EFFECT OF NITROGENOUS AND PHOSPHATIC FERTILIZATION ON SOME ECONOMICAL CHARACTERS OF SOYBEAN CRAWFORD CULTIVAR UNDER CALCAREOUS SOIL CONDITIONS

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Abstract

Two field experiments were carried out on calcareous soil in Northern Tahreer region during 2000 and 2001 summer seasons to study the effect of nitrogenous fertilizers (unfertilized, 60 kg N/fed. and 15 kg N/ fed. + rhizobium inoculation), phosphatic fertilization (untreated, soil application of 30 kg P_2O_5 / fed. and foliar spraying of 200 liter / fed. super-phosphate supernatant (prepared by soaking 4 kg Ca- super-phosphate in 200 liter tap water and kept overnight, then decanted and filtered through a piece of cloth), twice after 30 and 50 days from sowing) and their possible combinations on some economical characters i.e., seed, straw, protein and oil yield / fed. of soybean Crawford cultivar. Statistical analyses cleared significant effects on all studied characters due to both nitrogenous and phosphatic fertilization. The highest values were obtained by applying 15 kg N/fed. + rhizobium inoculation for the nitrogenous fertilizers and foliar spraying of 200 liter / fed. super-phosphate supernatant twice after 30 and 50 days from sowing for the phosphatic fertilization.

Amongst the interaction between nitrogenous and phosphatic fertilization, data showed significant effects on seed, protein and oil yield / fed. The superior treatment was 15 kg N / fed. + rhizobium inoculation + foliar spraying of 200 liter / fed. super-phosphate supernatant, twice after 30 and 50 days from sowing for increasing all studied criteria.

INTRODUCTION

Soybean cultivars grown under Egyptian conditions suffer greatly from the low efficiency of chemical fertilizers as a result of either nitrate leaching and ammonia volatilization from nitrogenous fertilizers or due to the high pH and high calcium carbonate content of the soil in the case of phosphatic fertilizers. To solve these problems, many investigators used rhizobium inoculation and foliar application of phosphatic fertilization. Sharaf and Salwau (1992), Vara *et al.* (1994) and Antoun (2001) stated that rhizobium inoculation of soybean seeds increased seed, straw, protein and oil yields in

comparison to un-inoculated plants. Zahran *et al.* (1998), on lentil and lupine, and Antoun (2001), on soybean, found that foliar application of super-phosphate increased yield and yield components over control and soil application; whereas Kabesh *et al.* (1989) on soybean reported that soil application of 30 kg P_2O_5 / fed. was the best treatment. El – Sayed (1988), Antoun (2001), on soybean, and Abu Baker *et al.* (1994), on peanut, stated that protein and oil yields were increased due to phosphorus application as foliar or soil treatments. They found that foliar application of super-phosphate supernatant resulted in the highest seed, straw, protein and oil yields. Mahmoud *et al.* (1991) and Abd El-Maksoud *et al.* (1995) reported that rhizobial inoculation under phosphatic fertilization as soil application at a rate of 30 kg P_2O_5 / fed. improved soybean yield and its components; whereas Antoun (2001) indicated that foliar application of super-phosphate supernatant and rhizobial inoculation was the superior treatment for increasing seed, straw, protein and oil yields of soybean plants.

The aim of this study was to give a clear view about the effect of nitrogenous fertilization, and phosphatic fertilization and their interaction on yield and some economical characters of soybean Crawford cultivar under calcareous soil conditions.

MATERIALS AND METHODS

Two field experiments were conducted during 2000 and 2001 summer seasons in Northern Tahreer region (Nubaria), representing calcareous soils, to study the effect of chemical and bio-nitrogenous fertilizers under phosphatic fertilization on seed, straw, protein and oil yields of soybean Crawford cultivar. The chemical analyses of the soil were carried out according to Jackson (1973) Data obtained are: $CaCO_3$ 14.2%, Organic matter 0.9%, E. C. 2.38 dS/m, pH 8.1 and available N, P and K are 25, 4.6 and 275 mg /kg soil, respectively.

Nitrogenous fertilization treatments were: unfertilized, 60 kg N/fed. and 15 kg N/fed. + rhizobium inoculation, while phosphatic fertilization treatments were: unfertilized, 30 kg P_2O_5 / fed. as soil application and foliar spraying of 200 liter / fed. Super-phosphate supernatant (prepared by soaking 4 kg Ca- super-phosphate in 200 liter tap water and kept overnight, then decanted and filtered through a piece of cloth) twice after 30 and 50 days from sowing. All possible combinations between N and P treatments were performed.

