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Influence of Biofertilizers and Weed Control Treatments on Weeds and Soybean Productivity

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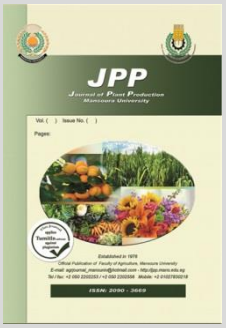

ABSTRACT

This work was conducted during the 2019 and 2020 seasons at the Agricultural Research Station in Sakha, Egypt to study the effect of various biofertilizers (Rhizobacterin and non-fertilized) and weed control treatments (pendimethalin 1.7 L/acre, Prometric n 1.25 L/acre, Pendimethalin). 1.7 L/acre + Fluazifob-p-butyl 1.5 L/acre, Prometrine 1.25 L/acre + Fluazifob-p-butyl 1.5 L/acre, scrabble 15 days after sowing (DAS) + Fluazifob-p-butyl 1.5 L/acre wice manual hoeing and control (untreated assay) on soybean nodules, weeds and yield. The results indicated that biofertilization (Rhizobacterin) and weed control treatments increased the nodule number, weight, plant height, number of branches, number and weight of pods, seed yield and seed yield/acre. of soybeans in the two years compared with un-Rhizobacterin plants. Moreover, the content of protein, oil, nitrogen and protein in soybean seeds increased in the two seasons. From the results obtained, bendemethalin 1.7 L/acre + fluazifob-p-butyl 1.5 L/acre, manual hoeing twice at 21, 35 days post-seeding (DAS) and cribbing 15 days after sowing + fluazifob-p-butyl 1.5 L / Feeding was the best treatment which gave the best weed control. Therefore, it is recommended to search using the Rhizobacterin in vivo fertilization, soybean plants were treated with pendimethalin 1.7 L/acre + fluazifop-p-butyl 1.5 L/acre, manual hoeing twice at 21, 35 days after sowing (DAS) and scribbling 15 days after Sowing + fluazifob-p-butyl 1.5 L/acre gave the highest soybean seed yield and the best weeding control under experimental conditions

Keywords: Soybean Biofertlizers – Herbicides, Weed control.Productivity

INTRODUCTION

Soybean (*Glycine max* L.) is most important oilseed and beancrop in the world. Special attention should be directed toward the proper choice of management practices to increase both seed yield and oil production. The cultivated area in the whole season of 2018 was 31 thousand feds, which produced 36 thousand tons, by an average of 1.16 ton / fed. (The yearly book of economic and statistics of ministry of agriculture in Egypt 2019). Successful weed control is an important practice practices for soybean production. Soybean production losses due to weeds have been one of the major limiting factors where, weeds compete with soybeans at early-season competition being most critical. During the first six weeks after planting, weed competition caused The most of the yield reduction.. However, this requires weed management practices in all growth stage of soybean production. Good soybean weed control involves utilizing all methods available and combining them in an integrated weed management system (Ferrell *et al.*, 2008). Huda (2009) revealed that Rhizobacterien significantly increased plant height, pod numbers/plant, plant, seed number/pod, seed weight/plant, 100-seed weight, seed yield/fed, nitrate reductase activity, protein and oil % in soybean. Abd El Hamid and El Metwally (2008) recorded that two-hand hoeing decreased the dry weight of broad-leaved, grassy and total weed by 98.3, 92.6 and 96.9%, respectively. Tilak *et al.* (2006) revealed that the dual inoculation with *Pseudomonas putida*, *P. fluorescens* or *Bacillus cereus* on pigeonpea (*Cajanus cajan* (L) Milsp.), resulted in significantly increase in enzyme activity. Tapas and Gupta (2005) stated that seed and straw yield of the crop soybean was increased with single inoculation of Rhizobium. Zayed (2003) noted that straw, seed yield, 100-seed weight, nodule fresh weights and nodule numbers were significantly higher by inoculation with Rhizobia than un-inoculated seeds. Pandya *et al.* (2005) indicated that hand-weeding at 20 and 40 days after planting, fenoxaprop-p + one hand-weeding at 40 DAS increased the pods/plant, seeds/pod, seed weight/plant, seed, straw and biological yields and significant reduced weed dry matter. Agha *et al.* (2004) stated that 50 kg N/ha + inoculation of R. 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. Raut *et al.* (2004) found that seed dressing with Rh, PSB and Mo in combination with half or full dose of RDF improved significantly number of pods plant^{-1}, weight of pods plant^{-1}, 100-seed weight and seed yield plant^{-1}. Galal (2004) showed that the application of hand hoeing significantly decreased weeds dry weight compared to the untreated treatment. Hand hoeing gave the lowest weeds dry weight Peneva (2003) showed that the seed fat content increased with the application of fluazifop-p-butyl 0.375 kg. El-Quesni *et al.* (1992) revealed that hand hoeing increased oil content of seeds soybean.

