Bangladesh J. Bot. **46**(2): 783-787, 2017 (June) **- Short communication**

INFLUENCE OF KINETIN ON GROWTH, CHEMICAL CONSTITUENTS AND NUTRIENT CONTENT OF BLACK CUMIN (*NIGELLA SATIVA* L.)

AISHA MA AHMED* AND KHALID A KHALID[1]

Department of Botany, National Research Centre, El Buhouth St., 12311, Dokki, Cairo, Egypt

Keywords: Nigella sativa, Growth, Fixed oil, Soluble sugars, Protein and NPK

Abstract

The effects of kinetin on the growth, fixed oil, soluble sugars, protein, and NPK content of black cumin (*Nigella sativa* L.) were investigated. Kinetin treatments increased growth characters and chemical constituents of *N. sativa.* Greatest plant growth characters [plant height (31.4 cm), leaf number (66.3/plant), branch number (11.2/plant)$^{-}$, capsule number (17.9/plant), herb dry weight (23.8 g/plant) and seed yield (13.9 g/plant)] were obtained in the 30 mg/l treatment. The highest values of fixed oil (33.9%), soluble sugars (11.5%), nitrogen (4.6%) and protein (28.8%) resulted from 20 mg/l treatment. The highest values of phosphorus and potassium (0.7 and 0.8%) content resulted from 30 mg kinetin/l treatment.

Nigella sativa L. (Ranunculaceae) seeds, commonly known as black seed or black cumin, have been employed for thousands of years as a spice and food preservative, as well as a protective and curative remedy for numerous ailments (Chopra *et al.* 1956, Nadkarni 1974).

Cytokinin (kinetin), a phytohormone plays a role in cell division, shoot initiation and growth, senescence delay and photo morphogenic development, control of chloroplast division and growth, modulation of metabolism and morphogenesis in response to environmental stimulus (Kieber 2001, Pozo *et al*. 2005, Hirose *et al*. 2007, Farooqi and Sharma 1988). Kinetin treatment (1.4 ppm) increased the total herb weight by 30 - 60% compared to control treatment of *Mentha piperita, Mentha spicata* and *Salvia officinalis* plants (El- Keltawi and Croteau 1987). Physiological effect of kinetin on the growth of lavender (*Lavandula angustifolia*) plants was investigated by Youssef and Talaat (1998) and they reported that kinetin (20 and 40 ppm) increased plant height, branch number, herb dry weight, carbohydrate, soluble sugars and NPK of lavender plants. Moussa and Sallam (1996a and 1996b) reported that kinetin treatments had a significant increase in plant growth characters of *Hordeum vulgare* plants.

In this study, the possible effect of kinetin on the growth, fixed oil, soluble sugars, protein and NPK content of black cumin (*Nigella sativ* L.) is investigated.

Experiments were carried out in a greenhouse at the National Research Centre (NRC), Cairo, Egypt, during 2014 and 2015. *Nigella sativa* L. seeds were obtained from the Ministry of Agriculture, Egypt. Uniform seeds were sown into plastic pots (30 cm diameter and 50 cm height) during the third week of October 2014; the pots were transferred to a greenhouse adjusted to natural conditions. Each pot was filled with 10 kg of air-dried soil. Physico-chemical properties of the soil used in this study were determined according to Jackson (1973) and Cottenie *et al*. (1982) and are presented in Table 1. Three weeks after sowing, the seedlings were thinned to three plants per pot. 45 days from sowing date plants were divided into five groups were subjected to different levels of Kn: 0, 10, 20, 30 and 40 mg/l. All agricultural practices were conducted according to the recommendations by the Egyptian Ministry of Agriculture.

*Author for correspondence: <aishazyat@yahoo.com>. [1]Research of Medicinal and Aromatic Plants Department, National Research Centre, El Buhouth St., 12311, Dokki, Cairo, Egypt.

At the end of fruiting stage (230 day from sowing), the plants were harvested. Vegetative growth characters measurements [Plant height (cm), leaf number/plant), branch number/ plant), capsule number/plant), herb dry weight (g/plant) and seed yield (g/plant)] were recorded.

