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Improving Growth, Productivity and Oil Yield of *Nigella sativa*, L. Plants by Foliar Spraying with some Stimulants

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ABSTRACT

A field experiment was conducted during the two successive seasons of 2018/2019 and 2019/2020 at the experimental farm of Horticultural Research Station at Sides, Beni-Suef Governorate to improve the growth, productivity and seed oil yield of black cumin plants to foliar application with α-tochopherol (vitamin E), amino acids (Aminoactal) and moringa leaf extract (MLE). Obtained results revealed that the best vegetative growth criteria (Plant height, stem diameter, number of main branches and plant weight at harvest), yield parameters (number of capsules per plant, and seeds yield per plant and per fed.), oil determinations characters (volatile and fixed oil percentages and oil yield /plant and /fed.) and chemical properties such as photosynthetic pigments, herb percentages of N, P and K, free fatty acid contents, iodine and saponification values were obtained due to foliar spray of the high dose of moringa extract at 5 ml/ l then amino acids 2ml/ l and α-tochopherol (vitamin E) at 100 ppm and with no significant differences being detected between such three concentration of the stimulants treatments. There for, it could be recommended that spraying *Nigella sativa* L. plants with the high concentration of moringa leaf extract (5 ml/ l) to enhance growth, seeds yield / plant and /feddan and fixed oil components under the same environmental conditions.

Keywords: Black cumin, Moringa leaf extract (MLE), α-tochopherol (Vitamin E), Amino acids, Volatile and fixed oil

INTRODUCTION

The black cumin (*Nigella sativa* L.) which belongs to family Ranunculaceae is a native herbaceous plant in the Mediterranean region and is one of the most valuable plants containing both volatile and fixed oil (Leung and Foster, 1996 and Burits and Bucar, 2000). In folk medicine, its seeds have been commonly used to treat a range of diseases, including diarrhea, jaundice, amenorrhea, helminthiasis, ophthalmia, paralysis and asthma. Black cumin seeds have a fixed oil rich in linoleic, oleic and palmitic acids (Al-Jassir, 1992 and Takruri and Dameh, 1998).

Moringa oleifera is a tree that can be called a miracle tree and is very useful. It has a strong role in various purposes, such as food, medicine and even in the industry (Moyo *et al.*, 2011). Moringa leaf extract (MLE) is known as a natural plant stimulant that, when applied as a foliar spray, improves yield. The active ingredients for promoting growth in MLE are stated to be zeatin, dihydrozeatin and isopentyladenine (Andrews, 2006 and Price, 2007). Leaves of moringa which collected from all over the world and discovered to have high zeatin concentrations of 5 to 200 µg/g of leaves (Fuglie, 2000). *Moringa oleifera* has also drawn immense attention because its leaves contain antioxidants such as ascorbic acid, flavonoids, phenolics, carotenoids, amino acids, macro and micro nutrients (Foidl *et al.*, 2001 and Yasmeen, 2011).

Amino acids are considered as precursors of proteins, which are vital for stimulating the growth of cells. They have a number of functions in plants, including regulatory and signaling molecules. Also, influence gene expression, redox homeostasis and the synthesis and activity of certain enzymes. Glycine and glutamic acids are essential for the development of vegetative growth and chlorophyll contents. They also chelate micronutrients, making them easier for plants to absorb and transport (Rai, 2002).

Vitamins are bio-regulator compounds that have profound effects on plant growth controlling factors that control many physiological processes, such as enzyme synthesis, function as co-enzymes and affect plant growth at relatively low concentrations (Abdel Aziz *et al.*, 2009). Tocopherols are a class of compounds generated exclusively by photosynthetic organisms that are concerned in the quenching and scavenging of oxygen (Neely *et al.*, 1988) and serve as extremely effective recyclable chain reaction terminators for the removal of polyunsaturated fatty acid (PUFA) radical species produced during lipid peroxidation (Munne-Bosch and Falk, 2004).

The aim of this study to investigate the response of *Nigella sativa* L. plants to foliar application of MLE, amino acids and α-tochopherol (vitamin E).