Soybean seeds were sown on 10th May in the two successive seasons. Agricultural practices usually done in this region were applied. At harvest (17th September) seed

and straw yields /fed. were calculated in kg. Total nitrogen percentage was determined using micro-kjeldahl method (A.O.A.C. 1995). The crude protein (kg/fed.) was calculated by multiplying the nitrogen percentage by 6.25 and seed yield (kg/fed.). Crude oil percentage was determined by soxhlet apparatus and hexane as a solvent (A.O.A.C. 1995). The crude oil yield (kg/fed.) was calculated by multiplying the oil percentage by seed yield (kg / fed.).

The treatments of each experiment were arranged in a complete randomized block design in four replications. The plot area was 21 m^2. Data were exposed to the proper statistical analyses of variance according to Snedecor and Cochran (1980). The Bartilet test was applied and the combined analysis of variance was performed for the data of the two seasons. L.S.D. at 5% level of significance was used to compare among means.

RESULTS AND DISCUSSIONS

This investigation has been carried out to evaluate the effect of either nitrogenous fertilization, phosphatic fertilization or their combinations on seed, straw, protein and oil yields kg / fed. of soybean Crawford cultivar under calcareous soil conditions.

1. Nitrogenous fertilizers effect:

Both mineral and bio-nitrogenous fertilizers play a beneficial role in soybean production. Table 1 shows that seed, straw, protein and oil yields of soybean Crawford cultivar were increased significantly by seed inoculation with rhizobia + 15 kg N / fed. over other nitrogenous treatments (untreated or soil application of 60 kg N / fed.)

Table 1. Effect of nitrogenous fertilizers on seed, straw, protein and oil yields of soybean plants. (Combined analysis of 2000 and 2001 summer seasons).

Nitrogenous treatments	Yields (kg / fed.)			
	Seed	Straw	Protein	Oil
Unfertilized	697	1143	252	142
60 kg N/fed.	803	1212	291	168
15 kg N/fed. + Rhiz*. Inoculation	896	1378	333	190
L.S.D. 5% level	63	113	16	21

*Rhiz.=rizhobium

These results may reveal that the inoculation of soybean seeds with suitable

strains of *Rhizobium japonicum* may be sufficient to supply the bulk of nitrogen and growth promoting substances such as auxins, gibberellins and cytokinins needed by the crop. The nitrogen fixed by rhizobia may be quite enough to produce the highest seed, straw, protein and oil yields of soybean. The increases of protein and oil yields may be due also to the increase of seed yield for the same treatment (Table 1) and / or the increase of their percentage in seeds. These results are in a harmony with those obtained by Sharaf and Salwau (1992), Vara *et al.* (1994) and Antoun (2001).

2. Phosphatic fertilization effect:

Soybean seed, straw, protein and oil yield in kg / fed. as affected by phosohatic fertilization are shown in Table 2.

Table 2. Effect of phosphatic fertilization on seed, straw, protein and oil yields of soybean plants. (Combined analysis of 2000 and 2001 summer seasons).

Phosphorus treatments	Yields (kg / fed.)			
	Seed	Straw	Protein	Oil
Unfertilized	647	1059	216	130
Soil, 30 kg P_2o_5 / fed.	836	1305	314	177
Foliar, super-phosphate supernatant	911	1369	347	192
L.S.D. 5% level	38	77	11	8

Applying phosphorus with different methods of application (soil application 30 kg P_2O_5 / fed. and foliar spraying of 200 liter / fed. super-phosphate supernatant twice after 30 and 50 days from sowing) increased significantly all studied parameters over unfertilized one. Foliar spraying of super-phosphate supernatant was the superior treatment for high economical yields (seed, straw, protein and oil yields). These results may be attributed to the important role of phosphorus in soybean growth at different stages through building proteins and protoplasm, encouraging cell division, meristemic tissues activity as well as energy stage and transfer of metabolite compounds in fertilized plants. The benefits from foliar application of phosphorus surpassed those from soil application due to the effect of some soil characters, i. e. high pH (8.1) and $CaCO_3$ content (14.2%). These soil characters fix the phosphorus and hence decrease the available form soil needed for supplementing the growing of soybean plants. These data are in agreement with those obtained by El-Sayed (1988) Abu Baker *et al.* (1994) and Antoun (2001) who stated that the order of increase in response to phosphatic fertilization was foliar > soil > unfertilized one.

enhance the utilization of fixed nitrogen by soybean plant, keep the suitable balance between nitrogen and phosphorus within the plant and solve the problems of soil high pH and calcium carbonate content which fix phosphorus under calcareous soil conditions. Similar findings were observed by Mahmoud *et al.* (1991), Abd El-Maksoud *et al.* (1995) and Antoun (2001).

