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Influence of Plant Spacing and Sowing Depth on Growth and Yield of Sunflower (*Helianthus annuus* L.) in Halfa Elgadidah Scheme, Sudan

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Abstract: ***In order to study the effect of plant population on growth and yield of sunflower, an experiment was conducted with complete randomize blocks design with four replications at Research Farm of Halfa Elgadidah Research Station during summer seasons of 2016 and 2017. Experimental factors including: sowing depth D1, D2,D3 and D4 at (3, 5, 7 and 10 cm) and plant population where Seeds were sown in hills spaced S1, S2 and S3 corresponding to 20, 25 and 30cm apart within ridges. The results revealed that, there was a linear increase in stem , head diameter, number and seed weight per head with increase in plant spacing. Also, increasing plant density increased plant height and leaf area. The highest seed yield (3216 and 3044 kg ha^{-1}) produced when 3 seeds of sunflower were planted at 20cm followed by the same spacing with 5 seeds per hill but the difference between them was statistically at par while 30cm plant spacing resulted in significantly less grain yield (2557kg ha^{-1}). Hence, for achieving optimum results in sunflower variety SY40-45, the crop may be sown in plant spacing of 20 with 3 cm depth to achieve high plant population ha $^{-1}$ which significantly increased seed yield per unit area***.

Keywords: Sunflower, yield, LAI, plant population and sowing depth

1. Introduction

Sunflower (*Helianthus annuus* L.) is an oil crop grown successfully when it is seeded as spring sown crop under irrigated and rain-fed conditions; it is adapted to wide types of soils and climatic conditions and produces its optimum yield when accompanied with sound management practices [1]. Sunflower is a native to North America and was grown by Indians as a food source. Russia, Argentina and USA are the leading producer countries of sunflower, it is a potential source of high quality edible oil, ranges third to soybean and rapeseed as an oil crop in the world [2]. Sunflower is considered to be a good source of both oil and proteins. Oil content of sunflower ranges from 39-49%. Sunflower oil is generally considered a premium oil because of its light color, high level of unsaturated fatty acids and lack of linolenic acid, bland flavor and high smoke points[2]. The primary fatty acids in the oil are oleic and linoleic (typically 90% unsaturated fatty acids), with the remainder consisting of palmitic and stearic saturated fatty acids. Due to its edible oil content it is very important food supplement. Protein percentage of sunflower meal ranges from 28% for non-dehulled seeds to 42% for completely dehulled seeds [3]. This low productivity is attributed mainly to the lack and/or weak application of cultural practices concerns with sunflower, e.g. suitable doses of fertilizers, methods of sowing, sowing dates, using of agricultural machines [4].

A suitable plant population is of prime importance in sunflower production. Increasing plant population decreased stem and head diameter and enhanced plant height [5]. Higher plant populations produce lighter seeds, thinner stems, taller plants and more yield than lesser plant populations [6]. Plant population did not significantly effect on harvest index [7]. Also, [8] argues that the reported effects of plant population on sunflower seed yield appear contradictory but agreement is general that sunflower compensates within a wide range of populations for too thick or too thin stands by adjusting head size and seed size arid seed numbers. The seeds were planted at a depth of 2 cm and at varying spacing according to treatments applied to each plot[8].

There are several causes of low productivity. Among them, mismanagement of plant density is considered to be the major one. Hence, there is a need to improve this major component of the production technology for getting higher sunflower production. so a precision seeds rate should be used to achieve correct plant density of sunflower. On the other hand, Sowing sunflower seeds into deeper depth, the colder the soil and the longer it will take for the plants to emerge. So, according to[9] establishment levels will vary depending on the type of seeding system you use. Therefore, the present study was conducted to evaluate the effect of four sowing depth on growth, grain yield of sunflower planted at three planting densities under agro-ecological conditions of Halfa Elgadidah Sudan.

2. Material and Methods

In order to study the effect of plant population on growth and yield of sunflower, an experiment was conducted as

factorial with complete randomize blocks design with four replications at Research Farm of Halfa Elgadidah Research Station during two summer seasons of 2016 and 2017. Experimental factors including: plant population (spacing) and sowing depth D1, D2,D3 and D4 at (3, 5, 7 and 10 cm). Seeds of sunflower hybrid (sunflower variety SY40-45) were sown on first week of July during two seasons. The plot size was 4 rows and 8 m long ridges spaced 0.70 m apart. Seeds were sown in hills spaced S1, S2 and S3 corresponding to 20, 25 and 30cm apart within ridges and thinned to one plant per hill two weeks after planting. All recommended agronomic practices were followed throughout the season. Data were collected from the middle two rows on days to 50% flowering, plant height (cm), Stem diameter(cm), leaf area index, head diameter (cm), number of seeds per head, seed yield per head (g) and seed yield (kg/ha). Analysis of variance was performed on individual trials and the F-test was made. statistical analysis package M-STATc software was used for the data analysis. Mean comparisons were worked out by methods of Duncan (Duncan's Multiple Range Test, DMRT) at 5% level of probability.