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Therefore, this work aimed to study the effect of various biofertilizers and weed control treatments on soybean nodules, weeds and productivity of soybean

MATERALS AND METHODS

The experimental work was carried out during 2019 and 2020 seasons in Sakha Research Station Kafr-Elsheikh, Governorate, Egypt to investigate the effect of biofertlizers and some weed control treatments on weeds, yield and yield components of soybean (*Glycine max* L cv.). A split plot design with four replications was used in both seasons. Biofertlizers: Rhizobacterin and Un-fertilized were allocated in the main_ plots which were:

1- Rhizobacterin (N_2-fixing bacteria) at the rate of (50g/kg seed).
2- Un-fertilized.

The sub _plots were assigned to weed control treatments which were:

1- Stomp 50% EC (pendimethalin 1.7 L/Fed.), applied after planting (AP)and before irrigation.
2- Gesagard 50 % SC (prometryn 1.25 L/Fed.), applied at 5% emergence of potato.
3- Stomp 50% EC (pendimethalin 1.7 L/Fed.), applied AP and before irrigation. + Fusilade forte 15 % EC (fluazifop-p-butyl 1.4 L/Fed.),applied at 30 days after planting (DAP).
4- Gesagard 50 % SC (prometryn 1.25 L/Fed.), applied at 5% emergence of potato. + Fusilade forte 15 % EC (fluazifop-p-butyl 1.4 L/Fed.),applied at 30 DAP.
5- Scrabble after 15 days from sowing (DAS) + Fusilade forte 15 % EC (fluazifop-p-butyl 1.4 L/Fed.),applied at 30 DAP.
6- Hand hoeing twice at 15 and 30 days after sowing (DAS)
7- Untreated (control)

The experiment area was divided into 21 m2 sub-plots which consisted of five rows of 7 m long and 0.6 m apart. Seeds were planted after inoculation with the recommended treatments. Seeds were planted in 15th and 21th of May in both years, respectively.The recommended doses of NPK were added as the following:nitrogen fertilizer was added at 30 kg N/fed and applied as urea (46.5% N) in one dose before the first irrigation. Phosphorus fertilizer was added as superphosphate (15.5% P_2O_5) at the rate of 22.5 kg P_2O_5/fed before sowing, and potassium as potassium sulphate K_2SO_4 (48% K_2O) was added to the soil before the first irrigation at the rate of 24 kg/fed. The recommended agricultural practices were carried out throughout the two growing seasons.

Recorded data

-Weed characters

Weeds were collected from one m^2 in each sub plot at 65 DAS, separated to grassy and broad-leaved and oven dried at 70 C° until a constant weight to record dry weight of grassy weeds, broad-leaved and total annual weeds (g/m^2).

Soybean characteristics:

- Nodulation:

Fifty- five after planting, soybean root samples were collected and washed from soil particles on 1 mm sieve holes. Number of nodules/plant, fresh weight (active and inactive) nodules/plant (g) and number of nodules inactive were recorded.

- Yield and yield components

At harvest, the following parameters were determined in a sample of 10 random guarded plants from each sub_plot: plant height (cm), number of branches/plant, number of pods/plant, weight of pods/plant (g), weight of seeds/plant (g), number of seed/plant and weight of 100 seeds A bulk seed sample from each

sub- plot was chosen to determine the seeds index. Seed yield (ton/fed) was calculated on plot basis.

- Chemical analyses:

1- Oil content (%): Oil content of soybean seeds was determined by Soxhlet apparatus on dry weight basis as described by Sorenson (1947).

2- Protein content (%): Protein was determined as total nitrogen by Micro-Kjeldahl method according to A.O.A.C. (1975), then N was multiplied by 6.25 (Tripathi *et al.,* 1971) to obtain protein content in soybean seeds.

3- NPK contents (%): NPK ware determined as according to Jackson (1958, 1967).

-Statistical analysis:

Data were subjected to the statistical analysis using analysis of variance method as described by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Effect of biofertilizers and weed control treatments on On weeds:

The dominant grassy weeds were *Setaria viridis* L., *Bra*chiaria repans L and broad-leaved weeds were *Corchorus olitorius* L.and *Amaranthus ascendens* L in both seasons.

Data concerning biofertilization and weed control management of soybean fields during 2019 and 2020 seasons are presented in Table 1. The efficiency of herbicides, as well as, hand weeding was extended to exert a depressing effect on dry weight of soybean weeds.

Table 1. Trade, common and chemical names of the herbicides used in the experiment:

Trade name	Common name	Chemical name
1-Stomp 50% EC	Pendimethalin	N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine
2-Gesagard 50 % SC	Prometryn	N,__N′-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine
3-Fusilade super EC 2.5%	fluazifop-p-butyl	(R)-2-[4-[5-(trifluoromthyl)-2-Pyridinyl]Phenoxy Propanoic.

