

Effect of nitrogen fertilizer and growth stimulants on flowering behaviour , seed yield and its quality of spinach.

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Abstract

This study was conducted at the experimental Farm of the Faculty of Agriculture Moshtohor , Quliubia governorate during the winter seasons of 2013/2014 and 2014/2015 to investigate the effect of nitrogen fertilizer at the rate of 0,25,50 and 75 kg N/fed. and spraying the plants with salicylic acid at 1g/l ,amino acids at 0.5ml/l and seaweed extract at 5ml/l and biogen bio fertilizer as a soil addition at 800 g/fed as well as their combinations in addition to the control treatment on flowering behavior ,seed yield and its quality of spinach plant ,cv. Saloniki. Obtained results showed that increasing nitrogen levels up to the highest used levels (50 or 75 kgN/fed) reflected the highest values of number of female plants ,sex ratio (M/F) , produced seed yield either per plants ,or feddan ,seed index(weight of 100 seeds) ,germination percentage and germination rate . In addition, treating the plants two times during the growing season with all tested growth stimulants enhanced positively the number of female plants and sex ratio towards females and improved the produced seed yield and its quality (seed index, germination percentage and germination rate.) In this connection, treating the plants with biogen as a soil addition was the best treatment in this concept. Therefore, it could be recommended to add nitrogen fertilizer at 50 or 75 kg N/fed combined with soil addition of biogen at 800g/fed to get the highest seed yield with best quality.

Key words: Spinach ,nitrogen salicylic ,biogen ,seaweed extract.

Introduction

Spinach (*Spinacia oleraceae L.*) is considered one of the most important leafy vegetable crops grown in Egypt .The area devoted for spinach was about 4145 feddan and the production was approximately 28352 tons with an average of 6.840 tons/fed. According to the statistics of Ministry of Agriculture (2013/2014).Spinach is essentially a dioecious plant and sex expression appears to be controlled genetically which is primary important for seed yield production .Although it is genetically controlled ,it may be affected by exogenous application of agricultural practices such as mineral and bio fertilizers addition as well as growth stimulants among them seaweed extract ,salicylic acid , amino acid and biogen .In this respect ,the relationship between nitrogen fertilizer application and flower formation and seed yield production was reported by Qulagliotti (1972), who mentioned that increasing the nitrogen rate increased the proportion of female spinach plants. Meanwhile Abo Sedera (1981) showed that increasing nitrogen levels ,decreased number of male plants. Nordestgard (1978) mentioned that seed yield and average seed weight were increased with rising nitrogen application .Abo sedera (1981) noted that both seed yield per plant and total seed yield per unite area were increased with increasing nitrogen application .In addition, Darani *etal* (2013) found that the highest number of seeds was correlated with nitrogen fertilizer level up to 150 kgN/ha. While the highest thousand seed weight related to the fertilizer level (0) control. Recently , it

was found that the use of bio fertilizers is a cheap means for supplying plants with nitrogen and phosphorus during the growth schedule which could partially substitutes the expensive applied of chemical fertilizers, thus leading to significant decrease in the production costs. In this connection, EL-Assiouty and Abo Sedera (2005) found that seed inoculation with 300g phosphorein inoculum /fed in the presence of 40 kgN/fed. gave the highest favorable effect on sex ratio and seed yield of spinach with the best quality .Moreover,many investigators reported the role of seaweed extract on increasing number of female flowers which in turn increased the produced seed yield .In this respect, AL Jebbouri and Musa (2009) indicated that spraying cucumber plants with seaweed extract i.e. seaforcel significantly influenced number of male and female flowers, sex expression ratio and ultimately the total seed yield of crop. Mohamed (2002) on squash reported that spraying the plants with salicylic acid combined with biogas fertilizer increased number of female flowers. Recently Seria *et al.* (2014) on Brassica species indicated that SA at 100 ppm as foliar spray produced significantly higher seed yield .In addition ,Razieh *etal* .(2012) on bean showed that seed yield was increased with amino acids foliar application more than the control .Therefore ,this investigation was carried out to elucidate the effect of nitrogen fertilizer levels and treating spinach plants with some natural growth stimulants and their interaction on flowering behaviour and seed yield and its quality.

