EFFECT OF DIFFERENT SOURCES OF NITROGEN FERTILIZATION ON GROWTH, SEED YIELD AND ITS COMPONENTS OF SOME SOYBEAN CULTIVARS.

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ABSTRACT

A field experiment was carried out at the Experimental Farm, Agricultural Research Station, Sakha, Kafr El-Sheikh, Egypt, during the two successive seasons of 2006 and 2007 to study the response of soybean cv. Crawford, Toano and Giza 22 to different sources of nitrogen fertilization, Urea (46%) at the rate of 75 kg N/fed, Bio-fertilizer (Bradyrhizobium japonicium), Compost (4.5 t/fed) and the combination among them. Different sources of nitrogen treatment significantly increased soybean characters. Combination of 2.25 ton compost + inoculation with Bradyrhizobium recorded the highest values of plant height, leaf area, dry matter, number , fresh and dry weigh of nodules/plant, number of pods, number of branches, 100-seed weight, biological yield, seeds and straw yield per feddan and harvest index.

In the light of the obtained results, it can be mentioned that cultivars differed significantly in values of such traits. These differences were due to the differences of maturity groups (MG) for tested cultivars and consequently the length of vegetative growth period and reproductive stages. Toano cultivar (MG V) surpassed the others cultivars in such characters. Cultivar Crawford (MG IV) had the lowest values of such traits. Under Sakha condition, it is recommended to sowing Toano cultivar inoculated preplanting with rhizobium and with the addition of 2.25 tons compost.

Key words: Soybean, compost, biofertilization, nitrogen fertilizer, seed yield.

INTRODUCTION

Soybean, Glycin max (L). Merr, is an annual plant belongs to the botanical family leguminous. It is considered as one of the major important crops grown in many different parts of the world as an oil crop. About 90% of oil is processed for human consumption i.e. cooking oil and margarine. Almost all world soybean meal production is fed to livestock or poultry , animal feed, and materials for many industrial uses. Soybean is a short-days plant that originated from latitudes of about 45 No.

Nitrogen is the most limiting nutrient for production in most agricultural systems, due to the large amounts harvested with the crops and because it can be lost easily through gaseous losses, leaching, runoff or erosion (Smaling et al., 1999). In some African farming systems, manure production is major reason indicated by

smallholder farmers for keeping cattle (Baijukya et al., 2005). Manure stored alone or mixed with urine, feed refusals or other organic materials are called compost after they have undergone a process of combined decomposition known as maturation or composting.

Applying different organic and bio N sources increased 1000-seed weight and number of branches (Shaban et al .,2008). Also, many investigators, indicated that combination of compost and inoculation with Bradyrhizobium significantly increased number of nodules/plant, fresh weight and dry weight of nodules/ plant (Abd El-Hafez and Abo El-Soud, 2007) and (Arshad and Mahmood,.2010).

Abdel Gawad and El-Batal (1995), El-Desoky and El-Far (1996), Atta Allah (2001), and Kandil, (2007) concluded that higher number of pods, 100-seed weight, seed yield and straw yield were recorded as a result of using combination of compost and inoculation with Bradyrhizobium. Significant increases in number of nodules/plant and dry weight of nodules /plant were recorded for Toano cultivars (Matsunami et al, 2004) and (Kandil, 2007).

The present investigation was designed to study the response of growth analysis attributes, yield and its components for different soybean cultivars to sources of nitrogen fertilization.

MATERIALS AND METHODS

During 2006 and 2007 summer seasons in Egypt, a field experiment was carried out at the Farm of Agricultural Research Station, Sakha, Kafr El-Sheikh, Egypt, to investigate the effect of different sources of nitrogen fertilization on growth analysis attributes, yield and its components of soybean (Glycine max L. cv Crawford, Toano and Giza 22). Soybean was sown for the two experiments on 17th and 20th of May in the first and second seasons, respectively. The preceding crop was flax (Linum usitatissimum, L) in the two seasons. A representative soil sample (0-30 cm) was taken before planting to determine some physical, chemical and nutritional properties of the experimental site (Table 1). The chemical compositions of the compost are shown in (Table 2).