Biofertilizers caused a significant decrease of the dry weight of grassy, broad-leaved and total weeds in 2019 and 2020 seasons. Rizobacterin minimized the dry weight of grassy, broad-leaved and total weeds by (32, 34 and 33.7%), in first season, while the reduction in the second seaon reached (32.8, 18.9 and 24%), respectively, compared with unfertlized plots. The decrease in dry weight of weeds in soybean might be due to increasing the vegetative growth of soybean plants, which subsequently inhibited the weeds growth. Similarly, Jianmei and Kremer (2006) reported that some biological control agents

including rhizobacteria isolates can inhibit growth of some weed plants without negative effect on crop plants. Weed population decreased more than 50% by applying the bioactive organic fertilizer on soil surface (Hui-lian *et al*.2009).

Weed control treatments significantly reduced the dry weight of grassy, broad-leaved and total weeds in both seasons. It's clear that hand hoeing twice at 15, 30 DAS, and scrabble after 15 days from sowing (DAS) + flauzifop-p-butyl at rate 1.5 l/fed and pendimethalin 1.7 L/f + flauzifop-p-butyl at rate 1.5 l/fed significantly caused depression of grassy weeds by 90.88 and 78% in first season and by 90.87 and 84% in second season, respectively, compared to unweeded treatment (control) (Table 2). Moreover, hand hoeing twice at 15.30 DAS, and scrabble after 15 DAS + flauzifop-p-butyl at rate 1.5 l/fed and pendimethalin 1.7 L/f + flauzifop-p-butyl at rate 1.5 l/fed significantly reduced the dry weight of broad-leaved weeds by 92, 92 and 76 in the first season and by 89, 88 and 82% in the second season respectively compared with unweeded treatment.

Table 2. Soil characterization for the experimental sites:

Seasons	Clay %	Silt %	Sand %	Soil texture %	Ph.	EC	Caco3	Organism	Total Nitra	Ca	Mg	Na	K	Hco3	Cl	SO4
2019	49.24	31.93	19.83	Clay	8.14	2.90	26.33	0.53	0.034	3.34	3.80	7.60	0.44	6.83	6.60	0.33
2020	50.93	32.63	16.44	Clay	8.11	3.20	25.93	0.55	0.03	3.50	4.46	8.00	1.66	7.50	7.46	0.42

It could be concluded that, the best results for weed control in soybean fields can be obtained by hand hoeing twice at 21.30 DAS, scrabble after 15 days from sowing (DAS) + flauzifop-p-butyl at rate 1.5 l/fed and pendimethalin 1.7 L/f + flauzifop-p-butyl at rate 1.5 l/fed Such potent treatments decreased soybean total weeds than unweeded control by 90.80 and 78%, respectively in the 2018 and 90, 87 and 84% in 2019 seasons. Efficency of hand hoeing treatments against weeds could be attributed to the destroying effect of hoeing on annual weeds since these weeds are not capable of regrowth from the underground parts. Similar results were obtained by Pandya *et al.* (2004) and Tiwari *et al.* (2006).

Table 4. illastreated that all interactions between biofertilizer and weed control treatments were pronouncedly affected the dry weight of grassy, broad-leaved and total weeds in both seasons. Hand hoeing twice, Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed and Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed gave the highest reduction on dry weight of grassy, broad-leaved and total weeds under biofertilizer in both seasons.

Table 3. Effect of biofertilization on dry weight of grassy, broad-leaved and total annual weeds in 2019 and 2020 seasons

Biofertlizers	Dry weight of weeds g/m^2					
	grassy weeds		Broad-leaved weeds		Total weeds	
	2019	2020	2019	2020	2019	2020
Rhizobacterin	112.3	90.7	180.1	139.7	292.4	230.4
Unfertilized	165.7	135.0	275.3	172.2	441.0	307.2
L.S.D. at 5%	12.11	11.01	28.87	8.18	31.06	17.17

Table 4. Effect of weed control tratments on dry weight of grassy, broad-leaved and total weeds (g/m^2) at 65 days after sowing in 2019 and 2020 seasons.

Treatments	Grassy weeds		Broad-leaved weeds		Total weeds			
	2019	2020	2019	2020	2019	% control	2020	% Control
Pendimethalin 1.7 l/fed.	61	59	319	230	380	38	289	41
Prometryn 1.25 l/fed	184	161	169	102	353	42	263	46
Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed	50	42	89	45	139	78	87	84
Prometryn 1.25 l/fed + fluazifop-p-butyl 1.5 l/fed	76	109	106	70	182	71	179	75
Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed	40	30	30	30	70	88	60	87
Hand hoeing twice at 15, 30 days after sowing (DAS)	40	30	31	29	71	90	59	90
Untreated (control)	232	223	372	257	604	0	480	0
L.S.D. $_{0.05}$	13.88	12.66	21.78	17.97	28.44		21.99	

Data in Table 5 represented the significant immpact of weed control and biofertilization on number and fresh weight of active and inactive nodules of soybean roots in both seasons. Inoculation of soybean seeds by Rizobecterien caused significant increase in the number, fresh weight of nodules and inactive nodules compared with unfertilized in 2019 and 2020 seasons. Rizobecterien gave the highest values in number of nodules (63.31and 62.65) and weight of nodules (2.51and 2.52g) in the first and second seasons, respectively, compared to unfertilized. Biofertilizer didn't affect the number of inactive nodules in both seasons. These increases in number and fresh weight of nodules were due to inoculation effect, which caused more atmospheric nitrogen fixation that required for crop growth and stimulate microorganism activities the soil to produce more organic compounds. Results of many investigators confirmed these results (Soliman *et al*., 1995; Agha *et al.*, 2004 and Raut *et al*., 2004).

