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RESPONSE OF BEAN PLANT *PHASEOLUS VULGARIS* L. TO SPRAY WITH HORNWORT EXTRACT AND NANO POTASSIUM ON GROWTH AND YIELD PARAMETERS

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Abstract

Field experiment was conducted in special farm kufa- alkizwinia area An-Najaf governorate during of 2018 in two season spring and autumn. The experiment included nine treatments, *i.e.* the interactions of three concentrations of hornwort extract (Shamplan) (first factor) (0, 10 and 20ml.L^{-1}) and nano-potassium (second factor) (0, 1.5 and 3g.L^{-1}) sprayed on vegetative. Sprays were applied third, first sprayed through four true leaves stages, second flowering initiation, third after two weeks from second sprayed. Factorial Design with in Randomized Complete Block Design (R.C.B.D.) was used with three replications. Means were compared according to Duncan's Multiple Range Test (D.M.R.T.) at probability of 0.05. Results can be summarized as follows: 1-Using of concentrations of hornwort extract had a significant effect on measured vegetative growth parameters especially 20ml.L^{-1} (plant height and leaves number) and yield parameters, yield per plant 395.5 and 253.1 g. $plant^{-1}$, total yield gaves 8.742 and 5.618 ton.H^{-1} for both seasons, respectively, compared with control treatment , which gaves the lowest average for the measured parameters included yield per plant 286.5, 178.1 g. $plant^{-1}$ and total yield reach 6.362 and 3.952 ton.H^{-1} for both seasons, respectively, 20 ml. L^{-1} gives the highest means for the chemical parameters (total chlorophyll, carbohydrate content in pod) for both seasons, respectively. 2- Using of concentrations of nano-potassium had a significant effect on measured vegetative growth parameters especial 3 g.L^{-1} (plant height and leaves number) yield parameters (yield per plant 142.50 and 107.29 g. $plant^{-1}$ and total yield 8.742 and 5.618 ton.H^{-1} for both seasons, respectively, compared with control treatment, which gives the lowest means for the measured parameters included yield per plant 265.6 and 133.7 g. $plant^{-1}$, total yield 5.856 and 2.966 ton.H^{-1} for both seasons, respectively, 3g.L^{-1} of nano-potassium gives the highest means for the chemical parameters (total chlorophyll and carbohydrate content in pod) for both seasons, respectively. 3- interaction between experimental factors (20ml.L^{-1} hornwort extract X 3g.L^{-1} of nano-potassium) improvement of vegetative growth parameters (plant height and leaves number) and yield parameters (yield per plant 449.7 and 306.1 g. $plant^{-1}$; total yield 9.990 and 6.797ton.H^{-1} for both seasons, respectively, compared with control treatment, which gave the lowest means for the measured parameters included yield per plant 203.7 and 83.0g. $plant^{-1}$; total yield 4.520 and 1.840ton.h^{-1} for both seasons, respectively, 20ml.L^{-1} hornwort extract and 3g.L^{-1} of nano-potassium gave a highest means for the chemical parameters (total chlorophyll and carbohydrate content in pod for both seasons, respectively.

Key words: *Phaseolus vulgaris* L., hornwort, nano potassium

Introduction

The common bean *Phaseolus vulgaris* L. belongs to family Leguminosae (Fabaceae), which consist of about 600 genera and about 13000 species, and it is an important legume as dietary for more than 300 million someone in all the world, especially in developing nations, which with total production exceeding 23 million metric tons, seven million of which are produced in Latin America and Africa (Brought *et al.,* 2003). The common bean have nutrition value *i.e.* protein, lipid, calcium, iron, phosphorus, vitamins (A, B1, B2, B6, C) (Ware and Mccollum, 1980). The United Nations FAO reported that the world production of common bean was 23595714 tones and Iraq production was 4610 tones (FAO, 2018).

Foliar application is the most efficient method to increase yield and vegetative parameters. Results have shown that foliar feeding can increases yields from 12% to 25% when compared to conventional fertilization (Hussien *et al.,* 2012). As the method of reducing the

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Table 1: Analysis of soil sample in the field experimental.