The experimental design was split plot with four replications. The main plots were designed for different nitrogen sources (I) Mineral (75 kg N/fed) in the form of urea (46 % N). (II) Seed inoculation with Bradyrhizobium at sowing. (III) Compost (4.5 t/fed). (IV) 2.25 t/fed compost+ inoculation with Bradyrhizobium. (V) 2.25 t/fed compost + 37.5 kg N/fed. (VI) 37.5 kg N/fed + inoculation with Bradyrhizobium., while the three cultivars (Crawford, Toano and Giza 22) were randomly distributed in the sub plots. The experimental unit was 10.5

m^2, which included 5 ridges (3 m long and 70 cm apart). Calcium super Phosphate (15.5% P_2O_5) at rate of 150 kg/fed was applied during soil preparation.

Four vegetative samples were taken from the second and fourth ridges of each sub plot during the growth period in, 15 days interval beginning at 60 days till 105 days after sowing (DAS) in the two growth seasons to measure leaf area/plant (dm^2), dry matter accumulation and Nodulation/plant, fresh weight and dry weight (at 60 days after sowing) in addition to flowering date, days to maturity. At harvest time a random sample of ten plants from each sub plot were taken in both seasons to determine the following characters: plant height (cm), number of pods/plant, number of branches/plant, seed yield/plant (g), 100-seed weight (g), biological yield (t/fed.), seed yield (t/fed.), straw yield (t/fed.) and harvest index %.

All the data collected were subjected to statistical analysis of variance as described by Snedecor and Cochran (1967). The mean values were compared according to Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Growth analysis and attributes:

Data presented in Table 3 show that growth analysis and attributes (i.e., flowering time, days to maturity and plant height were significantly increased due to the addition of mineral, bio and organic fertilizer individually or combined. Application of 2.25 tons compost + inoculation with Bradyrhizobium recorded the earliest flowering, earliest period to maturity and tallest plants in both seasons. These results may be due to the fact that the decomposition of organic matter and consequently increased nutrients in the soil which became more available to plant hence enhhance plant growth. The difference among cultivars in flowering time and days to maturity was highly significant in both seasons. Obviously, Toano cultivar was the earliest in flowering and maturity, while Crawford and Giza 22 had taller plants than the other cultivar, while Toano produced the shortest plants in both seasons. Difference in days to maturity among cultivars may be due to the difference in the pedigree among these cultivars.

Table (1): Soil physical and chemical analysis of the experimental field in 2006 and 2007 seasons.

Determination	Season	
	2006	2007
Physical analysis		
Sand %	13.74	15.53
Silt %	24.91	23.95
Clay %	61.35	60.52
Texture %	Clay	Clay
Chemical analysis		
Available N ppm	37	41
Available P ppm	6.9	7.4
Available K ppm	231.2	269.7
pH	7.9	8.2
EC	2.17	1.04
CaCo3 %	3.7	2.9
Organic matter %	1.9	2.3

Table (2):Chemical analysis of the compost in the two growing seasons.

Determination	Season	
	2006	2007
Weight/m^3 (kg)	530	510
Moisture content	30	28
PH	7.11	7.90
E.C	3.93	3.71
Organic matter %	42.15	40.23
Organic carbon %	21.35	23.12
C:N ratio	14.14:1	13.15:1
Total nitrogen %	1.6	1.6
Total soluble-N p.p.m	238.7	134.5
Total phosphorous %	1.11	1.00
Total potassium %	0.89	0.99
Fe p.p.m	940	929
Mn p.p.m	300	305
Zn p.p.m	260	255

Table (3):Flowering date, days to maturity and plant height of three soybean cultivars as affected by nitrogen fertilizer source in 2006 and 2007 seasons.