MATERIALS AND METHODS

The present study was conducted in the experimental farm of the Horticultural Research Station at Sides, Beni-Suef Governorate, over two successive seasons of 2018/2019 and 2019/2020. Prior to land preparation, several soil samples (0-40 cm depth) were taken for nutrient and trace element analysis (Table, 1) according to, Jackson, 1973.

The black cumin seeds were sown on the third week of October in both seasons in 3 X 3.60 m plots with 60 cm distance between the rows and 30 cm between hills within each row. So, each plot contained 6 rows and 60 hills. The plants were thinned to two plants per hill after one month of sowing. In addition, all experimental plots, including control, received 20 Kg/ plot of farm

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yard manure (FYM) before sowing date and all other agricultural practices were followed as usual. FYM was received from Sides Research Station belonging to Animal Production Research Institute (APRI), ARC, Egypt. Table (2), clearly show that some chemical properties of the used FYM at the both seasons, were determined according the method described by A.O.A.C., (1995).

Complete randomized block design (CRD) was also used in this investigation. The foliar sprayed for all treatments were done three times, the first sprayed was applied after 45 days from sowing date and repeated two times at 15 days intervals through the both growing season .The plants were harvested in the third week of April in both seasons.

Preperation of MLE

100 g of young fresh moringa leaves were collected and combined with 1 litre of distilled water to prepare an aqueous extract. A household blender was used to homogenies the suspension for 15 minutes. The solution was then filtered by squeezing with a mutton cloth. Finally, using No. 2 Whatman filter paper, the solution were re-filtered (Fuglie, 2000). Plants were sprayed directly with the extract. The extract was sprayed within 5 hours of the collection and extraction process (if not ready for use, the prepared extract was stored at 0.0 ° C, it is only taken out when it is needed for use) Abdel-Rahman and Abdel-Kader (2020).

Table 1. Chemical and physical properties of the experimental soil at 2018 and 2019.

Seasons	Particle size distribution*			Textural Class	Chemical properties**								pH
	Clay %	Silt %	Sand %		OM %	EC, dSm^{-1} (at 25°C)	Available (ppm) N	P	K	Fe	Zn	Mn	
2018/2019	49.80	33.20	17.00	Clay	1.75	1.12	41.00	14.18	260.5	2.40	0.25	0.60	7.7
2019/2020	48.10	33.60	18.30	Clay	1.60	1.03	38.00	12.60	244.6	2.25	0.30	0.65	7.8

Table 2. Chemical properties of the used FYM (2018 and 2019).

Parameter	Total N (%)	Total P (%)	Total K (%)	Organic matter (%)	Organic carbon (%)	C/N ratio	pH (1: 10 soil water suspension)	EC, dSm^{-1} (1:10 soil water extraction)
2018	1.42	0.31	1.05	45.22	26.23	1:18	7.82	4.75
2019	1.46	0.29	1.11	47.31	27.44	1.19	7.90	4.83

Amino acids source

The commercial product "Aminoactal" was used that contains the following amino acids mixture (Methionine, Cysteine and Treptophan) which was obtained from Shoura Chemical Company, Cairo-Alexandria Desert Road, Giza Governorate.

Recorded data

A- Vegetative growth criteria

Plant height, stem diameter, main branch number/ plant and plant weight at harvest.

B- Yield components

Number of capsules per plant, seeds yield per plant and per feddan (calculated as plot yield × plots number).

C- Oil productivity

Volatile oil percentage and yield/feddan, according to (Guenther, 1961), fixed oil percentage and yield/feddan, according to (Lo´ pez-Basco´ and de Castro, 2020).

D- Chemical properties

The three photosynthetic pigments were determined according to Moran (1982), N, P and K percentages were determined according to Wilde *et al.* (1985), Chapman and Pratt (1975) and Cottenie *et al.* (1982), respectively, the free fatty acid (FFAs), iodine value (IVs) and saponification value (SVs) of black cumin seed oil were measured as general indicator of the oil's condition and edibility, according to A.O.A.C. (1990).

