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Original research

Effect of Foliar Spray with Proline on the Productivity of Sesame under Different Planting Methods at Toshka Region, Egypt

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Abstract:

Two experiments were conducted at South Valley Farm Research Station, Toshka Region, Agriculture Research Center during 2018 and 2019 seasons. To study the effect of different proline concentrations and planting methods and their interaction on the productivity of sesame grown under a drip irrigation system. The experiment was carried out in (RCBD) using strip-plot arrangement with three replications, The two planting methods (terraces and rows) were assigned horizontally while, the four proline concentrations (0.0, 25, 50 and 75 ppm) were allocated vertically. The result showed that the studied planting methods had a significant impact on plant height, frouting zone length, number frouting nods plant^{-1}, number of seeds capsule^{-1}, weight of seeds plant^{-1}, seed yield, oil %, and oil yield traits in both seasons in favor of rows planting methods in most traits except oil percentage in favor of terraces planting methods and proline 50 ppm sprayed at 45 and 60 days after planting DAP recorded significantly higher seed yield (579.02 and 586.99 kg fed^{-1}) and yield attributes in both seasons, except plant height was not significant in the two seasons, frouting zone and oil percentage in the second season. The interaction between planting methods and proline concentrations had a significant impact on all traits in both seasons, except plant height and number of seeds capsule^{-1} in the 2nd season and frouting zone in both seasons. Consequently, the maximum average values of oil yield (294.62 and 302.98 kg fed^{-1}) in the 1st and 2nd seasons, respectively.

Keywords: Sesame, Planting methods, Proline, Yield, components, Toshka, Aswan

1- INTRODUCTION

Sesame (*Sesamum indicum*,L) is one of the most important oil crops in the world It belongs to the family (Pedaliaceae).The cultivated area of Sesame in Egypt is 81000 fed and the productivity was 39000 tons for the year 2020 (FAO, 2020).

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Increasing sesame plant production is very essential to cover the gap oil crops between production and consumption in Egypt. It has reached as much 95%. Therefore; sesame cultivation can be expanded by cultivating lands where not available traditional crops are and modern cultivation lands like project Toshka in south Egypt. In addition, this area differs in its soil particle distribution, chemical analyses, its fertility as well as climatic conditions when compared with Nile valley and Delta areas. (Hasaan and Bughdady, 2018) Due to Toshka's environmental conditions, proline was used in the research.

Planting methods found to be influenced by absorption of photo synthetically active radiations and effect on resource utilization like water and Fertilizer use and effect on weed germination. (Ndor and Nasir, 2019), (Imoloame et al., 2007), (Asghar Malik et al., 2003), (Mahmoud et al., 2020) and (Katanga et al., 2017).

Proline is an amino acid that is available contains a secondary amine group this is distinguishes it from the rest of the amino acids. It accumulation in the cells of the plant leaves helps with the change in osmotic pressure in plant tissue, it increases plant's ability to absorb water from the soil (Ayat et al., 2019), (Kahloui et al., 2014), (Moheb et al., 2012), (Mohammad Hassan Hashem and Haider Talib Hussein, 2020) and (Wael Shakir, 2019). Increasing the concentration of proline in the plant increases the plant's resistance to different stresses salinity, drought, and high temperatures. High temperature for the optimum limit the plant is working on Decrease in plant growth rate Therefore Decrease in the economic yield of plants.

The aim of the present investigation was to study the impact of foliar application with proline under different planting methods on the productivity of sesame grown in the Toshka region.

2- MATERIALS AND METHODS

Two experiments were conducted at South Valley Farm Research Station, Toshka Region Agriculture Research Center during 2018 and 2019 seasons.