Materials and Methods

Two field experiments were conducted on spinach plants (*Spinacia oleracea*) cv. Saloniky, at the Experimental Farm of the Faculty of Agriculture Moshotohor, Benha University, during the two successive winter seasons of 2013/2014 and 2014/2015. These experiments were undertaken to conceive the effect of nitrogen fertilizer application and some growth, stimulants as well as their

combinations on flowering behaviour, seed yield and its quality of spinach. The soil of the experimental field was clay loam in texture with PH 7, 8. Random soil samples were taken before sowing for physical and chemical analysis according to the methods described by Chapman and Pratt (1961) and Jackson (1965).

The chemical and physical analysis of the soil are given in Table A.

Table A. Soil mechanical and chemical analysis of the experimental soil (average of two seasons).

Physical analysis		Chemical analysis			
		Cations meq/l		Anions meq/l	
Coarse sand	7.14%	Ca ⁺⁺	7.26	CO ₃ ⁻	Zero
Fine sand	17.26%	Mg ⁺⁺	3.02	HCO ₃ ⁻	4.14
Silt	23.20%	Na ⁺	5.36	Cl ⁻	4.81
Clay	52.40%	K ⁺	0.83	SO ₄ ⁻	7.52
Texture class clay loam		Soil pH		7.83	
		E.C, dS/m		1.65	
		Organic matter		2.16%	
		Available N	21.3 mg/kg		
		Available P	8.43 mg/kg		
		Available K	117.4 mg/kg		

Table B. The metrological data in Kalubia region throughout both seasons of the experiment.

Year	Months	Air Temperature (C°)			Relative Humidity%	Wind speed (m/sec)
		Min.	Max.	Aver.	Aver.	Aver.
2013	October	15.6	34.9	24.3	58	0.1
	November	10.7	30.5	19.7	64	0.1
	December	6.2	30.2	16.7	65	0.1
	January	3.7	28.7	13.8	56	0.2
	February	5.5	29.9	14.9	55	0.3
2014	March	10.2	35.7	18.8	57	0.2
	April	10.8	38	20.9	49	0.3
	May	16.5	44.1	25.7	49	0.3
	October	13.9	36.9	25.8	60	0.1
	November	12.8	30.2	20.6	72	0.1
2015	December	7.2	23.5	15.5	74	0.1
	January	7.2	23.5	15.5	74	0.1
	February	1.5	29.2	12.6	76	1.1
	March	2.4	31.5	15	80	1.2
	April	6.2	29.5	17.3	61	1.8
	May	11.5	40.8	24.6	59	1.4

Seeds were sown in hills 15cm apart on both sides of ridges 60 cm width and 3.5 m long on October 26th and 28th in 2013 and 2014 seasons, respectively. Each experimental plot included 5 ridges and the plot area was 10.5m². One of the ridges was left without planting as a border to prevent fertilizers movement from any plot to the adjacent one.

This experiment included 20 treatments which were the combination of four levels of nitrogen fertilizer and five sources of growth stimulants as follows:-

A: - levels of nitrogen:-

- 1- 0 N : no nitrogen was applied (control)
- 2- 25 kgN/feddan
- 3- 50kgN/feddan

4- 75 kgN/feddan

Nitrogen was applied in the form of ammonium nitrate (33.5%). The amount of nitrogen fertilizer was divided into two equal portions. The first portion was added four weeks after sowing and the second one was added two weeks later.

B:- Sources of growth stimulants

- 1- Distilled water to act as control
- 2- Amino power as a source of amino acids at 0.5ml/l.
- 3- Seaweed extract at 5ml/l
- 4- Sward:- as a source of salicylic acid at 1g/l
Plants were sprayed two times during the growing season after four and six weeks from seed sowing.
- 5- Biogen bio fertilizer (nitrogen fixing and phosphorus dissolving bacteria) added to the soil at 800g/fed after four and six weeks from sowing.

Amino power :- is commercial product from Union for Agriculture Development (UAD) contain 20% free L. amino acids ,40% total amino acids ,3% mix of vitamins , 3.5% potassium citrate and some micro nutrients ,i.e., 1500ppm Fe , 500ppm Zn and 500ppm Mn .Amino power based on the energizing power of free amino acids and vitamins .

