بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College of Agriculture

Department of Agronomy

The Effect of Organic and Inorganic fertilizers on growth and Yield of Sunflower (*Helianthus annuus* L.).

أثر التسميد العضوي والغير عضوي علي إنتاجية ونمو محصول زهرة الشمس

Graduation Research Project for B.Sc. (Honours)

By:

Magda Osman Adam Mohamed

Supervisor:

Dr. Gafar Ali Farah

October 2017

الآيـة

قال تعالي :

بسم الله الرحمن الرحيم

هُوَ الَّذِي أَنْزَلَ مِنَ السَّماء ماء لَكُمْ مِنْهُ شَرابٌ وَمِنْهُ شَجَرٌ فِيهِ تُسِيمُونَ (10) يُنْبِتُ لَكُمْ بِهِ الزَّرْعَ وَالزَّيْتُونَ وَالنَّخِيلَ وَالْأَعْنابَ وَمِنْ كُلِّ الثَّمَراتِ إِنَّ فِي ذلِكَ لَآيَةً لِقَوْمٍ يَتَفَكَّرُونَ (11)

صدق الله العظيم

سورة النحل الآية(10-11)

Dedication

To me from under the feet the paradise of my eyes and the beauty of my dear mother God's pleasure in health and wellness.

To me who taught me respect, reverence and tenderness without waiting for my dear father.

To my brothers and sisters and all my family members

Who helped me morally and materially to continue in the way of science dear my brother (Boshra)

Tow how I spent the most beautiful years of study and will continue to be remembered in the hearts of my friends and colleagues

To all who stood with me in my academic career and all those who taught me the characters of the wail who contributed to this research

Acknowledgements

Thanks to my God before and after the lord of the worlds who made me complete this research. Thanks to college of Agriculture studies staff of evacuation whom taught me from the very, beginning, until reached this monumental edifice.

To all who helped me in this research and especially thanks to Dr. Gafar Ali Farah who oversaw this research and was the best help for my after God Almighty his work and guidance.

Contents

List of Tables

Abstract

A field experiment was carried out at Sudan university of science and technology college of Agriculture studies Shambat, winter season (2016 -2017) to study the effect of organic and inorganic fertilizers on growth and yield of some sunflower (*Helianthus annuus* L.) genotypes. The experiment was designed at factorial experiment in randomized complete block design with three replications and used three genotypes (V1= 0398, V2=SIRANA, V3=MR1362) and two types of fertilizers: Organic (compost), Inorganic fertilizers (Urea and Diamoniumphosphate). The parameters ware taken from the experiment is (plant height (cm), number of leaves, stem diameter (cm), leaf area (cm^2), disk diameter (cm), 100-seed weight (g) and yield (ton/ha).

The results showed that significant different among the fertilizers in: (plant height, number of leaves, stem diameter, leaf area, 100-seed weight and yield (ton/ha) but no significant different in disk diameter (cm). also that significant different among genotypes in number of leaves and yield but no significant different at all the rest of parameters and no significant different at interactions in all parameters except the yield (ton/ha).

ملخص البحث

أجريت هذه التجربة بالمزرعة التجريبية لكلية الدراسات الزراعية جامعة السودان للعلوم والتكنولوجيا ـ شمبات، في الموسم الشتوى (2016ــ 2017) بهدف دراسة تأثير السماد العضوي والغير عضوى علي نمو و إنتاجية بعض أصناف محصول زهرة الشمس .

صممت التجربة كتجربة عاملية بتصميم القطاعات العشوائية الكاملة بثلاثة مكررات واستخدمت ثلاثة أصناف من محصول زهرة الشمس (V1 = 0398, V2=SIRAN, V3= MR1362) عوملت بالسماد العضوى (كمبوست) والسماد الغير عضوى (اليوريا ـ الداب).