The data were statistically analyzed using the MSTAT-C (1985). the differences between means were tested using the least significant differences (L.S.D) test at 0.05.

RESULTS AND DISCUSSION

A- Vegetative growth criteria

Obtained results in Table (3) for plant height, stem diameter, main branch number/plant and plant weight at harvest of black cumin plants showed that all tested treatments, namely, α-tochopherol (50 and 100 ppm), amino acids (1 and 2 ml/l) and MLE (3 and 5 ml/l) caused a substantial and significant increase in the four tested vegetative characters in the two seasons, in comparison with untreated treatment. The highest overall values were given due to MLE at 5 ml/l followed by amino acids at 2 ml/l then α-tochopherol at 100 ppm, in the two growing seasons, in most cases. The increase in plant height, stem diameter, branch number/plant and plant weight at harvest due to MLE at 5 ml/l, in comparison with control treatment reached 36.65, 37.31, 39.29 and 51.38 % , respectively, in the first season and by 38.00, 37.68, 40.29 and 41.59 %, respectively, in the second one. The role of MLE in enhancing vegetative growth characters was demonstrated by Mostafa (2015) on fennel, Ali *et al.* (2018) on geranium, meanwhile, The importance of amino acids was highlighted by Zedan (2000) on Coriander and Caraway plants and Gamal El-Din *et al.* (2005) on chamomile plant. Vitamins also increased the height and diameter of coriander plants' stems, as defined by Abdou *et al.* (2015).

Table 3. Effect of the three stimulants treatments on some vegetative growth criteria of black cumin plants during 2018/2019 and 2019/2020.

characters	Plant height (cm)		Stem diameter (cm)		Branch number per plant		Plant weight at harvest (g)	
Seasons / Treatments	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control (water)	41.2	40.0	0.67	0.69	5.60	6.13	26.47	26.93
Vitamin E 50 ppm	46.5	45.6	0.78	0.81	6.20	7.20	31.93	31.07
Vitamin E 100 ppm	50.6	51.0	0.88	0.91	7.27	8.03	37.53	36.20
Amino acids 1 ml/l	48.6	48.9	0.84	0.87	6.87	7.63	35.47	33.80
Amino acids 2 ml/l	54.2	51.4	0.89	0.93	7.33	8.20	39.73	37.40
MLE 3 ml/l	54.5	52.3	0.86	0.88	6.80	7.73	37.00	36.07
MLE 5 ml/l	56.3	55.2	0.92	0.95	7.80	8.60	40.07	38.13
L.S.D 5%	3.7	4.0	0.07	0.04	0.75	0.94	2.39	1.93

These results may be explained by a high level of endogenous cytokinin (zeatin, dihydrozeatin, and isopentyladenine) in MLE (Fuglie, 2000, Andrews, 2006 and Price, 2007). Zeatin is a type of cytokinin naturally found in plants, and its role is not only necessary in cell division and elongation which stimulates plant growth, but it also has defensive properties on plants (Nagar *et al.*, 2006 and Anwar *et al.*, 2007). Moringa leaf extract is also high in Ca, P, Mg, Fe, Zn, Mn. It also contains other growth-promoting compounds, making it a natural plant growth pormoter (Makkar *et al.*, 2007, Jacob and Shenbagaraman, 2011 and Abd El-Hamied and El-Amary, 2015). Tao *et al.* (2008) observed an increase in plant growth criteria after amino acid application as a consequence of synthesis of protein. Amino acids are precursors of phytohormones and growth factors (El-Awadi and Hassan, 2010). The beneficial effect of α-tochopherol may be due to induced improvements in growth characteristics such as better water capacity, high antioxidant accumulation, less oxidative harm, and improved cross-talk among different growth regulators (Soltani *et al.*, 2012).