Weed control treatments significantly increased the number and fresh weight of nodules in 2019 and 2020 seasons (Table 5). Hand hoeing twice, Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed and Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed gave the highest values of the number and fresh weight of nodules. The number of nodules reached (49 and 52), (48.8 and 51.12) and (46.39 and 47.05), whereas, fresh weight of nodules amounted to (2.25 and 2.21), (2.20 and 2.17) and (2.12 and 2.23), in the first and second seasons, respectively, compared with control treatment. Analogous values of herbicidal treatments effect on number of inactive nodules were as follows: Prometryn 1.25 l/fed + fluazifop-p-butyl 1.5 l/fed (8 and 7), Pendimethalin 1.7 l/fed (7.92 and), Prometryn 1.25 l/fed (7.58 and 6.50) increased the number of inactive nodules than hand hoeing twice (3.25 and 2.58) and unweeded treatment (3.17 and 2.83) in both seasons, respectively. Similar the data in Table (6) while illustrated

interaction between biofertilization and weed control treatment the best results Hand hoeing twice, Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed and Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed gave the highest values of Number of active nodules, Fresh weight of active nodules g and Number of inactive nodules; conclusions were obtained by (Tilak *et al*. 2006) and (Abd El-Hamid and El-Metwally 2018) found that herbicides applied at higher doses significantly reduced fresh and dry weight of nodules compared to hand hoeing and unweeded treatments

Table 5. Effect of the interaction between bio -fertilization and weed control treatments on grassy, broad-leaved and total weeds (g/m^2) at 65 days after sowing in 2019 and 2020 seasons.

Bio fertilization	Weed control treatment	Grassy weeds (g/m^2)		Broadleaf weeds (g/m^2)		Total dry Weeds(g/m^2)	
		2019	2020	2019	2020	2019	2020
Rhizobacterin	Pendimethalin 1.7 l/fed.	55.0	46.0	254.8	164.8	309.8	210.8
	Prometryn 1.25 l/fed	135.7	113.9	160.5	102.7	296.2	216.6
	Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed	34.7	35.0	50.4	28.9	85.1	63.9
	Prometryn 1.25 l/fed + fluazifop-p-butyl 1.5 l/fed	45.9	53.5	66.6	53.8	112.5	107.3
	Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed	25.3	28.1	25.9	21.3	51.3	49.4
	Hand hoeing twice at 15, 30 days after sowing (DAS)	25.3	28.1	25.9	21.3	51.3	49.4
	Untreated (control)	182.7	156.0	294.9	176.0	477.5	332.0
Unfertilized	Pendimethalin 1.7 l/fed.	78.7	55.9	475.1	332.3	553.8	388.2
	Prometryn 1.25 l/fed	269.8	195.9	199.5	143.3	469.3	339.2
	Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed	86.8	62.5	195.7	66.7	282.5	129.2
	Prometryn 1.25 l/fed + fluazifop-p-butyl 1.5 l/fed	142.3	73.6	216.3	95.8	358.6	169.3
	Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed	75	38	48	35	123	73
	Hand hoeing twice at 15, 30 days after sowing (DAS)	74.8	37.2	47.3	34.8	122.2	72.0
	Untreated (control)	341.5	385.0	517.7	360.7	859.2	745.7
L.S.D. $_{0.05}$		32.52	45.37	42.72	37.27	66.71	74.82

Table 6. Effect of biofertilization on nodules at 55 days after sowing in 2019 and 2020 seasons.

Biofertlizers	Nodules/plant					
	Number of active nodules		Fresh weight of active nodules (g)		Number of inactive nodules	
	2019	2020	2019	2020	2019	2020
Rhizobacterin	63.31	62.65	2.51	2.52	6.67	5.72
Unfertilized	32.87	38.94	1.26	1.35	6.33	5.61
L.S.D. $_{0.05}$	5.28	3.29	0.05	0.16	NS	NS

Table 7. Effect of weed control treatments on nodules at 55 days after sowing in 2019 and 2020 seasons.

