33	280.7	409.7	5.503
	Metribuzin at 300 cm^3/fed.	4.00	7.67	291.0	418.0	5.697
	Unweeded	6.00	11.33	412.7	640.7	4.693
FYM	Pendimethalin at 1.7 cm^3/fed.	4.00	8.0	262.3	414.7	5.767
	Prometryn at 1.0 l/fed.	3.33	5.67	311.3	455.7	5.987
	Metolachlor at 1.0 l/fed.	4.00	8.0	308.7	480.0	5.960
	Metribuzin at 300 cm^3/fed.	5.00	9.0	300.3	475.7	5.663
	Unweeded	9.33	13.0	510.3	827.0	5.233
Unfertilized	Pendimethalin at 1.7 cm^3/fed.	2.33	8.0	210.3	306.3	4.893
	Prometryn at 1.0 l/fed.	2.33	5.0	193.0	267.0	4.953
	Metolachlor at 1.0 l/fed.	3.33	5.67	225.3	333.3	4.540
	Metribuzin at 300 cm^3/fed.	2.67	7.33	241.3	360.3	4.230
	Unweeded	4.00	9.0	342.0	528.7	3.620
L.S.D. 0.05		0.45	1.22	47.2	60.6	0.33

population at 20 and 40 DAT compared to the un- fertilized with Prometryn.

Interactions between FYM fertilizers and Prometryn herbicide increased N content % in seeds compared to un- fertilized with un-weeded.

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تأثير التسميد وبعض مبيدات الحشائش علي الحشائش والكائنات الحية الدقيقة وإنتاجية فول الصويا

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ملخص

أجريت هذه التجربة في صيف موسمي 2012 و2013 فى مزرعة محطة البحوث الزراعية بجزيرة شندويل – سوهاج بهدف دراسة تأثير التسميد (معدنى- عضوى - بدون تسميد) وبعض معاملات الحشائش (بنديماثين بمعدل 1.7 لتر/ فدان، برومترين بمعدل 1لتر/ فدان ، ميتولاكور بمعدل 1لتر / فدان و ميتربزين بمعدل 300جم / فدان وبدون معاملة) على مقاومة الحشائش والعقد البكتيرية والكائنات الحية الدقيقة ومحصول فول الصويا ومكوناته. أظهرت النتائج مايلى:-أدى استخدام الأسمدة العضوية لحدوث زيادة معنوية في الوزن الجاف للحشائش الضيقة والعريضة الأوراق بعد 30 يوم من الزراعة مقارنه بعدم التسميد . وحققت المعاملة بالأ سمدة العضوية زيادة عدد ووزن العقد البكتيرية النشطة/ نبات وعدد ووزن القرون/نبات وعدد ووزن البذور/قرن ومحصول الفدان من البذور(طن/ ف) وكذلك زيادة محتوي البذور من النيتروجين والفسفور والبوتاسيوم في كلا الموسمين مقارنه بمعامله عدم التسميد. كما أدت معاملات مكافحة الحشائش بالمبيدات الي تقليل الوزن الجاف للحشائش الضيقة والعريضة الأوراق وعدد العقد البكتيرية النشطة علي جذور نباتات فول الصويا. وعلى العكس من ذلك زيادة كل من عدد ووزن القرون/نبات وعدد ووزن البذور / قرن و محصول البذور(طن / ف) وكذلك محتوي البذور من النيتروجين والفسفور والبوتاسيوم مقارنه بمعامله المقارنة فى الموسمين.

توصي هذه الدراسة باستخدام مبيد بنديماثين بمعدل 1.7 لتر/ فدان أو ميتربزين 300جم / فدان مع السماد العضوى للحصول علي أفضل مقاومه للحشائش وأعلي محصول للفدان من بذور فول الصويا.

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