Season	Type of Sample	Soil texture	EC ds.m^{-1}	pH	ppm		Mm.L^{-1}					Organic Materials %
					P	N	K^+	S	Na^+	Mg^{++}	Ca^{++}	
Spring	soil	Silty loam	1.1	7.4	2.45	1.65	1.04	6.31	3.95	2.1	5.0	2.24
autumn.	soil	Silty loam	1.7	7.0	2.16	1.81	0.76	4.73	4.11	1.6	7.2	3.22

use of chemical fertilizers has been proposed in recent years, using new products in this field has been considered by producers and researchers. Using hornwort extract *Ceratophyllum demersum* L. as foliar fertilizers because contain many nutrition's and organic compound. Nano-technology as a leading science, tries to produce less harmful and more effective Nano based fertilizers.

Potassium is an essential plant nutrient, which is necessary for the plants in large amount and is supplied by the foliar fertilizer. Potassium is essential for many of physiological process such photosynthesis, respiration, pod formation, winter hardiness and disease resistance. (Shafeek, *et al.,* 2013).

Thus, the aim of the experiment was to elucidated the effect of spraying hornwort extract, nano-potassium and their interactions to determine the best focus on improving plant growth and yield of plant.

Materials and methods

An experiment was conducted during the growing season of 2018 in kufa- alkizwinia are a, An-Najaf governorate . The experiment design was factorial within Randomized Complete Block Design (R.C.B.D.) The experiment included 9 treatments *i.e.* the interaction of three concentrations of hornwort extract (Shamplan) (0, 10 and 20 ml.L^{-1}) and three concentrations of nano-potassium (0, 1.5 and 3 g.L^{-}) Sprays were applied third, first sprayed through four true leaves stages, second flowering initiation, third after two weeks from second sprayed. Planting seeds in 10/3/2018 in spring cultivation and 1/9/2018 in autumn cultivation, distance between plants (25) cm. Irrigation was done by dripping system. Cultural practices were done equally and when it is considered necessary *e.g*. cultivation, weeding, etc. as mentioned in (Matlob *et al*., 1989). Duncan multiple range test was used to compare means when it is considered significant at probability of 0.05 (Al-Rawi and Khalaf-Allah, 2000), studied parameters were taken as follows:

Table 2: Component of Hornwort extract.

Component of Hornwort extract			
N	1.65%	102.82 ppm	Glutamic acid
P	0.26%	4301.57 ppm	Serine
K	0.39%	528.16 ppm	Glysine
Ca	3.73%	9266.15 ppm	Threonine
IAA	124.6 ppm	898.86 ppm	Valine
GA_3	30.28 ppm	151.37 ppm	Tryptophane
Cytokinin	180.88 ppm	654.72 ppm	Phenylalanine
		361.91 ppm	Vitamin C

Vegetative growth parameters: This included the following:

Plant length (cm)

Leaves number (leaf.plant^{-1})

Yield and chemical parameters: This included the following:

Yield per plantwas calculated according the equation:

Yield per Plant(g.plant^{-1})= Experiment unit yield / Number of plants in experiment unit

Total yield: The cumulative yield was calculated for all plants harvested for each experimental unit until the end of the experiment as following:

Experiment unit yield = yield Plant × Number of plants in experiment unit

Total yield (ton.H^{-1}) = Experiment unit yield × area hectare (10000) m^2 /Experiment unit area

Total Chlorophyll in Leaves (mg.100g^{-1} fresh weight): By using acetone to extract chlorophyll pigment. According to (Mackinney, 1941)

Content of the pods of carbohydrates (g.kg^{-1}): According to (Herbert *et al.,* 1971).

Results

Results in Table 2, 3 revealed that, there were a significant differences between the treatments of hornwort extract. Treatment of 20 ml.L^{-1} gaves the highest value of vegetative growth parameters: Plant length and leaves number they were 41.81, 34.51 cm and 32.62, 25.36 leaf. plant^{-1}, for both seasons, respectively compared to the control treatment, which gave the least means 33.93, 28.13 cm and 24.91, 19.52 leaf. plant^{-1} , for spring and autumn seasons, respectively.