3. Results and Discussion

Results manifested in table 1 showed that, increasing plant density significantly increased the mean plant height and leaf area index (LAI) but decreased stem diameter in both seasons. In respect to sowing depth, sowing seeds of sunflower deeper in the soil significantly decreased plant height and LAI in both seasons (table1). Regarding interaction effects, when sowing seeds at 3cm depth (D1) in narrow spaces between holes significantly resulted in taller plants with greater leaf area values as compared to other interaction treatments (table1). While sowing seeds not deeper at wider space (S_3) significantly increased stem diameter.

Table 2 showed that, all yield attributes were significantly affected by all factors under study. With respect of head diameter, number and weight seeds per head, the maximum values of these characters were recorded from plots where seeds sown in wider spaces S_3 as compared to other plant population treatments. The bigger heads (19cm) were recorded in S_3 treatment followed by S_2 and S_1 treatments, respectively (table 2). Also, the same trends were observed for both number and weight of seeds per head for these treatments.

In contrast, the seed yield/ha was greater in narrow spaces relative to wider space. The maximum seeds yield per unit area (3000 kg/ha). The same trend was observed of the later character due to sowing depth when sowing seeds not deeper in the soil as compared to other sowing depths. It seems that sowing seeds not deeper in the soil increased number and weight of seeds per head (table 2).

The increase in growth attributes i.e. plant height stem diameter and leaf area index observed in this study due to increase in plant population might be through high photosynthesis of taller plants with greater loaf area which resulted in more dry matter accumulation. These results were agreed with those reported by [7,10].

On the other hand, a shallow seeding of 3-5 cm will allow more rapid emergence than deeper seeding. Further, deep seed sowing has a number of effects on seeding growth. For instance, there may be an increase in the time between seed germinating and seeding emergence which largely determines by ranking of seeding in the competitive hierarchy for resources therefore, the reduction in growth attributes in this study due sowing seeds deeper in the soil could be attributes to a fore mentioned reasons, the obtained results were accord with those stated by [11] who found that, seeding depth can have profound effects on seedling emergence, growth and development. Also,[12] reported that, sowing seeds at 3cm depth produced higher plant and more vigorous plants resulted in bigger head with high number of seed and more yield per unit area. The increased in yield attributes resulted from low plant density might be due to low high plant population this regard, [13,14] reported that the larger head diameter, number of seeds per head and heavier seeds per disc were achieved in wider spacing plant. In contrast, the higher seed yield per unit area was achieved in narrow spacing plant as reported by[15]. Although the sunflower performance in relation to its growth and yield contributing traits was better under wider planting spacing but due to improper plant population, their seed yield/ha was significantly lower.

Hence it is concluded that, for achieving optimum results in sunflower variety SY40-45, the crop may be sown in plant spacing of 20cm with 3cm depth to achieve high plant population per unit area to obtain higher seed yield.

References

[1] Killi F; (2005).A research on yield and yield components of some hybrid oil sunflower varieties (*Helianthus annuus* L.) under ecological conditions of Kahramanmaras. Trop. J. Agri. Fore., 21: 149–55.
[2] FAO (Food and Agriculture Organization); Production Year Book. 1985; 37(70):142-149.
[3] Putnam DH, Plinger ESO, Hicks DR, Durigan BR, Noetzel DM, Meronuck RA, Doll D, Schulte EE; Grain crops production and management, Sunflower, University of Wisconsin, Field Groups Manual, 1990; 1-10.
[4] Khidir MO; Oil Crops in Sudan, Khartoum University 2nd ed., 2007;103-120.
[5] Mojiri, A. and Arzani, A. (2003). Effects of Nitrogen Rate and Plant Density on Yield and Yield Components of Sunflower. *Journal of Science and Technology of Agriculture and Natural Resources*, 7: 115-125.
[6] Beg. A., Pourdad, S.S. and Alipour, S. (2007). Row and plant spacing effects on agronomic performance of sunflower in warm and semi-cold areas of Iran. Helia, 30: 99-104.
[7] Rasool,K.; Wajid, A.; Sanaullah, A.; Ghaffar1, M.; Arshad, S.M. and Abbas, S.(2015). Optimizing Nitrogen Rate and Planting Density for Sunflower under Irrigated Conditions of Punjab. *SAARC J.* Agri., 13(1):174-187.
[8] Jones, O.R (1984) Yield, water use efficiency and quality of dry land sunflower grown in the Southern high plains. Agron. J. 76(2); 200-201.