Sward :- is commercial product from Union for Agriculture Development (UAD) contain Salicylic acid 25% - K₂O 25% - ascorbic acid 0.1% - Zn 0.5% - Mg 0.5%

Seaweed extract :- is contain oligo skrdase 0.3%- Manitol 0.001% - Cytokinins 0.001% - Bentane 0.02% - N 1.0% -P₂O₅ 0.5% -Zn 0.3% - Alginic acid 0.5% - Zytene 0.003% - IAA 0.002% - K₂O 12%- Fe 0.2% Mg 0.1% .

Biogen :- it nitrogen fixing and phosphorus dissolving bacterial ,was obtained from the microbiology department, Soils, Water and Environment Res . Inst., Agric. Res. Center ,Giza, Egpt.

Data recorded:-

In this experiment two ridges in each experimental plot were left to seed production. At flowering stage both male and female plants were counted and at seed maturity stage (after 180 days from sowing) plants were harvested and seeds were extracted cleaned and air dried and weighed and the following data were determined

- 1- **Sex expression** :-
 - a- Number of male plants (♂)
 - b- Number of female plants (♀)
 - c- Sex ratio (♂/♀)
- 2- **Seed yield and its quality** :-
 - a- Seed yield: - calculated as g/plant kg/feddan

- b- **Germination percentage**: A random sample of 100seeds from each experimental plot was taken and divided into four replicates (25 seeds/replicate) and left to germinate in clean washed sand in germination chamber at 28C and the germinated seedlings were counted and the germination percentage at the end of germination period was calculated according to the equation.

$$\text{Germination \%} = \frac{\text{No. of germinated seeds}}{\text{Total planted seeds}} \times 100$$

- c- **Germination rate** :- it was estimated according to Bartlett equation (1937).

Germination rate per day =

$$\frac{\text{sum of (accounts day } \times \text{ number of germinated seed)}}{\text{Number of germinated seed}}$$

- d- **Seed index** :Evaluated as the weight of 100 seeds.

Statistical analysis:-

All obtained data were recorded on plot basis and statistically analyzed according to a split-plot design. L.S.D Multiple Range Test at 5% level was used to compare between treatment means .All the obtained data were subjected to statistical analysis of variance according to the procedure outlined by Gomez and Gomez (1984) .MSTAT-C program (1988) was used for statistical calculations.

Results and Discussion

1:- Flowering behaviour of spinach plants:

Data in Tables 3 and 4 show the effect of nitrogen fertilization levels, and growth stimulation treatments and their interaction, on flowering behaviour of spinach plants expressed as number of male and female plants as well as sex ratio during both seasons of study.

1.1. Effect of nitrogen fertilization:-

It is evident from data in Table 3 that there were significant differences in all measured flowering aspects i.e. number of male and female plants as well as sex ratio of spinach plants among the different levels of nitrogen fertilizer in both seasons of study .In this regard, number of male plants was significantly decreased while number of female plants was increased with increasing the nitrogen level up to the highest used one (75 kg N/fed).Moreover ,sex ratio was decreased with increasing nitrogen level .In this respect ,the lowest value was recorded in case of using 75 kg N/fed in both seasons of study .Such decrease in number of

male and that increase of female plants due to increasing levels of nitrogen and consequently increased the sex ratio in direction of female plants. In this regard, Abo Sedera (1981) reported that increasing nitrogen level decreased number of male plants, and sex expression ratio as well. Also, EL-Gizawy *et al* (1992) indicated that increasing nitrogen rates significantly reduced sex ratio (σ/ϕ). In addition EL-Shatoury (2005) on squash and Agbaje *et al.* (2012) on pumpkin noticed that increasing nitrogen levels increased number of flowers produced by plant and increased the female flowers and sex ratio.

1.2. Effect of growth stimulants treatments:-

As for the effect of growth stimulants i.e., salicylic acid, amino acid, seaweed extract and biogen, the same data in Table 3 show that treating spinach plants two times during the growing season starting after four weeks from seed sowing and two weeks later with salicylic acid at 1g/l, amino acids at 0.5ml/l, seaweed extract at 5ml/l as a foliar spray and biogen at 800g/fed as soil addition, significantly

decreased the number of male plants and in contrast it increased the number of female plants compared with the control. Furthermore, such treatments significantly decrease the sex ratio. Obtained results are true during both seasons of growth. In addition, the lowest number of male plants and the highest number of female ones and the lowest sex ratio in direction of femaleness were recorded in case of biogen soil addition followed by seaweed extract and salicylic acid as foliar spray in a descending order.