أخذت القياسات: طول النبات (سم)، عددالأوراق، قطر الساق (سم)، مساحة الورقة (سم^2)، قطر القرص (سم)، وزن الـ 100 بذرة (جم) والإنتاجية بالطن/الهكتار. أظهرت النتائج وجود فروقات معنوية بين الأسمدة في (طول النبات، قطر الساق، مساحة الورقة، وزن الـ 100 بذرة والإنتاجية بالطن/الهكتار) وعدم وجود فروقات معنوية في عددالأوراق و قطر القرص. كذلك وجدت فروقات معنوية بين الأصناف فى عددالأوراق والإنتاجية بينما لا توجد فروقات معنوية بين الأصناف فى بقية القياسات. أما التفاعل بين الأسمدة والأصناف فلم تظهر فروقات معنوية في كل القياسات ما عدا فى الإنتاجية فقد وجدت فروقات معنوية.

CHAPTER ONE

INTROUCTION

Sun flower (*Helianthus annuus* L.) is one of the four most important oil crops globally it is grown over 22million hectors worldwide produces 26 million tons (shirshikar, 2005; Skoric *et al*., 2007), sunflower belongs to the family *Asteraceae*, the giant sunflower is cultivated for edible seed (khan,2007). Sunflower considered as third oil crop in the word after soybean and rapes seed. Sunflower has many uses e.g. human food animal feed and oil production (Tayfour and Rasheed 1990).

The origin of the sunflower is south-west of the united states It was first introduced to Europe as an ornamental but it was established in eastern Europe and Russia as an oil seed crop, and it introduced to Africa by British (south Africa) in the20thcentury (khidir,1997).

Sunflower is adapted to a wide range of climatic conditions (temperate subtropical and tropical) and it is not sensitive to day length. In the tropical it is growing in rotation with maize, sorghum, groundnut and millet, it is tolerant to heat and drought likes sorghum and millet. Intemperate countries seed yield exceeds 2000kg/ha, where as in tropical Africa is as low as 350kg/ha. European countries import 85% of the crop entering the world trade, and Asian countries about 15% (Pursglove, 1982).

Although experimentation of sunflower in Sudan was started in 1932 at the Gezira Research station, more trials were conducted in 1946, which are the actual possibility of growing the crop in Sudan. The real commercial production of sunflower in Sudan started early eighties by private sector (Sheikh Mustafa Elamin Agricultural Company) an area of 36.6 ha in season

1987/1988 were grown at Damazien, Blue Nile state. The crop was also introduced to Rahad, Suki and White Nile schemes (khidir, 2007).

The major problems facing production of sunflower in Sudan are lack of adequate information about the crop under Sudan condition, distribution and fluctuation of rains, high percent of empty seeds, unavailability of good seeds and high yielding cultivars.

In northern and central of Sudan sunflower is grown only under irrigated conditions because of its sufficient precipitation conditions is well known (Ozer *et al*., 2003).

According to the Sudan ministry of Agriculture the total area under sunflower in season 2003/2004 was 6300 hectares out of this area 3360 ha was irrigated and 2940ha was under rain fed. The total production was 952.4kg/ha under irrigation and 238.1kg/ha under rain fed (Osman and Ahmed2005).

A study the effect of Nitrogen fertilizer on sunflower is well documented on the other side studies concerns the effect of compost, urea and Diamoniumphosphate (DAP) fertilizers is meager (Farah, 2009).

The objective of this study is to investigate the effect of some fertilizers on sunflower growth and yield Components.

CHAPTER TWO

LITERATURE REVIEW

2:1 Sunflower Classification:

The Sunflower (*Helianthus annuus* L.) is one of the 67species belongs to the *Asteraceae* (Compsiteae). There are many perennials among the sixty seven presently recognized species in the genus.

About seventeen species can be considered as other difficult commercial cultivars grown for seed (Weiss, 1983) .Throughout the study namely sunflower refers only to cultivars grown for their seed.

Sunflower is of two classes, a class and considered Every or garden class varsities in the oil seed class are characterized by smaller and darker seed of higher oil content and tower hull content than the varieties in the confection on very or garden class the frill of the confectionery varieties is heavier and does not a there tightly to the tone Kernel allowing for easy decertification (Litzenberger 1978).