[9] Roe, A. (2001). Growing Sunflower Management Package For Dryland Wa. Crop Management Notes - Western Downs, Maranoa and Balonne QLD, Australia.

[10] **Xiao sa;chen, shu;Zhao and Wang gang.(2006)**.Density effect on plant height growth and inequality in sun flower population .Journal of integrative plant population,48(5)513-519.

[11] **Proctor, J.T.A.and Sullivan J.A. (2013).Effect of seeding depth on seedling growth and dry matter partitioning in American ginsengJ** Ginseng Res.; 37(2):254-260.

[12] **Thiyam Yadav and PK Rai.**2017. Effect of seed size and sowing depth on seedling emergence and seed yield of pea (pisum) Journal of Pharmacogn Phosy and Phytochemistry;6 (4):1003-1005.

[13] **EL Naim, A.M.; and Ahmed, M.F.(2010).**Effect of irrigation intervals and inter-row spacing on the vegetative Growth Characteristics in sun flower (Helianthus Annus L.) hybrid in shambat soil .Journal of applied Sci.Res; 6(9):1440-1445.

[14] **TurKsun, A.O.; Killi, F.** Effect of different sowing arrangements of oil seed sun flower, in dry land conditions, KSUJ. Nat sic, 19(1)76-83.

[15] **Killi, F. (2004).** Influence of different nitrogen levels on productively of oil seed and confection sun flowers ((Helianthus Annus L.) under varing plant population. International of Agriculture and Biology 4-594-598.

Table 1: Effect of plant population and sowing depth on means of some growth attributes of sunflower

Season		2016			2017		
treatment		Plant height (cm)	LAI	Stem diameter (cm)	Plant height (cm)	LAI	Stem diameter (cm)
S1		134.13^{a}	4.38^{a}	1.53^{b}	159.44^{a}	2.31^{a}	1.42^{c}
S2		121.88^{b}	2.90^{b}	1.79^{a}	156.31^{a}	2.0^{3b}	1.50^{b}
S3		118.69^{b}	1.37^{c}	1.90^{a}	149.56^{b}	1.88^{b}	1.71^{a}
D1		131.17^{a}	2.92^{a}	1.67^{b}	162.92^{a}	2.08^{ab}	1.52^{ab}
D2		123.75^{b}	2.67^{ab}	1.70^{b}	157.75^{b}	1.89^{b}	1.56^{ab}
D3		123.50^{b}	2.63^{ab}	1.84^{a}	154.42^{b}	2.22^{a}	1.48^{b}
D4		121.17^{b}	2.47^{b}	1.78^{ab}	143.33^{c}	2.10^{ab}	1.60^{a}
S1	D1	142.25^{A}	5.34^{A}	1.45^{E}	166.5^{A}	2.55^{A}	1.32^{F}
	D2	131.75^{AB}	4.30^{B}	1.58^{DE}	160.00^{ABC}	2.00^{B-E}	1.40^{EF}
	D3	138.75^{A}	4.47^{B}	1.63^{CDE}	156.50^{B-E}	2.48^{AB}	1.40^{EF}
	D4	123.7^{BC}	3.41^{C}	1.48^{DE}	154.75^{CDE}	2.23^{A-D}	1.55^{BCD}
S2	D1	125.25^{BC}	2.24^{BE}	1.70^{BCD}	162.50^{AB}	1.75^{DE}	1.45^{DEF}
	D2	124.75^{AB}	2.26^{D}	1.68^{B-E}	158.00^{BCD}	2.05^{A-B}	1.53^{CDE}
	D3	117.75^{CD}	1.73^{EF}	1.90^{AB}	155.00^{CDE}	2.00^{B-E}	1.45^{DEF}
	D4	119.75^{CD}	2.13^{DE}	1.90^{AB}	149.75^{E}	2.30^{ABC}	1.58^{BCD}
S3	D1	114.50^{CD}	2.20^{G}	1.85A^{ABC}	159.75^{ABC}	1.95^{CDE}	1.80^{A}
	D2	114.75^{CD}	1.45^{FG}	1.83^{ABC}	155.25^{CDE}	1.65^{E}	1.75^{A}
	D3	114.00^{D}	1.75^{DEF}	2.00^{A}	151.75^{DE}	2.18^{A-D}	1.60^{AB}
	D4	131.50^{AB}	1.88^{DEF}	1.95^{A}	131.50^{F}	1.78DE	1.68^{AB}

$LSD_{0.05}$ ≡ Least significant difference at 5% probability level

Means with in the same column with different super scripts(letters)are significantly different at (P≤ 0.05).