In this connection, similar results were reported by Abd EL-Fattah and Sorial (2000) on squash and EL-Assiouty *et al.* (2005) on spinach in case of bio-fertilizer; Crouch and Vanstaden (1992) on tomato, AL-Jebbouri and Musa (2009) and Taha *et al.* on cucumber in case of seaweed extract and Moghazy (2014) on lettuce showed that treatment such vegetable crops with different concentrations of growth stimulants enhanced flowering production and increased number of female flowers in such studied vegetable crops. Moreover Mohamed (2002) on squash in case of salicylic acid.

Table 3. Effect of nitrogen fertilizer rates and growth stimulants treatments on flowering behavior of spinach plants in 2013/2014 and 2014/2015 seasons.

treatments		First season 2013-2014			Second season 2014-2015		
nitrogen fertilizer	Growth stimulants	No. of male plants (σ)	No. of female plants (ϕ)	Sex ratio (σ/ϕ)	No. of male plants (σ)	No. of female plants (ϕ)	Sex ratio (σ/ϕ)
Control (0 N)		39.76	50.44	0.79	40.16	50.46	0.79
25 kg N/fed		37.74	52.66	0.72	38.84	50.76	0.77
50 kg N/fed.		35.14	55.46	0.63	37.86	52.50	0.72
75 kg N/fed.		32.36	57.64	0.56	36.42	54.58	0.66
	L.S.D at 5%	1.62	1.95	0.19	1.74	2.11	0.14
	Control	40.97	49.52	0.83	42.10	48.40	0.86
	Salicylic acid (SA)	36.12	54.87	0.66	37.70	52.02	0.72
	Amino acids	37.15	51.85	0.72	39.67	48.57	0.78
	Seaweed extract	34.97	55.77	0.62	36.87	53.86	0.68
	Biogen	32.1	58.15	0.55	35.25	55.50	0.63
	L.S.D at 5%	1.30	1.54	0.11	1.36	1.79	0.11

1.3. Effect of the interaction:-

With regard to the effect of the interaction, data in Table 4 reveal that all measured flowering parameters were significantly affected as a result of the interaction among the different N fertilizer levels and the stimulants treatments in both seasons of study. In this respect, fertilizing spinach plants with 75Nkg/fed combined with biogen as a soil addition

followed by foliar spray with seaweed extract without significant differences among them as compared with all other used combinations reflected the lowest values of male plants and the highest number of female ones and sex ratio in direction of femaleness. This trend held true during both seasons of the experiment.

Table 4. Effect of the interaction of nitrogen fertilizer rates and growth stimulants treatments on flowering behaviour of spinach plants in 2013/2014 and 2014/2015 seasons.

treatments		First season 2013-2014			Second season 2014-2015		
nitrogen fertilizer	Growth stimulants	No. of male plants(♂)	No. of female plants(♀)	Sex ratio(♂/♀)	No. of male plants(♂)	No. of female plants(♀)	Sex ratio(♂/♀)
Control	Control	43.30	46.70	0.93	43.50	47.50	0.91
	Salicylic acid(SA)	40.20	50.80	0.79	40.10	50.00	0.80
	Amino acids	40.70	48.30	0.84	41.00	49.00	0.84
	Seaweed extract	38.10	52.90	0.72	39.00	52.00	0.75
	Biogen	36.50	53.50	0.68	37.20	53.80	0.69
25 kg N/fed	Control	41.90	48.10	0.87	42.00	46.00	0.91
	Salicylic acid(SA)	38.40	53.60	0.71	37.50	52.50	0.73
	Amino acids	38.90	50.10	0.78	39.90	49.10	0.81
	Seaweed extract	36.80	53.20	0.69	38.80	52.20	0.74
	Biogen	32.70	58.30	0.56	36.00	54.00	0.66
50 kg N/fed.	Control	40.70	50.30	0.81	41.90	48.10	0.87
	Salicylic acid(SA)	34.00	56.00	0.61	37.40	52.40	0.71
	Amino acids	35.20	53.80	0.65	39.30	52.70	0.74
	Seaweed extract	33.20	57.80	0.57	35.70	53.30	0.67
	Biogen	32.90	59.10	0.55	35.00	56.00	0.62
75 kg N/fed.	Control	38.00	53.00	0.71	41.00	52.00	0.78
	Salicylic acid(SA)	31.90	59.10	0.53	35.80	53.20	0.67
	Amino acids	33.80	55.20	0.61	38.50	51.50	0.74
	Seaweed extract	31.80	59.20	0.53	34.00	58.00	0.58
	Biogen	26.30	61.70	0.42	32.80	58.20	0.56
L.S.D at 5%		2.51	2.86	0.31	2.64	2.97	0.26

