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Study of Some Factors Affected on Dry Seed Yield and its Components of Common Bean (*Phaseolus vulgaris* L.)

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ABSTRACT

This experiment was suggested to study the beneficial effects of some levels of NPK fertilizers i.e. (0, 50, 75 and 100%) from NPK recommendation for common bean with humic acid (HA) on plant growth, dry seed yield and its components, quality and seeds chemical composition of common bean(*Phaseolus vulgaris* L.) cvs. Nebraska and Bronco. All experiments were achieved at the Experimental Farm of Kaha Research Farm, Horticulture Research Institute, Agriculture Research Center (ARC), Qaliobia Governorate, Egypt, during the two successive summer seasons of 2013 and 2014. The results showed that adding humic acid (HA) to common bean plantswith the level of 50% from NPK recommendation gave the highest values of vegetative growth, total dry seed yield and its chemical composition with cv. Nebraska or also cv. Bronco which cultivated under these study for the purpose of dry seed production. This treatment also led to save 50% of NPK fertilizers for common bean requirements. For that, it can be recommended that fertilization of common bean plants for the purpose of dry seed production by 50% from common bean NPK recommendation plus humic acid (HA) to obtain significant highest dry seed yield with best quality and at the same time save 50% from mineral fertilizer recommendation of common bean.
Keywords: Common bean, Nebraska, Bronco, Humic acid (HA), NPK, growth, dry seed yield, seed quality.

INTRODUCTION

Common bean *(Phaseolus vulgaris* L.*)* is one of the most important legume crops grown in Egypt not only for local consumption but also for export purposes. It is mainly grown for its green pods and dry seeds. Dry seeds of beans are a good source of proteins, which is commonly required for human nutrition.

For improving common bean dry seed yield and its quality as well as minimizing using mineral fertilizers, several investigators reported that, it can be recognizing that by using some active organic fertilizers.

One of the active organic fertilizers is humic acid. Humic acid is one of the major components of humic substances. Humic matter is formed through the chemical and biological humification of plant and animal matters and through the biological activities of microorganisms (Anonymous, 2010). The effects of humic substances on plant growth depend on the source and the used concentration, as well as on the molecular fraction weight of humus. Lower molecular size fraction easily reaches the plasma lemma of plant cells, determining a positive plasma lemma of plant cells, determining a positive effect on plant growth, as well as a later effect at the level of plasma membrane, that is, the nutrient uptake, especially nitrate. The effects on intermediary metabolism are less understood, but it seems that humic substances may influence both respiration and photosynthesis (Nardi *et al.*, 2002). Humic substances have a very profound influence on the growth of plant roots. When humic acids and fulvic acids are applied to the soil, enhancement of root initiation and increased root growth as observed by (Pettit, 2004). The stimulatory effects of humic substances have been directly correlated with enhancing uptake of macronutrients, such as nitrogen, phosphorus and sulfur (Chen and Aviad, 1990) and micronutrients as, Fe, Zn, Cu and Mn (Chen *et al.*, 1999). Humic substances have been reported to influence on plant growth both directly and indirectly. The indirect effects of humic compounds on soil fertility include:

1- Increase in the soil microbial population including beneficial microorganisms.
2- Improved soil structure.
3- Increase in the cation exchange capacity and the pH buffering capacity of the soil.

Directly, humic acid compounds may have various biochemical effects either at cell wall, membrane level or in the cytoplasm, including increased photosynthesis and respiration rates in plants, enhanced protein synthesis and plant hormone activity (Chen and Aviad, 1990). Humic substances may possibly enhance the uptake of minerals through the stimulation of microbiological activity (Mayhew, 2004). When adequate humic substances are present within the soil, the requirement for nitrogen, phosphorus and potassium fertilizer applications may be reduced (Pettit, 2004). Humic substances are major components of organic matter, often constituting 60 to 70% of the total organic matter (Schnitzer and Khan, 1972).

The aim of this experiment was to study the influence of using different levels from NPK recommendation for common bean in the presence of humic acid on improving growth, dry seed production and its quality as well as minimizing adding high levels of menial fertilizers.

MATERIALS AND METHODS

This study was conducted during the two summer seasons of 2013 and 2014 under the field conditions of the Experimental Kaha Farm, Horticulture Research Institute, Agriculture Research Center (A.R.C.), Qaliobia Governorate. A random soil samples were taken before planting for chemical and mechanical analysis as described by Chapman and Pratt (1961) and Jackson (1965) .The soil farm characterized with clay loam soil texture with the physical and mechanical analysis were shown in Table (1).