Treatments	Nodules/plant					
	Number of active nodules		Fresh weight of active nodules (g)		Number of inactive nodules	
	2019	2020	2019	2020	2019	2020
Pendimethalin 1.7 l/fed.	39.81	41.71	1.82	2.03	7.92	7.16
Prometryn 1.25 l/fed	39.07	39.00	1.87	1.98	7.58	6.50
Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed	46.39	47.05	2.12	2.23	3.33	2.92
Prometryn 1.25 l/fed + fluazifop-p-butyl 1.5 l/fed	42	41	2.2	2	8	7
Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed	48.87	51.12	2.20	2.17	3.19	2.49
Hand hoeing twice at 15, 30 days after sowing (DAS)	49	52	2.25	2.21	3.25	2.58
Untreated (control)	35.82	36.58	1.65	1.74	3.17	2.83
L.S.D. $_{0.05}$	4.04	3.13	0.10	0.13	0.53	0.95

The results in Table 8 showed that biofertlizers could increase soybean plant height, yield and yield components (number of branches/plant, number and weight of pods/plant, number and weight of seeds/pod, weight of seeds/plant g, seed index and seed yield t/fed) in both seasons. Highest values of the previously mentioned parameters were recorded with the application of Rhizobacterin in all treatments in both seasons. Rhizobacterin increased the Plant height cm, Number of branches/plant, Number of pods/plant, Weight of pods/plant g, Number of seeds/pod, Weight of seeds/pod g , in 2019 and 2020 seasons, respectively, compared with unfertilized. This in turn, accelerated the vegetative growth, enhances the photosynthetic activity which eventually form the carbohydrate pools, yield and yield components were increased. The results are agreement with those obtained by Agha *et al.* (2004) and Raut *et al.* (2004).

Data in Table 9 and indicated that weed control treatments caused increased of plant height, number of branches/plant, number of pods/plant, weight of pods/plant g, number of seed/pod and weight of seeds/pod g, in both seasons. Hand hoeing twice, Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed and Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed gave the highest values of seed index in the first and second seasons, respectively, compared with unweeded treatment (control). The aforementioned results indicated that hand hoeing twice, Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed and Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed treatment favors the growth of soybean plants. Superiority of these treatments is correlated with their efficiency for controlling soybean associated weeds, limiting weeds infestation and minimizing weed competition. Similar conclusions were obtained by Bhattacharya *et al*. (2004) and Pandya *et al*. (2005).

Table 8. Effect of the interaction between bio-fertilization and weed control treatments on nodules at 55 days after sowing in 2019 and 2020 seasons.

Bio fertilization	Weed control treatments	Nodules/plant					
		Number of active nodules		Fresh weight of active nodules g		Number of inactive nodules	
		2019	2020	2019	2020	2019	2020
Rhizobacterin	Pendimethalin 1.7 l/fed.	31.81	33.71	1.32	1.53	6.92	6.16
	Prometryn 1.25 l/fed	31.07	31	1.37	1.48	6.58	5.5
	Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed	38.39	39.05	1.62	1.73	2.33	1.92
	Prometryn 1.25 l/fed + fluazifop-p-butyl 1.5 l/fed	34	33	1.7	1.5	7	6
	Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed	40.87	43.12	1.7	1.67	2.19	1.49
	Hand hoeing twice at 15, 30 days after sowing (DAS)	41	44	1.75	1.71	2.25	1.58
	Untreated (control)	27.82	28.58	1.15	1.24	2.17	1.83
Unfertilized	Pendimethalin 1.7 l/fed.	26.81	28.71	1.28	1.49	6.88	6.12
	Prometryn 1.25 l/fed	26.07	26	1.33	1.44	6.54	5.46
	Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed	33.39	34.05	1.58	1.69	2.29	1.88
	Prometryn 1.25 l/fed + fluazifop-p-butyl 1.5 l/fed	29	28	1.66	1.46	6.96	5.96
	Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed	35.87	38.12	1.66	1.63	2.15	1.45
	Hand hoeing twice at 15, 30 days after sowing (DAS)	36	39	1.71	1.67	2.21	1.54
	Untreated (control)	22.82	23.58	1.11	1.2	2.13	1.79
L.S.D. 0.05		32.52	45.37	NS	3.94	0.12	0.18

Yield and yield components.

Table 9. Effect of the interaction between bio-fertilization on growth and yield components of soybean in 2019 and 2020 seasons. .

Biofertlizers	Plant height (cm)		Number of branches/plant		Number of pods/plant		Weight of pods/plant (g)	
	2019	2020	2019	2020	2019	2020	2019	2020
Rhizobacterin	95.33	90.61	2.35	2.43	65.50	59.0	80.70	73
Unfertilized	75.42	75.60	1.55	1.17	45.80	45.75	65.64	55.73
L.S.D. 0.05	7.78	8.61	0.22	0.16	6.75	4.41	6.22	8.12

Data in Table 10 illustrated that the result best in all interactions between biofertlizers and weed control treatments hand hoeing twice at 15, 30 days after sowing (DAS), Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed and Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed gave the highest values on Plant height cm, Number of branches/plan, Number of pods/plant, Weight of pods/plant g, Number of seeds/pod and Weight of seeds/pod g under biofertilizer in both seasons.

Table10. Effect of weed control treatments on growth characters and yield components of soybean in 2019 and 2020 seasons.