2. Seed yield and its quality:-

Data in Tables 5 and 6 show the effect of nitrogen fertilization level and treatment with growth stimulants and their interaction on total produced seed yield and its quality of spinach during the two seasons of growth.

2.1. Effect of nitrogen fertilization:-

Data recorded in Table 5 indicate that total produced seed yield /plant and yield/fed as well as seed quality expressed as 100 seed weight, germination percentage and germination rate were enhanced with all nitrogen fertilization levels as compared with the control treatment in both seasons of study .In addition ,such enhancing effect reached to 5% the level of significance in all yield and quality traits expect in case of germination rate in both seasons of growth .Moreover ,the highest produced yield and its components were obtained in case of using the highest levels of nitrogen fertilizer (50 and 75 kg nitrogen per feddan) without significant differences among them .Such increasing effect of nitrogen fertilizer on total produced yield was connected with the vegetative growth of the plants(Table 1) increasing number of female plants (Table 3) seed yield of plant and seed index which in

turn positively affected produced total yield .Obtained results are in agreement with those reported by Abo Sedera (1981), Kohli and sainsi (1985), EL-Gizawy *et al.* (1992) and Darani *et al.* (2013) all working on spinach.

2.2. Effect of growth stimulants treatments:-

With regard to the effect of growth stimulants, the same data in Table 5 show that spraying spinach plants with used growth stimulants i.e. salicylic acid at 1g/l ,amino acid at 0.5ml/l ,seaweed extract at 5ml/l as well as soil addition of biogen at 800g/fed two times during growth season significantly increased the produced seed yield for both plant and fedden as well as weight of 100 seeds and germination percentage expect the germination rate which was not significantly affected in both seasons compared with the control treatment .

In this connection ,the highest produced yield and its quality aspects were recorded in case of using biogen at 800g/fed as soil addition followed by using seaweed extract at 5ml/l as foliar spray without significant differences among them, especially in the second season of growth compared with other tested growth stimulants (salicylic acid and amino acids).

Table 5. Effect of the nitrogen fertilizer rates and growth stimulants treatments on total seed yield and its components of spinach plants during 2013/2014 and 2014/2015 seasons.

Treatments		First season2013-2014					Second season 2014-2015				
Nitrogen fertilizer	Growth stimulants	Seed yield per plant (g)	Seed yield kg/fed.	Weight of 100 seeds(g)	Seed germination %	Germination seed rate (days)	Seed yield per Plant(g)	Seed yield kg/fed	Weight of 100 seeds (g)	seed germination %	Germination seed rate (days)
Control(0 N)		4.34	277.20	1.14	94.00	9.14	3.78	247.60	1.11	88.70	9.10
25 kg N/fed		5.00	323.60	1.21	95.85	8.86	4.28	278.40	1.17	89.65	8.98
50 kg N/fed.		5.52	356.50	1.16	96.70	8.98	4.40	279.20	1.15	91.05	9.08
75 kg N/fed.		5.68	367.60	1.20	97.85	8.94	4.48	289.70	1.19	92.95	8.50
L.S.D at 5%		0.26	44.13	0.05	1.31	n.s.	0.21	33.85	0.04	1.58	n.s.
	Control	4.02	258.50	1.11	93.00	9.50	3.37	223.60	1.07	87.38	9.22
	Salicylic acid(SA)	4.95	320.20	1.21	95.38	8.90	4.32	280.80	1.15	89.69	9.27
	Amino acids	5.25	339.90	1.15	96.75	9.00	4.27	276.10	1.17	91.31	8.82
	Seaweed extract	5.37	345.00	1.21	97.13	8.75	4.55	289.70	1.17	91.69	8.50
	Biogen	6.07	392.60	1.27	98.25	8.72	4.65	298.40	1.21	92.88	8.50
L.S.D at 5%		0.34	47.22	0.07	1.76	n.s.	0.28	26.27	0.06	1.62	n.s.

