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Sesame (*Sesamum indicum* L.) Yield and Yield Components Influenced by Nitrogen and Foliar Micronutrient Applications in the Fayoum Region, Egypt

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THIS STUDY investigates nitrogen and foliar micronutrient applications to Sesame (*Sesamum indicum* L.) and their influence on yield and selected yield components. Also, determining the variation of contributions traits with seed yield of Sohag1 sesame variety under studied treatments in newly reclaimed soil condition. The experiment was conducted in split-plot design with three replications during the 2013 and 2014 growing summer seasons with four nitrogen rates as the main treatment and three rates of foliar micronutrients as sub plots. Results indicated that significant N levels and application of mixture of foliar micronutrients treatments for all studied traits in both seasons. The higher nitrogen rate 80 kg fad^{-1} (fad.=0.42ha) gave the highest averages for most traits except oil percentage was decreased in higher N level rate. Also, application of 400 g/fad foliar micronutrients led to increase for all studies traits, and the interaction between 80 kg N /fad with 400 g/fad foliar microelement gave the highest means for all studies traits in both seasons except harvest index was 60 kg fad^{-1} with 400 g/fad in the 1st season and 40 kg fad^{-1} with 400 g/fad in 2nd season. On the other hand, the highest value of oil percentage was recorded due to the interaction between 20 kg N /fad and 400 g/fad foliar micronutrients. According, the path way analysis of different traits contribute to seed yield per faddan show that the plant height followed by seed yield/plant and harvest index exhibited high positive direct effects, while the number of capsules /plant through weight of capsules and through seed yield /plant followed by seed yield /plant through weight of capsules /plant exhibited high positive the indirect effect.

Keywords: Sesame , Nitrogen fertilization , Foliar spraying , Land reclamation , Yield and yield components , Path coefficient analysis.

Sesame (*Sesamum indicum* L.) could be considered as one of the major ancient and important oil crops in the world. The crop has high quality of edible oil (42–54%) and protein contents (22 to 25%). It is an important oil seed crop of the warm region of the tropics and sub-tropics. The largest producers of the crop in 2007 were India, China, Myanmar, Sudan, Ethiopia, Uganda and Nigeria. The sesame cultivated area all over the world in 2013 was 9416368.86 ha. (FAO, 2015). In Egypt, sesame is considering essentials oilseed crop, because most of its seeds are directly consumed. The sesame production area in Egypt has decreased from 41214 faddan, in 2011 to 24639 faddan, in 2013 while, the productivity increased from 578 kg fad^{-1} in 2011 to 586 kg fad^{-1} in 2013 (Bulletin Agricultural Statistics, 2013 and 2014). The planting of sesame in less fertile soils and absence of nutrient management is one of the major causes for Low cultivated area and production (Purushottam, 2005).

Due to the increase in the demand for oils sources as well as the shortage of our local production, the expansion of oil crops cultivation in newly reclaimed lands would be quite helpful to cover the country needs. Sesame crop could be considered as a good choice to increase the local edible oil production by increasing growing area and raising the yield per unit area in newly reclaimed land, because of its short duration (3-4 months), low water requirement and drought resistance (Bedigian & Harlan, 1986).

The growing environment and cultural practices effect on yield of sesame. Nitrogen is a component of amino acids, proteins, chlorophyll, nucleic acids, ATP, and phospholipids influences respiration, photosynthesis, cellulose synthesis, root growth, maturity, nodulation and seed. The N fertilizer is considered one of the most important factors to increase crop yields per unit area. N application to sesame has been reported to increase plant height, number of capsules /plant, seed index, and yield of seed, (El-Habbasha *et al.,* 2007; El-Nakhlawy & Shaheen, 2009; Shehu *et al.,* 2010; Noorka *et al.,* 2011; Boghdady *et al.,* 2012; Jouyban & Moosavi, 2012 and Blal *et al.*, 2013). On the other side, seed oil content was reduced by increasing N application (El-Habbasha *et al.,* 2007 and Noorka *et al.,* 2011). While, Boghdady *et al.* (2012) specified that the treatment of 100% from the suggested dosage of mineral fertilizers NP did not factually contrast from that of half of the prescribed dosage of NP in addition to biofertilizers in their effect. Blal *et al.* (2013) found that increasing N fertilization up to 40 kg/fad plus seryalin significantly increased 1000-seed weight, number of capsules plant^{-1}, capsules weight, seed yield plant^{-1} and oil %. However, increasing N application to 60 kg/fad plus seryalin reduced all these traits. Also, Eisa *et al.* (2010) showed that micronutrients (Fe, Zn, Mn) as foliar spray on sesame improved their growth and yields. Yadav *et al.*, (2009) noted that utilization of either zinc or iron alone or in blend with natural manures has brought about increased all the development and yield of sesame. Heidari *et al.* (2011) found that iron fertilizer had significant effect on sesame seed yield. Hamideldin & Hussein (2014) showed that spraying sesame plants with boron (B) solutions improved their growth and yields. path way analysis is necessary to split the simple correlation into direct and indirect effects (Dewey & Lu, 1959). This would help to identify with certainty the component traits to be relied upon during selection to improve seed yield.

