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INFLUENCE OF PLANT POPULATION ON YIELD PERFORMANCE OF TWO SOYBEAN VARIETIES UNDER RAINFED CONDITIONS IN SUDAN

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Abstract

Field experiments were carried out at Damazeen, Central Sudan (11 45` N) on a clay soil (organic matter 1.62% and pH 7.0) during 1985 and 1986 seasons. The total amount of rainfall during the two growing seasons (June-October) were 732 and 912 mm, respectively. The effect of various seeding rates (180, 240, 300, 360, 420 and 480 thousand viable seeds/ha) on seed yield and other agronomic characteristics of Doko and Tropical soybean varieties were studied. Seeding rate did not affect days from planting to 50% flowering or maturity. Meanwhile, it affected significantly plant height and lowest pod height, in the two growing varieties. Increasing seeding rate significantly decreased all yield components, except 100-seed weight, but considerably increased seed yield and lodging of both varieties. Increasing seed rate from 180 to 240, 300, 360, 420 and 480 thousand viable seeds/ha significantly increased seed yield by 23, 86, 73, 57 and 39%, respectively in Doko variety and 22, 54, 83, 66 and 41%, respectively in Tropical variety. Optimum seeding rate was 300,000 or 360,000 viable seeds/ha for Doko variety and 360,000 and/or 420,000 for Tropical soybean variety.

INTRODUCTION

Recently, soybean have been introduced to the semi-arid region of Sudan. Growing soybean in such area is important for its role as an excellent break crop in cereal rotation and for limiting the build-up of many pests, especially *Striga spp.*

Seeding rate is one of the factors that affect soybean yield. Increasing seeding

rate was reported to increase plant height, lowest pod height and number of plants at harvest (Beatty *et al.* 1982, Boerma and Ashley 1982, Yacoubi, 1982 and Mawaki *et al.* 1984) In addition, Alessi and Power (1982), Beatty *et al.* (1982), Boerma and Ashley (1982), Yacoubi (1982), Mawaki *et al.* (1984), Balyan and Mohta (1985), Puech and Prudon (1986) and Hassan *et al.* (1988) found that seed yield per unit area and planting lodging increased, but plant seed weight, pod and seed number per plant decreased with increasing plant population. The broadcast seeding method is commonly practised for planting cereal and oil crops in the Central region of Sudan. However, in case of soybean broadcast seeding method often results in poor germination, inadequate plant stand, high levels of weed infestation and in turn low yields (Yacoubi, 1982). Therefore, this study was designed to yield information on the effect of various seeding rates on yield performance of two promising soybean varieties under broadcast seeding method in the Central region of Sudan.

MATERIALS AND METHODS

Four experiments were conducted at the farm of the Sudanese-Egyptian Agriculture Integration Company, Damazeen, Central Region, Sudan during 1985 and 1986 seasons. The farm lies between Latitudes 11 33` and 11 53` North and Longitudes 34 32` and 34 55` East within the tall grass Savannah Zone in the semi-arid climate. The total amount of rainfall during 1985 and 1986 seasons were 732 and 912 mm, respectively. Mechanical and chemical soil analysis indicated a clay textured soil with a pH of 7.0 and an organic matter content of 1.62%. The preceding crop was sorghum in both growing seasons. 30Kg P_2O_5/faddan (one faddan = 0.42 ha) was applied pre-sowing and 15 kg N/faddan was added as a starter dose at sowing. Seeds of the two promising varieties, i.e. Doko and Tropical were inoculated with a peat culture of *Rhizobium japonicum* at sowing, which took place on June 25 and July 9 in 1985 and 1986, respectively. Seeds of each variety were evenly broadcasted by hand at six different seeding rates (180,000; 240,000; 300,000; 360,000; 420,000 and 480,000 viable seeds/ha) in a separate experiment. The randomized complete block design with six replications was used. The experimental plot size was 80 m^2 (7 m long x 6 m wide). Data were statistically analyzed and combined analysis of both seasons was made.