Table 1. Soil chemical and mechanical analysis of Kaha Research Farm in season 2013.

PH	E.C (dS/ m)	$CaCO_3$ %	Soluble cations (M/L)				Soluble anions (M/L)				Macr`o elements (ppm)			Micro elements (ppm)			
			Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	CO_3^{-2}	HCO^{-3}	Cl^{-2}	SO_4^{-2}	N	P	K	Fe	Cu	Zn	Mn
8.4	0.39	3.6	1.0	0.65	2.19	0.48	-	1.9	0.9	1.5	48	3.9	58.8	4.1	2.8	1.75	2.7

The experiment included 10 treatments i.e. two cultivars of common bean; Nebraska as a dry yield cultivar and Bronco as a green yield cultivar but it cultivated for dry seed yield production within 5 fertilizer levels application as follows:

1-Control (100% of PNK recommendation) without adding humic acid.
2-Humic acid (HA) +0 NPK (using humic acid only without adding NPK).
3-HA+ 50% of NPK recommendation.
4-HA+75% of NPK recommendation.
5-HA+100% of NPK recommendation.

All studied treatments were laid out in a split plot design with four replicates; common bean cultivars were arranged in the main plots while, the levels of NPK fertilizers with humic acid application were served in sub-plots .The plot area was $12m^2$, it included 5 ridges, each ridge of 0.6m width and 4 m length .Seeds of common bean were sown at 20^{th} of February in both seasons in hills on one side of the ridge at 7 cm a part. NPK fertilizers were added to the soil in the forms of ammonium sulphate (20.5%N),calcium super phosphate (15.5% P_2O_5) and potassium sulphate. (48% K_2O) respectively. The recommendation of 100% NPK was (200kg of ammonium sulphate +200kg calcium super phosphate +100kg potassium sulphate), 75% of NPK recommendation was (150 kg of ammonium sulphate +150kg calcium super phosphate +75kg potassium sulphate) and 50% of NPK recommendation was (100kg of ammonium sulphate +100kg calcium super phosphate +50kg potassium sulphate. Whereas, Humic acid was mixed by sand and added to the soil before sowing with the rate of 12 Kg/Fedddan in powder form.

The other agricultural practices were conducted as the recommendation of the Egyptian Ministry of Agriculture.

Data recorded:

1-Vegetative growth characteristics:

At flowering stage (50 days after seed sowing), five plants were randomly taken from each experimental plot to evaluate vegetative growth characteristics i.e. plant height (cm) ,number of leaves/plant , leaf area (cm^2) and the total fresh as well as dry weight/plant (g). The plant organs of foliage (leaves, stems and branches) were dried at 70 C^o till constant weight and then the dry weight/plant was evaluated.

2-Dry seed yield and its components:

At full seed ripening stage (120 days after sowing), a random sample of 5 plants were taken from each plot to estimate dry seed yield components i.e. number of dry pods/plant, number of dry seeds/pod, dry seed weight/pod (g), seed index (100 seeds weight g), Shell out and dry seed yield (g/plant), while the total dry seed yield /fed was calculated through dry seed yield per plot.

Shell out of dry pods (%) was calculated using the following equation:

$$\text{Shell out of dry pods (\%)} = \frac{\text{Weight of dry seeds}}{\text{Weight of dry pods}} \times 100$$

3- Chemical composition of dry seeds:

Total N, P and K as well as protein content of dry seeds were evaluated. Protein content was calculated by multiplying N% with 6.25. Total nitrogen was determined according to Pregl (1945) using micro-kildahel method. Phosphorus was estimated colorimetrically due to the method described by Murphy and Riley (1962) as modified by John (1970). Potassium was determined flame photo-metrically as described by Brown and Lillelond (1946).

4-Seed germination tests:

Common bean dry seeds were treated with Tobsen fungicide then put it in filter paper inside germination incubator at 25 C^o and the germination tests were calculated i.e. Germination % and Germination rate as follows:

$$\text{Germination \%} = \frac{\text{No. of germinated seeds}}{\text{No. of sown seeds.}} \times 100$$

$$\text{Germination rate} = \frac{(G1 \times N1) + (G2 \times N2) + \ldots\ldots(Gn \times Nn)}{G1 + G2 + \ldots\ldots Gn}$$

Where: G = Number of germinated seeds in certain day, N = Number of this certain day

5-Economic study:

Economic study was performed based on the total net return, was calculated with the respect market price multiplying mean of the two seasons on total dry seed yield (kg/ fed.) × Price of sell one kg of common bean dry seed yield – costs of treatments / one fed. (Egyptian Pound) as well as total net return with Egyptian Pound /fed.