The objectives of the present investigations were: (i) to study the effect of nitrogen fertilization, mixture of foliar microelements and their interactions on yield and other studied traits and (ii) to determine characters of the strongest association and contribution with seed yield of sesame under studied treatments in newly reclaimed soil condition.

Materials and Methods

Two field experiments were carried out at the experimental farm of the Faculty of Agriculture, Demo, Fayoum University. It aimed to study the effect of nitrogen fertilizer and mixture of foliar micronutrients rates on yield, its components and oil percentage and determine suitable criteria for yield improvement of Sohag 1 sesame variety under sandy loam soil. Four nitrogen fertilizer rate *i.e.*, (N1) = 20, (N2) = 40, (N3) = 60 and (N4) = 80 kg fad^{-1} (fad = 0.42ha) as ammonium nitrate 33.5% N in two equal doses at 2nd and 3rd irrigation. And three mixtures with foliar microelement rates, *i.e.*, (M1)= 200, (M2)= 300 and (M3)= 400 g fad^{-1} (dissolved in 200L water fad^{-1}) were applied. The micronutrients were added in form of EDTA (Fe 7.5%, Mn 3.5%, Zn 0.70%, Cu 0.28%, B 0.65% and Mo 0.30% w/w) in three equal doses at the 1st, 2nd and 3rd irrigations .

A split-plot design with randomized complete block arrangement was used with three replications in both seasons. The four nitrogen treatments were allotted to the main plots and mixture of foliar microelements treatments were devoted to sub-plots. The sub-plots area was 10.5 m^2 (3 x 3.5 m equal 1/400fad) consisted of five rows. The variety was obtained from the Oil Crops Research Section, Field Crop Research Institute, ARC, Giza, Egypt. Sesame seeds (Sohag1) at the rate of 4 kg fad^{-1}. Seeds were planting at hills 10 cm apart. At the 1st irrigation, the plants were thinned to be one plants hill^{-1}. Calcium super phosphate (15.5% P_2O_5) at rate of 200 kg fad^{-1} was added during soil preparation and 50 kg fad^{-1} potassium sulphate (48% K_2O) with the 2nd irrigation were added, all other recommended agricultural practices for sesame production. Soil physical and chemical properties of the experimental site were determined according to Wilde *et al.* (1985) and presented in Table 1.

At harvesting, random sample of five guarded plants was taken from each sub-plot to determine the traits; plant height (cm), stem diameter (cm), number of capsules plant^{-1}, weight of capsules plant^{-1}(g), and seed yield plant^{-1}(g). Seed index, grain yield in kg was weighed from the whole area of each experimental unit (sub-plot) and harvest index. In addition, seed oil content (%) that determined by using Soxhelt extraction apparatus using petroleum either as a solvent according to A.O.A.C (1990).

All obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the split- plot design according to Gomez & Gomez (1984). Least Significant Difference (LSD) method was used to test the differences between treatment means at 5% level of probability. Path coefficient analysis partitions correlation coefficients into direct and indirect effects through alternate pathways. Path coefficient analysis was done following to the method suggested by Dewey & Lu (1959). The direct and indirect effects were classified based on scale given by Lenka & Mishra (1973) (Table 2).

TABLE 1. Physical and chemical properties of the experimental soil in the two growing summer seasons 2013 and 2014.

Properties		**2013**	**2014**
Physical properties:			
Sand %		75.64	76.46
Silt %		12.43	11.87
Clay %		11.93	11.67
Texture class		Loamy sand	Loamy sand
Chemical properties:			
$CaCO_3$%		10.11	8.64
Ece dS m^{-1}		3.56	3.64
pH		7.34	7.52
Organic matter %		0.83	0.76
Total N (%)		0.078	0.071
Available P (ppm)		6.54	5.86
Available K (ppm)		146	143
Micronutrients (ppm)	**Fe**	10.51	9.47
	Mn	2.11	1.76
	Cu	0.52	0.24
	Zn	0.54	0.38

TABLE 2. A scale of the direct and indirect effects values and their rate of scale.

