HNSJ Humanities & Natural Sciences Journal
ISSN: (e) 2709-0833
www.hnjournal.net

Peer-Reviewed Journal
Indexed at: NSP - SJIF
Impact Factor 2022 = 4.91

RESEARCH TITLE

EFFECT OF INTRA AND INTER ROW SPACING ON GROWTH OF SUNFLOWER (*HELIANTHUS ANNUUS* L.) UNDER ZERO TILLAGE

BadrEldin Mohamed Eisa Yahia[1] **Ekhlas Mohamedzein Musa[1]**

[1] Faculty of Agriculture- University of Sinnar

Email: ekhlasmohamedzein2@gmail.com

HNSJ, 2022, 3(12); https://doi.org/10.53796/hnsj31223

Published at 01/12/2022 **Accepted at 10/11/2022**

Abstract

A field experiment was conducted during two seasons 2013/14 and 2014/15 at Demonstration Farm of the Arab Sudanese Blue Nile Agricultural Company in Blue Nile State to study the effect of intra-row and inter-row spacing on the growth of sunflower under zero tillage system . It comprised three intra-rows spacing 20, 30 and 40 cm, and three inter-rows spacing 60, 80 and 100 cm .The experiment was laid out in a factorial randomized complete block design with three replications. Data were collected on days to 50 % flowering, days to physiological maturity, plant height (cm), stem diameter (cm). The result showed that, intra-row spacing showed significant effect on days to 50% flowering, days to physiological maturity, stem diameter (cm). Inter-row spacing revealed significant effect on days to physiological maturity. The interaction between intra-row spacing and inter-row spacing showed significant effect on days to 50% flowering ,days to physiological maturity, plant height, stem diameter (cm).

عنوان البحث

تأثير التباعد داخل الصفوف وبين الصفوف على نمو زهرة الشمس (Helianthus annuus L.) تحت نظام الحرث الصفري

بدر الدين محمد عيسى يحيى[1] اخلاص محمد زين موسى[1]

[1] كلية الزراعة، جامعة سنار، السودان.

بريد الكتروني: ekhlasmohamedzein2@gmail.com

HNSJ, 2022, 3(12); https://doi.org/10.53796/hnsj31223

تاريخ النشر: 2022/12/01م تاريخ القبول: 2022/11/10م

المستخلص

أجريت تجربة حقلية خلال المواسم 2014/2013 و 2015/2014م فى المزرعة التجريبية للشركة العربية السودانية بولاية النيل الأزرق ، لدراسة أثر المسافات داخل الصفوف وبين الصفوف على نمو محصول زهرة الشمس تحت نظام الزراعة الصفرية. أستخدمت ثلاث مستويات من المسافات داخل الصفوف هي 20، 30 و40 سم و ثلاثة مسافات بين الصفوف هي 60،80 و100 سم ونفذت التجربة بتصميم التجارب العاملية باستخدام تصميم القطاعات العشوائية الكاملة بثلاثة مكررات. تم جمع البيانات عن عدد الأيام حتى 50% من الإزهار، عدد الأيام للوصول لمرحلة النضج، طول النبات (سم)، قطر الساق (سم). . أظهرت النتائج أن المسافات داخل الصفوف له تأثير معنوي على عدد الأيام حتى 50% من الإزهار، عدد الأيام للوصول لمرحلة النضج، قطر الساق (سم)، أما المسافات بين الصفوف فقد أظهرت تأثيراً معنويًا على عدد الأيام للوصول لمرحلة النضج. أما التفاعل بين المسافات داخل الصفوف وبين الصفوف فقد أظهر فروقات معنوية على عدد الأيام حتى 50% من الإزهار، عدد الأيام للوصول لمرحلة النضج، طول النبات (سم)، قطر الساق (سم).

INTRODUCTION

Zero tillage defined as direct seeding without plowing or harrowing, using chemical treatment for weed control before and during the growing season. Zero-tillage system has been selected to replace the traditional system.