The physical and chemical analysis of experimental site are presented in (Table 1) was analyzed according to (Page,1982). Generally, many fragments of various rocks and gravels dominate on the surface. These fragments are different in shape, size and color. However, the soil texture is sandy loam to loamy under sesame experiments. In addition, the main soil characteristics and fertility condition reveal that the soil is very low level of salinity, cation exchange capacity and available nitrogen and phosphorus is low, but potassium is in medium level. In addition, the microelement data indicated that the iron, manganese, copper, zinc and boron are low. However, it can be concluded that the soil in Toshka is need of a good management and high amount of organic matter (manure) to improve the fertility and water holding capacity. In addition, whether information of Toshka region ***i.e***. monthly maximum and minimum temperature (C^o) of air and soil, and relative humidity percentage at Abo-Sembel, Toshka region in 2018 and 2019 seasons are shown in Table 2.

This investigation aimed to identify the suitable planting methods and proline concentration on growth, yield and yield components of sesame under drip irrigation under the region of Toshka conditions.

2.1. Treatments and experimental design

The experiments were design in a randomized complete block design (RCBD) using strip-split plot arrangement with three replications. The two planting methods (rows and terraces) were assigned horizontally while, four concentrations of proline (0.0, 25, 50 and 75 ppm) were

allocated vertically The plants were sprayed with different concentrations of proline freshly prepared solutions in two doses, after 45 and 60 days from planting. Meanwhile, untreated plants (0.0 proline concentration) were sprayed with distilled water to serve as a control.

2.2. Cultural practices

The plot area was 10.8 m^2 (3 × 3.6 m) contain 6 rows 60 cm apart as rows method and content two terraces by width 120 cm as terraces method. certified seeds of sesame (cv. Giza32) obtained from Oil Seeds Crops Research Department, Agriculture Research Center, Giza, Egypt were sown (4 to 6 seeds in a hole) on one side of the rows or terraces. Seeds were grown on 20th May at the rate of 6 kg fed^{-1} during the two growing seasons. A drip irrigation system was used in the study with a 30 cm distance between dippers (2L h^{-1}). After germination, the plants were thinned to two plants $hill^{-1}$ after 15 days from planting. All other practices were uniformly applied as recommended for sesame production in the region.

Plots were kept free of weeds through hand hoeing. The preceding winter crop was wheat in both seasons. The other agricultural practices needed for sesame were done as recommended by the agriculture ministry of Agriculture in the region of the study except for the factors under study.

2.3. Characters studied

Data were recorded on means of ten individual plants concerning growth characters after the spraying at 80 days from planting which were taken randomly from each plot representing the three replications. Sesame plants were harvested after 120 days from the planting. For yield characters, at harvest time another sample was assigned for this purpose. The procedure of recording the various data was carried out in the following manner:

A. Vegetative and growth characters

1- Plant height (cm): length of the main stem from the soil surface to plant apex has been measured using a ruler before harvest.

2- Frouting zone (cm): The length of the area from the first capsule from the bottom of the main plant stem to the top of the capsule has been measured using a ruler

3- Number of frouting nodes/plant.

B. Yield and its components

1- Number of seeds/capsule

2- Seeds weight/plant (gm).

3- Seeds yield (kg fed^{-1}.). Plants in the sub-plot were harvested dried threshed and seeds were weighted in kg m^{-2} then it was converted to seed yield (kg fed^{-1}).

4-Oil yield (kg fed^{-1}): Oil yield = Seed yield (kg fed^{-1}) × oil percentage

C.Seed oil percentage: was determined according to (AOAC, 1990).

2.4. Statistical analysis:- The collected data were statistically analyzed according to obtained (McIntosh, 1983) and**(** Gomez and Gomez, 1984**).** The treatment means were compared using LSD test according to (Steel and Torrie,1980).

Table (1): Soil particle distribution, chemical characteristics and fertility conditions of the experimental sites at Abo-Sembel, Toshka region in 2018 and 2019 seasons.

