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Influence of Chemical Fertilization and Amino Acids Mixture on *Ocimum basilicum* L. Plants Grown in Sandy Soils

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Abstract: A field experiment on sweet basil (*Ocimum basilicum* L.) was carried out at the sandy soil of Ismailia Agricultural Research Station during two successive seasons (2018 and 2019) to study the influence of foliar application of amino acids mixture at 3.33, 6.67 and 10 ml/liter in reducing the recommended NPK doses. And on vegetative growth, herb and essential oil yields and oil components as well as the chemical analysis of dry herb. The obtained results revealed that the foliar application of amino acids mixture had a positive effect on reducing NPK fertilizers doses and improved vegetative growth and yields components of sweet basil. Foliar spraying of amino acids mixture at 10ml/L with 75% of the recommended NPK dose significantly improved the vegetative growth characters, herb and essential oil yield per plant and feddan as well as N, P, K, total protein and free amino acids percentages in sweet basil herb compared to full recommended NPK dose (control). Moreover, spraying amino acids mixture at 10 ml/L with 50% of NPK dose gave results similar to full NPK dose. Therefore, reducing the amount and saving up to 25-50% of chemical fertilizers as well as reducing environmental risks.

Key words: *Ocimum basilicum* · NPK fertilization · Amino acids · Essential oil · Total protein · Free amino acids

INTRODUCTION

Medicinal and aromatic plants have a major role in agriculture and industry, as they are the main source of safe drugs and raw materials for the pharmaceutical and cosmetic industries. *Ocimum basilicum* is one of the major plants in this respect. *Ocimum basilicum* L. (sweet basil) is a perennial herb, but in Egypt grow as an annual herb that belongs to the Lamiaceae family and grows in several regions all over the world. The plant is widely used in food and oral care products. The essential oil of the plant also used in perfumery [1]. Various parts of basil plant have been widely used in traditional medicine; basil tea is good for treating nausea, flatulence and dysentery, leaves and flowering tops are used as carminative, galactogogue, stomachic and antispasmodic as well as a tonic and vermifuge [2, 3]. Extracts of basil herb have many properties, including antioxidant activity, immunomodulatory effects, antimicrobial properties and decreases cholesterol synthesis and lipid accumulation [4, 5].

Fertilization has an important role in growth, flowering, fruits, seeds and oil yields as well as biochemical constituents of plants. In this concern, Kandil *et al.* [6] recorded that increasing NPK rates increased the growth, herb yield and oil yield of *Ocimum basilicum*. Sifola and Barbieri [7] and Golcz *et al.* [8] found that increased nitrogen fertilization contributed to an increase in fresh herb yield and essential oil yield in basil. Hammam [9] on Senna (*Cassia acutifolia*) found that all NPK treatments increased plant height, fresh and dry weights per plant and per feddan compared with control. Moreover, Khater and Abd El-Azim [10] revealed that the NPK treatments recorded a significant effect on plant height, number of branches/plant, fresh and dry weights/plant as well as total proteins content in *Plantago psyllium* plant in comparison with control. Inorganic fertilization, though enhance productivity

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but adversely affect the environment and human health. So, an alternative approach is necessary for enhancing sweet basil production without causing substantial damage to the ecosystem, accordingly, amino acids were used.