Values of direct and indirect effects	**Rate of scale**
0.00-0.09	Negligible
0.10-0.19	Low
0.20-0.29	Moderate
0.30-0.99	High
More than	Very high

Results and Discussion

Effect of nitrogen fertilizer treatments

Results in Table 3 showed that highly significant differences existed among all N treatments for all studies traits in both seasons. Applying of the higher nitrogen rate 80 kg fad^{-1} gave the highest averages of plant height, No. of capsules per plant, weight of capsules per plant and seed yield/plant in both seasons and seed yield / fad in the first season. While the third level (N3) 60 kg N/fad gave the highest averages of seed index in both season, seed yield kg fad^{-1} and harvest index in the second season. Concerning, oil (%) increased with low level of nitrogen (20 kg N/fad) in both seasons. These increments may be due to the role of nitrogen in stimulating amino acid building and growth hormones, which in turn acts positively cell division and enlargement.

TABLE 3. Effect of nitrogen fertilization (kg fad^{-1}) on the seed yield/fad (kg) and its components of sesame in two seasons.

Treatments	Plant height (cm)	No. of capsules/ plant	Weight of capsules/ plant (g)	Seed yield/ plant (g)	Seed index (g)	Seed yield (kg) fad^{-1}	Harvest index	Oil (%)
	2013 (1st season)							
20 kg N/fad	143.44	48.00	23.78	12.04	3.63	489.33	21.98	52.21
40 kg N/fad	169.00	54.56	27.31	14.05	4.21	608.92	24.46	51.07
60 kg N/fad	186.72	67.89	32.46	17.03	4.27	636.68	24.16	50.59
80 kg N/fad	187.50	69.89	33.29	18.06	4.21	661.56	23.70	50.22
LSD (5%)	**6.67**	**1.70**	**0.58**	**1.23**	**0.12**	**8.71**	**0.39**	**0.32**
	2014 (2nd season)							
20 kg N/fad	142.01	49.83	25.59	12.60	3.54	494.01	22.33	52.24
40 kg N/fad	164.44	60.67	29.12	15.01	4.06	596.99	24.50	51.43
60 kg N/fad	181.89	65.06	31.89	18.06	4.37	651.91	24.78	50.82
80 kg N/fad	183.39	67.61	34.32	18.67	4.19	639.35	23.08	50.12
LSD (5%)	**1.83**	**1.39**	**1.29**	**0.54**	**0.05**	**6.75**	**0.25**	**0.59**

Each observation is a mean of three replication, LSD is less significant differences, fad is faddan=0.42ha.

These results are in harmony with those found by Sharar *et al.* (2000), El-Habbasha *et al.* (2007), Shehu *et al.* (2010), Noorka *et al.* (2011), Jakusko & Usman (2013), Amanullah *et al.* (2014) and Iorlamen *et al.* (2014).

Effect of mixture of microelements treats

Results in Table 4 revealed that highly significant differences existed among all application of mixture of foliar microelements treatments for all studied traits in both seasons. Increasing mixture of foliar microelements rate from 200 to 400 g fad^{-1} led to increase for all studied traits in both seasons. May be due to the shortage of these nutrients in the newly reclaimed soils.

Such finding can be attributed to the positive role of these nutrients in the metabolic processes that take place inside the plant of sesame and its importance in the formation and multiplying meristem cells and stimulate growth buds and form new branches. The useful impact of micronutrients on the yield traits of sesame may be because of actuation of different enzymes and proficient usage of applied supplements, the degree of seed yield increment under micronutrients might be because of positive and aggregate impact of bringing about higher number of capsules per plant, seed yield per plant and seed index. The obtained results are in agreement to those reported by Yadav *et al.* (2009), Eisa *et al.* (2010), Heidari *et al.* (2011), Hamideldin & Hussein (2014) and Mahdi (2014).

TABLE 4. Effect of Foliar microelements (g fad^{-1}) on the seed yield/fad (kg) and its components of sesame in two seasons.