In order to extract fixed oil, 20 g of seeds were crushed to coarse powered and extracted with petroleum ether (40 - 60°C) in a Soxhlet apparatus (AOAC, Association of Official Analytical Chemists 1970, Washington, D.C).

Total soluble sugars contents were determined from young leaves collected from each treatment follows of the method of Dubois *et al*. **(**1956**)**.

Total nitrogen and phosphorus in leaves of each treatment were determined using the methods described by the Association of Official Agricultural Chemists (AOAC 1970). The samples of leaves were dried, ground and K^+ extracted by acid digestion (Cottenie *et al.* 1982). Concentrations of K^+ were determined by atomic absorption spectrophotometer using a Perkin-Elmer (Gonzalez *et al*. 1973).

In this experiment, one factor (levels of kinetin) was considered: 0, 10, 20, 30 and 40 mg/l. For each treatment there were 4 replicates, each of which had 8 pots; in each pot 3 individual plants were planted. The experimental design followed a complete random block design. According to Snedecor and Cochran (1990) the averages of data were statistically analyzed using one-way analysis of variance (ANOVA-1). Significant values determined according to p values ($p < 0.05$ = significant, $p < 0.01$ = moderate significant and $p < 0.001$ = highly significant). The applications of that technique were according to the STAT-ITCF program (Foucart 1982).

Plant height (cm), leaf number/plant), branch number/plant), capsule number /plant), herb dry weight (g/plant) and seed yield (g/plant) were under the various kinetin levels compared to control, respectively. Greatest growth characters were obtained in the 30 mg/l treatment with the values of 31.4, 66.3, 11.2, 17.9, 23.8 and 13.9, respectively (Fig. 1). The highest values of fixed oil, soluble sugars, nitrogen and protein were 33.9, 11.5, 4.6 and 28.8%, respectively resulted from

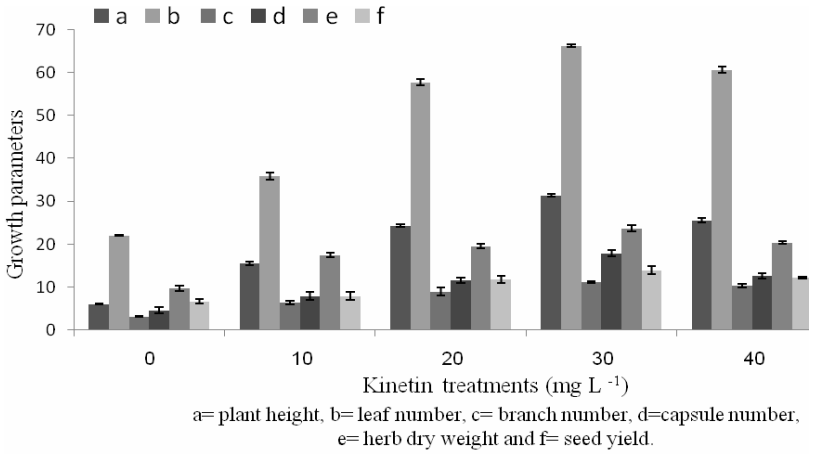

Fig. 1. Influence of Kn on growth characters.

20 mg/l treatment compared to control (16.8, 4.6, 1.3 and 8.1) (Fig. 2). Phosphorus and potassium contents increased with kinetin treatments compared to control (Fig. 3). However, the highest values of phosphorus and potassium (0.7 and 0.8%, respectively) content resulted from 30 mg/l treatment compared to control (0.1 and 0.3%).