B- Yield components

Table (4) showed that there were statistically significant differences, in both seasons, between the control treatment on the one hand and the other treatments examined (α-tochopherol, amino acids and MLE) except for the α-tochopherol (50 ppm) treatment, for seeds yield per plant. Among the six tested treatments, the three treatments of MLE at 5 ml/l, amino acids at 2 ml/l and α-tochopherol at 100 ppm resulted in the best values for number of capsules / plant, seeds yield / plant and / feddan without significant differences being obtained between them, except for seeds yield/fed. for second season. They increased the number of capsules per plant of black cumin plants, in comparison with check treatment, by 36.76%, 24.66% and 23.65%, respectively, in the first season and by 39.65%, 30.80% and 29.75%, respectively, in the second season. Numerically, the rise in seeds yield / plant and / fed. reached 38.15, 31.11 and 25.07 % for seeds yield / plant and by 37.90, 32.59 and 30.98 % for seeds yield / fed. in the first season, respectively, over that check treatment. The corresponding values in the second season were obtained for the same treatments, for seeds yield / plant 44.27, 33.36 and 29.73 % and by 44.74, 37.59 and 36.33 % for seeds yield / fed., respectively.

C- Oil productivity

Oil productivity of black cumin plants were greatly and significantly increased due to the use of six tested treatments, the only exceptional for vitamin E (50 ppm) for volatile and fixed oil percentages compared to control treatments in both experimental seasons as shown in Table (5). The highest volatile and fixed oil percentages among these five treatments was obtained from MLE at 5 ml/l treatment, followed by amino acids at 2 ml/l treatment, then, α-tochopherol (100 ppm) treatment which increased volatile oil percentage over check treatment by 31.71, 25.61 and 23.17 %, respectively, in the first season and by 25.88, 24.71 and 21.18 %, respectively, in the second one, while, the increments of fixed oil percentage of seeds due to these three treatments over control treatment reached 18.44, 18.01 and 12.32 %, respectively, in the first season and by 17.09, 14.43 and 11.76 % respectively, in the second one. Numerically, the rise in volatile and fixed oil yield / feddan for these three treatments was 73.31, 59.55 and 58.71 % for volatile oil and by 71.76, 59.88 and 55.52 % for fixed oil in the first season, respectively, over the control treatment. The corresponding values, for the same treatments in the second season came to 61.86, 50.52 and 48.45 % for volatile oil and by 70.73, 58.99 and 53.87 %, for fixed oil, respectively, as shown in Table (5). In accordance with the results which explored the capability of MLE, amino acids and vitamin E in promoting yield components and oil productivity of different plant species were the findings by Abdou *et al.* (2015) on coriander, Abdel-Rahman and Abdel-Kader (2020) on fennel and Poorghadir *et al.* (2020) on savory.

Table 4. Effect of the three stimulants treatments on yield components of black cumin plants during 2018/2019 and 2019/2020.

characters	Number of capsules per plant		Seeds yield per plant (g)		Seeds yield per feddan (Kg)	
Seasons / Treatments	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control (water)	26.93	24.87	10.93	11.00	442.97	438.50
Vitamin E 50 ppm	32.40	29.40	12.17	12.63	520.13	520.67
Vitamin E 100 ppm	33.30	32.27	13.67	14.27	580.20	597.83
Amino acids 1 ml/l	31.47	28.93	12.87	13.40	542.73	548.10
Amino acids 2 ml/l	33.57	32.53	14.33	14.67	587.33	603.33
MLE 3 ml/l	32.70	30.33	13.73	14.00	541.53	560.13
MLE 5 ml/l	36.83	34.73	15.10	15.87	610.87	634.67
L.S.D 5%	4.14	2.84	2.03	1.68	65.36	40.64

Table 5. Effect of the three stimulants treatments on oil productivity of black cumin plants during 2018/2019 and 2019/2020.