Amino acids help plants to fight stress and to better utilizing of fertilizers and existing nutrients from the soil. Amino acids are a great source of organic nitrogen, can serve as a source of carbon and energy, as well as protect the plants against pathogens. Moreover, in the synthesis of other organic compounds, such as protein, amines, purines and pyrimidines, alkaloids, vitamins, enzymes, terpenoids, auxin and others [11]. All plants synthesis their own amino acids during their growth and development, but this synthesis is highly energy consuming, thus, the application of amino acids allows plants to save energy and increase their development or reconstruction, especially when applied in critical times of plant development [12-14]. Tryptophan has an indirect role in the growth via its influence on auxin synthesis [15]. Regarding the effect of amino acids application, Reham *et al*. [16] showed the positive effect of foliar application with Phenylalanine on growth, yield and essential oil components of genovese basil plant (*Ocimum basilicum* L. var. Genovese). Likewise, Mandour *et al.* [17] reported that foliar spray of amino acids at 10m/l on strawberry under sandy soil conditions significantly increased vegetative growth parameters and yield components. Foliar spray of amino acids on sweet pepper (*Capsicum annuum* L.) gave a significant increase in plant height, number of branches and the percentage of dry matter of shoots [18]. All vegetative growth parameters and leaf NPK contents of two longiflorum-asiatic lily (L.A) hybrids were significantly affected by amino acid mixture treatments [19]. Foliar application of tyrosine, thiamine and tryptophan promoted all morphological characters and increased total free amino acid, essential oil %, essential oil yield as well as N, P, K and protein % of *Thuja orientalis* seedlings [20]. Moreover, Ghazal [21] and EL-Zefzafy *et al.* [22] recorded that foliar application of phenylalanine and tryptophan on *Thymus vulgaris* L. and *Artemisia abrotanum* plants, respectively, significantly promoted plant height, a number of branches, fresh and dry biomass, essential oil content and yield, as well as resulted in improving quantity and quality of essential oil components. Furthermore, foliar application of amino acids (tyrosine and phenylalanine) significantly promoted the growth parameters of *Ammi visnaga* and led to significant increments in seed yield and essential oil content and resulted in qualitative differences in oil components [23]. In addition, Al-Mayahy [24] showed that amino acid glycine significantly increased the characteristics of vegetative growth and significantly increased leaf N, P, K content in green faba bean. Kinetin spray increased the fresh and dry yield of rocket (*Eruca vesicaria* subsp. sativa) leaves as well as N, K and total free amino acids [25].

The objective of the present study was to investigate the various effects of foliar spraying of amino acids mixture in reducing doses of NPK fertilizers, on the vegetative growth, yield components of herb and essential oil as well as the content of N, P, K, total protein and total free amino acids in dry herb of sweet basil plant.

MATERIALS AND METHODS

A field experiments were carried out at the experimental farm of Ismailia Agricultural Research Station, Ismailia Governorate, Egypt, during two successive seasons 2018 and 2019. Sweet basil (*Ocimum basilicum* L.) seeds were obtained from Medicinal and Aromatic Plants Research Department, Horticulture Research Institute, Agricultural Research Center, Egypt. Seeds were sown in a nursery until the seedlings lengths were about 15 cm and then transplanted in the experimental area on 1st April in both seasons. The plot area was 12 m^2 (3x4 m) with 4 rows, 60 cm apart and 25 cm between seedlings within the row (64 plant /plot).

Experimental Soil Properties: The experimental soil was sandy and its physical and chemical properties are shown in Table A.

Amino Acids Mixture Source: Amino acids mixture contains a group of essential amino acids (Glycine, glutamine, lysine, proline, tryptophan and phenylalanine), was obtained from the Central Laboratory of Organic Agriculture, Agricultural Research Center (ARC), Giza, Egypt.

Experiment Design and Treatments: The experiment was conducted in a randomized complete blocks design with three replicates and was included seven treatments as follows:

Table A: Physical and chemical properties of the experimental soil

Physical properties:					
Sand %	Silt %	Clay %	Soil Texture	O.M %	$Ca\ Co_3$ %
90.4	1.8%	7.8	Sandy	0.38%	1.37
Chemical properties:					
pH	EC dSm^{-1}	Total N	Available N	Available P	Available K
7.90	0.79	0.25 g/kg	17 mg/kg	20 mg/kg	57 mg/kg

- 100% of the recommended dose of NPK fertilizers as a control.
- 75% of the recommended dose of NPK + amino acids mixture at 3.33 ml/L.
- 75% of the recommended dose of NPK + amino acids mixture at 6.67 ml/L.
- 75% of the recommended dose of NPK + amino acids mixture at 10 ml/L.
- 50% of the recommended dose of NPK + amino acids mixture at 3.33 ml/L.
- 50% of the recommended dose of NPK + amino acids mixture at 6.67 ml/L.
- 50% of the recommended dose of NPK + amino acids mixture at 10 ml/L.