RESULTS AND DISCUSSION

Experiment 1:

Effect of seeding rate on yield and its components of the soybean Doko variety:

Results in Table 1 showed that days from planting to either 50% flowering or maturity were not affected by seeding rate. However increasing seeding rate from 180,000 to 360,000 viable seeds/ha significantly increased plant height and lowest pod height. These may be attributed to the competition among plants for light at denser populations. These results are in general agreement with those obtained by Beatty *et al.* (1982), Boerma and Ashley (1982), Mawaki *et al.* (1984) and Hassan *et al.* (1988). The highest stand was obtained in the treatment of 480,000 germinable seeds/ha (Table 1). Similar results were reported by Yacoubi (1982). Increasing seeding rates from 180,000 to 480,000 germinable seeds/ha reduced number of branches, pods, seeds and seed weight/plant by 83, 63, 65 and 69% respectively (Table 1). However, 100-seed weight was not affected by seeding rate. Such reductions in the plant characters may be due to the increased competition for the essential environmental factors among soybean plants. These results support the findings of Alessi and Power (1982), Beatty *et al.* (1982), Puech and Prudon (1986) and Hassan *et al.* (1988).

Increasing seed rate from 180,000 to 240,000; 300,000; 360,000; 420,000 and 480,000 germinable seeds/ha increased seed yield/ha by 23, 86, 73, 57 and 39%, respectively (Table 1). The highest seed yield was obtained from sowing at a rate of 300,000 viable seeds/ha. These results are in accordance with those of Alessi and Power (1982); Beatty *et al.* (1982), Mawaki *et al.* (1984), Balyan and Mohta (1985), Puech and Prudon (1986) and Hassan *et al.* (1988). It seems that the optimum seed rate for the soybean variety Doko was ranging between 300,000 and 360,000 viable seeds/ha.

Experiment 2:

Effect of seed rate on growth, quantitative and qualitative characters of soybean variety Tropical:

Data in Table 2 showed that both days from planting to 50% flowering and maturity were not significantly affected by seed rate.

Table 1. Effect of seeding rate on yield and some agronomic characters of soybean variety Doko combined for the two growing seasons, 1985 and 1986.

Character	Viable seeds x 1000/ha						LSD at 5%
	180	240	300	360	420	480	
50% flowering[1]	50	50	49	49	49	49	NS
Maturity[2]	109	108	108	106	106	104	NS
Plant height (cm)	49	57	67	72	74	73	4
Lowest pod height (cm)	7	11	14	17	18	18	2
Branches / plant	6	4	3	3	2	1	2
Pods / plant	56	45	38	31	26	21	5
Seeds / plant	128	100	76	65	60	45	36
Seed weight / plant (g)	15.3	12.6	10.0	7.8	6.1	5.6	3.7
100-seed weight (g)	14.5	14.5	14.5	14.5	14.3	14.4	NS
Lodging[3]	1	1	1	1	1	2	NS
Plants harvested / m^2	16.1	22.2	26.1	34.1	40.3	46.5	0.6
Seed yield (kg/ha)	917	1124	1707	1590	1400	1271	238

1. Days from planting to emergence of the first flower on 50% of plants of each treatment.
2. Days from planting to maturity of 95% of total pods beared on soybean plant.
3. 1 = all plants erect , 5 = all plants lodging.

Height of plants, lowest pod height and stand significantly increased by increasing seeding rate. In contrast, the increase in rate of seeding from 180,000 to 480,000 viable seeds/ha significantly decreased number of branches, pods and seeds/plant as well as seed weight/plant by 83, 69, 58 and 58%, respectively (Table 2). Similar results were reported by Alessi and Power (1982), Beatty *et al.* (1982), Puech and Prudon (1986) and Hassan *et al.* (1988). Such decreases in the mentioned characters at denser plant populations may be due to the high competition

Table 2. Effect of seeding rate on yield and some agronomic characters of soybean variety Tropical combined for the two growing seasons, 1985 and 1986.

Character	Viable seeds x 1000/ha						LSD at 5%
	180	240	300	360	420	480	
50% flowering[1]	55	53	55	52	53	52	NS
Maturity[2]	111	111	109	109	109	108	NS
Plant height (cm)	48	45	62	73	72	72	9
Lowest pod height (cm)	9	10	12	16	18	18	2
Branches / plant	6	5	3	2	1	1	1
Pods / plant	65	58	47	36	24	20	4
Seeds / plant	131	109	96	78	65	55	12
Seed weight / plant (g)	16.5	13.5	11.5	9.5	7.8	7.0	2.1
100-seed weight (g)	12.4	12.6	12.5	12.4	12.2	12.5	NS
Lodging[3]	1	1	1	1	1	2	NS
Plants harvested / m^2	16.3	22.7	29.4	34.6	40.5	46.8	0.7
Seed yield (kg/ha)	905	1107	1393	1655	1500	1274	362

among plants for the environmental factors. 100-seed weight was not affected by varying plant population.