Treatment	Flowering time		Days to maturity		Plant height (cm)	
	2006	2007	2006	2007	2006	2007
Nitrogen source (A):						
1) 75kgN/fed	54.00	53.22 a	130.56 a	131.56 a	84.52 d	82.06 d
2) Rhizobium inoculation	48.78	48.44 de	125.67 de	126.56 d	81.28 e	79.16 e
3) 4.5 t/fed compost /fed	53.78	50.00 cd	126066 cd	127.44 c	88.32 c	86.07 c
4)2.25t/fedcomposted+inoculation	48.22	47.56 e	124.22 e	125.54 e	94.66 a	92.85 a
5)2.25t/fedcomposted+37.5kgN/fed	52.00	52.22 ab	127.78 bc	130.90 a	89.01 c	86.28 c
6) 37.5kgN/fed+inoculation	49.90	51.22 bc	129.00 b	128.67 b	92.23 b	89.78 b
F test	n.s	**	**	**	**	**
Cultivar (B):						
1) Crawford	46.90 c	47.83 c	119.67 c	121.00 c	98.11 a	96.24 a
2) Toano	55.56 a	54.78 a	140.78 a	141.44 a	68.68 b	65.82 b
3) Giza 22	50.89 b	48.72 b	121.50 b	122.89 b	98.22 a	96.04 a
F test	**	**	**	**	**	**
Interaction :						
A x B	n.s	**	n.s	n.s	*	**

*, ** and NS indicate P< 0.05 , P< 0.01 and not significant, respectively. Means designated by the same letter within columns are not significantly different at the 5% level according to Duncan's multiple range test.

Data in Tables 4 and 5 also show that the highest values of leaf area (dm2) and dry matter accumulation were obtained from combination of 2.25 tons compost + inoculation with Bradyrhizobium

and lowest one was obtained from inoculation with Bradyrhizobium only in both seasons The obtained results indicated clearly to the effect of compost on leaf area per plant at all sampling dates and mainly its high contents of nutritive elements and better effects on soil characteristics and application of organic fertilizer, enables the crop to produce rapid leaf area and this is reflected in increasing LAI. These results are similar to those reported by [Tahsin (2006) and Abd El-Hafez and Abo El-Soud (2007)]. The results also, indicate highly significant differences among soybean cultivars in leaf area and dry matter accumulation in the two seasons. Toano cultivar gave the highest values in both seasons at all growth stages. These results are in agreement with those obtained by Kandil (2007) and Jason and Pedersen (2009).

Table (4): Means of leaf area / plant (dm^2) at four samples dates of three soybean cultivar as affected by N- fertilizer source and their interaction in 2006 and 2007 growing seasons.

Treatment	1st sample		2nd sample		3rd sample		4th sample	
	2006	2007	2006	2006	2006	2007	2006	2007
Nitrogen source (A):								
1) 75kgN/fed	2921.8 e	2983.9 e	4026.2 e	4084.7 e	6112.4 e	5324.7 e	5112.2 d	4833.9 e
2)Rhizobium inoculation	2456.9 f	2507.9 f	3712.7 f	3770.7 f	5630.8 f	4777.0 f	4615.0 e	4286.2 f
3) 4.5 t/fed compost /fed	3201.8 c	3273.0 d	4810.3 d	4858.3 d	6390.1 d	5577.7 c	5418.5 c	5086.9 c
4) 2.25t/fed+inoculation	8838.8 a	4787.6 a	5749.1 a	6096.0 a	7537.7 a	6862.5 a	6593.9 a	6371.7 a
5) 2.25t/fed+37.5kgN/fed	3722.3 b	3871.9 c	5122.6 c	5209.7 c	7427.3 b	5326.8 d	5131.4 d	4836.0 d
6) 37.5kgN/fed+ inoculation	3131.6 d	4450.7 b	5548.7 b	5618.3 b	6858.2 c	6279.3 b	6166.8 b	5788.5 b
Sig.	*	*	**	*	**	*	**	*
Cultivar (B):								
1) Crawford	3056.6 c	3121.4 c	4468.9 c	4537.6 c	6209.3 c	5347.2 c	5243.7 c	4856.4 c
2) Toano	3318.7 a	4203.0 a	5215.2 a	5419.8	7148.5 a	5970.0 a	5750.5 a	5479.2 a
3) Giza 22	3551.6 b	3603.3 b	4802.7 b	4861.4 b	6620.5 b	5756.8 b	5524.8 b	5266.0 b
Sig	*	*	*	*	**	*	**	*
Interaction :								
A x B	n.s	n.s	n.s	n.s	n.s	n.s	n.s	n.s