Soil Depth (cm)	Sand	Silt	Clay	Soil texture	OM (%)	$CaCO_3$ (%)	pH (1:1) soil extract	EC (dS m^{-1}) (1:1) soil extract
	%							
0-20	87.28	8.22	4.50	Loamy sand	0.40	4.73	7.65	0.50
20-40	87.35	5.30	7.35		0.48	3.70	7.91	0.43
40-60	87.22	6.50	6.28		0.31	2.35	7.93	0.39

Soil Depth (cm)	Soluble cations and anions (meq L^{-1})							
	Na^+	K^+	Ca^{2+}	Mg^{2+}	Cl^-	CO_3^{2-}	HCO_3^-	SO_4^{2-}
0-20	1.6	0.23	1.8	1.07	1.7	0.0	2.0	1.02
20-40	1.5	0.22	1.6	0.55	1.4	0.0	1.8	0.67
40-60	1.4	0.21	1.7	0.67	1.3	0.0	1.64	1.02

Source: Laboratories unit in Toshka

Table (2): Monthly maximum and minimum temperature (C^o) of air and soil, and relative humidity (%) at Abo-Sembel Toshka region in 2018 and 2019 seasons.

Month	2018 season						2019 season					
	Air temperature		Soil temperature		Relative humidity		Air temperature		Soil temperature		Relative humidity	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
January	9.1	22.5	15.3	23.0	23.9	63.7	6.8	19.7	16.4	19.4	25.2	63.9
February	9.3	23.0	16.3	25.2	17.4	55.0	12.0	26.2	19.5	22.5	18.1	58.6
Marsh	13.8	30.9	23.4	32.6	12.0	51.1	15.2	31.0	21.8	25.2	12.9	54.9
April	19.0	34.9	27.6	34.7	8.3	44.5	17.7	35.2	23.8	28.3	10.4	48.4
May	22.4	37.9	30.1	36.2	8.4	46.5	21.1	37.6	28.4	31.9	8.1	40.0
June	22.6	38.3	30.8	36.6	8.0	39.3	26.6	39.0	30.9	34.1	9.2	37.3
July	24.4	40.1	31.8	37.4	9.2	39.2	25.1	39.8	31.4	35.2	9.9	38.4
August	26.2	41.2	33.5	38.3	10.1	37.0	25.3	40.1	32.9	36.3	10.3	41.1
September	23.7	38.4	32.4	36.6	11.2	38.8	24.9	39.1	32.0	35.5	10.8	42.6
October	19.7	33.2	28.9	32.5	14.3	48.2	21.5	35.2	30.2	33.4	16.2	49.2
November	15.3	29.3	24.5	27.8	16.6	55.4	16.4	29.5	25.6	28.2	15.5	53.7
December	8.5	22.6	20.1	23.4	24.8	66.2	7.1	21.1	19.8	22.8	24.6	67.5

**Laboratories unit in Toshka*

3.RESULTS AND DISCUSSION

3.1. Vegetative growth traits

Average of plant height ,frouting zone and number of frouting nods /plant as affected by planting methods, proline treatment and their interactions during 2018 and 2019 seasons. Data presented in Table 3 clear that plant height , frouting zone and number of nodes / plant was significant affected by planting methods in both seasons the highest value for all previous character resulted from using rows methods in both seasons as compared with terraces methods. The result could be to the rows methods had led to be optimum condition of good standing bitter field air circulation and such as effect increase vegetative growth as well as reproductive growth concerning the proline treatments results in the same Table showed that had a significant impact on frouting zone in the second season only application proline at rate 50 ppm give the highest value in the first season, number of nodes / plant was significant in both seasons the best value resulted from application proline at rate 50 ppm in both seasons. Similar results were obtained by (Moheb et al., 2012) and (Hussain et al., 2010).

This may due to the role of proline in plant development particularly in reproductive phase also, play vital role in response of plant to environmental stress similar results were also found by (Adnan et al., 2013) and (Sevgi et al., 2004) .while plant height was insignificant in both season.

Table 3: Means of Vegetative growth traits of sesame as affected by planting methods, proline treatment and their interactions during 2018 and 2019 seasons.