Treatments	Plant height cm		Number of branches/plan		Number of pods/plant		Weight of pods/plant (g)		Weight of seeds/plant g	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Pendimethalin 1.7 l/fed.	83.45	78.72	1.91	1.94	54.41	48.22	56.50	51.23	72.40	65.07
Prometryn 1.25 l/fed	80.46	78.22	2.12	1.93	52.05	45.78	56.15	48.39	73.67	65.12
Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed	88.62	93.59	2.00	2.07	62.37	53.10	70.10	61.10	88.77	81.16
Prometryn 1.25 l/fed + flauzifop-p-butyl 1.5 l/fed	85.89	94.58	2.02	2.03	68.06	58.38	66.12	58.68	81.38	72.07
Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed	90.11	101.3	2.11	1.75	79.42	72.38	80.76	70.29	101.6	90.77
Hand hoeing twice at 15, 30 days after sowing (DAS)	93.11	103.3	2.14	1.77	79.42	72.38	81.76	73.29	100.6	91.77
Untreated (control)	71.28	77.97	1.72	1.69	46.36	39.64	52.30	51.72	67.54	60.77
L.S.D. 0.05	7.10	6.22	0.18	0.10	6.45	6.14	6.71	6.69	5.83	7.14

Seed oil content (%)

The results in Table 11. Showed that inoculation of soybean seeds by biofertlizers treatments especially Rhizobacterin caused significant increase in the Weight of seeds/plant g, Seed Index, Seed yield ton/fed, Oil %, Protein% and (NRAµg NO_2/g fw/hr) compared with unfertilized in 2019 and 2020 seasons.

While.data in Table 12 Which shows that the best treatments for weed control led to an increase Weight of seeds/plant g, Seed Index, Seed yield ton/fed, Oil %, Protein% and (NRAµg NO_2/g fw/hr) were hand hoeing twice, Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed and Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed in the two seasons, compared with untreatead treatment. The increase in oil content due to application of herbicides may be attributed to increasing phospholipids formation which is considered one of oil constituents. Similar conclusions were obtained by El-Quesni *et al.* (1992).

Also in Table 13 the interaction between bio-fertilization and weed control treatments shows that the best treatment is bio-fertilization with the use of any of the following treatments: hand hoeing twice, Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed and Pendimethalin 1.7 l/fed + fluazifop-p-butyl. Which led to a significant increase for both weight of seeds/plant g, Seed Index, Seed yield ton/fed, Oil % and Protein%. These results may be revealed that the inoculation of soybean seeds with biofertlizers may be sufficient to supply the bulk of nitrogen and growth promoting substances. Thus,

biofertilizers application might play an important role in the protein biosynthesis by either direct nitrogen supply (through N_2-fixation) or indirectly by enhancing the uptake of soil nitrogen and enhancing the photosynthetic process. The favorable effect of biofertilization treatments on the nitrate reductase activity may be due to improving of mineral nutrition (NPK) in addition to release plant promoting substances such as IAA, gibberellins and cytokinin-like substances (Tilak *et al*., 2006). It is clear that, the nitrogen contents in seeds increased in inoculated plants compared to that of the uninoculated. The obtained results may be attributed to the N2-fixing bacteria which increased the available content of nitrogen in the soil. The positive effect of biofertilization may be due to its containing Azotobacter and Bacillus, lead to produce adequate amounts of growth regulators (Patten and Glick, 1996), Inoculation with B. japonicum significantly increased potassium content of soybean leaves and seeds compared with those uninoculated ones, in both years (Egamberdiyeva and Höflich, 2004).

Table 11. Effect of interaction between bio fertilization and weed control treatments on growth characters and yield components of soybean in 2019 and 2020 seasons.

Bio fertilization	Weed control treatment	Plant height cm		Number of branches/plan		Number of pods/plant		Weight of pods/plant g		Weight of seeds/plant (g)	
		2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Rhizobacterin	Pendimethalin 1.7 l/fed.	78.5	73.7	1.9	1.9	49.4	43.2	51.5	46.2	67.4	60.1
	Prometryn 1.25 l/fed	75.5	73.2	2.1	1.9	47.1	40.8	51.2	43.4	68.7	60.1
	Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed	83.6	88.6	2.0	2.0	57.4	48.1	65.1	56.1	83.8	76.2
	Prometryn 1.25 l/fed + flauzifop-p-butyl 1.5 l/fed	80.9	89.6	2.0	2.0	63.1	53.4	61.1	53.7	76.4	67.1
	Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed	85.1	96.3	2.1	1.7	74.4	67.4	75.8	65.3	96.6	85.8
	Hand hoeing twice at 15, 30 days after sowing (DAS)	88.1	98.3	2.1	1.7	74.4	67.4	76.8	68.3	95.6	86.8
	Untreated (control)	66.3	73.0	1.7	1.7	41.4	34.6	47.3	46.7	62.5	55.8
Unfertilized	Pendimethalin 1.7 l/fed.	73.5	68.7	1.6	1.6	44.4	38.2	46.5	41.2	62.4	55.1
	Prometryn 1.25 l/fed	70.5	68.2	1.6	1.6	42.1	35.8	46.2	38.4	63.7	55.1
	Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed	78.6	83.6	1.6	1.5	52.4	43.1	60.1	51.1	78.8	71.2
	Prometryn 1.25 l/fed + flauzifop-p-butyl 1.5 l/fed	75.9	84.6	1.5	1.5	58.1	48.4	56.1	48.7	71.4	62.1
	Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed	80.1	91.3	1.5	1.5	69.4	62.4	70.8	60.3	91.6	80.8
	Hand hoeing twice at 15, 30 days after sowing (DAS)	83.1	93.3	1.4	1.4	69.4	62.4	71.8	63.3	90.6	81.8
	Untreated (control)	61.3	68.0	1.4	1.4	36.4	29.6	42.3	41.7	57.5	50.8
L.S.D. 0.05		7.10	6.22	0.18	0.10	6.71	7.10	6.22	6.69	5.83	7.14