*, ** and NS indicate P< 0.05 , P< 0.01 and not significant, respectively Means designated by the same letter within columns are not significantly different at the 5% level according to Duncan's multiple range test.

Table (5): Means of dry matter accumulation (g/ plant) at four samples dates of three soybean cultivar as affected by nitrogen fertilizer source and their interaction in 2006 and 2007 growing seasons.

Treatment	1st sample		2nd sample		3rd sample		4th sample	
	2006	2007	2006	2006	2006	2007	2006	2007
Nitrogen source (A)								
1) 75kgN/fed	35.30 e	41.67 d	45.92 e	51.31 e	110.64 d	118.28 c	145.79 e	153.75 e
2)Rhizobium inoculation	32.60 f	37.97 e	38.72 f	44 57 f	90 08 e	97 53 d	119.75 f	132 95 f
3) 4.5 t/fed compost /fed	44.54 d	50.54 c	62.12 c	67.48 c	111 74 d	120.19 c	159 09 d	168 36 d
4) 2.25t/fed+inoculation	54.57 a	57.60 a	68.02 a	73.40 a	154.19 a	160.15 a	206.44 a	214 06 a
5) 2.25t/fed+37.5kgN/fed	46.48 c	52.09 b	57.45 d	62.98 d	125.26 c	136.75 b	167.06 c	179.64 c
6) 37.5kgN/fed+inoculation	51.01 b	57 55 a	65.93 b	71.15 b	133.94 b	139.35 b	186.15 b	188.43 b
Sig.	**	**	**	**	**	**	**	**
Cultivar (B)								
1) Crawford	40.43 c	45.40 c	53.40 c	58.80 c	117.46 c	123.09 b	159.91 c	169.45 b
2) Toano	48.30 a	54.35 a	59.82 a	65.45 a	124.61 a	132.69 a	167.91 a	180.04 a
3) Giza 22	43.70 b	48.82 b	55.86 b	61.20 b	120.90 b	130.35 a	167.33 b	169.11 b
Sig	**	**	**	**	**	**	**	**
Interaction :								
A x B	**	**	**	**	n.s	n.s	n.s	n.s

*, ** and NS indicate P< 0.05 , P< 0.01 and not significant, respectively Means designated by the same letter within columns are not significantly different at the 5% level according to Duncan's multiple range test.

The results in Table 6 showed that combination of 2.25 tons compost + inoculation with Bradyrhizobium gave high significant increases in number of nodules/plant, fresh weight and dry weight of nodules per plant in both seasons. Nodulation of the legumes were improved by the compost. On the other hand, application of 75 kg N/fed caused significant reduction in number of nodulation. Even so, the uninoculated plants were nodulated indicating that nutural rhizobia were presented in these soils, perhaps resulting from the cultivation of legumes for long time , or from natural contamination of the soil via water and wind movement. These results are in agreement with those previously reported by Arshad and Mahmood (2010). Number of nodulation per plant, fresh weight of nodules per plant and dry weight of nodules per plant differed highly significant among cultivars under this investigation in both seasons. Toano produced significantly

greater number, fresh and dry weight of nodulation per plant than the other cultivars, while Crawford gave the lowest values in 2006 and 2007 seasons.

Table (6): Number of nodules/plant, fresh and dry weight of nodules/ plant of three soybean cultivar as affected by N-fertilizer source in 2006 and 2007 seasons.