The recommended doses of NPK fertilizers per feddan in the newly reclaimed soils according to the Ministry of Agriculture, Egypt were 600kg of ammonium sulfate (20.6% N), 400kg calcium super phosphate (15.5% P_2O_5) and 150kg potassium sulfate (48% K_2O) [26]. NPK fertilizers were added to the soil as follow: the full dose of calcium super phosphate was added with soil preparation for the growing. While ammonium sulfate and potassium sulfate fertilizers were divided to four equal doses and added on the root area, the first one was applied after month from transplanting and the other three doses were applied at one-month intervals.

The amino acids mixture treatments were 3.33, 6.67 and 10ml/L (0.5, 1 and 1.5 L/150L/fed.) and was sprayed on the herb six sprays during the growing season, the first one was applied after one month from transplanting and the other five sprays were applied at 15 days intervals. All plants received normal agricultural practices whenever they are needed.

Data Recorded:

Vegetative Growth Parameters and Herb Yield: Two cuts were taken; the first cut on 15th June and the second one on 30th July during both seasons and the vegetative growth parameters were recorded as follows: plant height (cm), number of branches per plant, fresh and dry weights per herb (g). Yield of dry herb per feddan (ton) calculated by multiplication of herb dry weight per plant (g) by plant number per feddan (28000 plant).

Chemical Analysis of Dry Herb: N, P, K and total free amino acids percentages were determined in the dry herb according to A.O.A.C. [27]. Total proteins percentage has been calculated by multiplication of nitrogen quantity with a conversion factor (6.25) according to A.O.A.C. [27].

Essential Oil Extraction and Oil Yield: The essential oil was extracted of the dry herb by hydro-distillation using a Clevenger type apparatus according to Guenther [28]. The essential oil percentage calculated based on herb dry weight and essential oil yield per plant (ml) calculated by multiplication of herb dry weight (g) by oil percentage as well as essential oil yield per feddan (liter) calculated by multiplication of essential oil yield per plant (ml) by plant number per feddan (28000 plant). The essential oil was dried with anhydrous sodium sulphate and subjected to gas chromatography analysis.

Gas Chromatography Analysis of the Essential Oil: The gas chromatography (GC) analysis of the essential oil samples was carried out in the Laboratory of Medicinal and Aromatic Plants Research Department, Horticulture Research Institute, ARC using Ds Chrom 6200 Gas Chromatograph apparatus, fitted with a capillary column BPX-5, 5 phenyl (equiv.) polysillphenylene-siloxane 30 x 0.25 mm ID x 0.25µ film. The temperature program varied in the range 70° -200° C, at a rate of 10° C/min. Flow rates of gases were nitrogen at 1 ml/min, hydrogen at 30 ml/min and 330 ml/min for air. Detector and injector temperatures were 300° C and 250° C respectively. The identification of the compounds was done by matching their retention times with those of authentic samples injected under the same conditions.

Statistical Analysis: The simple experiments were arranged at a randomized complete blocks design (RCBD) in three replicates and the collected data were computed and statistically analyzed with analysis of variance according to Mead *et al.* [29] using SPSS (Version 22) program and the differences between the means of treatments were tested by L.S.D test at 0.05 probability level.

Table 1: Influence of NPK fertilizers and amino acids mixture foliar application on plant height and branch number/ plant of sweet basil during 2018 and 2019 seasons