Treatments	Plant height (cm)	No. of capsules / plant	Weight of capsules/ plant (g)	Seed yield/ plant (g)	Seed index	Seed yield (kg) fad^{-1}	Harvest index	Oil (%)
	2013 (1st season)							
200 g fad^{-1}	155.88	43.00	20.13	10.20	3.92	515.01	22.24	48.86
300 g fad^{-1}	174.12	59.62	29.44	15.28	4.05	602.54	23.96	51.81
400 g fad^{-1}	185.00	77.62	38.07	20.40	4.28	679.82	24.52	52.39
LSD (5%)	**2.98**	**1.03**	**0.76**	**0.36**	**0.08**	**6.25**	**0.29**	**0.43**
	2014 (2nd season)							
200 g fad^{-1}	150.75	44.04	22.31	11.35	3.86	513.28	22.59	50.01
300 g fad^{-1}	167.83	61.29	29.65	16.30	4.04	602.99	24.00	51.39
400 g fad^{-1}	185.22	77.04	38.73	20.60	4.22	670.44	24.44	52.06
LSD (5%)	**1.21**	**1.33**	**0.69**	**0.60**	**0.03**	**4.31**	**0.20**	**0.43**

Each observation is a mean of three replication, LSD is less significant differences, fad. is faddan=0.42ha.

Effect of interaction between treatments

Regarding the interaction effect between nitrogen and foliar spraying with foliar microelement rates, the results clearly showed significant and highly significant differences for all studied traits in both seasons except seed index in the 1st season and oil percentage in 2nd season which was not significant (Table 5).

According to means comparison of interaction between nitrogen and foliar spraying with foliar microelement rates, the results were obtained from 80 kg N /fad with 400 g fad^{-1} foliar microelement gave the highest means for all studies traits in both seasons except harvest index was 60 kg fad^{-1} with 400 g fad^{-1} in the 1st season and 40 kg fad^{-1} with 400 g fad^{-1} in 2nd season. On the other hand, the highest value of oil percentage was recorded due to the interaction between 20 kg N /fad and 400 g fad^{-1} foliar microelement in both seasons. It could be recommended that to maximize sesame yields 80 kg N /fad together with 400 g fad^{-1} foliar microelement should be applied.

TABLE 5. Effect of nitrogen fertilization (kg fad^{-1}) and foliar microelements (g fad^{-1}) interactions on the seed yield fad^{-1} (kg) and its components of sesame in two seasons.

Treatments		Plant height (cm)	No. of capsules/ plant	Weight of capsules/plant (g)	Seed yield/ plant (g)	Seed index	Seed yield (kg) fad^{-1}	Harvest index	Oil (%)
		2013 (1st season)							
20 kg N/fad (N1)	200 g fad^{-1}	130.83	36.00	16.92	9.38	3.50	441.07	21.29	50.90
	300 g fad^{-1}	143.67	47.00	23.42	11.93	3.57	472.34	21.88	52.48
	400 g fad^{-1}	155.83	61.00	31.00	14.80	3.83	554.58	22.76	53.26
40 kg N/fad (N2)	200 g fad^{-1}	148.33	42.00	20.07	10.43	4.09	528.18	23.25	48.14
	300 g fad^{-1}	172.00	51.67	26.62	13.48	4.16	615.03	25.05	52.30
	400 g fad^{-1}	186.67	70.00	35.23	18.23	4.38	683.55	25.09	52.77
60 kg N/fad (N3)	200 g fad^{-1}	172.67	43.50	20.11	10.57	4.04	524.94	21.75	48.12
	300 g fad^{-1}	189.17	71.67	35.68	17.52	4.28	643.76	24.64	51.23
	400 g fad^{-1}	198.33	88.50	41.60	23.00	4.49	741.34	26.10	52.41
80 kg N/fad (N4)	200 g fad^{-1}	171.67	50.50	23.40	10.40	4.05	565.85	22.66	48.30
	300 g fad^{-1}	191.67	68.17	32.04	18.18	4.19	679.03	24.28	51.24
	400 g fad^{-1}	199.17	91.00	44.44	25.58	4.40	739.82	24.15	51.13
LSD (5%)		**5.95**	**2.07**	**1.52**	**0.72**	**NS**	**12.50**	**0.58**	**0.86**
		2014 (2nd season)							
20 kg N/fad (N1)	200 g fad^{-1}	127.17	35.50	19.71	10.45	3.29	454.37	22.95	51.24
	300 g fad^{-1}	135.50	53.33	25.60	12.40	3.50	485.92	22.03	52.43
	400 g fad^{-1}	163.37	60.67	31.45	14.95	3.82	541.75	22.02	53.04
40 kg N/fad (N2)	200 g fad^{-1}	143.00	45.50	20.51	10.67	3.95	500.87	22.54	50.27
	300 g fad^{-1}	167.67	58.00	26.84	15.53	4.07	601.19	25.11	51.31
	400 g fad^{-1}	182.67	78.50	40.01	18.82	4.15	688.90	25.86	52.73
60 kg N/fad (N3)	200 g fad^{-1}	163.00	49.67	24.84	11.92	4.16	551.15	23.00	49.45
	300 g fad^{-1}	178.83	62.83	30.49	18.13	4.41	684.44	25.70	51.31
	400 g fad^{-1}	203.83	82.67	40.35	24.13	4.54	720.15	25.64	51.71
80 kg N/fad (N4)	200 g fad^{-1}	169.83	45.50	24.17	12.38	4.05	546.71	21.87	49.08
	300 g fad^{-1}	189.33	71.00	35.68	19.13	4.16	640.40	23.14	50.49
	400 g fad^{-1}	191.00	86.33	43.11	24.48	4.38	730.94	24.23	50.78
LSD (5%)		**2.42**	**2.66**	**1.37**	**1.19**	**0.06**	**8.61**	**0.40**	**NS**