characters	Volatile oil % of seeds		Volatile oil yield L. per feddan		Fixed oil % of seeds.		fixed oil yield L. per feddan	
Seasons / Treatments	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control (water)	0.82	0.85	3.56	3.88	28.09	28.49	98.70	103.17
Vitamin E 50 ppm	0.89	0.91	4.32	4.68	29.34	29.86	133.13	136.57
Vitamin E 100 ppm	1.01	1.03	5.65	5.76	31.55	31.84	153.50	158.75
Amino acids 1 ml/l	0.97	0.94	4.79	4.87	31.08	31.29	134.65	136.87
Amino acids 2 ml/l	1.03	1.06	5.68	5.84	33.15	32.60	157.80	164.03
MLE 3 ml/l	0.99	1.01	5.33	5.48	31.09	31.72	150.92	162.13
MLE 5 ml/l	1.08	1.07	6.17	6.28	33.27	33.36	169.53	182.33
L.S.D 5%	0.08	0.05	0.54	0.60	2.51	1.97	24.67	28.29

MLE improves crop yield mainly due to the presence of zeatin and other hormones and also a variety of active compounds (Duke, 1992). When zeatin-related hormone is applied as an extract from fresh ML, it enhances crop yields, according to Fuglie (2000). Furthermore, the simulative impact of such treatments on enhancing characteristics of seeds, essential and fixed oil percentages and oil yield may be due to their improving impact on vegetative growth criteria and plant chemical properties for example, NPK in black cumin plants, which can affect seeds and oil yield. The influence of amino acids may be attributed to their functions in improving a variety of physiological processes, such as nutrient absorption by roots and metabolism in treated plants (Hanafy *et al.*, 2010). Also, their role in changes in levels and/or enzymes involved. Furthermore, micronutrients, especially iron and Zinc, serve as metal components of a variety of enzymes as well as functional, structural, and regulatory cofactors. Sadak *et al.* (2010) on sunflower and Soltani *et al.* (2012) on calendula plants stated that foliar spray of α-tochopherol (vitamin E) led to increase seed yield. The impact of vitamins on protein synthesis and delaying senescence is primarily responsible for the increment in black cumin seed yield as a result to foliar application of vitamin E, but it could also be linked to an improve in photosynthetic products.

D- Chemical properties

Photosynthetic pigments

The response of photosynthetic pigment content to various concentrations of MLE, amino acids, and α-tochopherol, as shown in Table (6), indicates that these treatments were found to be positively affected compared to the check treatment in both growing seasons. The exceptional were the treatments of α-tochopherol at 50 ppm for the three photosynthetic pigments and amino acids at 1 ml/l for carotenoids content in the two growing seasons. The highest contents of photosynthetic pigments were obtained from the following treatments in descending order, MLE at 5 ml/l followed by the amino acids at 2 ml/l then the α-tochopherol at 100 ppm. These three treatments increased the photosynthetic pigments over those of control plants by 14.87, 10.94 and 9.40 % in the first season and by 14.31, 10.52 and 9.86 % in the second one, respectively, for chlorophyll a, and by 19.42, 17.63 and 16.29 % in the first season and 19.16, 18.28 and 17.40 % in the second one, successively, for chlorophyll b, while for carotenoids, by 10.31, 7.80 and 6.48 % in the first season and 9.27, 7.84 and 6.70 % in the second one, consecutively. These results of this study back up the findings of the other studies such as Aslam *et al.* (2016) on spinach and Abdou *et al.* (2018) on gladiolus.

Table 6. Effect of the three stimulants treatments on photosynthetic pigments of black cumin plants during 2018/2019 and 2019/2020.

characters	Chlorophyll (a) content (mg / g F.W)		Chlorophyll (b) content (mg / g F.W)		Carotenoids content (mg / g F.W)	
Seasons / Treatments	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control (water)	1.042	1.055	0.448	0.454	0.679	0.701
Vitamin E 50 ppm	1.101	1.112	0.485	0.499	0.685	0.715
Vitamin E 100 ppm	1.140	1.159	0.521	0.533	0.723	0.748
Amino acids 1 ml/l	1.126	1.138	0.495	0.525	0.705	0.725
Amino acids 2 ml/l	1.156	1.166	0.527	0.537	0.732	0.756
MLE 3 ml/l	1.135	1.150	0.518	0.522	0.715	0.744
MLE 5 ml/l	1.197	1.206	0.535	0.541	0.749	0.766
L.S.D 5%	0.082	0.059	0.044	0.051	0.032	0.027