	Plant height (cm)				Number of branches/plant			
	First season		Second season		First season		Second season	
Treatments	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
100% NPK (control)	44.83	42.50	47.28	44.33	15.67	17.56	17.22	18.78
75% NPK + Amino acids 3.33 ml/L	44.78	41.33	46.07	43.56	14.88	16.89	16.89	18.11
75% NPK + Amino acids 6.67 ml/L	46.44	44.55	47.44	46.56	16.55	18.78	18.22	19.55
75% NPK + Amino acids 10 ml/L	47.78	46.00	50.00	48.33	18.33	20.22	19.00	21.00
50% NPK + Amino acids 3.33 ml/L	42.33	40.33	44.00	42.61	13.44	15.44	16.22	17.33
50% NPK + Amino acids 6.67 ml/L	43.78	42.11	46.11	43.96	14.55	16.11	17.33	18.44
50% NPK + Amino acids 10 ml/L	45.22	43.61	47.00	45.89	16.67	18.33	18.22	19.67
L.S.D. at 0.05	0.65	0.49	0.80	0.44	0.60	0.51	0.47	0.53

Table 2: Influence of NPK fertilizers and amino acids mixture foliar application on fresh, dry weights/ plant and herb yield/fed. of sweet basil during 2018 and 2019 seasons

	Fresh weight (g)/plant				Dry weight (g)/plant				Yield of dry herb (T/fed.)			
	First season		Second season		First season		Second season		First season		Second season	
Treatments	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
100% NPK (control)	217.99	231.56	225.72	239.34	56.05	60.01	60.10	61.98	1.57	1.68	1.68	1.74
75% NPK + Amino acids3.33ml/L	208.42	218.43	221.43	236.37	53.53	58.04	59.30	61.15	1.50	1.63	1.66	1.71
75% NPK + Amino acids6.67ml/L	224.03	245.50	246.50	251.07	57.95	61.20	61.81	63.80	1.62	1.71	1.73	1.79
75% NPK + Amino acids 10 ml/L	245.52	262.00	259.40	266.66	60.57	63.42	63.00	65.02	1.70	1.78	1.76	1.82
50% NPK + Amino acids3.33ml/L	201.50	210.98	213.86	225.94	52.44	57.21	58.25	59.53	1.47	1.60	1.63	1.67
50% NPK + Amino acids6.67ml/L	216.05	221.61	232.28	243.06	55.46	58.75	60.57	61.25	1.55	1.65	1.70	1.72
50% NPK + Amino acids 10 ml/L	224.60	238.27	249.30	259.94	58.14	60.70	61.86	62.51	1.63	1.70	1.73	1.75
L.S.D. at 0.05	3.22	3.92	2.53	1.92	0.43	0.65	0.47	0.44	0.01	0.02	0.01	0.01

RESULTS AND DISCUSSION

Influence of NPK Fertilizers and Amino Acids on Vegetative Growth and Herb Yield: From the data recorded in Tables (1 and 2), it can be concluded that the amino acids mixture had a significant effect on plant height, number of branches per plant, weights of sweet basil herb and herb yield/fed. Reducing NPK fertilizers up to 75% of recommended doses and spraying of amino acids mixture at 10 ml/L gave the highest values of these parameters in the 1st and 2nd cuts during the two growing seasons with significant differences compared with control or other treatments. In contrast, the minimum values of growth parameters and herb yield were obtained from plants received 50% recommended NPK doses plus spraying the lowest level of amino acids mixture (3.33ml/L) in the 1st and 2nd cuts during the two seasons. As well, 75% of NPK doses with spraying amino acids mixture at 6.67ml/L treatment resulted significant increases of all growth parameters and herb yield/fed. compared to control treatment. Moreover, 50% of NPK doses with spraying amino acids mixture at 10 ml/L treatment gave significant increases of number of branches, fresh and dry weights per herb and herb yield/fed. in the first and second cuts and plant height in the second cut compared to control during both seasons. Generally, all vegetative growth parameters and herb yield significantly were increased by increasing the NPK rate from 50 to 75% in the two seasons. These results are in line with these were reported by Reham *et al.* [16] on genovese basil, Mandour *et al.* [17] on strawberry plants and Marhoon and Abbas [18] on sweet pepper.

Such increase in sweet basil growth parameters and herb yield by using amino acids mixture could be attributed to the role of amino acids in help plants to save energy and increase the pace of their development or reconstruction and hence help plants to fight stress, better utilization of fertilizers and existing nutrients from the soil [12-14]. Therefore activating photosynthesis, protein synthesis, auxins and other metabolites in plant organs resulting more plant growth materials [11, 15].