Table 6. Effect of the interaction of nitrogen fertilizer rates and growth stimulants treatments on total seed yield and its components in 2013/2014 and 2014/2015 seasons.

Treatments		First season 2013-2014					Second season 2014-2015				
Nitrogen fertilizer	Growth stimulants	Seed yield per plant (g)	Seed yield kg/fed.	Weight of 100 seeds(g)	seed germination %	Germination seed rate (days)	Seed yield per Plant(g)	Seed yield kg/fed	Weight of 100 seeds (g)	seed germination %	Germination seed rate (days)
Control	Control	2.70	165.00	1.16	91.00	9.50	2.40	173.30	0.98	84.75	10.10
	Salicylic acid(SA)	4.20	274.50	1.40	93.00	9.20	3.90	250.80	1.11	87.50	8.90
	Amino acids	4.40	287.80	1.02	94.00	9.80	4.00	256.60	1.09	89.75	8.70
	Seaweed extract	4.70	290.80	1.28	95.00	8.50	4.20	271.00	1.24	90.25	7.90
	Biogen	5.70	368.00	1.35	97.00	8.70	4.40	286.50	1.13	91.25	8.90
25 kg N/fed	Control	3.90	255.60	1.25	92.50	9.50	3.50	229.30	1.13	86.25	9.40
	Salicylic acid(SA)	5.02	321.30	1.30	95.00	9.10	4.30	281.30	1.20	88.50	8.80
	Amino acids	5.10	330.60	1.15	96.75	7.80	4.40	284.30	1.17	90.75	8.90
	Seaweed extract	5.10	329.30	1.13	97.25	10.00	4.50	291.00	1.09	91.00	9.30
	Biogen	5.90	381.00	1.23	97.75	7.90	4.70	306.30	1.30	91.75	8.50
50 kg N/fed.	Control	4.70	303.00	0.95	93.75	9.50	3.70	241.00	1.06	87.50	8.20
	Salicylic acid(SA)	5.10	332.50	1.02	95.75	8.90	4.40	286.50	1.12	90.25	10.80
	Amino acids	5.70	364.80	1.17	97.75	7.90	4.40	283.30	1.19	91.50	8.40
	Seaweed extract	5.80	376.50	1.19	97.50	8.20	4.70	286.80	1.15	92.25	9.30
	Biogen	6.30	405.50	1.21	98.75	10.30	4.80	298.30	1.25	93.75	8.70
75 kg N/fed.	Control	4.80	310.30	1.08	94.75	9.50	3.90	251.00	1.16	91.00	9.20
	Salicylic acid(SA)	5.50	352.50	1.15	97.75	8.40	4.70	304.80	1.20	92.50	8.60
	Amino acids	5.80	376.30	1.27	98.50	10.50	4.30	280.00	1.23	93.25	9.30
	Seaweed extract	5.90	383.30	1.25	98.75	8.30	4.80	310.00	1.20	93.25	7.50
	Biogen	6.40	415.17	1.29	99.50	8.00	4.70	302.80	1.17	94.75	7.90
L.S.D at 5%		0.68	94.45	0.11	3.53	n.s.	0.57	52.54	0.10	3.25	n.s.

Such superiority of biogen and seaweed extract may be attributed to the effect of biogen fertilizer on nitrogen fixation and phosphorus solubility and its uptake by plants and growth substance of seaweed extract which all of each affect positively on plant growth, enhanced sex ratio in direction of femalness which consequently increased the produced yield. Such results are coincided with those reported by EL-Assiouty *et al* (2005) on spinach, EL-Khatib *et al* (2007) and Youssef (2007) on pea in case of bio-fertilizer, Demir *et al* (2006) on pepper, Rathore *et al* (2009) on soy bean, Moghazy (2014) on lettuce in case of seaweed extract, Serita *et al* (2014) on Brassica species in case of salicylic acid, Razieh *et al* (2012) on mango and Moghazy (2014) on lettuce in case of amino acids.