Each observation is a mean of three replication, LSD is less significant differences, fad is faddan=0.42ha.

Path way analysis

Estimated direct, indirect and residual effect of eight traits under study are presented in Table 6. According to study have suggested scales for path coefficients by Lenka & Mishra (1973), the data revealed that the plant height followed by seed yield/plant and harvest index exhibited high positive direct effects in the 1st season (0.291 , 0.290 and 0.284, respectively), while the weight of capsules/ plant followed by harvest index and seed index reveal high positive direct effects in the 2nd season (0.313, 0.267 and 0.241, respectively). However, the estimates were low for number of capsules plant^{-1} (0.167), seed index (0.111) in the 1st season and seed yield per plant (0.192) in the 2nd season, and negligible for plant height (0.085) followed by capsules number plant^{-1} (0.036). While, weight of capsules plant^{-1} (-0.05) in 1st season and oil percentage in both season (-0.031 and -0.068, respectively) exhibited negative and negligible direct effect on seed yield faddan^{-1}. The same results obtained by Muhamman *et al.* (2010) observed that number of branches and plant height reveal positive direct effect on seed yield per faddan.

TABLE 6. Estimation of direct effects and indirect effects for some studied traits on the seed yield/faddan of sesame in 2013 and 2014 seasons.

Traits	1st season (2013)		2nd season (2014)		Total r	
	Values	Rate of scale	Values	Rate of scale	2013	2014
1- Effect of plant height on seed yield/fad:						
Direct effect	0.291	Moderate	0.085	Negligible		
Indirect effect through No. of capsules/plant	0.141	Low	0.031	Negligible		
Indirect effect through Weight of capsules/plant	-0.041	Negligible	0.267	Moderate		
Indirect effect through Seed yield/plant	0.234	Moderate	0.168	Low		
Indirect effect through Seed index	0.096	Negligible	0.217	Moderate		
Indirect effect through Harvest index	0.215	Moderate	0.163	Low		
Indirect effect through Oil percentage	-0.004	Negligible	0.001	Negligible	0.931**	0.932**
2- Effect of No. of capsules/plant on seed yield/ fad.:						
Direct effect	0.167	Low	0.036	Negligible		
Indirect effect through plant height	0.246	Moderate	0.073	Negligible		
Indirect effect through Weight of capsules/plant	-0.050	Negligible	0.307	High		
Indirect effect through Seed yield/plant	0.283	Moderate	0.182	Low		
Indirect effect through Seed index	0.083	Negligible	0.172	Low		
Indirect effect through Harvest index	0.212	Moderate	0.168	Low		
Indirect effect through Oil percentage	-0.014	Negligible	-0.022	Negligible	0.928**	0.915**
3- Effect of weight of capsules/plant on seed yield/fad:						
Direct effect	-0.050	Negligible	0.313	High		
Indirect effect through plant height	0.240	Moderate	0.072	Negligible		
Indirect effect through No. of capsules/plant	0.165	Low	0.035	Negligible		
Indirect effect through Seed yield/plant	0.281	Moderate	0.180	Low		
Indirect effect through Seed index	0.081	Negligible	0.161	Low		
Indirect effect through Harvest index	0.214	Moderate	0.157	Low		
Indirect effect through Oil percentage	-0.016	Negligible	-0.022	Negligible	0.915**	0.896**

TABLE 6. Cont.