Sunflower (*Helianthus annuus* L.) belongs to the family (Compositae). Originated in North America, the genus Helianthus is formed of annual, as herbaceous, and perennial species. Sunflower hybrids grown in the Sudan contain from 39 to 52 % oil in the seed and still have better yield potential. Sunflower seed was the third largest source of vegetable oil worldwide, following cotton seed and soybean. 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. The primary fatty acids in the oil are oleic and linolenic (Typically 90 % unsaturated fatty acids), with the remainder consisting of palmatic and stearic saturated fatty acids (Anon., 1987). Sunflower was introduced into Sudan in 1932 by Gezira research station. It was tried as a summer crop in 1951 and failed due to low fertilization (Khidir, 1997).Generally Sunflower plant grows well in areas which receive annual rainfall of 750 mm. Weiss (1983) reported that Sunflower plant can grow well in a temperature range of about 20-25 ˚C . In Sudan Sunflower was recently introduced to diversify the cropping system in rainfed (Gedarif, Damazine, Kadugli) and irrigated Gezira, Rahad, El suki and Halfa Schemes (Skoric, 1982; Ishag, 1988; Ahmed *et al.*, 1997).

Sunflower´s head has many disc-flowers in circles or rings. However, these disc –flower do not open at the same time. After ray glower appearance, the outer rings of disc- flowers start open towards the head centre. Kandil and El- Mohandis (1986) stated that, flowering duration of sunflowers head is about 7-10 days according to genotype and prevailing environmental conditions. AAAID (1986) found that, no significant differences in number of days to flowering when comparison was made between hybrids and non - hybrids genotypes. On the other hand, AAAID (1986) reported that, number of days to 50% flowering and days to maturity were both shortened. In a field trail, conducted at Sumsum, Gedarif State, of Sudan to compare 31sunflower varieties from different origins under rainfed conditions, the results showed that there were significant differences in days to 50 % flowering (Arnon, 1987). Also significant these differences were recorded by other workers (Asifcan *et al.*, 2003). A wide range of variability in days to 50% flowering was also reported by El Ahmer *et al*., (1989). Patial *et al*. (1996) stated that, days to 50% flowering were less affected by environmental conditions.

Arshad *et al*. (2007) noted that, days to maturity had positive correlation with head diameter but negative association with seed yield.

Shaeriff *et al*. (1985) reported that, a wide range of variation was observed and the genotypes differed significantly for all the traits except dry mater. Similar significant differences for plant height were reported by Cruz and Dela, (1989) and Tarig *et al*. (1992). A wide range of variability was reported by Klusa and Musniki (1998) in sunflower hybrids and open pollinated varieties. Patial *et al*. (1996) stated that, plant height was less affected by environmental conditions. Andrei and Eva (1997) stated that plant height ranged from 131 to 158 cm.

Rashed and Moosa (1990) reported that, significant differences were found among genotypes for all characters including stem diameter. Suzer and Atakisi (1993) reported marked differences in the stem diameter of sunflower genotypes and attributed these variations to gene effects. Significant genetic variability was observed among 77 recombined inbred lines for flowering, plant height, stem diameter, head diameter, grain yield/head and 1000 seeds weight (Rachid *et al*., 2004).

The objective of this study was to determine the effect of intra and inter rows on the growth of sunflower under zero tillage.

MATERIALS AND METHODS

A field experiment was conducted for two consecutive seasons (2013/14 and 2014/15) to study the effect of intra and inter row spacing on growth of sunflower (*Helianthus annuus* L.) under Zero tillage conditions. The Experiment was carried out at the Demonstration Farm of the Arab Sudanese Blue Nile Agricultural Company, Blue Nile State, Sudan; about 500km South of Khartoum (Latitude 11˚.4′ - 12˚ .2′ N Longitude 34˚.39′- 35˚.90′ E and Altitude 580 meters above sea level). Soil at the site is heavy clay soil. The climate of the locality is semi arid with mean annual rainfall of about 600-900 mm and with maximum temperature of about 37 C˚ in summer and around 21.6 C˚ in winter. Data on temperature and relative humidity in each season were obtained from the Damazine Metrological Station.