2:2 Cultivars:

Sunflower cultivars are categorized with high maturity. Seed size and color according to height. Four cultivars are recognized Dwarf (less than 120 cm height). Semi-dwarf (120-175cm) cultivars are divided into quick medium slow maturing. According to seed color and size cultivars are divided into large white. Small black seeded and intermediate tripped seed. Anon (1987) Tested 31 sunflower cultivars at eastern Sudan and results showed significant differences in days to flowering and maturity , plant height head diameter and

seed yield Also Mohamed *ea al.,(*2003) reported significant difference in seed yield per ha , 1000 seed weight percentage of empty seed and number of seed plant Hamad lilnoil (1997), reported that cultivars did not difference significantly in plant height in the first season were highly significant expressed in both season on the other hand , Elnaim (1992), reported significant differences between cultivars in plant height

2:3 Adaptation of sunflower:

2:3:1 Temperature:

Sunflower is a crop of temperate origin is tolerant to both low and high temperature (Robinson 1983), it is germinates and grows success fully across a wide range of environment including hot tropic like Sudan (Khalifa 1984; Weiss 1983) reported that arrange of 8-34° C is, tolerated without signify can yield reduction.

However, the greater part of world production occurs in latitudes 20-50 and 20 to 40

2:3:2 Soil:

Sunflower is adapted to a variety of soil condition but growth best on well drained high water holding capacity soil with an ear neutral to moderately alkaline soil with average of ph 6.5 to 8, but dislike acid condition whatever soil is available good drainage is more important than basic fertility . for it is usually easier to supply nutrients than improve drainage (Weiss , 1983).

2:4 Cultural Practices:

2:4:1 Land preparation:

Sunflower requires seed bed preparation similar to that for Maize. All wing weeds should be killed, trash and crop removed or turned under, and larger colds broken up.

The soil should be mast and reasonably yellow to ensure prompt germination (Litzen Berger, 1978).

2:4:2 Planting:

Planting the sunflower as a winter crop the most suitable dates for planting sunflower as a summer crop in Sudan is the month of July, whether under rain or irrigation. In experiments the crop was given the highest productivity when planted in mid-July under rainy conditions in late November.

2:4:3 Rotations:

Continue cropping for sunflower for more two years is not recommend to avoid disease and pests for the mechanized rain fed areas of the Sudan , no serious attempts were made to device a suitable rotation on the convention crops such as se seam , sorghum and cotton therefore have to be included in a workable rotation other crops such as soybean , sunflower and groundnuts have their own limitation soybeans is not a hardy Corp and susceptible to pest and disease inoculums to be imported annually for proper nodulation this no doubting this no doubt will increase costs of production sunflower though yield satisfactorily under experimental condition never attracted farmers the crop is known to be very sensitive to water logging groundnuts have its own problems of harvesting under rain fed with good management Guar (cluster bean) a

legume early maturing and drought to leant to leant can be very useful in a rotation.

Sesame and cotton together could from on area. Guar as legume could be included as well the rotation since Soybean is too sensitive under rain fed condition (Ali, 1988)

2:4:4 Fertilization:

Sunflower considered in efficient converter of plant nutrients as measured by it is harvest index accurate determination of optimum Fertilization application rates is important adequate nutrients are essential for high seed yield for instance. In USSR 100 kg seed contained nitrogen, 2 kg, P_2O_5 and 18 kg Potassium and the three quarters of the total phosphate up take by the plant was contained in the seed (Weiss, 1983).

An examination of the results of fertilizer trials on sunflower around the world leads in evitable, and results were conflicting. Often sowing more too climatic influence than true crop response (Weiss, 1983). There can be interaction between fertilizer response and season reflects in varying growth – rates, period to maturity and seed yield.

2:5 Harvest and storage:

Sunflower mature when the backs of the head are yellow the outer branches turn bract brown seed caring may take plc on standing stalk, if bird damage is not imminent but harvest most occur before the head begin to drop on the ground .If harvest is required before seed is completed dry, the heads must be placed in thin layers on open drying floors. With occasional turning, When

moisture is reduced large headed varieties are frequently can by hand: but both larger header and smaller combines (Litzenberger , 1983).