The existence of significant quantities of chlorophyll and carotenoids in moringa leaf extract could explain its positive impact on photosynthetic pigments (Ashfaq *et al.*, 2012). Moringa leaves also contain a variety of components, including Mg (Yameogo *et al.*, 2011), a chlorophyll component, as well as cytokinins, which play an important role in biosynthesis of chlorophyll (Taiz and Zeiger, 2010) therefore, the quantity of photosynthetic pigments in black cumin herb were increased.

The beneficial effect of amino acids on chlorophylls content of black cumin plants can be explained simply because of their crucial function in chlorophyll biosynthesis. Saburi *et al.* (2014) found that foliar tryptophan application resulted in an increase in total chlorophyll and carotenoids in basil plants. This stimulatory influence of α-tochopherol could be attributed to their antioxidantal scrounging impact, which preserved chloroplasts and inhibited chlorophyll deterioration by toxic reactive oxidative damage (Bowler *et al.*, 1992 and Aono *et al.*, 1993).

N, P and K percentages

The percentages of N, P and K in the dry herb of black cumin plants was significantly affected by different treatments (MLE, amino acids, and α-tochopherol at 100 ppm) in both seasons, according to data provided in Table (7). Plants treated with the two concentrations of MLE yielded the highest percentages of the three elements over those of the control treatment by 27.90 and 21.45 % in the first season and by 29.92 and 25.34 % in the second one, respectively for N % and by 20.62 and 17.90 % in the first season and 16.73 and 14.87 % in the second one, successively for P %, as well as, by 6.63 and 5.72 % in the first season and by 12.68 and 10.13 % in the second one, respectively for K %. The above-mentioned findings on the benefits of vitamin E, amino acids and MLE on N, P and K % in the black cumin herb were on line with those of Mady (2009) on tomato, Abd-Elkader *et al.* (2020) on gerbera and Abdel-Rahman and Abdel-Kader (2020) on fennel, respectively.

The presence of amino acids, P, Ca, Fe, vitamin E, ascorbates, phenolic compounds and growth regulating hormones like zeatin in MLE can explain the increase in the three photosynthetic pigments and the NPK (Siddhuraju and Becker, 2003 and Nagar *et al.*, 2006). Moringa leaf extract contains Ca and P, which may play a vital role in crop growth and development through osmoregulation, enzyme activation, photosynthesis and different physiological processes (Hasegawa *et al.*, 2000 and Epstein and Bloom, 2005). The amino acids may have had a beneficial effect because of their essential function in the chlorophyll molecules biosynthesis, which reflected NPK percentages. Furthermore, antioxidants like vitamin E protected cell membranes and their binding transporter proteins (H+-ATP-ase membrane pumps), preserving their structure and function against the toxic and destructive effects of reactive oxygen species during stress, resulting in increased mineral absorption and translocation (Dicknson *et al.*, 1991).

Free fatty acid, iodine value and saponification value

The results for free fatty acid contents, iodine value and saponification value as shown in Figure (1), were ranked in order of transactions (amino acids, α-tochopherol, MLE and control) in descending order of transactions. FFAs were 14.25, 13.75, 13.25 and 12.25, respectively., IVs were (102, 109, 110 and 113 g I2/100 g oil), successively, and for SVs were (206.25, 205.5, 205.25 and 197), consecutively.