Nano-potassium spraying with con. 3ml.g-1 clearly influenced on vegetative growth parameters: Plant length and leaves number were 40.72, 34.58 cm and 32.73, 25.08 leaf.plant^{-1} for spring and autumn seasons, respectively, compared with control treatment (without spraying of nano-potassium), that gained the least values 35.13, 28.36 cm and 23.47, 19.47 leaf.plant^{-1} for both seasons, respectively.

The interaction between both factors appeared significant differences on all vegetative growth parameters: Plant length and leaves number .Treatments of (20 ml.L^{-1} of hornwort extract and 3 ml.L^{-1} nano-potassium) gave the highest values were 46.37, 38.23cm and 36.80, 30.03leaf.plant^{-1} for both seasons, respectively. While, treatment of (0 hornwort extract X 0 nano-potassium) gave the lowest values of 32.40, 24.40 cm and 19.93, 18.70 leaf.plant^{-1} for both seasons, respectively.

Table 3: Effect of hornwort extract and nano potassium on growth, yieldand chemical parameters in common bean plantof 2018 in spring season.

Treatments	Conc-entra-ration		Plant length (cm)	Leaves number (leaf. plant^{-1})	yield per plant (g.plant^{-1})	plant total yield (ton.h^{-1})	Total chlor-ophyll(mg. 100g fresh weight	carbohyd-rate content in pod (g.kg)
Hornwort extract (mg.L^{-1})	0		33.93c	24.91b	286.5b	6.362b	25.00c	20.02B
	10		38.08b	26.82b	335.1ab	7.433ab	27.44b	22.25B
	20		41.81a	32.62a	395.5a	8.742a	29.92a	25.50A
Nano potassium (g.L^{-1})	0		35.13b	23.47c	265.6b	5.856b	25.51b	20.33B
	1.5		37.97ab	28.19 b	354.4a	7.871a	26.86b	22.45 ab
	3		40.72a	32.73 a	397.1a	8.811a	30.00a	25.00 A
hornwort extract (mg.L^{-1}) ×	0	0	32.40d	19.93d	203.7d	4.520d	23.40e	17.88C
		1.5	35.30bcd	24.17cd	316.3bc	7.023bc	24.60de	22.01bc
		3	34.10cd	30.63abc	339.7abc	7.543abc	27.00cd	20.16bc
nano potassium (g.L^{-1})	10	0	34.27cd	21.47d	245.1cd	5.443cd	24.60de	20.11bc
		1.5	38.27bcd	28.33bc	358.3abc	7.957abc	27.73bc	20.79bc
		3	41.70ab	30.67abc	401.9ab	8.900ab	30.00b	25.86ab
	20	0	38.73bcd	29.00bc	348.0abc	7.603 abc	28.53bc	23.00bc
		1.5	40.33abc	32.07ab	388.7 ab	8.633 ab	28.23bc	24.55ab
		3	46.37a	36.80a	449.7a	9.990a	33.00a	28.96 A

Table 4: Effect of hornwort extract and nano potassium on growth, yieldand chemical parameters in common bean plantof 2018 in autumn season.

Treatments	Conc-entra-ration		Plant length (cm)	Leaves number (leaf. plant^{-1})	yield per plant (g.plant^{-1})	plant total yield (ton.h^{-1})	Total chlor-ophyll(mg. 100g fresh weight	carbohyd-rate content in pod (g.kg)
Hornwort extract (mg.L^{-1})	0		28.13C	19.52c	178.1b	3.952 b	24.66B	17.68b
	10		32.22B	21.94b	198.8b	4.412 b	26.17A	18.03b
	20		34.51A	25.36a	253.1a	5.618 a	26.83A	20.68a
Nano potassium (g.L^{-1})	0		28.36C	19.47c	133.7c	2.966 c	25.13B	17.24b
	1.5		31.93B	22.28b	226.3b	5.023 b	26.06ab	18.84ab
	3		34.58A	25.08a	269.9a	5.993 a	26.47A	20.31a
hornwort extract (mg.L^{-1}) ×	0	0	24.40E	18.70 c	83.0e	1.840 e	24.07C	15.46b
		1.5	29.70D	19.67c	204.9cd	4.550 cd	24.60bc	17.23ab
		3	30.30 cd	20.20c	246.2bcd	5.467 bcd	25.30abc	20.35a
nano potassium (g.L^{-1})	10	0	29.27D	19.20c	116.1e	2.573 e	24.93abc	16.99ab
		1.5	32.20Bcd	21.63c	222.9bcd	4.947 bcd	26.73ab	18.27ab
		3	35.20 ab	25.00b	257.4b	5.717 b	26.83ab	18.83ab
	20	0	31.40Bcd	20.50c	202.1d	4.483 d	26.40abc	19.26ab
		1.5	33.90Bc	25.53b	251.1bc	5.573 bc	26.83ab	21.04a
		3	38.23A	30.03a	306.1a	6.797 a	27.27A	21.74a