A factorial experiment was laid out in Arandomized Complete Block Design with three replicates. The seeds of sunflower (Sarina) obtained from Switch Company for Agricultural Services. The treatment consist of three intra - row spacing 20,30 and 40 cm designated as WR1,WR2 and WR3 respectively, and three inter - row spacing 60,80 and 100 cm designated as BR1 ,BR2 and BR3 respectively.

The land where the experiment was conducted was divided into plots. The size of each plot was 5×3 meters consisting of five rows, 5 meters in length and rows spacing was 70 cm, after the weeds germination and appearance at the top of the soil we applied glyphosate at rate 1 L/F, and we also used pre-emergence herbicides (Stomp) at rate 0.8 L/F to prevent the germination of grasses. Knapsack sprayer was used for herbic application. Seeds were sown in rows; the crop was sown on the first week of July in both seasons and we used zero tillage system was adopted.

The parameters which are measured were days to 50 % flowering (calculated as the number of days from emergence to time when 50 % of the plant flowered in each plot), days to physiological maturity (days from sowing to physiological maturity), Plant height (cm) of five selected and tagged plants from each plot were measured when reached maturity from the soil surface up to the base of the head, using a measuring tape. The stem diameter was determined also at maturity stage measured by verniner caliper 15 cm above the soil surface from the five tagged plants.

RESULTS AND DISCUSSIONS

Intra-raw spacing showed significant difference on days to 50% flowering in second season only. Inter-raw spacing showed no significant effect in both seasons. Moreover, the interaction between intra-row and inter-row spacing showed significant

effect in both seasons. However, the earliest plants to flower was given by the combination WR3×BR1 in the second season and the latest plants to flower was given by the combination WR3×BR3 in the second season (Table 1). These results agreed with Patil *et al*. (1996) who stated that, days to 50% flowering were less affected by environmental conditions. Also significant differences were recorded by other workers (Asifcan *et al*., 2003). A wide range of variability in days to 50% flowering was also reported by (El Ahmer *et al*., 1989).

Intra-raw spacing showed significant difference on days to maturity in second season only. On the other hand, inter-raw spacing showed significant effect in both seasons. Moreover, the interaction between intra-row and inter-row spacing showed significant effect in both seasons (Table 2). This result agreed with Arshad *et al*. (2007) who noted that days to maturity had positive correlation with head diameter but negative association with seed yield.

Intra-raw spacing showed no significant difference on plant height (cm) in both season. Inter-raw spacing showed no significant effect in both seasons. Moreover, the interaction between intra-row and inter-row spacing showed significant effect in both seasons, where the highest plant height was given by the combination WR1×BR1 in the second season and the shorter plant height was given by the combination WR3×BR1 in the first season (Table 3), this results agreed with Klusa and Musniki (1998) who stated that, there was a wide range of variability observed in plant height in sunflower hybrids and open pollinated varieties , this may be due to genotypic different between the varieties. However, the trend of increase in plant height with decrease in intra-row spacing supported by many workers (Sheriff *et al*., 1985; Patial *et al*., 1996) who stated that, plant growing at closer intra-row spacing and low inter-row spacing were taller than those at higher intra-row spacing. They attributed this to the density of plant population and ultimately increase plant height, whereas inter-row spacing had no significant effect on plant height in both season. This result disagreed with Andrei and Eva (1997) who reported that, plant height ranged between 131to 158 cm. Also Mohamed *et al*. (2005) indicated that, wider spacing (20cm) between plants significantly increased plant height.