Influence of NPK Fertilizers and Amino Acids on Essential Oil Percentage and Yield: As shown in Table (3), essential oil percentage in dry herb ranged from 0.57 to 1.00 % in the 1st cut and from 1.18 to 1.46 % in the 2nd one, during both seasons. In addition, plant yield of essential oil ranged from 0.30 to 0.63 ml in the 1st cut and from 0.68 to 0.95 ml in the 2nd one in the two seasons. Essential oil yield per fed. ranged from 8.40 to 17.73 liter in

Table 3: Influence of NPK fertilizers and amino acids mixture foliar application on essential oil percentage, essential oil yield/ plant and /fed. of sweet basil during 2018 and 2019 seasons.

	Essential oil %				Essential oil yield/plant (ml)				Essential oil yield/fed. (L)			
	First season		Second season		First season		Second season		First season		Second season	
Treatments	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
100% NPK (control)	0.62	1.25	0.78	1.39	0.35	0.75	0.47	0.86	9.80	21.09	13.16	24.08
75% NPK+Amino acids 3.33ml/L	0.60	1.25	0.72	1.33	0.32	0.73	0.43	0.81	8.87	20.35	11.95	22.77
75% NPK+Amino acids 6.67ml/L	0.75	1.28	0.82	1.37	0.44	0.78	0.51	0.87	12.23	21.84	14.19	24.36
75% NPK+ Amino acids 10 ml/L	0.93	1.41	1.00	1.46	0.57	0.89	0.63	0.95	15.87	25.01	17.73	26.51
50% NPK+Amino acids 3.33ml/L	0.57	1.18	0.76	1.31	0.30	0.68	0.44	0.78	8.40	18.95	12.32	21.75
50% NPK+Amino acids 6.67ml/L	0.74	1.30	0.84	1.39	0.41	0.76	0.50	0.85	11.48	21.37	14.09	23.80
50% NPK+ Amino acids 10 ml/L	0.78	1.34	0.91	1.42	0.45	0.81	0.57	0.89	12.69	22.77	15.87	24.92
L.S.D. at 0.05	0.05	0.04	0.04	0.05	0.02	0.02	0.02	0.02	0.62	0.59	0.65	0.63

Table 4: Influence of NPK fertilizers and amino acids mixture foliar application on essential oil composition of sweet basil in the the1st and 2nd cuts during season 2019.

	Treatments													
	100 % NPK (Control)		75% NPK + 3.33 ml/L *Amino acids*		75% NPK + 6.67 ml/L *Amino acids*		75% NPK + 10 ml/L *Amino acids*		50% NPK + 3.33 ml/L *Amino acids*		50% NPK + 6.67 ml/L *Amino* acids		50% NPK + 10 ml/L *Amino acids*	
Compound %	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
α-pinene	4.76	6.25	2.87	8.81	5.17	5.92	7.69	4.92	9.47	5.23	9.14	4.40	11.93	6.06
β-pinene	2.83	1.22	----	0.28	0.77	----	0.88	----	0.28	----	0.29	0.15	----	0.29
Linalool	44.99	40.42	43.36	40.40	45.53	42.23	41.43	42.88	42.01	38.83	41.55	41.37	47.66	43.07
Camphor	1.01	8.13	1.15	8.81	5.05	4.73	6.31	6.49	7.69	3.33	8.96	3.93	5.62	4.98
α-terpenol	2.83	2.59	5.23	2.41	2.06	4.66	1.79	11.93	1.85	----	2.50	----	1.77	----
Methyl chavicol	7.07	7.29	2.32	5.81	5.77	5.19	5.62	11.20	5.68	5.40	6.03	4.93	4.84	3.96
Fenchyl acetate	2.91	----	2.18	2.65	2.89	1.65	5.28	----	2.44	----	2.74	1.66	----	1.39
Geraniol	2.31	7.84	----	4.03	4.38	2.96	0.19	----	4.89	2.70	4.18	3.07	3.88	3.02
Eugenol	19.68	19.41	23.35	21.35	22.02	27.31	27.09	18.06	20.81	11.29	19.79	11.07	19.54	12.06
β-caryophyllene	2.11	1.60	2.08	----	----	----	0.60	----	----	----	----	0.75	----	----
Identified compounds	90.5	94.75	82.54	94.55	93.64	94.65	96.88	95.48	95.12	66.78	95.18	71.33	95.24	74.83