The dried heads may be threshed by hand or by a rough or slatted threshing board or by threshing machine. All chaff and foreign matter should be winnowed out at threshing time to avoid molding and to eliminate contamination external insects (Lizenberger , 1983) .

CHAPTER THREE

Materials and Methods

3:1 Experimental site:

The experiment of this study was carried out in winter season 2016/2017, at demonstration farm of college of Agricultural studies, Sudan university of Science and Technology, Shambat (23˚ - 35˚ longitude, 15˚ -30˚ latitude and 288m above sea level) within the semi desert region. The soil of the experiment is described by as loamy clay soil and characterized by a deep cracking. Moderately alkaline clays and low permeability (Abdelhafiz.2001).

3:2 Treatments :

The treatments used in this experiment consist of: Organic fertilizer (compost at dose of 15 ton/ha), inorganic fertilizer (urea46%N at dose of 186.7kg/ha and Diamoniumphosphate DAP at dose of 50 kg/ha) and control without. All treatments added to the experiment units follows: Compost (com 13.5kg/plot), Urea (Ur 168g/plot), DAP 45g/plot).

The seeds of the Three genotypes (V1:0398, V2: SIRANA and V3:MR1362) used in the experiment were obtained from National Research Center Khartoum.

3:3 Land Preparation and Cultural Practices:

3:3:1 Land Preparation:

The Land was Preparation by disc plough Leveled and ridging up (north-south) the spaces between ridges were 70 cm, and divided into plots of size 3 x3m^2 consisting of three ridges.

3:3:2 planting and replanting:

Four seeds were planted in the hole at the space of 35cm between each hole. After germination the seedling was sinning to one plant and the empty holes were replanting with the second irrigation.

3:3:3 Irrigation:

An irrigation interval was 7days in maximum; sixteen times irrigation were added at the season.

3:3:4 Weeding:

Manual weeding was practiced two times after three weeks from sowing date and after one month from the first one.

3:3:5 Fertilization:

The organic fertilizer added to the soil after fifteen days from the sowing date, but the organic fertilizers addition with first irrigation.

3:4 Birds damage:

Bird damage is important problem facing sunflower production. In this study the heads of sunflower were covered by paper bags after flowering to avid bird damage.

3:5 Data collection:

The data collection in this experiment following:

3:5:1 Plant height (cm):

Eight Plants were selected randomly form each plot to measurement plant height, used meter from soil surface to plant tip, three times 30, 60 and 90 days after sowing (DAS).

3:5:2 Number of Leaves per plant:

It was determined by counting all green Leaves of eight plants and obtaining mean number of leaves plant to every treatment alone, two times at 60days after sowing (DAS) and after flowering.

3:5:3Stem diameter (cm):

Stem diameter measurement as the average thickness of the stem using thread on main stem of eight randomly selected plants and the mean obtained.

3:5:4Leaf area (cm^2):

Measured from the middle plant leaves by using graph papers and mean was counted in cm^2.

3:5:5 Head diameter (cm):

Three heads were chosen from each plot and head diameter was measured in cm to count mean.

3:5: Grain yield (ton/ha):

The total seed of plant in squire meter was collected and the grain yield in (ton/ha) was calculated.

3:6 Statistical analyses:

Data collected in this investigation were statistically analyses in accordance to analysis of variance (ANOVA), and means were separated for significant by

leas significant different (LSD) test according to Gomez and Gomez (1984), using Statistix 8 computer Program.

CHAPTER FOUR

RESULTS

4:1 Plant height (cm):

The analysis of variance showed significant differences among treatments at 30, 60 and 90 DAS, but no significant differences among genotypes and interaction at (P≥0.05) at all samples occasions Appendix 1.

The height mean of plant height was obtained by V2xcom (54.82 cm) Table 4-1.

4:2 Number of Leaves per plant:

The analysis of variance showed significant differences among genotypes at all samples occasions Appendix 2.The highest number of Leaves was obtained by V1 (24) in read 1, and V2 (27) in read 2. The lower and leaves number per plant was (21, 22) obtained by V3 at read 1, and read 2 respectively (Table 4-2).