Table 7. Effect of the three stimulants treatments on NPK percentages of black cumin plants during 2018/2019 and 2019/2020.

characters	Nitrogen%		Phosphorus%		Potassium%	
Seasons / Treatments	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control (water)	1.147	1.093	0.257	0.269	1.977	2.003
Vitamin E 50 ppm	1.220	1.207	0.284	0.292	2.010	2.077
Vitamin E 100 ppm	1.283	1.297	0.293	0.304	2.070	2.186
Amino acids 1 ml/l	1.237	1.280	0.279	0.293	1.996	2.067
Amino acids 2 ml/l	1.371	1.349	0.297	0.308	2.073	2.198
Moringa ex. 3 ml/l	1.393	1.370	0.303	0.309	2.090	2.206
Moringa ex. 5 ml/l	1.467	1.420	0.310	0.314	2.108	2.257
L.S.D 5%	0.119	0.131	0.019	0.017	0.055	0.087

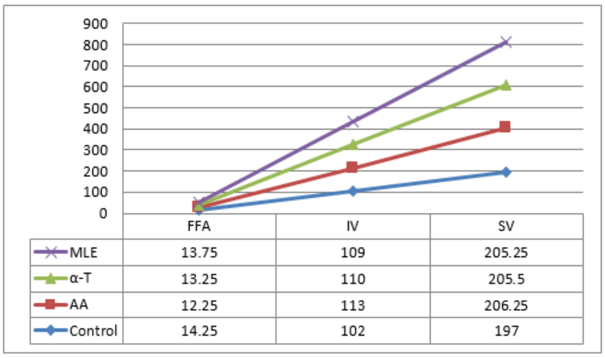

Figure 1. Effects of treatments on free fatty acid, iodine value and saponification value of *Nigella sativa* seed oil

*** (AA) Amino Acid, (α-T) α-Tocopherol, (MLE) Moringa Leaf Extract, (FFA) Free Fatty Acids,(IV) Iodine Value and (SV) Saponification Value.**

CONCLUSION

The important consideration of this study is the use environmental stimulants to improving the seed yield and fixed oil quality of the black cumin plants. Under the environmental conditions of same study, the highest value of the growth characters, seed yield and fixed oil of *Nigella sativa* plants, were obtained due to foliar spray of moringa leaf extract (MLE), amino acids and α-tochopherol at high concentration use.

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تحسين النمو والانتاجية ومحصول الزيت لنباتات حبة البركة بالرش الورقي ببعض المنشطات

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أجريت تجربة حقلية خلال الموسمين المتعاقبين 2019/2018 و 2020/2019 بالمزرعة البحثية بمحطة بحوث بساتين سدس بمحافظة بني سويف، بهدف تحسين النمو والانتاجية وكذلك محصول الزيت من خلال الرش الورقي بفيتامين هـ والأحماض الأمينية ومستخلص اوراق المورينجا. أوضحت النتائج أن أفضل صفات النمو الخضري (طول النبات وقطر الساق وعدد الأفرع الرئيسية ووزن النبات عند الحصاد)، والصفات المحصولية (عدد الكبسولات للنبات ومحصول البذور للنبات والفدان)، انتاجية الزيت (النسبة المئوية للزيت العطري والثابت ومحصول الزيت العطرى والثابت للفدان) ، وكذلك الخصائص الكيميائية مثل صبغات التمثيل الضوئي والنسبة المئوية للنيتروجين والفوسفور والبوتاسيوم والاحماض الدهنية الحرة والرقم اليودي ورقم التصبن للزيت الثابت وذلك نتيجة الرش الورقي بالتركيزات الاعلى من مستخلص اوراق المورينجا (5 مل/ لتر) يليها الأحماض الأمينية (2 مل/ لتر) ثم فيتامين ه بمعدل 100 جزء في المليون، مع عدم وجود فروق معنوية في اغلب الصفات بين هذه المعاملات الثلاثة. لذلك يمكن التوصية برش نباتات حبة البركة بالتركيز الاعلى من مستخلص أوراق المورينجا بمعدل 5 مل/ لتر لتحسين صفات النمو وإنتاجية الفدان من البذور ومحصول الزيت الطيار والثابت تحت نفس الظروف البيئية المماثلة.

الكلمات المفتاحية: حبة البركة ، مستخلص أوراق المورينجا ، فيتامين هـ ، الأحماض الأمينية، الزيت العطرى والزيت الثابت