Traits		Plant height (cm)		Frouting zone (cm)		Number of frouting nodes\plant	
		2018	2019	2018	2019	2018	2019
Planting methods (A)							
A1: Terraces		164.46	163.47	135.87	132.49	17.79	19.19
A2: Rows		165.63	164.00	137.33	138.02	19.82	21.32
LSD at 5%		2.76	0.28	3.63	3.98	0.33	2.27
proline treatment (B)							
b1: Controle		154.77	154.37	125.28	127.62	19.96	20.35
b2: 25 ppm		153.57	153.51	127.20	128.40	20.20	21.56
b3: 50 ppm		154.35	153.68	128. 06	129.38	21.20	21.64
b4:75 ppm		153.62	153.15	126.53	129.61	20.01	21.71
LSD at 5%		N.S	N.S	2.71	N.S	0.25	1.26
Planting method × proline treatment (A × B)							
A1	b1	164.20	165.13	136.67	131.00	17.19	18.42
	b2	165.93	165.47	135.27	131.73	17.75	20.55
	b3	164.20	162.60	135.87	134.13	18.43	18.40
	b4	163.53	160.67	135.67	133.13	17.80	19.41
A2	b1	165.60	164.00	138.40	135.87	19.86	20.63
	b2	165.60	163.87	136.13	137.96	19.51	22.78
	b3	169.13	165.80	137.80	139.20	20.63	21.67
	b4	162.20	162.33	137.00	139.07	19.30	20.20
LSD at 5%		2.52	N.S	N.S	NS	0.33	1.58

Concerning the interaction between sowing dates and plant methods, (A×B) had a significant effect on plant height in frist season and number of frouting/plant in both seasons. While frouting zone was insignificant, in both seasons the highest results obtained from application rows methods with proline at rate 50 ppm, while Frouting zone (cm) ˉ was insignificant in both seasons.

3.2. Yield and its components

Table 4: Means of yield and its components of sesame as affected by planting methods and proline treatment and their interactions during 2018 and 2019 seasons.

Traits		Number of seeds\capsule		Seeds weight\plant (gm		Seeds yield (kg\fed.).	
		2018	2019	2018	2019	2018	2019
Planting methods (A)							
A1: Terraces		51.71	52.04	15.77	15.85	492.29	485.86
A2: Rows		53.59	53.58	16.14	16.16	588.89	603.03
LSD at 5%		0.25	0.72	0.37	0.34	3.02	13.06
proline treatment (B)							
b1: Control		54.18	53.86	15.07	15.14	540.09	540.68
b2: 25 ppm		55.29	54.67	14.65	14.60	557.59	559.79
b3: 50 ppm		56.71	56.33	14.84	14.84	579.02	586.99
b4:75 ppm		55.17	54.58	14.98	14.97	576.81	576.96
LSD at 5%		0.37	1.21	0.28	0.29	4.21	17.47
Planting method × proline treatment (A × B)							
A1	b1	50.08	50.83	15.77	15.95	483.03	468.19
	b2	51.91	51.33	15.72	15.67	483.51	471.60
	b3	53.42	53.33	15.73	15.94	506.09	516.67
	b4	51.46	52.67	15.88	15.85	496.51	487.00
A2	b1	53.26	53.67	16.40	16.37	552.96	513.51
	b2	53.48	53.00	16.15	16.14	577.54	528.45
	b3	54.25	53.67	15.95	16.04	604.06	574.33
	b4	53.40	54.00	16.06	16.11	621.01	561.50
LSD at 5%		0.37	N.S	0.56	0.52	7.07	25.80

