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Research paper

Effect of Sowing Methods on Growth, Yield and Yield Components of Groundnut (*Arachis hypogaea* L.) Varieties at Dongola-Sudan

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ABSTRACT

This study was conducted at the demonstration farm of Dongola Research Station, Northern state, Sudan during 2016 and 2017, to assess the effect of sowing methods namely; flat and ridges on the performance of five released varieties of groundnut under the environment of Arid-soil and Surface irrigation system. The experimental design was arranged as split- plot in randomized complete block design with three replications. Five released groundnut varieties (Sodari, Madani, Kiriz, Tozi and Ahmadi) were used and assigned to the main plots and the two sowing methods (Flat and Ridge) were assigned to the sub plots. The hole to hole and ridge to ridge (or row to row) spacing were 30 cm and 60 cm, respectively, with plot size 3 x 3 m. In both seasons, sowing date was 24th July. The results for growth attributes of this study revealed that sowing methods significantly affected main stem diameter in the first season and days to 50% flowering in the second season. On the other hand, non-significant differences were indicated for plant height (cm), days to maturity and biomass/plant. The results of Yield and yield components indicated significant differences in 100-seed weight in both seasons, number of branch/plant and seed yield (kg/ha) in the first season and seed yield/plant in the second season. However, this result indicated a non-significant differences in number of pods/plant, number of pods/branch, pod yield/plant, pod yield (kg/ha) and number of seeds/pod in both seasons.

Keywords: groundnut, sowing method, varieties

تأثير طريقة الزراعة على الانتاجية ومكوناتها لبعض اصناف الفول السوداني بدنقلا، السودان

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مستخلص

أجريت هذه التجربة في مزرعة محطة البحوث الزراعية في شمال السودان بدنقلا خلال موسم 2016 و2017 لدراسة تأثير طريقة الزراعة بالسرابات والزراعة في الأرض المسطحة على نمو وانتاجية خمس أصناف من محصول الفول السوداني (سودري، مدني، كرز، توزي واحمدي). تم استخدام تصميم القطاعات العشوائية الكاملة وفق تنظيم القطع المنشقة بثلاث مكررات وكانت مسافات الزراعة بين النباتات 30سم وبين السرابات 60 سم وكان تاريخ الزراعة يوم 7/24 في الموسمين. أظهرت النتائج التي تم الحصول عليها لصفات النمو ان هنالك فروقات معنوية في سمك الساق الرئيسي وفى مواعيد الازهار في الموسم الأول وفروقات غير معنوية في طول النبات وتاريخ النضج والوزن الحيوي للنبات. اما النتائج المتحصل عليها لصفات الإنتاجية أظهرت فروقات معنوية في وزن ال 100 حبة في الموسمين وفى عدد الفروع للنبات وفى إنتاجية البذور بالكيلوجرام للهكتار وانتاجية البذور للنبات وفروقات غير معنوية في عدد القرون للنبات وعدد القرون في الفرع وعدد البذور في القرن وانتاجية القرون للنبات وانتاجية القرون بالكيلوجرام للهكتار في الموسمين.

كلمات مفتاحية: الفول السوداني، طريقة الزراعة، الاصناف

Introduction

Sudan, cultivated about 1900000 hectares of groundnut and produced 1200000 metric tons with an average yield of 632 kg/ha (FAO, 2006). In Sudan, the crop is grown under irrigation in the central clay plains and in the rain fed areas in the sandy soils of Western Sudan. About 80% of the area and two third of the national production came from the traditional rain fed sector of western Sudan. In North Kordofan, groundnut comes after sorghum in area under cultivation. Barberton, Sodiri and Gubiesh cultivars are widely grown and were characterized by early maturity.

Wakweya and Meleta (2016) revealed that sowing method significantly affected plant height, number of pods/ plant, biomass and seed yield (kg/ha). The seed yield gained by row sowing method was 20.2% higher than broadcast sowing method. the highest plant height (16.43 cm), pods/plant (22.4) and biomass. Seed yield of 11272.1 and 5297.9 kg/ha were recorded by row planting method as compared to broadcast planting. Dalley *et al*. (2004) reported that wide-row treatments recorded relatively larger biomass than the narrow-row treatments probably due to lesser competition for growth resources compared to narrow-row treatments. The low biomass recorded by some narrow row treatments could be compensated-for by the additional plants/m^2, resulting in significantly large biomass yield compared to wider-row spacing. Yilmaz (1999) reported that, the highest yield was obtained with 60 x15 cm spacing and the lowest yield was obtained with the widest spacing of 50 ×20 cm. Baldwin *et al.* (1998) reported a significant increase in yield of 381 kg/ha and total sound mature kernel (TSMK) with the twin-row spacing over the conventional row pattern when averaged across four runner cultivars and locations. Troedson *et al*. (1989) concluded that planting method has a significant effect on better resource utilization like water, nitrogen and phosphorus economy, energy savings and overcoming problems of soil compaction. Moreover, absorption of photosynthetically active radiations has also been found to be influenced by planting methods (Lal *et al*., 1991). Kaushik and Chaubey (2000) observed that pod yield of peanut was significantly affected by row spacing. The pod yield of 30 cm inter-row spacing was significantly higher than that of 45 cm inter row spacing. Kadiroglu (2012) reported significant higher yield in twin row planting compared to single row planting pattern. Ahmed *et al.* (2007) and Konlan *et al*. (2013) also reported that pod yield was 16.0% higher in narrow-row plantings than traditional wide-row crop. Kadiroglu (2012) found out that pod yield was 22% higher in twin-row plantings compared to traditional single-row ground nuts.