Chemical charactaristics

Table 12. Effect of bio-fertilization on weight of seeds/pod (g), weight of seeds/plant (g), seed index, seed yield (ton/fed), oil%, protein% and nitrate reductase activity (NRA) in 2019 and 2020 seasons.

Treatments	Weight of seeds/plant(g)		Seed Index		Seed yield (ton/fed)		Oil %		Protein %		NRA* µg NO_2/g fw/hr	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Rhizobacterin	59.72	52.60	19.40	19.89	1.96	2.02	21.11	20.15	36.27	31.48	11.80	10.89
Unfertilized	48.86	42.19	18.12	16.36	1.04	1.13	20.32	18.32	34.18	28.52	9.28	8.26
L.S.D. 0.05	6.20	5.19	0.88	1.44	0.07	0.08	1.29	0.80	1.58	1.55	0.29	0.51

Table 13. Effect of weed control on weight of seeds/pod (g), weight of seeds/plant (g), seed index, seed yield (ton/fed), oil%, protein% and nitrate reductase activity (NRA) in 2019 and 2020 seasons.

Treatments	Seed yield (ton/fed)		Oil %		Protein%	
	2019	2020	2019	2020	2019	2020
Pendimethalin 1.7 l/fed.	1.63	1.72	19.46	19.02	34.84	30.35
Prometryn 1.25 l/fed	1.71	1.81	20.11	18.89	35.11	31.47
Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed	1.83	1.90	20.80	19.14	36.00	31.66
Prometryn 1.25 l/fed + flauzifop-p-butyl 1.5 l/fed	1.92	2.00	22.44	20.91	36.78	32.02
Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed	2.10	2.21	25.10	22.34	38.15	33.93
Hand hoeing twice at 15, 30 days after sowing (DAS)	2.10	2.21	25.10	22.34	38.15	33.93
Untreated (control)	1.36	1.41	18.38	18.30	33.31	28.50
L.S.D. 0.05	0.06	0.06	1.34	1.42	1.79	2.24

NPK determination.

The results in Table 14. showed that inoculation of soybean seeds by Rhizobacterin increase in the NPK contents in seeds percentage compared with un-inoculated plants. Rhizobacterin gave the highest values of NPK contents of leaves and seeds percentage compared with un-bio fertilized treatments in 2019 and 2020 seasons. It is clear that, the nitrogen contents in leaves and seeds increased in inoculated plants compared to that of the un-inoculated. The obtained results may be attributed to the N_2-fixing bacteria which increased the available content of nitrogen in the soil. This increase may be resulted in a better absorption of water and nutrients from the soil (Egamberdiyeva and Höflich, 2004).

Results presented in Table 15،16 Showed that weed control treatments increased the mean value of NPK contents % in seeds in both seasons. Hand hoeing twice at 15, 30 days after sowing (DAS), Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed and Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed gave the highest values of NPK contents of leaves and seeds % in the first and second seasons. Weed control mechanically or chemically may be increased amount of nutrients absorbed by the roots which resulted in increased NPK contents in both soybean seeds and leaves.

Table 14. Effect of the interaction between bio fertilization and weed control treatments on seed yield (ton/fed), oil %, protein% in 2019 and 2020 season.

Bio fertilization	Treatments	Seed yield (ton/fed)		Oil %		Protein%	
		2019	2020	2019	2020	2019	2020
Rhizobacterin	Pendimethalin 1.7 l/fed.	1.6	1.7	17.5	17.0	32.8	28.4
	Prometryn 1.25 l/fed	1.7	1.8	18.1	16.9	33.1	29.5
	Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed	1.8	1.9	18.8	17.1	34.0	29.7
	Prometryn 1.25 l/fed + flauzifop-p-butyl 1.5 l/fed	1.9	2.0	20.4	18.9	34.8	30.0
	Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed	2.1	2.2	23.1	20.3	36.2	31.9
	Hand hoeing twice at 15, 30 days after sowing (DAS)	2.1	2.2	23.1	20.3	36.2	31.9
	Untreated (control)	1.3	1.4	16.4	16.3	31.3	26.5
Unfertilized	Pendimethalin 1.7 l/fed.	1.6	1.6	15.5	15.0	30.8	26.4
	Prometryn 1.25 l/fed	1.6	1.7	16.1	14.9	31.1	27.5
	Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed	1.8	1.8	16.8	15.1	32.0	27.7
	Prometryn 1.25 l/fed + fluazifop-p-butyl 1.5 l/fed	1.8	1.9	18.4	16.9	32.8	28.0
	Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed	2.0	2.1	21.1	18.3	34.2	29.9
	Hand hoeing twice at 15, 30 days after sowing (DAS)	2.0	2.1	21.1	18.3	34.2	29.9
	Untreated (control)	1.3	1.3	14.4	14.3	29.3	24.5
L.S.D. 0.05		6.71	6.69	5.83	7.14	0.14	0.13

Table 15. Effect of biofertilization on N, P and K contents (%) of soybean seeds in 2019 and 2020 seasons.