Average of number of seeds/capsule. Seeds weight/plant (gm Seeds yield (kg/fed.). as affected by planting methods, proline treatment and their interactions during 2018 and 2019 seasons. Data presented in Table 4. clear that Number of seeds\capsule. Seeds weight\plant (gm) and Seeds yield (kg/fed.). were significant affected by planting methods in both seasons the highest value for all previous character resulted from using rows methods in both seasons as compared with terraces methods the result. Could be to the role of rows methods in enhancement number of seeds/capsule. Seeds weight\plant (gm) and Seeds yield (kg/fed.) consequently increase all previous characters. Similar results were obtained by (Mahmoud et al. 2020), (Sevgi caliskan et al. 2004) and (Beytollah Vahedi *et al*. 2010). Concerning the proline treatments results in the same table showed that it had a significant impact Number of seeds/capsule. Seeds weight/plant (gm Seeds yield (kg/fed.) in both seasons application proline at rate 50ppm give the highest value. This may due to the role of proline in plant development particularly in reproductive phase

and enhancement of photosynthesis proses play vital role in response of plant to environmental stress. Similar results were obtained by (Awadalla, et al.2020), (Ismail and Helmy, 2018) and (Marco et al.2015). Concerning the interaction between sowing dates and plant methods, (A×B) had a significant effect on Number of seeds/capsule. Seeds weight\plant (gm Seeds yield (kg/fed.) in both seasons. the highest results obtained from application rows methods with proline at rate 50 ppm, in both seasons.

3.3. Seeds oil percentage (%)

Average of oil % and oil yield (kg/fed.) as affected by planting methods, proline treatment and their interactions during 2018 and 2019 seasons. data presented in Table 5 clear that oil % and oil yield (kg/fed.) was significant affected by planting methods in both seasons the highest value for all previous character resulted from using rows methods in both seasons as compared with terreces methods the result coud be to the rows methods had led to be optimium condation of good standing bitter field air circulation and such as effect increase vegetative growth as well as reproductive growth consequently increase oil % and oil yield kg/fad.

Table 5: Means of Chemical compositions of sesame seeds as affected by planting methods and proline treatment and their interactions during 2018 and 2019 seasons

Traits		Oil %		Oil yield (kg/fed.)	
		2018	2019	2018	2019
Planting methods (A)					
A1: Terraces		48.47	48.60	238.60	236.06
A2: Rows		47.46	47.71	279.52	287.70
LSD at 5%		0.44	0.38	0.57	6.21
proline treatment (B)					
b1: Controle		46.65	47.47	254.81	256.51
b2: 25 ppm		47.01	47.48	261.62	265.28
b3: 50 ppm		47.23	47.35	269.68	277.40
b4:75 ppm		46.79	47.03	269.28	270.91
LSD at 5%		0.29	N.S	2.90	10.78
Planting method × proline treatment (A × B)					
A1	b1	48.69	48.38	235.18	226.49
	b2	48.79	49.22	235.93	231.97
	b3	47.77	48.67	241.79	251.39
	b4	48.66	48.16	241.53	234.39
A2	b1	47.76	47.99	264.09	268.18
	b2	47.19	47.40	272.60	277.51
	b3	47.47	47.81	286.77	302.13
	b4	47.44	47.65	294.62	302.98
LSD at 5%		0.36	0.91	2.96	13.02

Concerning the proline treatments results in the same table showed that had a significant impact on oil yield (kg/fed.) in both seasons. while, oil % was significant in the first season only application proline at rate 50 ppm give the highest value in both seasons. This may due to the role of proline in plant development particulary in reproductive phase also, play vital role in response of plant to environmental stress and protein synthesis. Similar results were obtained by (Desoky et al., 2017), (Arif Shafi et al.,2017) and (Khaled et al, 2020). Concerning the interaction between

sowing dates and plant methods (A×B) had a significant effect on oil % and oil yield (kg/fed. in both seasons.

4. CONCLUSION

It is concluded from present results that planting sesame plants (cv. Giza32) on Rows and foliar spraying with 50 ppm proline at 45 and 60 DAP led to a significant increase in most traits of sesame under the climatic conditions of the Toshka region-Aswan Governorate.

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