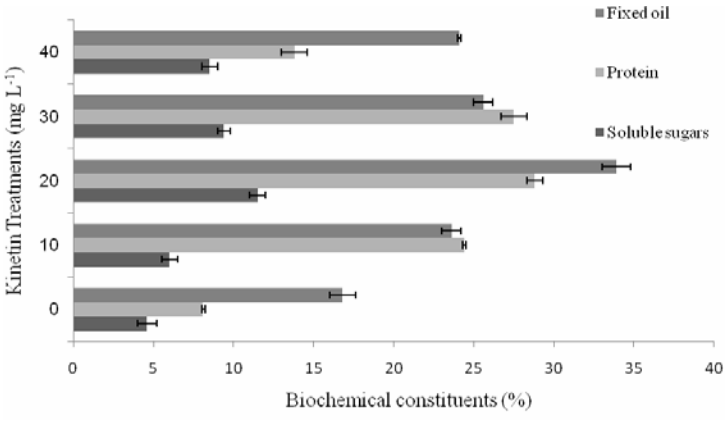

Fig. 2. Influence of Kn on some biochemical constituents.

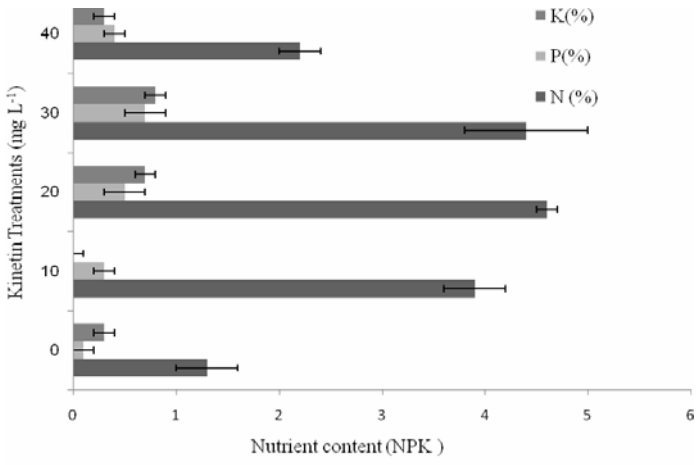

Fig. 3. Influence of Kn on nutrient content (NPK).

Table 1. Soil properties.

Parameter	Value	Parameter	Value (meq/l)
Sand (%)	75.5	K	0.6
Silt (%)	12.5	Fe	4.4
Clay (%)	2.5	Cu	0.4
Gravel	10.5	Zn	0.3
pH	7.3	Mn	1.1
EC (dS/m)	1.5	CO_3	1.7
Ca (meq/l)	4.3	HCO_3	1.5
Mg (meq/l)	4.2	Cl	2.1
Na (meq/l)	5.1	SO_4	4.2

Changes in cytokinin levels are generally positively correlated with levels of mineral nutrients, especially nitrogenous nutrients (Schmülling 2004). The effect of different treatments (levels of kinetin) on fixed oil may be due to its effect on enzyme activity and metabolism of fixed oil production (Burbott and Loomis 1969). Our results are in accordance with those obtained by

Shah (2007) as well as Balakrishnan and Gupta (2011) reported that kinetin increased the vegetative growth characters such as shoot length, leaf number, leaf area, branch number and dry weight, capsule number and seed yield of *Nigella sativa* (L.). Kinetin had a significant effect on nitrogen metabolism of *Nigella sativa* (L.) (Shah abd Samiullahm 2007). Youssef and Talaat (1998) reported that kinetin increased plant height, branch number, herb dry weight, carbohydrate, soluble sugars and NPK of lavender plants. Moussa and Sallam (1996 a, b) reported that kinetin treatments had a significant increase in plant growth characters of *Hordeum vulgare* plants. Kinetin treatments caused significant increases in growth, yield and various chemical constituents of *N. sativa* (Khalid and Shedeed 2014 and 2016).

References

Association of Official Agricultural Chemistry (AOAC) 1970. Official Methods Analysis. Washington, D.C., USA.

Balakrishnan BR and Gupta P 2011. Effect of pre-sowing seed treatment with kinetin on physiological parameters of *Nigella sativa* Linn. Int. J. Pharma. Life Sci. **2**: 1046-1049.

Burbott AJ and Loomis D 1969. Evidence for metabolic turnover monoterpene in peppermint. Plant Phys. **44**: 173-179.