6-Statistical analysis:

A split plot design was adopted of the experiment using 4-replicates. Common bean cultivars were arranged in the main plots while, fertilizer application were served in sub-plots.

The obtained data were recorded on plot basis and statistically analyzed were done according to the methods of split plot design described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1. Vegetative growth characteristics:

Data presented in Table (2) showed the differences between common bean cultivars i.e. Nebraska and Bronco on vegetative growth characteristics expressed as plant height, number of leaves, leaf area as well as fresh and dry weight/plant.

Such data showed that, all plant vegetative growth characteristics were increased in the case of using cv. Nebraska in both seasons as compared with cv. Bronco. This increment was significant in all tested parameters in both seasons except leaf area which was significantly increased only in the second season.

Regarding to the effect of fertilizer levels application on vegetative growth characteristics, such data in Table (2) revealed that fertilizing common bean plants with humic acid (HA) at 12kg/fed and 50% of NPK recommendation led to a significant increases in the all growth parameters as compared with the control (100% NPK recommendation without HA) in both seasons and the same treatment was also the superior than the other treatments in the all studied parameters.

According to the interaction effect between cultivars and fertilization treatments on vegetative growth characteristics, data in Table (3) indicated that adding humic acid and 50% from the recommendation of NPK gave the highest values of all tested parameters in the two cultivars, whereas, the superior treatment was obtained by fertilizing common bean with humic acid and 50% NPK with cv. Nabraska compared with cv. Bronco with the all fertilization treatments in both seasons.

In this concern, the superiority of adding humic acid and 50% of NPK with cv. Nabraska significantly increased plant height and fresh weight/plant in both seasons, while, leaf area and dry weight/plant were significantly increased only in one season. On the other hand, number of leaves/plant doesn't show any significant increases in both seasons.

The increment in growth parameter may be due to that HA are extremely important component led to constitute stable fraction of carbon, thus regulating the carbon cycle and release of nutrients, including nitrogen, phosphorus, and sulfur which decreasing the need for mineral fertilizer for plant growth.

Humic acid stimulate plant growth by the assimilation of major and minor elements, enzyme activation and/or inhibition, changes in membrane permeability, protein synthesis and finally the activation of biomass production (Ulukan, 2008).

The obtained results on the improving effect of HA and NPK application on vegetative growth characteristics are in agreement with those reported by Muharremkaya *et al.*,(2005) and Zaki *et al.*,(2006) on common bean they found that plant height was markedly increased by spraying plants with humic acid. Also, El-Ghamry *et al.*,(2009) on faba bean pointed out that adding humic acid at 2000 ppm significantly increased plant height, number of leaves and branches/plant. Furthermore, Büyükkeskin *et al.*, (2015) on broad bean illustrated that adding HA increased fresh and dry weight/plant. Moreover, Gad El-Hak *et al.*,(2012) on pea mentioned that plant height, number of branches and dry weight/ plant obviously show highest values by spraying pea plants with humic acid at the high rate of 2.0 g/L .Similar results were obtained by Senesi and Loffredo (1994) on pea and Neri *et al.*,(2002) on cowpea.

Table 2. Vegetative growth of common bean as affected by cultivars and NPK levels with humic acid applications during the two seasons of 2012 and 2013.

Seasons / Treatments	1st season					2nd season				
	Plant height (cm)	**No. of leaves/ plant**	**Leaf area (cm^2)**	**Fresh weight (g/plant)**	**Dry weight (g/plant)**	**Plant height (cm)**	**No. of leaves/ plant**	**Leaf area (cm^2)**	**Fresh weight (g/plant)**	**Dry weight (g/plant)**
Cultivars										
Nebraska	44.45	15.78	533	47.33	16.3	54.65	11.78	625.09	52.99	16.25
Bronco	39.36	11.55	523.6	35.54	15.96	48.00	9.95	611.18	47.99	15.1
L.S.D at 0.05	2.34	3.18	N.S	5.11	N.S	2.98	1.8	7.04	1.24	0.84
Fertilizer application										
Control (100% of NPK)	40.31	12.69	496.64	44.09	15.37	51.85	10.58	540.26	48.5	16.63
HA+0 NPK	38.65	12.63	369.65	32.14	14.45	49.45	9.67	393.59	43.17	13.63
HA+50% NPK	45.54	15.04	628.84	50.04	17.43	55.02	12.17	799.74	58.37	17.00
HA+75% NPK	41.69	13.91	566.56	39.44	16.43	49.53	10.46	700.34	51.33	15.5
HA+100% NPK	43.34	14.06	579.96	41.49	16.97	50.78	11.47	656.76	51.11	15.63
L.S.D at 0.05%	3.89	2.11	70.04	11.76	N.S	4.55	1.92	33.62	4.16	1.7

HA: Humic aid Control: 100% of NPK fertilizer recommendation for common bean.