Traits	1st season (2013)		2nd season (2014)		Total r	
	Values	Rate of scale	Values	Rate of scale	2013	2014
4- Effect of seed yield/plant on seed yield/ fad:						
Direct effect	0.290	Moderate	0.192	Low		
Indirect effect through plant height	0.235	Moderate	0.074	Negligible		
Indirect effect through No. of capsules/plant	0.163	Low	0.034	Negligible		
Indirect effect through weight of capsules/plant	-0.049	Negligible	0.294	Moderate		
Indirect effect through Seed index	0.079	Negligible	0.179	Low		
Indirect effect through Harvest index	0.206	Moderate	0.176	Low		
Indirect effect through Oil percentage	-0.015	Negligible	-0.016	Negligible	0.910**	0.933**
5- Effect of seed index on seed yield/fad						
Direct effect	0.111	Low	0.241	Moderate		
Indirect effect through plant height	0.251	Moderate	0.076	Negligible		
Indirect effect through No. of capsules/plant	0.125	Low	0.026	Negligible		
Indirect effect through weight of capsules/plant	-0.036	Negligible	0.209	Moderate		
Indirect effect through Seed yield /plant	0.206	Moderate	0.143	Low		
Indirect effect through Harvest index	0.233	Moderate	0.170	Low		
Indirect effect through Oil percentage	-0.001	Negligible	0.013	Negligible	0.888**	0.877**
6- Effect of harvest index on seed yield/fad						
Direct effect	0.284	Moderate	0.267	Moderate		
Indirect effect through plant height	0.220	Moderate	0.052	Negligible		
Indirect effect through No. of capsules/plant	0.124	Low	0.023	Negligible		
Indirect effect through weight of capsules/plant	-0.038	Negligible	0.184	Low		
Indirect effect through Seed yield /plant	0.210	Moderate	0.126	Low		
Indirect effect through seed index	0.091	Negligible	0.153	Low		
Indirect effect through Oil percentage	-0.012	Negligible	-0.017	Negligible	0.880**	0.787**
7- Effect of oil percentage on seed yield/fad						
Direct effect	-0.031	Negligible	-0.068	Negligible		
Indirect effect through plant height	0.041	Negligible	-0.002	Negligible		
Indirect effect through No. of capsules/plant	0.073	Negligible	0.012	Negligible		
Indirect effect through weight of capsules/plant	-0.025	Negligible	0.103	Low		
Indirect effect through Seed yield /plant	0.135	Low	0.046	Negligible		
Indirect effect through seed index	0.004	Negligible	-0.046	Negligible		
Indirect effect through harvest index	0.112	Low	0.066	Negligible	0.307	0.111
Residual effect =	0.014		0.014			

* and** is significant at $P \leq 0.05$ and $P \leq 0.01$, respectively. r is regression

High indirect effect was found for capsules number plant^{-1} via seed yield / plant (0283), through weight of capsule /plant was 0.307 in the 1st season and 2nd season, respectively and followed by seed yield/ plant via weight of capsules/ plant was 0.294 in 2nd season and weight of capsules plant^{-1} via seed yield /plant was 0.281 in the 1st season, also followed by seed index through plant height was 0.251and by oil percentage through seed index was in negative direction (- 0.046) in 2nd season and by weight of capsules /plant was -0.025 in the 1st season. The previous results revealed that the indirect effect of number of capsules / plant through weight of capsules and through seed yield /plant followed by seed yield /plant through weight of capsules /plant exhibited high positive indirect effects. The correlation between seed yield /faddan and all studied traits was positive and highly significant except with oil percentage which was not significant. The residual effect (0.014) was low in magnitude which show that the traits under this study were important contributing to seed yield. Similar results recorded by Khan *et al.* (2001) and Muhamman *et al.* (2010).

Conclusion

In generally, using higher level of nitrogen (80 kg N /fad) and the highest rate of foliar micronutrients (400 g/fad) under newly reclaimed soils produce the heaviest yield of seeds 739.8 and 730.9 (t/fad) in 1st and 2nd seasons, respectively. The path way analysis of eight traits contributing towards seed yield per faddan show that the plant height followed by seed yield/plant and harvest index in the 1st season, and the weight of capsules/ plant followed by harvest index and seed index in the 2nd season were exhibited high positive direct effects. However, the indirect effect was high for capsules number/ plant via seed yield /plant, through weight of capsule /plant in the 1st season and 2nd season, respectively.