Intra-row spacing showed significant difference on stem diameter (cm) in first season only. Inter-row spacing showed no significant effect on stem diameter (cm) in both seasons. Moreover, the interaction between intra-row and inter-row spacing showed significant effect on stem diameter (cm) in both seasons, where the highest level of the stem diameter (cm) was given by the combination WR3×BR3 in the second season and the lowest level was given by the combination WR1×BR1 in the first season (Table 4). This result agreed with many workers (Rashed *et al*., 1990; Rachid *et al*., 2004) who reported that significant differences were found among sunflower in stem diameter. Mohamed *et al*. (2005) indicated that, wider spacing (20cm) between plants significantly increased stem thickness. On the other hand, inter-row spacing had no significant effect on stem diameter in both seasons. This result agreed with Khalifa (1984) who reported that, row spacing (Between rows) had no significant effect under rainfed conditions. At high intra-row spacing there was high stem diameter (cm).

Table (1): Effect of intra-row, inter-row spacing and their interaction on days to 50% flowering of sunflower (2013/2014 and 2014/2015) seasons

Season 2013/14					Season 2014/15				
Treatment	WR1	WR2	WR3	**Mean**	Treatment	WR 1	WR2	WR3	**Mean**
BR1	64.90[b]	61.50[c]	66.0[a]	**64.13[a]**	BR1	65.40[a]	64.6[b]	63.30[b]	**64.43[a]**
BR2	65.00 [a]	64.50[b]	65.40[a]	**64.97[a]**	BR 2	64.90[b]	63.7[b]	64.60[b]	**64.40[a]**
BR3	63.70[b]	65.90[a]	63.30[b]	**64.30[a]**	BR 3	65.70[a]	61.90[c]	66.90[a]	**64.83[a]**
Mean	**64.53[a]**	**63.97[a]**	**64.90[a]**		**Mean**	**65.33[a]**	**63.40[b]**	**64.93[a]**	
LSD		1.13			LSD		1.43		
C.V.		2.85 %			C.V.		2.23 %		

* Means within the same column followed by the same letters are not significantly different

Key:

LSD: Least significant difference CV: Coefficient of variation
WR1: Within row (Intra-row spacing) 20 cm BR1: Between row (Inter-row) 60 cm
WR2: Within row (Intra-row spacing) 30 cm BR2: Between row (Inter-row) 80 cm
WR3: Within row (Intra-row spacing) 40 cm BR3: Between row (Inter-row) 100 cm

Table (2): Effect of intra-row, inter-row spacing and their interaction on days to maturity of sunflower (2013/14 and 2014/15) seasons

Season 2013/14					Season 2014/15				
Treatment	WR1	WR2	WR3	**Mean**	Treatment	WR 1	WR2	WR3	**Mean**
BR1	91.90[c]	88.53[d]	92.0[b]	**90.81[b]**	BR1	90.40[d]	94.6[b]	93.30[b]	**92.76[b]**
BR2	95.0[a]	92.60[b]	95.45[a]	**94.35[a]**	BR 2	92.90[c]	93.7[b]	94.40[b]	**93.67[a]**
BR3	93.50[b]	95.90[a]	93.80[b]	**94.40[a]**	BR 3	95.80[a]	91.60[c]	96.80[a]	**94.73[a]**
Mean	**93.47[a]**	**92.34[a]**	**93.75[a]**		**Mean**	**93.03[b]**	**93.3[b]**	**94.83[a]**	
LSD		2.23			LSD		1.43		
C.V.		3.75 %			C.V.		4.23 %		

* Means within the same column followed by the same letters are not significantly different

Key:

LSD: Least significant difference CV: Coefficient of variation
WR1: Within row (Intra-row spacing) 20 cm BR1: Between row (Inter-row) 60 cm
WR2: Within row (Intra-row spacing) 30 cm BR2: Between row (Inter-row) 80 cm
WR3: Within row (Intra-row spacing) 40 cm BR3: Between row (Inter-row) 100 cm

Table (3): Effect of intra-row, inter-row spacing and their interaction on plant height (cm) of sunflower (2013/14 and 2014/15) seasons

