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Improving The Productivity and Quality of Black Cumin (*Nigella Sativa*) By Using Algae Biofertilizer

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Abstract

Two field experiments were conducted field experiment were designed in a split Field experiment was carried out during two successive winter seasons of 2017/2018 and 2018/2019 in sand soil at Ali Mubarak farm Station South El- Tahrir Horticultural Research Institute - Agricultural Research Center to evaluate the effect of incorporation six algae concentration (10g/hill) three marine and three River varieties marine (laurencia microcladia, Jania rubens and Ulva lactuca) and river algae (Scenedesmus obliqus, Ankistrodesmus falacatus, and Chlorela vulgaris) on black cumin growth and nutritional status under drip irrigation . Results showed that plant growth , plant height, number of branches and weight of capsules were increased by algae addition , volatile and fixed oil were increased by adding algae compared to control or by adding mineral fertilizer verities show most effect with 50% mineral fertilizer while Scenedesmus obliqus show most effect with adding 25% nitrogen fertilizer .

Key words : algae, marine, River, black cumin

Introduction

Black cumin, *Nigella sativa*, L. plant belongs to *Ranunculaceae* family, common known as black cumin is cultivated for seed yield and oil production. The whole seeds contain 30- 35 % of oil which has several uses for pharmaceutical and food industries **(Ustun *et al.* 1990).** The black cumin seed cake is a by-product obtained from the black cumin seeds with cold pressing and it is used in the production of bio-oil **(Sen and Kar 2012).**

Medicinal plants are a unique type of natural product requiring special consideration due to their potential impact of people's health. Therefore, improving the productivity and quality of various medicinal and aromatic plants in Egypt was an ultimate goal, in the latter decade, to meet the increase of population and to avoid chemical therapy side effects on human health. One of the most important plants containing volatile and fixed oil is black cumin family

Ranunculaceae is an herbaceous indigenous plant in the Mediterranean region. Seeds of this plant have been used for centuries as a spice and food preservative, as well as a traditional medicine for the treatment of various diseases, including skin infections **Schleicher and Saleh (2000)** and **Goreja (2003).**

Biofertilizers have the ability to access a major part of nutrients for growing Plant along with growth-promoting factors. These benefits play an effective role in reduction of chemical fertilization and also result in higher crop yield **(Cordovilla et al., 1999).** Algae are a large and diverse group of microorganisms that can carry out photosynthesis since they capture energy from sunlight, that play an important role in agriculture where they are used as bio fertilizer and soil stabilizers.

The production of algae biomass as a fertilizer has dual value; the use of algae for the purification of wastewater coupled with the application of obtained biomass as fertilizer. The underlying concept is circular economy fertilization and has been reviewed before **(Solovchenko et al., 2016).** others were aimed to specifically produce algae biomass from simulated waste water **(Gimondo et al., 2019)**. **(Alobwede et al., 2019)** used algae as fertilizer on different plant species**.**

The objective of this study was to assess the response of *Nigella Sativa* plants to different fertilizers (Algae and mineral fertilizer) supply and their effect on the some morphological and chemical properties of Nigella
plants.

Materials And Methods

This investigation was carried out during two successive winter seasons of 2017/2018 - 2018/2019 at Ali Mubarak Farm -Station South El Tahrir Horticultural Research Institute Agricultural Research Center

Table(1) some Physical and chemical properties of the studied sandy soil.
under drip irriga

	Physical properties				chemical properties								
	Sand %	Silt %	Clay %	Texture Class	EC ds/m	PH	Soluble cation mg/L			Soluble anion mg/L			Total N %
							Ca++	Mg+	K+	Hco3-	Cl-	So4-	
2015/2016	92.8	4.2	3.0	Sandy	0.15	8.7	0.73	0.59	1.61	0.58	0.42	1.48	0.009
2016/2017	93.6	5.0	1.4	Sandy	0.22	8.6	0.69	0.58	0.28	0.54	0.43	0.57	0.008

tion system.

Soil samples to 20 cm depth from each experiments site were collected and analyzed for some important physical and chemical properties according to the methods described by **Page *et al*. (1982)** The results of these analyses are shown in Table (1).

Soil was left free of plants for 40 days then divided into several rows. Each row includes five hills, 25 cm in between. A distance of 75 cm was left between each two rows. Three replicates were used for each treatment. three seeds of *Nigella sativa* with each treatment in each hill. Such plants were thind to be two plants per hill after 20 days of planting. A row of control plants and a row of plants with chemical fertilizer were also assembled.