Table 3. Vegetative growth of common bean as affected by the interaction between cultivars and NPK levels with humic acid during the two seasons of 2013 and 2014.

	Seasons / Treatments	1st season					2nd season				
		Plant height (cm)	**No. of leaves/ plant**	**Leaf area (cm^2)**	**Fresh weight (g/plant)**	**Dry weight (g/plant)**	**Plant height (cm)**	**No. of leaves/ plant**	**Leaf area (cm^2)**	**Fresh weight (g/plant)**	**Dry weight (g/plant)**
Nebraska	Control(100% of NPK)	43.75	15.00	530.3	42.30	16.05	54.16	11.65	490.3	52.50	14.00
	HA+0 NPK	41.50	14.12	456.5	36.23	14.75	52.53	10.83	382.9	46.16	13.50
	HA+50% NPK	46.32	17.75	635.3	60.95	17.47	58.98	12.41	772.3	59.41	17.00
	HA+75% NPK	45.06	16.80	552.6	48.83	16.93	55.87	11.91	734.3	53.83	16.00
	HA+100% NPK	45.30	16.25	541.8	45.32	16.96	54.06	12.11	645.7	53.30	15.00
Bronco	Control (100% of NPK)	36.87	11.25	464.9	35.88	14.67	49.52	9.65	491.7	44.50	13.75
	HA+0 NPK	35.75	10.37	378.4	28.05	14.12	46.50	8.50	404.3	40.18	13.00
	HA+50% NPK	44.25	12.63	622.4	38.62	18.11	53.03	11.91	727.2	57.33	16.80
	HA+75% NPK	38.30	11.75	580.5	37.53	15.92	47.23	9.00	666.4	48.83	16.50
	HA+100% NPK	41.37	11.87	567.6	37.61	16.97	52.16	10.83	667.8	49.16	16.25
	L.S.D at 0.05%	3.31	N.S	8.7	1.63	2.28	1.55	N.S	9.9	1.13	N.S

HA: Humic aid Control: 100% of NPK fertilizer recommendation for common bean.

2-Dry seed yield and its components:

The differences between common bean cultivars in dry seed yield and its components i.e. number of dry pods/plant, number of dry seeds/pod, dry seed weight/pod, shell out, seed index and dry seed yield/plant as well as per fed are presented in Table (4). Data indicated that, all dry seed yield components were increased with cv. Nebraska compared with cv. Bronco and this increment were significant in seed index (100 seeds wt.) and dry seed yield per plant as well as per fed. as a general trend in both seasons. Whereas, Number of seeds/pod and shell out were significantly increased only in one season. However, data also showed that cultivars did not affect on number of pods/plant in both seasons.

Concerning with dry seed yield and its components as affected by fertilizer application i.e. NPK fertilizer levels in the presence of humic acid, data in Table (5) revealed that fertilizing common bean plants with humic acid +50% of NPK gave the higher dry seed yield than that of plants fertilized with the other treatments or the control.

In this concern, dry seed yield and its components; seed index, dry seed yield/plant and per fed were significantly increased by adding HA and 50% of NPK in both seasons. Meanwhile, number of dry pods/plant, number of dry seeds/pod and shell out were significantly affected only in one season. Whereas, the increases in these characters not reach to the significant level in the other season.

Regarding to the interaction effect between cultivars and adding some levels of NPK with humic acid on common bean dry seed yield and its components, data in Tables (6a, b) showed that the highest dry seed yield with the best components were obtained by adding humic acid and 50% NPK either with Nebraska or Bronco cultivars but it increased cv. Nebraska than Bronco. It can be consider that this treatment was the superior treatment to produce high dry seed yield with good quality of seeds. This treatment led to significant increases in seed index, shells out and dry seed yield/plant as well as per fed as shown in both seasons. While, number of dry pods/ plant and number of seeds/ pod were significantly increased only in one season. In addition, this treatment, i.e. HA+50% NPK recommendation led to save 50% of NPK for common bean fertilizer requirements.