4:3 Stem diameter (cm):

According to the analysis of variance table Appendix 2, clearly highly significant differences among fertilizers at (P≥0.05) in stem diameter, table 4-2 showed high mean (5.62cm) obtained by V3xcom.

Table (4-1) the effect of organic and inorganic fertilizers on plant height (cm) of sunflower genotypes at 30, 60 and 90 (DAS).

genotypes	Treatments	plant height (cm) 30d	plant height (cm) 60d	plant height (cm) 90d
V1	Control	36.3^{a}	39.8^{ab}	51.0^{ab}
	Dap	27.5^{ab}	31.7^{bc}	41.2^{bc}
	Compost	32.4^{ab}	39.3^{ab}	51.0^{ab}
	Urea	29.1^{ab}	32.5^{bc}	42.3^{bc}
V1 mean		**31.3^{a}**	**35.8^{a}**	**46.6^{a}**
V2	Compost	29.3^{ab}	33.6^{abc}	43.7^{abc}
	Dap	32.8^{ab}	38.1^{abc}	49.6^{abc}
	Compost	38.2^{a}	42.2^{a}	54.8^{a}
	Urea	24.3^{b}	29.8^{c}	38.7^{c}
V2 mean		**31.2^{a}**	**35.9^{a}**	**46.7^{a}**
V3	Control	31.4^{ab}	34.3^{abc}	44.6^{abc}
	Dap	30.5^{ab}	33.3^{abc}	43.3^{abc}
	Compost	35.6^{a}	38.1^{abc}	50.0^{abc}
	Urea	29.7^{ab}	34.3^{abc}	45.3^{abc}
V3 mean		**31.8^{a}**	**35.2^{a}**	**45.9^{a}**
LSD		10.8	9.5	12.3

*Mean follows with same letter(s) are not significant different (P≥0.05) in the same column for treatments and in the column for genotypes.

Table (4-2) the effect of organic and inorganic fertilizers on number of leaves & stem diameter of sunflower genotypes.

genotypes	Treatments	L.N1	L.N2	Stem diameter(cm)
V1	Control	25.5^{ab}	26.9^{ab}	4.7^{abc}
	Dap	23.0^{abc}	26.1^{abc}	3.3^{d}
	Compost	24.5^{abc}	26.9^{ab}	5.0^{ab}
	Urea	24.0^{abc}	25.9^{abc}	4.5^{abcd}
V1 mean		**24.3^{a}**	**26.4^{a}**	**4.4^{a}**
V2	Compost	23.3^{abc}	25.9^{abc}	3.6^{cd}
	Dap	25.6^{ab}	27.7^{a}	4.5^{abcd}
	Compost	26.5^{a}	28.3^{a}	5.5^{a}
	Urea	21.4^{abc}	26.4^{abc}	3.9^{bcd}
V2 mean		**24.2^{ab}**	**27.0^{a}**	4.4^{a}
V3	Control	22.0^{abc}	24.3^{abcd}	3.9^{bcd}
	Dap	19.7^{c}	20.8^{d}	4.6^{abcd}
	Compost	23.3^{abc}	22.3^{bcd}	5.6^{a}
	Urea	24.0^{bc}	22.1^{cd}	4.6^{abcd}
V3 mean		**21.5^{b}**	**22.4^{b}**	4.4^{a}
LSD		5.4	4.6	1.3

*Mean follows with same letter(s) are not significant different (P≥0.05) in the same column for treatments and in the column for genotypes.

4:4 Leave area (cm^2):

Statistical analysis results showed that a significant difference among fertilizers in leave area (Appendix 3), while there were no significant differences among genotypes in this parameter, also no significant differences at interaction between genotypes and fertilizers (Appendix 3).

The highest mean of Leave area was recorded by V3xcom (18.3) and the lower leave area recorded by V3xC (11.5) Table 4.3.

4:5 disk diameter:

The analysis of variance showed no significant differences among the cultivars, fertilizer and interaction (Appendix 3).

The highest mean of disk diameter was obtained (6.4) recorded by V2xC and the lower mean (4.0) recorded by V1xDAP Table 4.3.