Marine algae *laurencia microcladia, Jania rubens* and *Ulva lactuca,*and River algae *Scenedesmus obliqus*, *Ankistrodesmus falacatus*, and *Chlorella vulgaris*, were obtained from Biotechnology Unit, National Research Center. Algal grown in BG-11 free nitrogen medium **Rippka et al.,(1999)**. Algae were grown in Erlenmeyer flasks, (250 ml) on liquid BG11 medium. The cultures were incubated in the room temperature of approximately 25±2°C and a light intensity 2500 lux provided by cool, white, fluorescent tubes under continuous illumination. The maximum algae yield **(Hamza and Hamouda, 2013).**

Experimental design

The Experimental layout split plot design randomized blocks with three replication.

Fertilizer applications

The algae were applied as a soil treatment at rate (10 g/hill) for each alga.. Algae were added twice again around the plants the first was added with sowing and the second after 30 day from sowing . Urea at the concentration of (4.5 g urea /hill) was added once at sowing time as chemical fertilizer (control without treatment).

and unmanaged operation while efficiently recycling a small amount of solvent to dissolve a larger amount of material.

Results And Discussion

Utilization of different algae types as biofertilizer on characterization of *Nigella Sativa*:

This part assesses the efficiency of various algae type with Vegetative growth, oil content and yield of ***Nigella Sativa*** as well as, chemical macro, micro elements and some measurements of extract fixed and volatile oil contents of the plant .

Table (2) Effect of Algae treatment and nitrogen fertilizer on plant length of *Nigella Sativa* after 60 day from sowing .

N-Fertilizer / Algae strains		100%	75%	50%	25%	0%	Mean (A)
Marine	*Jania rubens*	68.33ABCDEF	63.33 CDEFGH	65.00 BCDEFGH	61.33 FGH	60.33 FGH	69.87 A
	laurencia microcladi	67.00 ABCDEFG	72.00 AB	60.33 FGH	57.33H	61.67 EFGH	65.40 B
	ulva lactuca	71.00 ABC	64.33 BCDEFGH	61.33 FGH	60.33 FGH	64.33 BCDEFGH	59.60 C
River	Scenedsmus	73.33 A	62.33 DEFGH	70.00 ABCD	59.33 GH	64.67 BCDEFGH	62.53 BC
	chlorella vulgaris	69.67 ABCDE	64.67 BCDEFGH	58.67 H	60.67 FGH	60.00 GH	62.53 BC
	Ankistrodesmus falacatus	64.67 BCDEFGH	64.33 BCDEFGH	62.67 DEFGH	57.33 H	58.00 H	61.73 BC
Mean (B)		64.94 A	62.56 AB	65.72 A	63.56 AB	61.28 B	
LSD at level 5%			A 3.667	B 3.348	AxB 8.200		

Data presented in Table (2) show the main effect of algae types shows that biofertilizer gave positive results; plants length was enhanced (69.8 cm) when plants were treated with *jania rubens* algae. On the other hand, the lowest plants length (59.6 cm) was observed by *ulva lactuca* algae. Concerning the main effect of biofertlizer doses of *Nigella Sativa* plant length data show that, Treat by 100% N.fertilizer was maximized plants length (65.72cm), while the lowest plants length Treate by less concentrate was recorded (61.28 cm) from mineral fertilizer. Concerning interaction between fertilization types and fertilizer doses, data revealed that *laurencia microcladia* algae at high dose (25% algae) gave the highest plant length (72.00cm).

number of brunches

table (3) shows retaliation between algae and number of branches.

N Fertilizer / Algae strains		100%	75%	50%	25%	0%	Mean (A)
Marine	*Jania rubens*	11.00 AB	10.33 ABCD	11.00 AB	9.333 CDEF	9.000 DEF	10.93 A
	laurencia microcladi	10.67 ABC	11.33 A	9.667 BCDEF	9.667 BCDEF	9.667 BCDEF	10.33 AB
	ulva lactuca	10.67 ABC	10.67 ABC	9.333 CDEF	10.00 ABCDE	9.000 DEF	9.467 D
River	Scenedsmus	11.00 AB	9.667 BCDEF	11.00 AB	9.000 DEF	10.33 ABCD	9.600 CD
	chlorella vulgaris	11.33 A	9.000 DEF	10.33 ABCD	9.333 CDEF	9.667 BCDEF	10.20 BC
	Ankistrodesmus falacatus	11.33 A	9.333 CDEF	8.667 EF	10.00 ABCDE	8.333 F	9.400 D
Mean (B)		10.50 A	9.722 B	10.44 A	9.667 B	9.611 B	
LSD at level 5%			A 0.7186	B 0.6560	AxB 1.607		