Table 2: Effect of plant population and sowing depth on means of yield and its components of sunflower

season		20162017							
Treatments		Head diameter (cm)	Number of seed / head	seed weight/ disc (g)	Seed yield (kg/ha)	Head diameter (cm)	Number of seed per head	seed weight/ disc (g)	Seed yield (kg/ha)
S1		16.88^{c}	707.33^{b}	61.73^{c}	3009.5^{a}	17.16^{c}	924.9^{b}	87.46^{b}	2792.6^{a}
S2		17.53^{b}	804.50^{ab}	73.96^{b}	2619.8^{b}	18.46^{a}	1202.1^{a}	100.11^{a}	2735.2^{ab}
S3		19.06^{a}	845.39^{a}	94.65^{a}	2584.3^{b}	19.46^{a}	1265.3^{a}	103.26^{a}	2557.7^{b}
D1		17.33^{a}	729.37^{b}	70.78^{b}	2950.4^{a}	17.48^{b}	1176.7^{a}	99.27^{a}	2866.2^{a}
D2		17.68^{a}	731.68^{ab}	74.41^{b}	2847.3^{a}	19.06^{b}	1074.5^{b}	99.23^{a}	2808.5^{a}
D3		19.90^{a}	854.4^{a}	84.26^{a}	2363.1^{b}	18.43^{ab}	1169.3^{a}	95.89^{ab}	2558.4^{b}
D4		18.10^{a}	807.56^{ab}	77.67^{ab}	2790.7^{a}	18.22^{ab}	1102.0^{ab}	93.38c	2547.5^{b}
S1	D1	16.10^{E}	671.6^{CD}	54.70^{E}	3216.1^{A}	16.30^{D}	853.5^{E}	88.98^{DE}	2953.3^{A}
	D2	17.00^{DF}	610.35^{D}	61.40^{DE}	3044.6^{AB}	17.55^{CD}	901.5^{E}	89.15^{DE}	2912.6^{AB}
	D3	16.85^{DE}	727.8^{BC}	65.38^{DE}	2915.2^{AB}	17.43^{DC}	959.7^{DE}	88.25^{E}	2691.5^{ABC}
	D4	16.75^{DF}	819.60^{ABC}	65.45^{DE}	2862.5^{AB}	17.35^{CD}	985.0^{DE}	83.48^{E}	2612.9^{ABC}
S2	D1	17.38^{ABC}	685.68^{CD}	72.53^{CD}	3025.3^{AB}	18.03B^{CD}	1220.0^{BC}	97.13^{C}	2896.3^{AB}
	D2	17.33^{CDE}	693.53^{C}	69.13^{CDE}	3021.0^{AB}	18.53^{BC}	1046.3^{D}	101.25^{BC}	2865.8^{AB}
	D3	17.62^{CD}	913.65^{A}	82.88^{BC}	1786.0^{C}	18.30^{BC}	1315.3^{B}	101.55^{B}	2580.1^{BC}
	D4	17.78^{BCD}	925.37^{AB}	71.33^{CD}	2646.7^{AB}	18.25^{BC}	1226.5^{BC}	100.50^{BC}	2598.8^{ABC}
S3	D1	18.53^{ABC}	830.88^{ABC}	85.10^{BC}	2609.7^{AB}	18.13B^{CD}	1456.0^{A}	111.70^{A}	2749.1^{ABC}
	D2	18.73^{ABC}	951.15^{A}	92.75^{AB}	2476.3^{DC}	21.10^{A}	1277.3^{B}	107.30^{AB}	2647.0^{ABC}
	D3	19.20^{AB}	921.85^{AB}	104.53^{A}	23.88.1^{BC}	19.58^{AB}	1233.3^{B}	97.88^{C}	2403.8^{C}
	D4	19.38^{A}	677.70^{CD}	96.23^{AB}	2862.9^{AB}	19.05^{BC}	1094.5^{CD}	96.15^{CD}	2430.9^{C}

Means within the same column with different super scripts(letters)are significantly different at (P≤ 0.05).