Treatment	No. of nodulation		Fresh weight (g)		Dry weight (g)	
	2006	2007	2006	2007	2006	2007
Nitrogen source (A):						
1) 75kgN/fed	49.43 d	57.29 d	0.451 d	0.578 c	0.375 d	0.508 c
2)Rhizoblum inoculation	74.43 bc	74.95 c	0.524 c	0.682 b	0.418 cd	0.580 c
3) 4.5 t/fed compost /fed	74.88 b	82.14 bc	0.613 b	0.716 b	0.456 bc	0.589 bc
4)2.25compostedt/fed+ inoculation	129.72 a	133.06 a	0.773 a	0.862 a	0.577 a	0.714 a
5) 2.25 composted t/fed+ 37.5kgN/fed	69.16 c	78.97 bc	0.522 c	0.708 b	0.421 cd	0.580 c
6)37.5kgN/fed +inoculation	79.86 b	85.55 b	0.619 b	0.728 b	0.509 b	0.683 ab
F test	**	**	**	**	**	**
Cultivar (B):						
1) Crawford	65.06 c	72.08 c	0.397 c	0.538 c	0.300 c	0.452 c
2) Toano	96.29 a	100.33 a	0.787 a	0.893 a	0.647 a	0.786 a
3) Giza 22	77.39 b	83.57 b	0.566 b	0.705 b	0.432 b	0.589 b
F test	**	**	**	**	**	**
Interaction :						
A x B	**	*	*	**	**	**

*, ** and NS indicate P< 0.05 , P< 0.01 and not significant, respectively. Means designated by the same letter within columns are not significantly different at the 5% level according to Duncan's multiple range test.

Yield and Yield components studies:

Data presented in Table 7 show that yield and its components (i.e., number of pods/plant, number of branches and seed yield/plant) significantly increased due to the addition of nitrogen from all sources. The combination of 2.25 tons compost + inoculation with Bradyrhizobium recorded the highest number of pods/plant, number of branches and seed yield/plant in the two seasons. This finding may be due to the improvement in plant growth and could help in increasing nutrient availability from applied and native sources and mineralization

of macro and microelements particularly nitrogen, which led to increase in the minerals availability to the plants. Similar results were reported by Abd El-Hafez and Abo El-Soud (2007) and Arshad and Mahmood (2010). The differences among cultivars in number of pods/plant, number of branches and seed yield/plant were highly significant in both seasons. Obviously, Toano have the highest pods/plant, number of branches and seed yield/plant than the other cultivars in both seasons.

Table (7): Pods number/plant, number of branches/plant and seed yield/plant (g) of the three soybean cultivars as affected by N-fertilizer source and their interactions in 2006 and 2007 seasons.

Treatments	No. of pods/plant		No. of branches/plant		Seed yield/plant (g)	
	2006	2007	2006	2007	2006	2007
Nitrogen source (A):						
1) 75kgN/fed	79.37 e	82.98 f	5.47 f	5.60 e	29.46 d	29.61 d
2) Rhizobium inoculation	83.08 d	86.86 e	5.71 e	5.64 e	26.92 e	27.91 e
3) 4.5 t/fed compost /fed	88.11 b	93.51 c	6.76 c	6.82 c	31.69 c	31.78 c
4) 2.25 composted t/fed+ inoculation	99.16 a	103.95 a	7.66 a	7.69 a	35.41 a	36.74 a
5) 2.25 composted t/fed+ 37.5 kgN/fed	86.19 c	89.74 d	6.16 d	6.22 d	30.04 d	30.29 d
6) 37.5kgN/fed+inoculation	98.89 a	97.49 b	7.21 b	7.26 b	34.16 b	34.11 b
F test	**	**	**	**	**	**
Cultivar (B):						
1) Crawford	75.24 c	75.68 c	6.12 c	6.14 c	24.22 c	24.95 c
2) Toano	101.36 a	105.76 a	6.89 a	6.95 a	41.04 a	41.61 a
3) Giza 22	90.80 b	95.83 b	6.47 b	6.52 b	28.58 b	28.67 b
F test	**	**	**	**	**	**
Interaction :						
A x B	**	**	**	n.s	**	**

*, ** and NS indicate P< 0.05 , P< 0.01 and not significant, respectively Means designated by the same letter within columns are not significantly different at the 5% level according to Duncan's multiple range test.