Results in Tables 3, 4 illustrated that a significant variance between the treatments of hornwort extract on yield, chlorophyll and carbohydrate content in pods were 395.5, 253.1 g. plant^{-1}; 8.742, 5.618ton. H^{-1}; 29.92, 26.83mg.100g^{-1}; 25.50, 20.68 mg. g^{-1} for both seasons, respectively with spraying 20 ml.L^{-1} of hornwort extract, compared with control treatment, which gaves the lowest means were 286.5, 178.1g. plant^{-1}; 6.362, 3.952 ton.H^{-1}; 25.00, 24.66 mg.100g^{-1}; 20.02, 17.68 mg.g^{-1} for both seasons, respectively.

Nano-potassium spraying had an increasing effect with con. 3 ml.L^{-1} between the treatments on yield, chlorophyll and carbohydrate content in pods were 286.5, 253.1 g. plant^{-1}; 8.742, 5.618ton.H^{-1}; 30.00, 26.47 mg.100g^{-1}; 25.00, 20.31mg. g^{-1} for both seasons, respectively, compared with treatment (without spraying of nano-potassium) that gaves the lowest values were 265.6, 133.7g. plant^{-1}; 5.856, 2.966 ton.H^{-1}; 25.51, 25.13 mg.100g^{-1}; 20.33, 17.24 mg. g^{-1}, respectively.

The interaction between both factors gave significant differences on yield, chlorophyll and carbohydrate content in pods. Treatments of (20 ml.L^{-1} hornwort extract X 3 ml.L^{-1} nano-potassium) gave the largest values 449.7, 306.1 g. plant^{-1}; 9.990, 6.797 ton.H^{-1}; 33.00, 27.27 mg.100g^{-1}; 28.96, 21.74 mg. g^{-1} for both seasons, respectively,. While, treatment of (0 hornwort extract X 0 nano potassium) gave the lowest values 203.7, 83.0 g.plant^{-1};4.520, 1.840ton.H^{-1}; 23.40, 24.07mg.100g^{-1}; 17.88, 15.46 mg. g^{-1} for both seasons, respectively.

Discussion

The results showed that spraying with the hornwort extract in combination with nano-potassium fertilizer had a "significant" effect on the increase in vegetative growth (plant height and number of leaves), yield traits and chemical parameters such chlorophyll and carbohydrate content in pods tables (3 and 4) respectively. The reasons of these effects could be attributed to hornwort extract spraying that had affected many physiological processes, Because it contains many essential nutrients (N, P, K) as shown in Table 2, which play an important role in the construction of important organic compounds in the physiological and biological processes within the plant, amino acids, nucleic acids, chlorophyll, proteins, hormones and important enzymes, which are involved in the process of building protoplasm, phospholipids and enzymatic accompaniments such as NAD and NADP, which are important in respiration and photosynthesis reactions, This in turn leads to an increase in the parameters above (Alsahaf, 1989). As well as the hornwort extract contain on some growth organizationsas shown in Table 2 that increase the rate of cell division and increase the efficiency of the process of photosynthesis and the formation of pigments for light reactions and increase the rate of cell division and increase the efficiency of photosynthesis process (Thomas, 1982), and then increase the plant's ability to manufacture food through the process of photosynthesis, which is reflected positively "in increasing the rates of vegetative growth, including the height of the plant and the number of leaves, which in turn lead to an increase in parameters of the yield, which reflects positively" on the total and the nutritional content of green pods, and the content of leaves of total chlorophyll.

