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PRODUCTIVITY OF TWO SOYBEAN VARIETIES UNDER DIFFERENT IRRIGATION REGIMES AND NITROGEN FERTILIZATION

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Abstract

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An experiment was conducted during 2002 and 2003 seasons to study the effect of irrigation regimes and nitrogen on yield and quality of soybean (*Glycin max* (L.)Merr.). The plant height, number of branches/plant, number of pods/plant, seed index, seed yield kg/feddan*, oil and protein yields of soybean were significantly higher under irrigation at 60 % from a.w**. The maximum oil and protein contents in soybean seeds were obtained from irrigation at 60 % from a.w., while the minimum was established in irrigation at 20 % from a.w. Increasing nitrogen increased seed, oil and protein yields of soybean. However, the oil content of seeds was maximum when the crop was fertilized with 30 kg N/feddan. Conversely, the protein content of the seeds was increased with increasing levels of nitrogen. Seed, oil and protein yields for Craowford were higher than Clark variety.

Key words: *Soybean, Moisture Stress, Nitrogen Fertilization, Irrigation Regimes.*

Notes: * feddan = 4200 m^2 ; ** a.w. = available water

Резюме

Махмуд, А. М. и А. Ел-Саади, 2004. Продуктивност на два сорта соя при различни режими на напояване и азотно торене.

През 2002 и 2003 г. бе проведен опит за проучване влиянието на режимите на напояване и азотно торене върху добива и качеството на соята (*Glycin max* (L.)Merr.). Височината на растенията, броят разклонения на едно растение, броят чушки на едно растение, семенният индекс, добивът от семена кг/федан*, добивът масло и протеин при соята бяха значително по-високи при напояване с 60 % от наличната вода. Максимално съдържание на масло и протеин в соевите семена е получено при напояване с 60 % от наличната вода, докато минимумът е при напояване с 20 % от наличната вода. Увеличаването на азота повиши добива от семе, масло и протеин. Съдържанието на масло обаче е най-високо, когато посевът се наторява с 30 кг. N/федан. Обратно, съдържанието на протеин в семената се увеличава с увеличаване на азотната норма. Добивът от семе, масло и протеин от сорт Крофърд бе по-висок от този на сорт Кларк.

Ключови думи: Соя, Воден стрес, Азотно торене, Режими на напояване.
*Забележка: * 1 федан = 4200 м²*

INTRODUCTION

Soybean (*Glycin max* (L.) Merr.) is one of the relatively new crops introduced to Egyptian Agriculture which could supply Egyptians with oil and protein, in addition we could feed animals with its meal and use it as soil improving crop particularly in the soil under reclamation.

The yield potential of soybean cold be regulated through the reconstitution of genetic structure, i.e. breeding program and/or by improving cultural treatments.

The plants exposed to water stress and nitrogen appear to be the most frequently limiting factors for yield. The effect of water stress and nitrogen fertilization on yield and its components were studied by several workers (Teodoro et *al*, 2001; Al-Assil and Mohamed, 2002 and Eman,S, 2002). Thus, the aim of this study is to investigate the productive efficiency of two soybean varieties under different moisture stress and nitrogen fertilization.

Materials and Methods

The present investigation was conducted at the Experimental farm of the Faculty of Agriculture, Assiut, Egypt, during 2002 and 2003 seasons to investigate productive efficiency of two soybean varieties (Clark and Craowford) in relation to moisture stress and nitrogen fertilization. Three different irrigation regimes were practiced: I_1 , I_2 and I_3 (Irrigation at 60, 40 and 20% from available water, respectively) and three nitrogen fertilization rates: 30, 60 and 90 kg N/feddan were used.

The soil at depth 0-60 cm. was performed to determine the field capacity and permanent wilting range. The soil type of the Experimental site was clay with a pH of 8.00, saturation capacity of 42 %, organic matter 1.90 %, available phosphorus 11.15 ppm and total nitrogen 0.10 % . The trial was laid out in a split-split plot design with four replications.