Data in Tables 8 and 9 indicated that 100-seed weight, biological yield, seed yield (t/fed), straw yield (t/fed) and harvest index increased significantly due to addition of 2.25 ton compost plus inoculation with Bradyrhizobium. The present results were also reported by Tahsin (2006) and Abd El-Hafez and Abo El-Soud (2007). These results may be due to the increase in the growth characters

and photo-synthetic pigments by the application of N fertilizer, consequently they give more ability to convert light energy to chemical energy which were expressed in more dry matter accumulation in the seeds. In addition, the positive effect of compost fertilizer on seed yield was mainly due to the significant increase in LAI, C G R, NAR, DM, yield components and greater translocation of photo-synthats from leaves to the sink. The present results were also reported by Abdel Gawad and El-Batal (1995), Tahsin (2006) and Abd El-Hafez and Abo El-Soud (2007).

Table (8): 100-seed weight (g), biological yield (t/fed), seed yield (t/fed), straw yield (t/fed) and harvest index % of three soybean cultivars as affected by N-fertilizer source and their interaction in 2006 season.

Treatments	100-seed weight (g)	Biological yield (t/fed)	Seed yield (t/fed)	Straw yield (t/fed)	Harvest index %
Nitrogen source (A):					
1) 75kgN/fed	20.607 ab	5.49 de	1.91 d	3.58 a-c	34.80 c
2) Rhizobium inoculation	20.210 c	4.86 e	1.63 e	3.23 c	33.65 c
3) 4.5 t/fed compost /fed	20.69 a	6.30 bc	2.62 b	3.68 a-c	41.67 ab
4) 2.25 composted t/fed+ inoculation	20.79 a	7.32a	3.12 a	4.20 a	43.07 a
5) 2.25 composted t/fed+ 37.5 kgN/fed	20.72 bc	5.79 cd	2.27 c	3.52 bc	39.14 b
6) 37.5kgN/fed+inoculation	20.79 a	6.92 ab	2.92 a	4.00 ab	42.16 ab
F test	**	**	**	**	**
Cultivar (B):					
1) Crawford	20.11 c	5.80 c	2.19 c	3.61 b	37.54 b
2) Toano	20.99 a	6.64 a	2.64 a	3.99 a	39.47 a
3) Giza 22	20.65 b	5.90 b	2.39 b	3.51 b	40.23 a
F test	**	**	**	**	**
Interaction :	**	**	**	**	**

*, ** and NS indicate P< 0.05 , P< 0.01 and not significant, respectively. Means designated by the same letter within columns are not significantly different at the 5% level according to Duncan's multiple range test.

Table (9): 100-seed weight (g), biological yield (t/fed), seed yield (t/fed), straw yield (t/fed) and harvest index % of three soybean cultivars as affected by N-fertilizer source and their interaction in 2007 season.

Treatments	100-seed weight (g)	Biological yield (t/fed)	Seed yield (t/fed)	Straw yield (t/fed)	Harvest index %
Nitrogen source (A):					
1) 75kgN/fed	20.04 ab	5.72 c	1.91 c	3.81 c	32.30 cd
2) Rhizobium inoculation	19.48 c	5.57 d	1.73 d	3.84 c	30.39 e
3) 4.5 t/fed compost /fed	19.76 bc	6.58 b	2.30 b	4.28 b	34.65 b
4) 2.25 composted t/fed+ inoculation	20.11 ab	6.73 a	2.56 a	4.16 b	37.99 a
5) 2.25 composted t/fed+ 37.5 kgN/fed	20.23 a	5.63 cd	1.80 cd	3.84 c	31.40 de
6) 37.5kgN/fed+inoculation	20.07 ab	6.74 a	2.29 b	4.45 a	33.84 bc
F test	**	**	**	**	**
Cultivar (B):					
1) Crawford	19.51 c	5.26 c	1.63 c	3.63 c	30.43 c
2) Toano	20.39 a	7.14 a	2.68 a	4.46 a	37.54 a
3) Giza 22	19.95 b	6.09 b	1.99 b	4.10 b	32.32 b
F test	**	**	**	**	**
Interaction :	n.s	**	**	**	**