4:6 yield (tno/ha):

Statistical analysis results showed highly significant differences among varieties and among fertilizers in yield (ton/ha) also there were significant differences in interaction between genotypes and fertilizers (Appendix 3). The highest yield was obtained (1.6 ton) recorded by V1xcom, and the lower yield obtained (0.7 ton) recorded by V3xC Table (4-4).

Table (4-3) the effect of organic and inorganic fertilizers on Leave area (cm2) & Disk diameter (cm) of sunflower genotypes.

	genotypes	Control	Dap	compost	urea	V mean	LSD
Leave area(cm^2)	V1	12.7^{bc}	13.0^{bc}	15.3^{ab}	13.5^{bc}	13.6^{a}	3.6
	V2	12.8^{bc}	13.7^{bc}	17.6^{a}	13.9^{bc}	14.5^{a}	
	V3	11.5^{c}	15.1^{abc}	18.3^{a}	13.1^{bc}	14.5^{a}	
treatment mean		12.3^{b}	13.9^{b}	17.0^{a}	13.5^{b}	----	
Disk diameter (cm)	V1	4.3^{ab}	4.1^{b}	4.7^{ab}	4.3^{ab}	4.3^{a}	2.2
	V2	6.4^{a}	4.5^{ab}	4.6^{ab}	4.3^{ab}	4.9^{a}	
	V3	4.1^{ab}	4.1^{b}	4.1^{b}	4.6^{ab}	4.2^{a}	
treatment mean		4.9^{a}	4.2^{a}	4.5^{a}	4.4^{a}	----	

*Mean follows with same letter(s) are not significant different (P≥0.05) in the same rows for treatments and in the rows for genotypes.

Table (4-4) the effect of organic and inorganic fertilizers on yield (ton/ha) of sunflower genotypes.

yield (ton/ha)	genotypes	Control	Dap	compost	urea	V mean	LSD
	V1	0.9^{cd}	0.9^{cd}	1.6^{a}	1.0^{c}	1.1^{a}	0.1
	V2	0.9^{a}	0.8^{de}	1.3^{b}	0.9^{cd}	1.1^{a}	
	V3	0.7^{ab}	0.9^{cd}	1.2^{d}	0.8^{de}	0.9^{a}	
treatment mean		0.8^{c}	0.9^{bc}	1.4^{a}	0.9^{b}	----	

*Mean follows with same letter(s) are not significant different (P≥0.05) in the same rows for treatments and in the rows for genotypes.

CHPTER FIVE

DISCUSSION

In this study there were significant differences between organic fertilizer (compost) and inorganic fertilizers (Urea and DAP) throw the studied of three genotypes of sunflower, and no significant difference in interaction among them for different characters. These findings were in agreed with Khalifa (1984).

Generally the result showed that the effect of the organic (compost) fertilizer is higher than the effect of urea and DAP fertilizer at different characters of the genotypes. Therefore, it seems that there is need to raise the ratios of the organic (compost) fertilizer so as to gain more beneficial and good result in crop growth and yield.

Height the results showed that increasing of plant with the added of the organic fertilizer (compost), similar findings were reported by Farah (2009).

The organic fertilization (compost) had significant effect on number of leaves per plant in this study similar result was reported by Ozer (2003).

The application of organic fertilizer (compost) affected stem diameter significant similar findings were obtained by Farah (2009). Organic

fertilization (compost) application had no significant effect on desk diameter in this study.

In percent study organic fertilizer (compost) rates increased the seeds weight, the seeds yield of sunflower genotypes was highly significant response to organic fertilizer (compost) comparing to inorganic one and comparing to untreated control.

CHAPTER SIX

CONCLUSION AND RECOMONDATIONS

The results from this study show that all genotypes of Sunflower responded positively to all types of fertilizers applied. The results confirmed that the appropriate use of organic fertilizers is important to increase their potentiality and efficiency.

Growth and yield parameters of Sunflower were significantly increased in response to the application of organic fertilizer. Better Sunflower grain yield from organic fertilizer than those from inorganic fertilizers is a further indication that the nutrients supplied from organic fertilizer application was more effective than those supplied with inorganic fertilizer.