the 1st cut and from 18.95 to 26.51 liter in the 2nd one in the two seasons. Applying of 75% of recommended NPK doses with spraying 10ml of amino acids mixture resulting in the highest percentage and yields of essential oil in the 1st and 2nd cuts for both seasons with significantly differences compared to all other treatments. In contrast, the minimum values of essential oil percentage and yields were obtained by application 50% of recommended NPK doses with spraying 3.33ml of amino acids mixture in the 1st and 2nd cuts during both seasons. Moreover, both percentage and yields of essential oil were significantly increased by increasing both amino acids mixture level and the NPK rate in the two seasons. Spraying 6.67ml/L of amino acids mixture with 75% of recommended NPK doses and spraying 10ml/L with 50% of NPK dose treatments gave a significant increase of essential oil percentage and oil yields/plant and /fed. in comparing with full NPK doses (control) during both seasons. These results were in concert with those obtained by Reham *et al.* [16] on genovese basil, Abdel Aziz *et al.* [20] on *Thuja orientalis* seedlings, Ghazal [21] on *Thymus vulgaris* and EL-Zefzafy *et al.* [22] on *Artemisia abrotanum* plants.

Amino acids can serve as a source of organic nitrogen, carbon and energy, as well as have a function in the synthesis of other organic compounds, such as protein, amines, purines and pyrimidines, alkaloids, vitamins, enzymes, auxins, terpenoids and others [11, 15]. Therefore, the application of amino acids allows plants to save energy and increase the pace of their development or reconstruction as well as enhancing the vegetative growth as previously mentioned in this work and then reflect on synthesis, accumulation and yield of essential oil in sweet basil herb [12-14].

Influence of NPK Fertilizers and Amino Acids on Essential Oil Composition: Data illustrated in Table (4) reveal that the main identified components of essential oil were α-pinene (2.87-11.93%), β-pinene (0.28-2.83%), linalool (41.43-47.66%), camphor (1.01-8.96%), α-terpenol (1.77-5.23%), methyl chavicol (2.32-7.07%), fenchyl acetate (2.18-5.28%), geraniol (0.19-4.89%), eugenol (19.54-27.09%) and β-caryophyllene (0.60-2.11%) in the 1st cut. And in the 2nd cut were α-pinene (4.40-8.81%), β-pinene (0.15-1.22%), linalool (38.83-43.07%), camphor (3.31-8.81%), α-terpenol (2.41-11.93%), methyl chavicol (3.96-11.20%), fenchyl acetate (1.65-2.65%), geraniol (2.70-7.84%), eugenol (11.07-27.31%) and β-caryophyllene (0.75-1.60%). When spraying amino acids mixture at 10ml/L with 75% of NPK dose treatment recorded the highest content of α-terpenol (11.93%), methyl chavicol

Table 5: Influence of NPK fertilizers and amino acids mixture foliar application on N, P, K, Total protein and total free amino acids percentage in the 2nd cut of sweet basil herb during 2018 and 2019 seasons.