References

A.O.A.C. (1990) "*Official Methods of Analysis"*. 15th ed., Association of Official Agricultural Chemists, Washington, D.C., U.S.A.

Amanullah, J. S. A. and Ahmad, M. (2014) Influence of sowing time and nitrogen fertilization on Alternaria leaf blight and oil yield of *Sesame* cultivars. *Pure Appl. Bio.,* **3**(4): 160-166.

Blal, A. E. H., Kamel, S. M. Mahfouz, H. M. and Said, M. (2013) Impact of opened, non opened pollination and nitrogen fertilizer on sesame production in the reclaimed land. Ismailia governorate, Egypt. *Cercetări Agronomice în Moldova* **XLVI** (3) ,155.

Boghdady, M. S., Nassar, Rania M.A. and Ahmed, F. A. (2012) Response of sesame plant (*Sesamum orientale* L.) to treatments with mineral and bio-fertilizers. *Res. J. Agric., & Bio., Sci.* **8**(2), 127-137.

Bulletin of Agricultural Statistics (2013) Arab Republic of Egypt, Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, summer and nili crops, part (2), p.121.

Bulletin Agricultural Statistics. (2014) Arab Republic of Egypt, Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, summer and nili crops, part (2), p.119

Dewey, J. R. and Lu, K. H. (1959) A correlation and path coefficient analysis of components of crested wheat seed production. *Agron. J.* **51**, 515-518.

Eisa, Salwa A. I., Abass, M. M. and Behary, S.S. (2010) Amelioration productivity of sandy soil by using amino acids, sulphur and micronutrients for sesame production. *J. American Sci.* **6**(11), 250-257.

El-Habbasha, S.F., Abd El Salam, M.S. and Kabesh, M.O. (2007) Response of two sesame varieties (*Sesamum indicum L.*) to partial replacement of chemical fertilizers by bio-organic fertilizers. *Res. J. Agric. Bio. Sci.* **3**(6), 563-571.

El-Nakhlawy, F. S. and Shaheen, M. A. (2009) Response of seed yield, yield components and oil content to the sesame cultivar and nitrogen fertilizer rate diversity. *Env. & Arid Land Agric. Sci.* **20**(2), 21-31

FAO (2015) Agricultural data FAOSTAT. Food and Agriculture Organization of the United Nations, Rome.

Gomez, K. A and Gomez, A. A. (1984) "*Statistical Procedures for Agriculture Research*". 2nd ed. John Wiley and Sons. New York, USA. 680pp.

Hamideldin, N. and Hussein, O. S. (2014) Response of sesame (*Sesamum indicum L.*) plants to foliar spray with different concentrations of boron. *J. Am. Oil Chem. Soc.* **91**, 1949–1953.

Heidari, M., Galavi, M. and Hassani, M. (2011) Effect of sulfur and iron fertilizers on yield, yield components and nutrient uptake in sesame (*Sesamum indicum L.*) under water stress. *African J. Biotechnology,* **10**(44), 8816-8822.

Iorlamen, T., Ayam, F. M. and Akombo, R. A. (2014) Growth and yield response of sesame (*Sesamum indicum L.*) to foliar and soil applied fertilizer in Makurdi, Benue State. *International Journal of Scientific Research and Management,* **2**(2), 528-541.

Jakusko, B.B. and Usman, B.D. (2013) Effects of NPK fertilizer and plant population density on productivity of sesame (*Sesamum indicum L.*). *Res. J. Agric. Enviro. Management,* **2**(5), 121-126.

Jouyban, Z. and Moosavi, S. G. (2012) Effect of different irrigation intervals, nitrogen and superabsorbent levels on chlorophyll index, yield and yield components of sesame. *J. Food Agric. Enviro.* **10** (1), 360-364.

Khan, N. I., Akbar, M. Sabir, K. M. and Iqbal, S. (2001) Characters association and path coefficient analysis in sesame (*Sesamum indicum L.*). *Online J. Bio. Sci.* **1**(3), 99-100.

Lenka, D. and Mishra, B. (1973) Path coefficient analysis of yield in rice varieties. *Indian Journal of Agricultural Sciences,* 43, 376-379.

Mahdi, A. S. (2014) Effect of foliar application with iron and zinc on growth and yield of sesame. *The Iraqi J. Agric. Sci.* **45**(1), 18-25.