Further studies may be needed regarding the optimum application levels of organic and inorganic fertilizers which give the best results.

REFERENCES

Abdel hafiz, M.E . (2001). Effect of partially acidulated phosphate rocks and triplemsupr phosphate and their combination growth mineral composition and yield of wheat. Ph.D. Thesis, Sudan university of Science and Technology.

Ali,M. (1988). A paper in guide of the cultural practices for crop sorws in the Gezer ARG . Wad median Sudan.

Farah, G.A.(2009). Effect of Nitrogen Fertilization on growth and yield of some sunflower (Helianthus annuus L .) Thesis University Khartoum.

Gomez, K. and Gomez, A.A.(1984). Statistical procedure for agriculture reach 2nd Ed. John Wily and son Cine New York.

Itzenberger C.S. (1978).Guide for field crop in the tropics and sub. Canter J.F (1978) (ed.) sunflower science and technology agronomy monograph No 9.

Khalifa, F.M. (1984). Effect of spacing and fertilization on growth and yield of sunflower (Helianthus annuus L.) under two system of dry arming in Sudan. Journal of Agricultural Science Cambridge, 103, 213-222.

Khan, S.k (2007). Macrophoninaphaseolina as causal agent for charcoal rot of sunflower . My Copatl, 5: 111-18.

Mahmud, A.M. (1987). He agronomy potential proceeding of sunflower, seminar in Sudan Hilton, Khartoum, 1:21-25.

Osman, A.M and Ahmed, A,M.M. (2005). The time series of main food and oil crop. In Arabic. Ministry of agriculture and forestry. Khartoum Sudan.

Purseglove J.W. (1982). Tropical : Dictyledons . Long man gouplld .u.

Shirshikar , S.P. (2005). Mildew disbase in India helia. 28: 153-15.

Skokie, D.: Jociclecic, N. and Sakac, Z. (2007). Development of sunflower hybarids with different oil quality . Helia 30:205-212.

Tayfour, H.A. and Rasheed, R.H. (1990). Oil crop. Elmosil University, Crop pp. 85-124.

Appendix (1) : Mean squares form the analysis of variance :

Source of variance	d.f	ms $P.H_1$	ms $P.H_2$	ms $P.H_3$
rep	2	7.76^{ns}	15.50^{ns}	26.21^{ns}
var	2	1.29^{ns}	1.56^{ns}	2.62^{ns}
treat	3	95.36^{*}	92.50^{*}	156.39^{*}
Var*treat	6	36.92^{ns}	32.41^{ns}	54.71^{ns}
Error	22	40.54^{ns}	31.32^{ns}	52.92^{ns}
Total	35	——	——	——
CV%	——	20.25	15.70	15.70

*= significant

**= significant

ns = not significant

Appendix (2): Mean squares form the analysis of variance:

Source of variance	d.f	ms $L.N_1$	ms $L.N_2$	ms stem diameter
rep	2	0.81^{ns}	11.66^{ns}	5.8^{**}
var	2	29.92^{*}	77.38^{*}	0.37^{ns}
treat	3	11.48^{ns}	2.67^{ns}	3.45^{**}
Var*treat	6	7.24^{ns}	4.11^{ns}	0.98^{ns}
Error	22	10.32^{ns}	7.53^{ns}	0.61^{ns}
Total	35	——	——	—
CV%	——	13.78	10.85	17.54

*= significant

**= significant

ns = not significant

Appendix (3) Mean squares form the analysis of variance :

Source of variance	d.f	ms .Leave area	ms .disk the weight	ms .yield
rep	2	2.22^{ns}	0.43^{*}	0.001^{ns}
var	2	3.10^{ns}	1.69^{ns}	0.10^{**}
treat	3	37.17^{**}	0.76^{ns}	0.52^{**}
Var*treat	6	3.19^{ns}	1.18^{ns}	0.020^{**}
Error	22	4.46^{ns}	1.70^{ns}	0.007^{nss}
Total	35	——	——	——
C.v	——	13.78	10.85	17.54

*= significant

**= significant

ns = not significant