*, ** and NS indicate P< 0.05 , P< 0.01 and not significant, respectively. Means designated by the same letter within columns are not significantly different at the 5% level according to Duncan's multiple range test.

Conclusion

From the economic point of view, and from the obtained results, it could be recommended to use combination of 2.25 tons compost + Bradyrhizobium inoculation, with Toano cultivar for high growth, seed yield, its components and for increasing the organic matter % and available nitrogen . Thus, it will keep out environment clean, decreasing the environment pollution and fertilizer cost from applying low fertilizer rates.

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الملخص العربي

تأثير استخدام مصادر مختلفة من التسميد النيتروجيني علي النمو والمحصول و مكوناتة لبعض أصناف فول الصويا

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**** قسم تكنولوجيا البذور بسخا– مركز البحوث الزراعية**

أجريت تجربة حقلية في المزرعة البحثية بمحطة البحوث الزراعية بسخا- مركز البحوث الزراعية- جمهورية مصر العربية خلال موسمي الزراعة ٢٠٠٦ و٢٠٠٧م و تم إجراء هذه التجارب بهدف دراسة استجابة ثلاثة أصناف من فول الصويا و هي كراوفورد و توانو و جيزة ٢٢ لمصادر مختلفة من السماد النيتروجيني و هي ٧٥ كجم نيتروجين /فدان (في صورة يوريا ٤٦ % نيتروجين)و التلقيح ببكتريا العقد الجذرية و ٤,٥ طن كمبوست/فدان و ٢,٢٥ طن كمبوست/فدان + التلقيح ببكتريا العقد الجذرية و ٢,٢٥ طن كمبوست/فدان + ٣٧,٥ كجم نيتروجين/فدان و ٣٧,٥ كجم نيتروجين/فدان + التلقيح ببكتريا العقد الجذرية. إضافة ٢,٢٥ طن كمبوست + التلقيح ببكتريا العقد الجذرية سجلت أعلي قيمة لطول النبات و مساحة الأوراق و تراكم المادة الجافة للنبات و عدد العقد الجذرية ووزنها الرطب و الجاف و عدد القرون و عدد الأفرع للنبات و وزن ١٠٠ بذرة و المحصول البيولوجي و محصول البذور و القش للفدان و دليل الحصاد وكذلك زيادة في المادة العضوية و نسبة النيتروجين الميسر و ذلك في كلا الموفي التربة.

أظهرت النتائج المتحصل عليها اختلاف الأصناف في قيم الصفات المدروسة. و يرجع هذا الاختلاف إلي مجاميع النضج التي تتبعها هذه الأصناف و بالتالي اختلافها في فترة النمو الخضري و فترة تكوين البذور، حيث تفوقت الأصناف التابعة لمجموعة النضج V و هو توانو في جميع الصفات المدروسة. بينما أعطي الصنف كراوفورد التابع لمجموعة النضج IV أقل قيم للصفات المدروسة. و علي ذلك يمكن التوصية بزراعة الصنف توانو مع معاملة البذور قبل الزراعة ببكتريا العقد الجذرية مع إضافة ٢,٢٥ طن كمبوست قبل الزراعة تحت ظروف سخا. بالإضافة إلي المحافظة علي البيئة من التلوث بمعدلات عالية مع خفض تكاليف المنتج من المحصول.