2.3. Effect of the interaction:-

As for the effect of the interaction between different nitrogen fertilization levels and growth stimulants treatments, the same data in Table 6 indicate that total produced seed yield either per plant or feddan as well as seed quality were significantly affected as a result of the interaction treatments except the seed germination rate which was not significantly affected in both seasons of study. In this respect, fertilizing spinach plants with 50 or 75 kg N/fed. combined with soil addition of biogen at 800g/fed or spraying the plant, two times with seaweed extract after four weeks and two weeks later from seed sowing estimated the highest produced seed yield with best quality compared with other interaction treatments.

References

- Abo-Sedera, F.A. 1981. Effect of nitrogenous fertilizer and giberellic acid (GA3) on yield and quality of spinach. M.Sc. Thesis, Faculty of Agric Moshtohor. Zagazig Univ., 76pp.
- AbdEL-Fattah, M.A. and M. E-Sorial 2000. Sex expression and productivity response of summer squash to bio fertilizer application under different nitrogen levels. Zagazig J. Agri. Res. 27(2): 255-281.
- Agbaje G.O., Oloyede F.M. and Obisesan L.O. 2012. Effects of NPK and sex expression of pumpkin (*cucurbita pepo*), J. Agric. Sci. ISSN: 2167-0447. 2(11). 291-295.
- AL-Jebbouri, M. A. and A. Musa 2009. Effect of humic acid and seaweed extracts on growth flowering and yield of cucumber (*Cucumis sativus L.*) M.Sc. thesis college of Agriculture, University of Tekrit, Ministry of Higher Education and Scientific Research, Republic of Iraq (in Arabic).
- El-Gizawy A.M., I. EL-Oksh., A. Sharaf and M. EL-Habar. (1992). Effect of sowing date, rate and number of Nitrogen applications on spinach plants flowering and seed yield. Annals Agric. Sci., Ain -Shams Univ., 37(1). 159-166.
- ELKhatib, H.A., S.M. Gabr and A.M. EL-Keriawy. 2007. Mathematical aspects of seed production response of pea (*Pisum sativum L.*) to nitrogen and bio - fertilization. J. Agric. & Env. Sci. Alex. Univ., Egypt, 6(2): 218-237.
- EL-Shatoury, R.S. 2005. Effects of plant density and nitrogenous fertilizer on growth characters of summer squash. M.Sc. Agric. Hort., (Veget) Agric., Suez Canal.
- Bartlett, M.S. 1937. Some samples of statistical methods of research in agriculture and applied biology. J. Roy. Soc. 4, 2.
- Chapman, H.O. and P. Pratt (1961). Method of analysis for soil, plant and water. Univ. of Calif., Dev. of Agric. Sci.
- Crouch I.J., and J. Van- Staden 1992. The effect of aqueous seaweed concentrate on the establishment and yield of greenhouse tomato plants. J Appl Phycol, 4: 291-296.
- Darani, F. H., H. Zeinali, A. H. S. Red, A. Khourgami and H. Nasrollahi. (2013). Effect of planting date and nitrogen fertilizer on two varieties (inner and outer) of spinach. Annals of Biological Research., 4. (2): 56-59.
- Demir, N., B. Dural and K. Yildirim. 2006. Effect of seaweed suspensions on seed germination of tomato, pepper and aubergine. J. Biol. Sci., 6(6): 1130-1133.
- EL-Assiouty F.M.M. and S.A. Abo-Sedera. (2005). Effect of bio and chemical fertilizers on seed production and quality of spinach (*Spinacia oleracea L.*). INT. J. Agri. Biol., 7, (6): 947-952.
- Gomes, K.A and A.A. Gomes 1983. Statistica procedures for agricultural research. 2nd ed. John Willy and Sons. Pp. 139-153.
- Jackson, M.L. 1965. Soil chemical analysis advanced course, pub. by the author, Dept. of Soils, Univ. of Wisc., Madison 6, Wiscnsin, U.S.A.
- Kohli, UK. and S.S. Saini. 1985. A note on nitrogen nutrition of spinach (*Spinacia oleracea*) seed crop cv. long standing. Haryana J. Hort. Sci 14: 141-142, India.
- Moghazy, A.M. 2014. Effect of some Bio-stimulants and anti-oxidants on head and seed production of Balady lettuce. J. plant production, Mansoura Univ., 5(10): 1675-1689.
- Mohamed, S.M.A. (2002). Effect of some Agriculture treatments on yield productivity of squash. Ph.D. thesis Agric. Sc. (vegetable crops), Fac. Agric. Moshtohor, Zagazig university.
- Nordestgaard, A. 1978. Trials of spinach (*Spinacia oleracea L.*) growth for seed using various soil nitrogen and row spacing. Tidsskrift for planteavl 82: 231-242. (Hort Abstr. 49, 1667. 1979).