	Nitrogen %		Phosphorus %		Potassium %		Total protein %		Total free amino acids %	
Treatments	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
100% NPK (control)	2.83	3.02	0.39	0.46	2.11	3.03	17.67	18.87	1.89	1.91
75% NPK + Amino acids 3.33 ml/L	2.76	2.93	0.34	0.39	1.98	2.94	17.27	18.33	1.83	1.86
75% NPK + Amino acids 6.67 ml/L	2.83	3.05	0.38	0.43	2.10	3.13	17.69	19.08	1.90	1.91
75% NPK + Amino acids 10 ml/L	3.09	3.17	0.45	0.49	2.19	3.18	19.29	19.83	1.95	1.99
50% NPK + Amino acids 3.33 ml/L	2.62	2.81	0.31	0.33	1.87	2.69	16.37	17.54	1.76	1.78
50% NPK + Amino acids 6.67 ml/L	2.75	2.91	0.34	0.37	1.95	2.92	17.17	18.19	1.86	1.84
50% NPK + Amino acids 10 ml/L	2.81	3.02	0.38	0.42	2.01	3.10	17.56	18.85	1.89	1.90
L.S.D. at 0.05	0.02	0.03	0.02	0.03	0.03	0.02	0.14	0.18	0.01	0.02

(11.20%) and fenchyl acetate (5.28%), a full dose of NPK gave the highest content of β-pinene (2.83%), geraniol (7.84%) and β-caryophyllene (2.11%). While the highest contents of α-pinene (11.93%) and linalool (47.66%) were obtained by spraying amino acids mixture at 10ml/L with 50% of NPK dose, spraying amino acids mixture at 6.67ml/L with the same NPK dose gave the highest camphor content (8.96%). Moreover, 75% of NPK dose with spraying 6.67ml/L recorded the highest eugenol content (27.31%). Furthermore, the lowest content of methyl chavicol (2.32%) was obtained by 75% of NPK dose with spraying 3.33ml/L of amino acids. Accordingly, the abovementioned results showed that the composition of essential oil was altered and depended on the NPK rate and foliar spraying of amino acids mixture. Similar results were found by Ghazal [21] on *Thymus vulgaris*, EL-Zefzafy *et al.* [22] on *Artemisia abrotanum* and Talaat *et al.* [23] on *Ammi visnaga* plants.

Influence of NPK Fertilizers and Amino Acids on Chemical Analysis of Sweet Basil Herb: Data regarding the minerals, total protein and total free amino acids in the dry basil herb in the second cut during the two seasons were recorded in Table (5). The percentage of N, P, K, total protein and total free amino acids in dry herb was increased as amino acids mixture level or NPK fertilizers rate increased. Spraying the highest level of amino acids mixture (10ml/L.) with 75% of NPK fertilizers gave the maximum values in these constituents with significant differences comparing to the all other treatments in the two seasons. Moreover, the treatments of 75% of NPK fertilizers dose with spraying 6.67ml/L of amino acids mixture and 50% of NPK fertilizers with spraying 10ml/L of amino acids mixture gave values similar to these recorded with the full NPK doses (control) in both seasons. Results of using the amino acids are in agreement with those recorded by Abdel Aziz *et al.* [20] on *Thuja orientalis* seedlings, Al-Mayahy [24] on green faba bean and Hanafy Ahmed *et al.* [25] on rocket plants.

The positive effect of amino acids on accumulation of minerals, total protein and total free amino acids in sweet basil herb may be due to that uptake of sprayed amino acids allows plants to save energy and increase the pace of their development or reconstruction and utilization of fertilizers and existing nutrients from the soil [12-14]. Thus, its function in the synthesis of other organic compounds, such as protein, amines, purines and pyrimidines, alkaloids, vitamins, enzymes, auxins, terpenoids and others and hence, activating photosynthesis, synthesis and accumulation of minerals, protein and other metabolites [11,15].

CONCLUSION

Accordingly, it could be conclude that amino acids mixture spraying led to enhance reducing of the chemical fertilization. Foliar spraying by 6.67 or 10ml/L of amino acids mixture with 75% of recommended NPK dose significantly enhanced vegetative growth, herb and essential oil yields as well as minerals, total proteins and total free amino acids percentage in sweet basil herb compared to the full recommended NPK dose (control). Likewise, the treatment 50% of NPK dose with spraying amino acids mixture at 10 ml/L gave similar results to these were obtained by the full NPK dose. Therefore, reducing of the amount of chemical fertilizers and saving up to 25-50% as well as reducing environmental risks.

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