Biofertlizers	Seed contents %					
	N		P		K	
	2019	2020	2019	2020	2019	2020
Rhizobacterin	5.206	5.703	0.532	0.563	0.289	0.306
Unfertilized	4.389	4.891	0.422	0.432	0.196	0.213
L.S.D. 0.05	0.20	0.25	0.01	0.01	0.01	0.01

Table 16. Effect of weed control treatments on N, P and K contents (%) of soybean seeds in 2019 and 2020 seasons.

Treatments	Seed contents %					
	N		P		K	
	2019	2020	2019	2020	2019	2020
Pendimethalin 1.7 l/fed.	5.217	5.712	0.512	0.540	0.247	0.268
Prometryn 1.25 l/fed	5.373	5.875	0.508	0.536	0.247	0.267
Pendimethalin 1.7 l/fed + fluazifop-p-butyl 1.5 l/fed	5.295	5.796	0.524	0.552	0.268	0.285
Prometryn 1.25 l/fed + flauzifop-p-butyl 1.5 l/fed	5.310	5.840	0.532	0.561	0.263	0.280
Scrabble after 15 (DAS) + fluazifop-p-butyl 1.5 l/fed	5.579	6.070	0.547	0.575	0.278	0.294
Hand hoeing twice at 15, 30 days after sowing (DAS)	4.050	5.028	0.484	0.500	0.223	0.250
Untreated (control)	4.020	5.018	0.454	0.510	0.233	0.260
L.S.D. 0.05	0.17	0.26	0.01	0.02	0.01	0.01

The interaction between biofertlizer and weed control treatments had no signivicant effect on NPK contents% of leaves and seeds in both seasons

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تأثير الأسمدة الحيوية ومعاملات مكافحة الحشائش على الحشائش وانتاجيه فول الصويا

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تم إجراء هذا البحث خلال موسمي 2019 و 2020 في محطة البحوث الزراعية في سخا ، مصر لدراسة تأثير الأسمدة الحيوية (Rhizobacterin والغير حيوية) ومعاملات مكافحة الحشائش وهي(بندميثالين 1.7 لتر / فدان ، بروميتريك ن 1.25 لتر / فدان. ، بنديميثالين). 1.7 لتر / فدان + فلوازيفوب -p - بيوتيل 1.5 لتر / فدان ، بروميترين 1.25 لتر / فدان + فلوازيفوب -p -بيوتيل 1.5 لتر / فدان ، خربشة بعد 15 يومًا من البذر + (DAS) فلوازيفوب -p -بيوتيل 1.5 لتر / فدان مرتين العزق اليدوي ومعامله المقارنه) على نمو العقد البكتيرية لفول الصويا والحشائش والمحصول .أشارت النتائج إلى أن التسميد الحيوي (Rhizobacterin)ومعاملات مكافحة الحشائش أدت إلى زيادة عدد العقد البكتيرية ووزنها وارتفاع النبات وعدد الأفرع وعدد ووزن القرون ومحصول البذور/ للنبات ومحصول البذور / فدان. من فول الصويا في العامين مقارنة بالنباتات الغير مسمده حيويا . كما زاد محتوى البروتين والزيت والنيتروجين والبروتين في بذور فول الصويا في الموسمين. من النتائج التي تم الحصول عليها كانت أفضل معاملة لمقاومة للحشائش هى إستخدام bendemethali بمعدل 1.7لتر / فدان + فلوازيفوب -ب -بيوتيل 1.5 لتر / فدان ، العزق اليدوي مرتين في 21 و 35 يومًا بعد البذر (DAS) والخربشة بعد 15 يومًا من البذر + فلوازيفوب -p - بيوتيل 1.5 لتر / فدان لذلك ، يوصى البحث باستخدام Rhizobacterin في التسميد الحيوى ، كذلك استخدام اى من معاملات مكافحة الحشائش pendimethalin بمعدل 1.7 لتر / فدان + luazifop-p-butyl بمعدل 1.5 لتر / فدان ، العزق اليدوي مرتين في 21 ، 35 يومًا بعد البذر (DAS) ، والخربشة بعد 15 يوم من الزراعة + فلوازيفوب -ب -بيوتيل 1.5 لتر / فدان للحصول علي أعلى محصول لبذور فول الصويا وأفضل مكافحة للحشائش.