Data presented in Table (3) show the main effect of branches number as affected with some algae jania rubens, laurencia microcladia, and Chlorella vulgares algae maximized number of branches (10.9,10.3 and 10.2 branch/plant, respectively). While, number of branches resulted with Ankistrodesmus falcatus algae possessed the lowest significant number of branches (9.4 branch/plant). Regarding data of the main effect of fertilizer doses, Treat 100% N.fertilizer and 75% maximized number of branches (10.5 and 10.4 branch/plant, respectively) with no significant differences among doses. Interaction between alga types and biofertlizer doses revealed that laurencia microcladia algae at 100% dose gave (11.33 branch/plant for each) . Ankistrodesmus falcatus and chlorella vulgaris algaes revealed that (11.33 branch/plant) at 75% dose fertilizer .

number of flowers

Table (4) Effect of Algae treatment and nitrogen fertilizer on number of flowers of Nigella Sativa 60 day from sowing .

N-Fertilizer / Algae strains		100%	75%	50%	25%	0%	Mean (A)
Marine	*Jania rubens*	63.00 A	49.33 BCDEF	62.00 AB	43.00 DEFG	27.67 H	51.00 AB
	laurencia microcladi	51.00 ABCDEF	55.00 ABCDE	49.33 BCDEF	44.00 DEF	45.67 CDEF	51.00 AB
	ulva lactuca	45.00 CDEF	51.67 ABCDEF	42.00 EFG	45.00 CDEF	30.00 GH	42.07 CD
River	Scenedsmus	47.67 CDEF	55.33 ABCD	57.67 ABC	50.00 ABCDEF	49.00 BCDEF	46.53 BC
	chlorella vulgaris	48.33 CDEF	48.00 CDEF	55.67 ABCD	48.67 CDEF	47.00 CDEF	54.80 A
	Ankistrodesmus falacatus	47.33 CDEF	55.33 ABCD	46.00 CDEF	39.00 FGH	27.67 H	39.87 D
Mean (B)		52.33 A	49.11 A	50.89 A	42.83 B	42.56 B	
LSD at level 5%			A 5.863	B 5.352	AxB 13.11		

Data presented in Table (4) show the main effect of biofertilizer types and plants number of flowers was enhanced (54) when plants were treated with *chlorella vulgaris* algae as biofertilizer. Data of the main effect of biofertilizer doses showed that, the high dose of biofertilizer was maximized number of flowers with low significant difference at Treat by 100% N.fertilizer (mineral fertilizer) (52.33). The interaction recorded that *jania rubens* algae at high dose gave the higher values of plants dry weight (63) when compared with mineral fertilization and all other algae doses with 75% dose fertilizer.

fresh weight

Table (5) Effect of Algae treatment and nitrogen fertilizer on fresh weight of *Nigella Sativa* 60 day from sowing .

N-Fertilizer / Algae strains		100%	75%	50%	25%	0%	Mean (A)
Marine	*Jania rubens*	32.67 FGH	48.00 AB	45.67 BC	29.33 I	31.33 HI	38.07 B
	laurencia microcladi	31.67 GHI	47.00 AB	18.33 K	20.33 K	25.67 J	41.40 A
	ulva lactuca	48.67 A	31.67 GHI	30.33 HI	30.33 HI	30.67 HI	31.93 C
River	Scenedsmus	40.33 D	31.33 HI	24.33 J	34.00 FG	29.33 I	27.33 D
	chlorella vulgaris	37.00 E	34.00 FG	47.00 AB	34.67 EF	41.33 D	37.40 B
	Ankistrodesmus falacatus	46.67 ABC	44.33 C	32.33 FGH	29.33 I	30.33 HI	31.47 C
Mean (B)		32.61 D	38.28 A	36.94 B	30.33 E	34.83 C	
LSD at level 5%			A 1.162	B 1.061	AxB 2.598		

Data presented in Table (5) show effect of biofertilizer types and types on fresh weight, data shows positive effects; fresh weight was enhanced (41.4 g) when plants were treated with *laurencia microcladia* algae. Also, data of the main effect of biofertilizer dose shows that high dose of biofertilizer (T2) was maximized fresh weight (38.28 g) compared with mineral fertilizer (T4). The interaction between biofertilizer types and doses revealed that *ulva lactuca* and *jania rubens* at high dose recorded the higher fresh weight (48.67 and 48.00 g for each) respectively .

dry weight

Table (6) Effect of Algae treatment and nitrogen fertilizer on dry weight of *Nigella Sativa* after 60 day from sowing .