CONCLUSION

It could be concluded that the promising treatment for increasing all studied characters, i.e., seed, straw, protein and oil yields of soybean plant Crawford cultivar under calcareous soil conditions is to apply:

15 kg N/fed. + rhizobium inoculation + foliar spraying of 200 liter / fed. super-phosphate supernatant (prepared by soaking 4 kg Ca- super-phosphate in 200 liter tap water and kept overnight, then decanted and filtered through a piece of cloth) twice after 30 and 50 days from sowing.

Table 3. Effect of phosphatic fertilization under nitrogenous fertilizers on seed, straw, protein and oil yields of soybean-plants. (Combined analysis of 2000 and 2001 summer seasons).

Fertilization		Yields (kg / fed.)			
Nitrogen	Phosphorus	Seed	Straw	Protein	Oil
Unfertilized	Unfertilized	541	954	176	114
	Soil, 30 kg P_2o_5 / fed.	749	1215	276	150
	Foliar, super-phosphate supernatant	801	1260	304	161
60 kg N/fed.	Unfertilized	679	1100	234	136
	Soil, 30 kg P_2o_5 / fed.	827	1238	305	174
	Foliar, super-phosphate supernatant	902	1299	335	193
15 kg N/fed. + Rhiz*. Inoculation	Unfertilized	719	1122	237	141
	Soil, 30 kg P_2o_5 / fed.	933	1463	360	206
	Foliar, super-phosphate supernatant	1031	1549	402	223
L.S.D. 5% level		93	N.S	21	14

* Rhiz= rhizobium

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تاثير التسميد النيتروجيني والفوسفاتي علي بعض الصفات الاقتصاديه لنبات فول الصويا صنف كراوفورد تحت ظروف الارض الجيرية

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الملخص العربي

أجريت تجربتان حقليتان بشمال التحرير (اراضي جيريه) خلال الموسم الصيفي ٢٠٠٠، ٢٠٠١ لدراسة اثر السماد الازوتي (بدون تسميد ،٦٠كجم ن / فدان ، ١٥ كجم ن / فدان + تلقيح ميكروبي بالريزوبيا) والتسميد الفوسفاتي (بدون تسميد ، ٣٠ كجم فو ٢/٥ / فدان ، الرش الخضري بمعدل ٢٠٠ لتر / فدان بمنقوع سوبر فوسفات* مرتين بعد ٣٠، ٥٠ يوم من الزراعه) والتفاعل بينهما و ذلك علي بعض المكونات الاقتصاديه (محصول كجم / فدان لكل من البذور ، القش، البروتين ، الزيت) لفول الصويا صنف كراوفورد .

اظهر التحليل الاحصائي تاثيرا معنويا لكلامن السماد الازوتي والتسميد الفوسفاتي علي جميع الصفات المدروسه وكانت افضل المعاملات هي :

-اضافة ١٥ كجم ن / فدان + التلقيح البكتيري بالريزوبيا عند مقارنة معاملات السماد الازوتي .

-الرش الخضري بمعدل ٢٠٠ لتر / فدان بمنقوع سوبر فوسفات* مرتين بعد ٣٠، ٥٠ يوم من الزراعه عند مقارنة معاملات التسميد

أوضحت النتائج تاثيرا معنويا للتفاعل بين معاملات التسميد الازوتي والفوسفاتي علي محصول البذور ، البروتين ، الزيت وكانت افضل المعاملات لزيادة جميع الصفات المدروسه هي اضافه ١٥ كجم ن /فدان + التلقيح البكتيري بالريزوبيا مع الرش الخضري بمعدل ٢٠٠ لتر / فدان بمنقوع سوبر فوسفات* مرتين بعد ٣٠، ٥٠ يوم من الزراعة.

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* محضر بواسطة نقع ٤ كجم كالسيوم سوبر فوسفات في ٢٠٠ لتر مياه صنبور ويترك لمدة ليله ثم يرشح الرائق للحصول علي المنقوع.