- **Quagliotti L .1972** .The effects of nitrogen fertilization on growth habit and sex expression in Riccio d Asti spinach.Sementi Elette 18: 5-19.
- Razieh ,K., M.Tajbakhsh and J. Jalilian .2012.** Effect of foliar application of bio- organic fertilizers and urea on yield and yield components characteristics of mung bean . International J.of Agric . : Res . and Review , 2(5): 639-645.
- **Rathore, S.S.,D.R.Chaudhary ,G.N.Boricha, A.Ghosh,B. P.Bhatt, S.T.Zodape and J.S.Patolia.2009.**Effect of seaweed extract on the growth ,yield and nutrient uptake of soybean (Glycine max.) under rained conditions. South African J.of Bot ., 75: 351-355.
- **Sarhan., T.Z and S.F.Ismael.2014.** Effect of low temperature and seaweed extracts on flowering and yield of two cucumber cultivars (*Cucumis sativus L*).Inter.J. Agric and Res.,3.1 ,41-54.
- **Sarita Muhal ,N.S.Solanki ,P.Singh and K.B.Shukla . 2014** Effect of salicylic acid on productivity and nutrient uptake of Brassica species under different planting durations.Afr .J.Agric. Res., 9(13). 1101-1106 .
- Youssef , A.Y.I.2007.** Physiological studies on pea nutrition and production. M.Sc. Thesis , Fac. Agric., Zag .Univ.

تأثير التسميد النتروجيني ومنشطات النمو علي السلوك الزهري والمحصول البذري وجودة البذور في السبانخ

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المخلص العربي

أجريت هذه الدراسة بمزرعة التجارب بكلية الزراعة بمشتهر بمحافظة القليوبية خلال الموسم الشتوي لعامي 2014/2013 ، 2015/2014 م وذلك لدراسة تأثير التسميد النتروجيني المضاف للأرض بمعدل صفر ، 25 ، 50 ، 75 كجم ن / فدان ومعاملة النباتات بمنشطات النمو وهي حمض السلسيك بتركيز 1جم /لتر ، الاحماض الامينية بتركيز 5 ، 0 مل /لتر ، مستخلص الطحالب بتركيز 5 ملي / لتر والاضافة الارضية للسماد الحيوي البيوجين بمعدل 800جم/فدان . بالاضافة الي معاملة المقارنة والتفاعل بينهما علي السلوك الزهري والمحصول البذري وجودة البذور لنباتات السبانخ صنف سالونيكى . وقد اوضحت النتائج المتحصل عليها أن زيادة معدل التسميد النتروجيني الي 50 ، 75 كجم نتروجين ادي الي اعلي القيم استجابة معنوية لعدد النباتات المؤنثة والنسبة الجنسية (مذكر/ مؤنث) والمحصول البذري الناتج سواء بالنسبة للنبات او الفدان وكذلك وزن 100 بذرة كما ادت هذه المعاملات الي زيادة نسبة الانبات وكان لها تأثير ايجابي علي سرعة الانبات . كذلك أدت معاملة النباتات بجميع منشطات النمو المستخدمة الي زيادة عدد النباتات المؤنثة و حسنت النسبة الجنسية في اتجاه النباتات المؤنثة والمحصول البذري متمثلا في نسبة الانبات ومعدل الانبات ووزن 100 بذرة . وقد اظهرت المعاملة بالسماد الحيوي البيوجين اضافة ارضية أفضل النتائج في هذا الشأن . وبذلك يمكن التوصية بأستخدام 50 أو 75 كجم نتروجين /فدان والاضافة الارضية للسماد الحيوي البيوجين بمعدل 800 جم/ فدان للحصول علي افضل محصول بذري مع أفضل مواصفات جودة لبذور السبانخ من الصنف سالونيكى .