Muhamman, M. A., Mohammed, S. G., Lado, A. and Belel, M. D. (2010) Interrelationship and path coefficient analysis of some growth and yield characterestics in sesame (*Sesamum indicum L.) . Journal of Agricultural Science.* **2** (4), 100-105.

Noorka, I. R., Hafiz, S.I. and El-Bramawy, M. A. S. (2011) Response of sesame to population densities and nitrogen fertilization on newly reclaimed sandy soils. *Pakistan J. Bot.* **43**(4), 1953-1958.

Purushottam, G. (2005) Integrated nutrient management in sesame (*Sesamum indicum* L.) and its residual effect in succeeding chickpea (*Cicer arietinum L.*). *M.Sc Thesis*, University of Agricultural Sciences, Dharwad, India, 100 pp.

Sharar, M.S., Ayub, M., Choudhry, M.A. and Asif, M. (2000) Growth and yield of sesame genotypes as influenced by NP application. *International J. Agric. Biol.* **2**(1-2), 86-88.

Shehu, H. E., Kwari, J. D. and Sandabe, M. K. (2010) Nitrogen, phosphorus and potassium nutrition of sesame (*Sesamum indicum*) in Mubi, Nigeria. *New York Sci. J.* **3**(12), 21-27.

Wilde, S. A., Corey, R. B., Lyer, J. G. and Voigt, G. K. (1985) "*Soil and Plant Analysis for Tree Culture*". 3rd ed. pp.93–106, Oxford and IBM Publishers, New Delhi, India.

Yadav, R. A., Tripathi, A. K. and Yadav, A. K. (2009) Effect of microelements in combinations with organic manures on production and net returns of sesame (*Sesamum indicum*) in bundelkhand tract of uttar Pradesh. *Ann. Agric. Res. New Series.* **30** (1&2), 53-58.

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محصـول السمسـم ومكوناتـه المتـأثرة بأضـافة النيتـروجين والـرش الورقى بالمغذيات الصغرى فى منطقة الفيوم

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اجري هذا البحث لدراسة تأثير اضافة النتروجين والرش الورقى بالمغذيات الصغرى على محصول السمسم ومكوناته وتحديد مدى مساهمة الصفات على محصول البذور للصنف سوهاج١ وذلك تحت ظروف الأراضى حديثة الأستصلاح بمحافظة الفيوم. وأجريت التجربة في موسمين متتالين (٢٠١٣ ، ٢٠١٤) وكان التصميم الأحصائى القطع المنشقة مرة واحدة في قطاعات كاملة العشوائية لأربعة معدلات من النيتروجين فى القطع الرئيسية وثلاثة معدلات من المغذيات الصغرى فى القطع المنشقة فى ثلاث مكررات.

وأشارت النتائج إلى وجود فروق معنوية للمستويات المختلفة من النتروجين وكذلك العناصر الصغرى على جميع الصفات المدروسة في كلا الموسمين. وأعطى معدل النيتروجين الأعلى (٨٠كجم/ فدان) أعلى القيم لمعظم الصفات بينما أنخفضت النسبة المئوية للزيت. وأيضا كان أستخدام معدل٤٠٠ جم /فدان من العناصر الصغرى أدى إلى زيادة فى جميع الصفات المدروسة، وكان التفاعل ما بين ٨٠ كجم نيتروجين/فدان مع ٤٠٠ جم من المغذيات الصغرى/ فدان قد أعطى أعلى القيم لجميع الصفات المدروسة في كلا الموسمين ماعدا صفة دليل الحصاد كانت اعلى قيمة عند استخدام ٦٠ كجم/فدان نيتروجين مع ٤٠٠ جم / فدان من العناصر الصغرى في الموسم الأول و ٤٠ كجم نيتروجين/فدان مع ٤٠٠ جم عناصر صغرى/ فدان في الموسم الثانى. واظهر استخدام ٢٠ كجم نيتروجين / فدان و ٤٠٠ جم عناصر صغرى / فدان أعلى قيمة لنسبة الزيت.

وبدراسة معامل المرور لمعرفة مدى مساهمة الصفات المختلفة في محصول البذور اظهر طول النبات يليه محصول البذور/ نبات ودليل الحصاد التأثير المباشر الأعلى، في حين كان التأثير الغير مباشر اعلى لعدد الكبسولات/نبات من خلال وزن كبسولات/نبات ومن خلال محصول البذور/ نبات يليه محصول البذور/ نبات من خلال وزن الكبسولات/ نبات.