Season 2013/14					Season 2014/15				
Treatment	WR1	WR2	WR3	**Mean**	Treatment	WR 1	WR2	WR3	**Mean**
BR1	181.90^{a}	180.50^{ab}	171.0^{c}	**177.80^{a}**	BR1	214.40^{a}	202.6^{b}	206.30^{ab}	**207.77^{a}**
BR2	172.0^{c}	172.50^{bc}	175.40^{abc}	**173.30^{a}**	BR 2	201.90^{b}	203.7^{ab}	200.60^{b}	**202.07^{a}**
BR3	171.70^{c}	175.90^{abc}	171.30^{c}	**172.97^{a}**	BR 3	204.70^{ab}	205.90^{ab}	200.90^{b}	**203.83^{a}**
Mean	**175.20^{a}**	**176.30^{a}**	**172.57^{a}**		**Mean**	**207.00^{a}**	**204.07^{a}**	**202.60^{a}**	
LSD		8.37			LSD		11.43		
C.V.		2.75 %			C.V.		3.23 %		

* Means within the same column followed by the same letters are not significantly different

Key:

LSD: Least significant difference
WR1: Within row (Intra-row spacing) 20 cm
WR2: Within row (Intra-row spacing) 30 cm
WR3: Within row (Intra-row spacing) 40 cm
CV: Coefficient of variation
BR1: Between row (Inter-row) 60 cm
BR2: Between row (Inter-row) 80 cm
BR3: Between row (Inter-row) 100 cm

Table (4): Effect of intra-row, inter-row spacing and their interaction on stem diameter (cm) of sunflower (2013/14 and 2014/15) seasons

Season 2013/14					Season 2014/15				
Treatment	WR1	WR2	WR3	**Mean**	Treatment	WR 1	WR2	WR3	**Mean**
BR1	5.62^{bc}	5.96^{ab}	5.99^{ab}	**5.86^{a}**	BR1	6.02^{c}	6.36^{bc}	6.68^{abc}	**6.35^{a}**
BR2	5.60^{bc}	5.94a^{b}	6.51^{a}	**6.02^{a}**	BR 2	6.34^{bc}	7.15^{ab}	7.31^{a}	**6.93^{a}**
BR3	5.13^{c}	6.19^{ab}	6.72^{a}	**6.01^{a}**	BR 3	6.68^{abc}	7.15^{ab}	7.54^{a}	**7.12^{a}**
Mean	**5.45^{b}**	**6.03^{a}**	**6.41^{a}**		**Mean**	**6.35^{a}**	**6.89^{a}**	**7.18^{a}**	
LSD		0.7837			LSD		0.91		
C.V.		7.58 %			C.V.		10.79 %		

* Means within the same column followed by the same letters are not significantly different

Key:

LSD: Least significant difference
WR1: Within row (Intra-row spacing) 20 cm
WR2: Within row (Intra-row spacing) 30 cm
WR3: Within row (Intra-row spacing) 40 cm
CV: Coefficient of variation
BR1: Between row (Inter-row) 60 cm
BR2: Between row (Inter-row) 80 cm
BR3: Between row (Inter-row) 100 cm

REFERENCES

A.A.A.I.D. (1989). Arab Authority for Agricultural Investment and Development, Annual Research Report.

Ahmed, E. H.;Tayfour ,S.E. ;Kambal ,H.O. and Ismail,U.I. (1997). Technical And Economical study on Sunflower production in Gezira Scheme.

Andrei, E. and Eva, F. (1997). Manifestation of Correlation in Sunflower Hybrids, *Agronomic Moldova Romania*, **30**(1):107-114.

Anon, (1987). Sumsum Dryland Farming annual Report, pp 21. Mechanized Farming Corporation, Khartoum.

Arnon,D.(1987). "Susum dry lands farming". Annual Report, PP.21, Mechanized Farming Corporation, Khartoum.