The present study was designed to evaluate the effect of two sowing methods on the performance of five released cultivars of ground nut under the environment of Arid-soil and Surface irrigation system at Dongola, Northern Sudan.

Materials and methods

This study was conducted at the Demonstration Farm, Dongola Research Station, Northern State, Sudan. Dongola lies between latitudes16 º:22′ N and longitudes 20 º:32′ E. The experiment was conducted during seasons of 2016 and 2017.

Two sowing methods namely; flat and ridges using five released cultivars of ground nut *Arachis hypogaea* L were evaluated. The experimental design was arranged in split- plot in randomized complete block design with three replications. Five released groundnut varieties (Sodari, Madani, Kiriz, Tozi and Ahmadi) were used and assigned to the main plots and the two sowing methods (Flat and Ridge) were assigned to the sub plots. The hole to hole and ridge to ridge (or row to row) spacing were 30 cm and 60 cm, respectively with plot size 3 x 3 m. In both seasons, sowing date was 24th July. The irrigation was applied at an interval of 8- 10 days in both seasons and no fertilizer was applied. Weeding was carried out twice by hand. For data collection, five randomly selected plant per plot were sampled, in both seasons to study the following parameters: plant height (cm), days to 50% flowering, days to maturity, main stem diameter (cm), biomass(g), number of reproductive branches/ plant, number of pods/ plant, number of pods/ branch, number of seeds/pod, 100-seed weight, pod yield/plant, seed yield/plant, pod yield (kg/ha) and seed yield (kg/ha).

Statistical analysis:

The collected data were subjected to standard procedures of statistical analysis as follows:

The procedure described Gomez and Gomez (1984) was used to estimate the individual and combined analysis of variance. Individual analysis of variance was carried out each season separately; then combined analysis of variance was done for those characters in which the mean squares of error (b) were homogenous.

Mean separation:

Duncan's multiple range test (DMRT) at 0.05 level of significance was performed, according to Gomez and Gomez (1984), as follows:

Step one: all the treatment means were ranked in decreasing order.

Step two: the adequate standard error of the differences (Sd) was computed according to the following equations:

a) For means over all varieties:

$Sd_1 = \sqrt{2[(b-1) E_b + E_a]/rb}$

b) For means over the two sowing methods:

$Sđ_2 = \sqrt{(2E_a)/rb}$

Where:

E_a and E_b = mean squares of error (a) and error (b), respectively.

r and b = numbers of replications and sub-plots, respectively.

Step three: values of the shortest significant range at 0.05 level were calculated as:

$R_p = [(r_p). (Sđ)]/\sqrt{2}$ for p = 2, 3, …,t

Where:

R_p = the (t-1) value.

t = the total number of treatment means under comparison.

p = the distance in rank between the pairs of treatment means to be compared.

r_p = the tabular values of significant studentized ranges at 0.05 level.

Step four: all treatment means, which did not differ significantly from each other, were then identified and grouped together.

Step five: alphabet notations were then used to indicate the non- significant difference between any two treatment means.

Coefficient of variation:

Coefficient of variation (CV) for each character, in both seasons, was determined using the following formula:

$CV\ a = (\sqrt{E_a} \chi\ 100)/ G$

$CV_b = (\sqrt{E_b} \chi\ 100)/ G$

Where:

E_a and E_b = the mean squares of error (a) and error (b), respectively .