The obtained results are in a good accordance with these recorded by Al- Amin (2018) who found that increasing hornwort extract levels increased plant growth characters and yield in cucumber *Cucumis sativus* L. plant .

The reason for the significant increase in the use of nano-potassium fertilizer due to important effect of the potassium nutrient as it works to activate more than 60 enzymes important in metabolic processes and has an important role in the operations of opening and closing the stomata and the transfer of carbohydrates manufactured in the leaves to the rest of the plant parts (Devlin and Witham, 1986). As well as "help in the processes of the formation of proteins and nucleic acids and photosynthesis, which leads to an increase in the amount of processed food, which is reflected positively" in the increase parameters of vegetative growth and yield (Alsahaf, 1989).

Potassium nutrient very important in biochemical pathways in plants, where Potassium acts as an activator for several enzymes involved in carbohydrates metabolism (Taiz and Zeiger, 2006). The obtained results are in a good accordance with these recorded by Hasaneen *et al.*, (2016) who found that increasing potassium fertilizer levels increased plant growth characters and yield in common bean plant.

References

Al-Amin, A.F. (2018). Response of cucumber plant *cucumissativus* L. to spray with hornwort extract and magnetically treated water on growth and yield parameters. M.Sc. Thesis. Faculty of Agriculture. University of Kufa. Iraq.

Al-Rawi, K.M. and A.M. Khalaf-Allah (2000). Design and Analysis of Agricultural Experiments. MosulUniversity. Ministry of Higher Education and Scientific Research. Iraq. (in Arabic).

Alsahaf, F.H. (1989). Plant nutrition practice. Ministry of higher

education and scientific research. University of Baghdad. Dar-Alhekma for printing and publishing . Iraq.

Broughton, W.J., G. Hernandez, M. Blair, S. Beebe, P. Gepts and J. Venderleyden (2003). Bean (*Phaseolus* spp) - model food legumes. *Plant and Soil,* **252:** 55-128.

Devlin, R.M. and F.H. Witham (1986). Plantphysiology. 4th Ed. CBSpublishers anddistributors 485, Jan Bhawan, Shadhara, Delhi, 110032. India.

Food and Agriculture Organization of the United Nation (FAO). (2018). http://www.fao.org/faostat/en/#data/QC.

Hasaneen, M.N., H.M. Abael-aziz and A.M. Omer (2016). Effect of foliar application of engineered nano materials: carbon nanotubes NPK and chitosan nanoparticlesNPK fertilizer on the growth of French bean plant. *Biochemistry and Biotechnology Research,* **4(4):** 68-76.

Herbert, D., P.J. Philips and R.E. Strange (1971). "In Methods in Microbiology". J.R. Norries and D.W. Robbins (eds.) Acad., Press, New York. 5B. Chap. 3. USA.

Hussien, M.M., A.I. Rezk, H.M. Mehanna and A.B. El-Nasharty (2012). Response of Castor Bean Plants to Potassium Foliar Application and Treated Sewage Water. *Australian Journal of Basic and Applied Sciences,* **6(7):** 611-616.

Mackinney, G. (1941). Absorption of light by chlorophyll solutions. *Biol . Chem.,* **140:** 315 - 322.

Matlob, A.N., A. Sultan and K.S. Abdool, (1989). Vegetables Production. Part 1, (2nd ed.). Higher Education Publisher in Mosul. Mosul University. Ministry of Higher Education and Scientific Research. Iraq. (in Arabic).

Shafeek, M.R., Nagwa, M.K. Hassan, S.M. Singer and H.M. Nadia El-Greadly (2013). Effect of potassium fertilizer and foliar spraying with Etherel on plant development, Yield and bulb Quality of onion plants (*Allium cepa* L.). *J. of Appl. Sci. Res.,* **9(2):** 1140 1146.

Taiz, L. and E. Zeiger (2006). Plant Physiology, 4thed , Sinauer Associates, Inc, Publishers, Sundeland, Massachusetts, USA, PP, 103-124.

Thomas, T.H. (1982). Plant Growth Regulator Potential and Practice. BCPC Publications 14-150 London Rd, Croydon CRO 2TD U.K.

Ware, W.G. and J.P. Mccollum (1980). Hand Book for production vegetable crops. Printed in U.S.A. PP 607.