Arshad, M. M.; Kashif, I. and Ayub Khan, M.(2007). Genetic Divergence and Path Coefficient analysis for Seed Yield Traits in Sunflower (*Helianthus annuus* L.) Hybrids, *Pakistan Journal of Botany*, **39**(6):2009-2015.

Asifcan,I.;Ullah,S.;Murtaza, B. and Khan,M.Y.(2003). Variability and correlation study in different newly developed sunflower hybrids. *National Agric. Res. Centre Asina of plant Sci*. **2**(12):887-890.

Cruz,Q. D. and Dela, R. (1989). Heterosis and combining ability for yield and yield components in sunflower (*Helianthus annuus* L.). *Philippine Journal of Crop Science* **11**(3):171-174.

El-Ahmer, B.A.; El-Mohandis, S.I. and Madkour,M.A.(1989). Varition and interactions of some characteristics in sunflower (*Helianthus annuus* L.). *Assuti. Agric. Sci*. **20**(2):327-343.

Ishag, H. M.(1988).Sunflower a potential new crop for the Sudan. Proceeding of the 4th Oil Crops and Network Workshop, held at Njore Kenya pp82-88.

Kandil, A. A. and El-Mohandis, I.S. (1986). Head diameter of sunflower (*Helianthus annuus* L.) as an indicator for seed yield. *Helia* **11**: 21-23

Khalifa,F.M.(1984). Effect of spacing on growth and yield of sunflower (*Helianthus annuus* L.) under two systems of dry farming in Sudan. *J. of Agric. Sci*. Cambridge,**103**:213-222.

Khidir,M.O.(1997). Oil crops in Sudan, University of Khartoum, Press/sted. pp103-

120.

Klusa, M. and Musniki, C. (1998). Variability and heterability of some morphological features of sunflower (*Helianthus annuus* L.) hybrids in comparison to population cultivars. *Rosliny-oleiste* **19**(2):423-428.

Mohamed,I.E.G.A.;Elkhalifa,I.;Khair,E.M. and Gangi,A. S.(2005). Effect of plant spacing and seasonality on growth and seed yield of sunflower (*Helianthus annuus* L.). *Gezira Journal of Agriculture Sciences*,**3** (2):222-232.

Patial, B. R.; Rudmaradhya, M.; Vijaya Kumar, C. H. M.; Basappa, H. and Virupakshapa,K.(1996). Genatic variability in sunflower (*Helianthus annuus* L.). *Journal of Oil Seeds Research* **13**(2): 157-161.

Rachid, G.A.; Chaarami, I.; Huang, X.Q. and Sarrafi, A.(2004). Variation and genotypic identification of QTLs of sunflower (*Helianthus annuus* L.). TAG Theoretical and Applied Genetic .V. **109**. (7):1353-1360.

Rashed, R.H. and Moosa, J. T.(1990). Effect of inbreeding and open pollination on some yield characters of sunflower (*Helianthus annuus* L.), *Mesopotamia J. of Agric*., **22**(2):253-263.

Shaeriff ,N. M.; Appenduroi, R. and Rangaswamy ,M.R.(1985). Combining ability in sunflower (*Helianthus annuus* L.), *Indian J. of Agric. Sci.* **55**(5): 315-318.

Skoric, D. (1982). The Potential of Sunflower in the Sudan, Pre-feasibility Study, *Arab Organization for Agricultural Development*, Khartoum.

Suzer , S. and Atakisi, J.(1993). Evaluation of yield and yield components of sunflower hybrids (*Helianthus annuus* L.) under different ecological conditions. University of Trakya, Faculty of Tekirdgzir vol. **2**(2):81-92.

Tariq, M.; Idress, G. and Tahir, A.(1992). Genetic variability and correlation studies in sunflower (*Helianthus annuus* L.) ,*Sarhad Journal of Agriculture* **8**(6): 659-663.

Weiss, E.A. (1983). Oil seed crops, first edition Longman group Ltd, Longman pp 402-462.