N-Fertilizer / Algae strains		100%	75%	50%	25%	0%	Mean (A)
Marine	*Jania rubens*	21.33 DE	26.67 A	22.67 C	15.00 JK	15.33 IJ	21.13 B
	laurencia microcladi	20.67 E	24.00 B	9.000 M	10.00 M	13.00 L	21.80 A
	ulva lactuca	24.67 B	16.33 GHI	15.00 JK	15.33 IJ	15.00 JK	15.93 D
River	Scenedsmus	20.67 E	15.67 HIJ	10.00 M	16.67 GH	14.00 KL	13.27 E
	chlorella vulgaris	18.33 F	18.33 F	24.00 B	17.00 G	21.00 DE	18.80 C
	Ankistrodesmus falacatus	24.33 B	22.00 CD	16.33 GHI	15.33 IJ	14.67 JK	15.53 D
Mean (B)		17.00 C	20.33 A	18.44 B	15.56 D	17.39 C	
LSD at level 5%			A 0.5582	B 0.5096	AxB 1.248		

Data presented in Table (6) show effect of biofertilizer types and plants dry weight was enhanced (21.8 and 21.13 g) when plants were treated with *laurencia microcladia* or *jania rubens* algae as biofertilizer. Data of the main effect of biofertilizer doses showed that, the high dose of biofertilizer was maximized dry weight with low significant difference at T2 (mineral fertilizer) (20.33 g). The interaction recorded that *jania rubens* algae at high dose gave the higher values of plants dry weight (26.67 g) when compared with mineral fertilization and all other algae doses.

fixed oil

Table (7) shows retaliation between algae and fixed oil

N-Fertilizer / Algae strains		**100%**	**75%**	**50%**	**25%**	**0%**	**Mean (A)**
Marine	*Jania rubens*	25.00 FG	28.67 D	29.00 D	29.00 D	24.33 FGH	25.56 C
	laurencia microcladi	28.67 D	31.00 C	28.67 D	28.67 D	23.00 HIJ	23.11 D
	ulva lactuca	23.67 GHI	24.67 FG	26.67 E	24.67 FG	22.00 JK	26.56 B
River	Scenedsmus	24.33 FGH	29.00 D	33.00 B	25.00 FG	25.33 EF	25.44 C
	chlorella vulgaris	23.00 HIJ	22.67 IJK	35.00 A	28.67 D	25.33 EF	27.22 B
	Ankistrodesmus falacatus	21.33 K	25.33 EF	24.67 FG	24.67 FG	25.00 FG	32.22 A
Mean (B)		24.95 C	27.86 A	26.38 B	25.95 C	24.38 B	
LSD at level 5%		A 0.9484	B 0.6209	AxB 1.643			

Data presented in Table (7) show effect of biofertilizer types and that plants exctract fixed oil was (32.22) when plants were treated with Ankistrodesmus falcatus algae as biofertilizer. Data of the main effect of biofertilizer doses showed that, the high dose of biofertilizer was maximized fixed oil with low significant difference at Treat by 75% (mineral fertilizer) (27.86). The interaction recorded that *jania rubens* and *Scenedesmus bijunga* algae at high dose gave the higher values of fixed oil (29.00) when compared with mineral fertilization was full and half all other algae doses.

volatile oil

Table (8) shows retaliation between algae and volatile oil

N-Fertilizer / Algae strains		**100%**	**75%**	**50%**	**25%**	**0%**	**Mean (A)**
Marine	*Jania rubens*	1.227 B	1.277 AB	1.280 AB	1.307 AB	1.287 AB	25.56 C
	laurencia microcladi	1.307 AB	1.343 A	1.347 A	1.310 AB	1.323 A	23.11 D
	ulva lactuca	1.310 AB	1.353 A	1.353 A	1.307 AB	1.297 AB	26.56 B
River	Scenedsmus	1.297 AB	1.317 A	1.310 AB	1.310 AB	1.287 AB	25.44 C
	chlorella vulgaris	1.300 AB	1.287 AB	1.317 A	1.307 AB	1.343 A	27.22 B
	Ankistrodesmus falacatus	1.307 AB	1.323 A	1.300 AB	1.310 AB	1.353 A	32.22 A
Mean (B)		24.95 C	1.298 A	1.305 A	1.347 A	1.297 AB	1.317 A
LSD at level 5%		A 0.9484	**A** 0.05161	**B** **0.03379**	**AxB** 0.08940		

Data presented in Table (8) show the effect of biofertilizer types and plants exctract volatile oil was (1.3) when plants were treated with Ankistrodesmus falcatus, *Scenedesmus bijunga and laurencia microcladia* algae as biofertilizer. Data of the main effect of biofertilizer doses showed that, the high dose of biofertilizer was maximized volatile oil with low significant difference at treat by 100% and 75 % N.fertilizer (mineral fertilizer) (1.3). The interaction recorded that *laurencia microcladia* and *Scenedesmus bijunga* algae at high dose gave the higher values of volatile oil (1.3) when compared with mineral fertilization was 75% and 50% all other algae doses.

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