Increasing seeding rate up to 480,000 germinable seeds/ha increased lodging (Table 2). Results reported by Alessi and Power (1982) and Mawaki *et al.* (1984), indicated that seeding rate had a great effect on lodging. Seed yield/ha was found to be increased by 22, 54, 83, 66 and 41%, respectively, with the increase in seeding rate from 180,000 to 240,000, 300,000, 360,000, 420,000 and 480,000 viable seeds/ha (Table 2). Seeding rate of 360,000 and/or 420,000 germinable seeds/ha were significantly more productive as compared with the other applied seeding

rates. The obtained increases in seed yield of Tropical soybean variety as a result of increasing seeding rates were in agreement with the results of Alessi and Power (1982), Boerma and Ashley (1982), Mawaki *et al.* (1984), Balyan and Mohta (1985), Puech and Prudon (1986) and Hassan *et al.* (1988). According to the present findings it could be concluded that the optimum seeding rate for Tropical soybean variety is either 360,000 or 420,000 viable seeds/ha. The reduction in seed yield at the lowest or highest applied seeding rate may be due to the insufficient light energy interception of plants in the first case and the competition for light and the other essential environmental requirements in the second one.

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تأثير عدد النباتات على المحصول وصفات أخرى لصنفين من الفول الصويا تحت ظروف الزراعة المطرية بالسودان

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فول الصويا من المحاصيل الجديدة على الزراعة المطرية بجمهورية السودان الديمقراطية ونظرا لاستنباط اصناف عالية المحصول وموائمة لظروف مناخية عديدة ومنها ظروف الزراعة المطرية فى المنطقة تحت الاستوائية بمنطقة الدمازين (خط عرض ٣٣` ١١° – ٥٣` ١١° شمالا بالسودان).

اجرى هذا البحث بمزرعة الشركة السودانية المصرية للتكامل الزراعى عامى ١٩٨٥ ، ١٩٨٦ لدراسة تأثير عدد النباتات وهى ١٨٠ ، ٢٤٠ ، ٣٠٠ ، ٣٦٠ ، ٤٢٠ ، ٤٨٠ الف بذرة قادرة على الانبات للهكتار على المحصول وصفات زراعية اخرى لصنفى فول الصويا دوكو وتروبيكال وتشير النتائج انه لم يكن لمعدل التقاوى اى تأثير على المدة من الزراعة حتى ٥٠٪ تزهير وكذلك المدة من الزراعة حتى النضج فى كلا الصنفين.

زاد ارتفاع النبات وارتفاع اول قرن والنسبة المئوية للنباتات الراقدة وعدد النباتات المحصودة زيادة معنوية بزيادة معدل التقاوى فى كلا الصنفين كما نقصت مكونات المحصول نقصا معنويا بزيادة معدل التقاوى فى صنفى دوكو وتروبيكال.

ادى زيادة معدل التقاوى من ١٨٠ الى ٢٤٠ ، ٣٠٠ ، ٣٦٠ ، ٤٢٠ ، ٤٨٠ الف بذرة / للهكتار الى زيادة معنوية فى المحصول بلغت ٢٣ ، ٨٦ ، ٧٣ ، ٥٧ ، ٣٩٪ على التوالى فى محصول الصنف دوكو بينما بلغت الزيادة ٢٢ ، ٥٤ ، ٨٣ ، ٦٦ ، ٤١٪ فى محصول الصنف تروبيكال.

ويتضح من نتائج هذه الدراسة ان افضل معدل تقاوى للصنف دوكو هو ٣٠٠ او ٣٦٠ الف بذرة قادرة على الانبات للهكتار و ٣٦٠ او ٤٢٠ الف بذرة قادرة على الانبات للهكتار للصنف تروبيكال.