Each sub-sub plot consisted of six rows 3.5 m long and 60 cm apart. Seeds were sown in hills of 10 cm apart. Thinning was done 15 days after sowing to one plant per hill. All other cultural practices were applied as recommended for soybean production in both seasons.

Results and Discussion:

1. Effect of Irrigation Regimes(I)

A - Yield and its components.

The data in Table 1 revealed that irrigation treatments exerted a highly significant influence on yield and yield attributes, except number of seeds/pod while number of branches/ plant was influenced during the first season only.

The yield components plant height, number of branches/plant, total number of pods/plant and seed index, were significantly higher with irrigation at 60 % from a..w. than at 40 and 20 % from a.w.

Rajendran and Lourduraj (2000) reported that moisture stress reduced the number of pods/plant, number of seeds/pod and seed index.

Table 1. Effect of treatments on yield and yield attributes.

Treatments	Plant height (cm)		No. of branches/pl.		No. of pods/plant		No. of seeds/pod		Seed index (g)		Seed yield/plant (g)		Seed yield/ feddan (kg)	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Irrigation														
60% from a.w	61.79	61.13	1.427	1.908	48.96	44.25	2.458	2.579	11.99	12.70	12.11	9.59	920.33	722.67
40% from a.w	51.67	59.29	1.496	1.708	41.87	35.18	2.567	2.500	10.39	11.07	10.03	7.83	646.67	615.17
20% from a.w	49.83	51.92	1.300	1.025	38.13	28.87	2.454	2.400	9.80	11.28	7.34	7.61	557.50	607.83
F-test	**	**	n.s	**	**	**	n.s	n.s	**	**	**	*	**	*
Lsd (0.05%)	5.14	3.95	n.s	0.393	3.12	3.84	n.s	n.s	0.27	0.56	1.34	1.17	102.89	95.61
Fertilization														
30 kg N/fed	52.21	56.04	1.271	1.446	39.87	31.65	2.421	2.492	10.03	11.25	8.06	7.63	566.00	599.33
60 kg N/fed	55.46	58.83	1.471	1.529	43.98	35.77	2.537	2.558	10.73	11.73	9.66	8.17	756.50	634.83
90 kg N/fed	55.63	57.46	1.471	1.667	45.12	40.88	2.521	2.429	11.42	12.06	11.77	9.23	802.00	711.50
F-test	*	*	n.s	n.s	*	**	n.s	n.s	**	*	**	**	**	**
Lsd(0.05%)	2.58	1.98	n.s	n.s	3.56	3.19	n.s	n.s	0.34	0.58	0.74	0.65	53.34	58.04
Varieties														
Clark	50.31	53.33	1.456	1.731	41.47	36.88	2.444	2.522	10.01	11.40	9.00	8.26	674.33	643.33
Craowford	58.56	61.56	1.353	1.364	44.50	35.32	2.542	2.464	11.44	11.96	10.65	8.42	742.00	653.78
F-test	**	**	n.s	**	*	n.s	n.s	n.s	**	**	**	n.s	*	n.s

n.s, * and ** were non significant, significant and highly significant , respectively.

This results may be due to, at higher levels of irrigation, the fact that the plants did not experience any moisture stress and assimilates translocated from the stem and leaves may have been distributed throughout the pod, resulting in an increase number of pods/ plant and seed index. Similarly, the unrestricted and uniform availability of water resulted in higher photosynthesis and increased photosynthetic translocation from stem and leaves to seeds. This favourably influenced the plant height, number of branches/ plant, number of pods/plant and number of seeds/pod at higher levels of irrigation as also reported by Dubey et *al*.(1995).

The higher moisture level (irrigation at 60 % from a.w.) produced a significantly higher mean seed yield of 821.50 kg/feddan as compared to 40 and 20 % from a.w., which led to 630.92 and 582.67 kg/feddan, respectively. The variation in seed yield with varying levels of irrigation could be related to the variation in the number of branches, number of pods/plant and seed index. These yield components were highest at irrigation at 60 % from a.w. and lowest at irrigation at 40 and 20 % from a.w. Ramesh and Gopalaswanig, 1992; Al Assil and Mohamed, 2002; EL Amathi and Singh, 2001, also reported a drastic reduction in soybean yield due to moisture stress.