Chopra RN, Nayar SL and Chopra IC 1956. Glossary of Indian medicinal plants. New Delhi: Council of Scientific and Industrial Research.

Cottenie A, Verloo M, Kiekens L, Velghe G and Camerlynck R 1982 . Chemical analysis of plant and soil. Laboratory of Analytical and Agrochemistry, State Univesity, Ghent. Belgium**.**

Dubois MKA, Gilles JK, Hamilton PA, Roberts and Smith F 1956. Phenol sulphuric acid method for carbohydrate determination. Ann. Chem. **28**: 350-359.

Farooqi AH and Sharma S 1988. Effect of growth retardants on growth and essential oil content in Japanese mint. Plant Growth Reg. **7**: 39-45.

El-Keltawi NE and Croteau R 1987. Influence of foliar applied cytokinins on growth and essential oil content of several members of the Lamiaceae. Phytochem. **26**: 891-895.

Foucart T 1982. Analyse factorielle, programmatiol sur micro-ordinateur. Masson, ITCF, Paris.

Gonzalez C, Banez M, Wylle M and Sole J 1973. La Nutricion Miniral de le Vegetables. Fac. Agro., Univ. Catulica de Chile.

Hirose N, Takei K, Kuroha T, Kamada-Nobusada T, Hayashi H and Sakakibara H 2007. Regulation of cytokinin biosynthesis, compartmentalization, and translocation. J. Exp. Bot. **14**: 1-9.

Jackson M L 1973. Soil Chemical Analysis. Published by Perntice Hall of India Private Limited M.97, Connght Citrus, New Delhi.

Khalid A K and Shedeed MR 2014. Influence of kinetin on growth and biochemical accumulation in *Nigella sativa* plants grow under salinity stress conditions. Thai J. Agric. Sci. **47:** 195-203.

Khalid A K and Shedeed MR 2016. Yield and chemical composition of *Nigella sativa* L. essential oil produced under kinetin treatments. J. Ess. Oil Bear. Plant. **19:** 1740 – 1746.

Kieber J J 2001. Cytokinin. *In:* The Arabidopsis Book. Somerville, C. Meyerowitz, E. (eds). Amer. Soc. Plant Bio.

Moussa AZ and Sallam HAM 1996a. Effect of kinetin and abscisic acid application on barley plant grown under salinity conditions. 1- Changes in growth and nitrogenous constituents. Annals Agric. Sci., Ain Shams Univ. **41**: 51-59.

Moussa AZ and Sallam HAM 1996b. Effect of kinetin and abscisic acid application on barley plant grown under salinity conditions. Changes in some endogenous growth substances. Annals. Agric. Sci. Ain Shams Univ. **41**: 61-73.

Nadkarni K 1974. *Crocus sativus, Nigella sativa*. *In:* Nadkarni KM (Ed.), Indian materia medica. Bombay: Popular Prakashan.

Pozo JC, Lopez-Matas MA, Ramirez-Parra E and Gutierrez C 2005. Hormonal control of the plant cell cycle. Physiol. Plant. **123**: 173-183.

Shah SH. 2007. Effect of kinetin spray on growth and productivity of black cumin plants. Russian J. Plant Physiol. **54**: 702-705

Shah SH and Samiullah IA 2007. Responses of *Nigella sativa* to foliar application of gibberellic acid and kinetin. Biol. Plant. **51**: 563-566.

Schmülling T 2004. Cytokinin. *In:* Encyclopedia of Biological Chemistry (Eds. Lennarz, W., Lane, M.D.) Academic Press/Elsevier Science.

Snedecor GW and Cochran WG 1990. Statistical Methods. 11th Ed. Iowa State Univ. Press. Ames, Iowa, U.S.A.

Youssef AA and Talaat IM 1998. Physiological effect of brassinosteroid and Kn on the growth and chemical constituents of Lavender plant. Ann. Agric. Sci. **43**: 261-272.

(Manuscript received on 15 November, 2015 ; revised on 6 September, 2016)