G = overall mean of the character

Results and Discussion

Growth attributes:

The result of this study indicated significant differences in the analysis of variance between the two sowing methods (ridges and flat) in main stem diameter in the first season and days to 50% flowering in the second season. On the other hand, non-significant differences were indicated in both seasons for plant height (cm), days to maturity and biomass/plant. Similar findings for plant height was reported by Khalil *et al*. (1993) and Abdalla *et al*. (2000). However, this contradicted the funding of Wakweya and Meleta (2016) who indicated significant differences in plant height. In the first season, the earliest sowing methods reached 50 % flowering in 47 days with flat sowing and the latest (48 days) with ridge sowing (Table 1). Whereas, in the second season both sowing methods reached 50 % flowering in 48 days (Table 2). In both seasons, the higher main stem diameter was recorded with ridge sowing (4.213 and 4.483cm) and the lower main stem diameter (4.147 and 4.400 cm) with flat sowing. (Table 1 and 2).

Yield and yield components:

The analysis of variance indicated significant differences with 100-seed weight in both seasons, seed yield (kg/ha) in the first season and number of branches/plant and seed yield/plant in the second season. Similar findings for seed yield (kg/ha) was reported by Wakweya and Meleta (2016). These results are in parallel with the conclusion of Trodson *et al*. (1989) who stated that planting method has a significant effect on resource utilization like water, nitrogen and phosphorus economy, energy savings and soil compaction. Moreover, Lal *et al*. (1991) concluded that absorption of photosynthetically active radiations has also been found to be influenced by planting methods. On the other hand, this result indicated a non-significant difference in number of pods/plant, number of pods/branch, number of seed/pod, pod yield/plant, pod yield (kg/ha) and number of seeds/pod in both seasons. In the first season, the higher 100-seed weight (53.876 g) was recorded by the flat sowing and the lower (49.000 g) by ridge sowing (Table 1). However, in the second season the higher 100-seed weight (51.689 g) was recorded by the ridge sowing and the lower (45.139 g) by flat sowing (Table 2). In both seasons, the higher seed yield (151.660 and 166.331 kg/ha) was recorded by ridge sowing and the lower seed yield (149.940 and 140.381 kg/ha) by flat sowing (Table 1 and 2).

The combined analysis indicated insignificant differences for all studied characters. In addition, the sowing method x variety interaction was insignificant for all characters reflecting a similar response of the five varieties to the two sowing methods (Table 3).

Table (1): Means of different characters of groundnut as affected by sowing methods in season 2016

Sowing method	Ridge	Flat
Plant height (cm)	14.867	13.933
Days to 50% flowering	48.067	47.867
Days to maturity	143.467	143.467
No. of branches/plant	8.933	8.800
No. of pods/plant	38.867	34.733
No. of pods/branch	6.267	6.133
No. of seeds/pod	2.00	2.00
100 seed weight (g)	49.000a	53.867b
Biomass/plant (kg)	0.107	0.109
Seed and husk yield/plant (g)	32.280	29.067
Seed yield/plant (g)	17.053	15.573
Seed and husk yield (Kg/ha)	246.840	256.107
Seed yield (Kg/ha)	151.660b	149.940a
Maim stem diameter (mm)	4.213b	4.147a

Table (2): Means of different characters of ground nut as affected by sowing methods in season 2017

Sowing method	Ridge	Flat
Plant height (cm)	13.780	13.196
Days to 50% flowering	48.133a	48.400b
Days to maturity	139.667	139.667
No. of branches/plant	5.133b	4.600a
No. of pods/plant	23.133	20.733
No. of pods/branch	4.467	3.867
No. of seeds/pod	2.00	2.00
100 seed weight (g)	51.689b	45.139a
Biomass/plant	0.111	0.108
Seed and husk yield/plant	68.333	52.333
Seed yield/plant	36.627b	26.321a
Seed and husk yield (Kg/ha)	324.440	283.840
Seed yield (Kg/ha)	166.331	140.381
Maim stem diameter	4.483	4.400

Table (3): The combined analysis of variance for the different characters for five groundnut varieties and two sowing methods evaluated in seasons 2016/2017

Character	Mean Squire		
	Season 2016/2017		
	SM × S (d.f = 4)	V × SM × S (d.f = 4)	Error (d.f = 20)
Plant height (cm)	0.398	4.045	2.187
Days to 50% flowering	0.058	0.275	0.217
Days to maturity	0.000	0.000	0.000
Main stem diameter (mm)	0.390	0.425	0.323
Number of branch/plant	1.333	1.767	1.317
Number of pods/plant	35.358	12.558	57.700
Number of pods/branch	2.017	0.817	3.117
Number of seeds/pod	0.000	0.000	0.000
100 seed weight (g)	119.333	6.062	52.974
Biomass/plant (kg)	0.004	0.003	0.017
Pod yield/plant	146.481	239.931	296.385
Seed yield/plant (g)	301.647	97.329	192.152
Pod yield (Kg/ha)	262803.023	168501.833	171919.959
Seed yield (Kg/ha)	2460.704	572.887	52989.26

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