B - Oil and Protein contents

Irrigation regimes had a significant effect on oil and protein contents as well as on its yields (Tabel 2). Soybean seed under irrigation at 60 % from a.w. gave the maximum mean oil and protein contents, followed by irrigation at 40 and 20 % from a.w.

Table 2. Effect of treatments on oil and protein content

Treatments	Oil %		Protein %		Oil yield (kg/fed)		Protein yield (kg/fed)	
	2002	2003	2002	2003	2002	2003	2002	2003
Irrigation								
60% from a.w	22.58	23.17	35.12	34.18	206.1	167.2	323.8	247.3
40% from a.w	20.67	20.92	34.15	33.21	133.7	128.5	221.5	205.3
20% from a.w	20.50	20.42	33.74	31.78	112.6	124.0	187.9	193.0
F-test	**	**	**	**	**	**	**	**
Lsd (0.05%)	0.51	0.88	0.26	0.31	3.49	5.74	1.40	1.87
Fertilization								
30 kg N/fed	22.67	22.58	33.64	32.34	129.9	136.3	191.1	194.1
60 kg N/fed	21.50	21.75	34.40	33.16	165.6	139.8	260.5	210.9
90 kg N/fed	19.58	20.17	34.95	33.67	156.9	143.6	281.6	240.5
F-test	**	**	**	**	**	*	**	**
Lsd(0.05%)	0.37	0.71	0.18	0.16	2.38	4.90	1.11	0.98
Varieties								
Clark	21.39	22.11	34.22	32.89	145.6	143.4	231.9	212.2
Craowford	21.11	20.89	34.45	33.22	155.9	136.5	256.9	218.2
F-test	n.s	**	**	**	**	**	**	**

The increase in oil and protein contents under higher irrigation regimes was probably due to adequate moisture supply for growth and development of crop which lead to greater metabolic activites during reproductive stage of crop. Similar effect of irrigation was also reported by Kumawat et *al* (2000).

2- Effect of Nitrogen fertilization (N)

A - Yield and its components

Application of N had a significant effect on plant height, number of pods/plant, seed index, seed yield/plant and seed yield kg/feddan (Table 1).

The seed yield increased significantly with increasing N level. The mean seed yield 756.75 kg/feddan was recorded with 90 kg N /feddan and was higher by 8.07 and 23.00 % than that recorded with 60 and 30 kg N/feddan, respectively. The increase in seed yield by N application was mostly owing to the beneficial effect of N nutrition in exploiting inherent potential of the crop. Similar results were also reported by Kumawat et *al* ,2000 and Patel and Chandravanshi, 1996.

B - Oil and Protein contents

Results in Table 2 showed that protein content of seeds increased significantly with the increase in the N levels, while the reverse trend was noticed for oil content. The maximum mean of oil and protein content was found at 30 and 90 kg N/feddan, respectively. The oil and protein yields were significantly increased with increasing nitrogen levels. The maximum mean of oil and protein yields was recorded under 90 kg N/ feddan. Eman (2002) reported that increasing N levels caused increasing of protein content and decreased oil content.

3. Varietal differences

A - Yield and its components

Table 1 shows that the differences among Clark and Craowford varieties in plant height and seed index were significant in both seasons, while number of branches, number of pods and seed yield were influenced during one year only. It is clear that the variety Craowford had the highest mean values for plant height, number of pods/plant, seed index and seed yield. Similar results were obtained by Hefni (1994).

B - Oil and Protein contents

Table 2 shows that the differences between Cark and Craowford were highly significant for oil and protein contents and oil and protein yields.

The maximum and minimum mean values of oil and protein, respectively, were obtained from Clark variety. The highest oil and protein yields were obtained from Craowford variety .The same results were obtained by Hefni (1994).

CONCLUSIONS

This study shows that drastic reduction in soybean yield and its components occurred when plants were grown under moisture stress.

Seed, oil and protein yields were increased significantly with increasing nitrogen.

Productivity of Craowford variety was higher than Clark.

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