The favorable effect of using this treatment in dry seed yield production could be referred to that Humic substances may possibly enhance the uptake of minerals through the stimulation of microbiological activities (Mayhew, 2004). When adequate humic substances are present within the soil, the requirement for nitrogen, phosphorus and potassium fertilizer applications may be reduced (Pettit, 2004). Also, Humic substances will maximize the efficient use of residual plant nutrients, reduce fertilizer costs, and help release those plant nutrients presently bound in minerals and salts.

The obtained results are in harmony with those of Saruhan *et al.,* (2011) on common millet, they found that humic acid treatments raised the yield and its components. Waqas *et al.,*(2014) on mung bean mentioned that HA application methods significantly affected on the grain yield. Highest grain yield was produced by HA soil application at the rate of 3 kg/ha, followed by HA soil application at the rate of 2 kg/ha. Also, Gad El-Hak *et al.,*(2012) on pea, noticed that dry seed yield and its components, i.e. seed weight/pod, 1000 seeds wt. , shill out % and dry seed yield were significantly increased by foliar application of humic acid during two seasons. El-Ghamry *et al.,*(2009) on faba bean demonstrated that spraying faba bean plants with HA (2000 ppm) + AA (2000 ppm) significantly improved number of pods/plant and 100-seeds weight. Moreover, Azarpour *et al.*(2011) on cowpea illustrated that the foliar spraying of humic acid increased dry seeds and its components.

Table 4. Dry seed yield and its components of common bean as affected by cultivars during the two seasons of 2013 and 2014

Treatments	No. of pods/plant	No. of seeds/pod	Seed index 100 seeds wt. (g)	Shell out	Dry seed yield (g/plant)	Dry seed yield (kg/fed)
			1st season			
Nebraska	10.17	3.76	48.8	85.79	31.40	895.1
Bronco	9.68	2.67	15.79	75.85	13.81	421.1
L.S.D at 0.05%	N.S	N.S	1.96	2.99	7.97	19.27
			2nd season			
Nebraska	9.53	4.21	49.17	74.89	29.71	946.1
Bronco	9.29	3.09	16.86	73.60	16.40	499.8
L.S.D at 0.05%	N.S	0.4	1.97	N.S	2.64	45.25

Table 5. Dry seed yield and its components of common bean as affected by some NPK fertilizer levels with humic acid during the two seasons of 2013 and 2014.

Treatments	No. of pods /plant	No. of seeds/pod	Seed index 100 seeds wt. (g)	Shell out	Dry seed yield (g/plant	Dry seed yield (kg/fed)
			1st season			
Control (100% of NPK)	9.63	3.65	30.72	81.06	20.80	733.8
HA+0 NPK	9.20	3.00	30.49	79.97	20.26	711.7
HA+50 %NPK	10.47	4.04	36.25	86.28	28.06	882.6
HA+75% NPK	10.06	3.79	32.92	80.85	22.40	855.8
HA+100% NPK	9.85	3.84	33.10	80.92	21.52	856.8
L.S.D at 0.05%	N.S	0.29	3.31	N.S	2.02	49.54
			2nd season			
Control (100% of NPK)	9.23	3.49	32.15	78.20	22.84	722.9
HA+0 NPK	8.43	3.39	31.24	74.20	20.68	679.4
HA+50 %NPK	11.06	4.97	35.10	84.65	25.04	853.4
HA+75% NPK	9.51	4.63	32.75	81.91	23.48	801.3
HA+100% NPK	9.85	4.28	33.85	80.79	23.24	819.9
L.S.D at 0.05%	1.38	N.S	2.15	2.89	2.94	55.11

Table 6 a. Dry seed yield and its components of common bean as affected by the interaction between cultivars and some NPK fertilizer levels with humic acid during the first season of 2013.

Treatments		No. of pods/plant	No. of seeds/pod	Seed index 100 seeds wt. (g)	Shell out	Dry seed yield (g/plant)	Dry seed yield (kg/Fed)
Nebraska	Control(NPK)	9.75	3.60	47.58	84.79	28.60	855.1
	HA+0 NPK	8.75	3.13	46.58	82.40	26.95	821.3
	HA+50% NPK	10.20	4.11	51.75	88.87	30.18	919.8
	HA+75% NPK	9.81	3.68	49.56	85.65	29.37	895.0
	H+100% NPK	9.75	4.02	50.84	86.21	29.94	912.4
Bronco	Control(NPK)	9.88	3.70	14.89	74.90	13.57	413.6
	HA+0 NPK	9.65	3.46	13.72	71.29	12.55	388.9
	HA+50% NPK	11.18	4.96	17.75	77.69	14.61	445.3
	HA+75% NPK	10.75	4.57	16.29	77.05	13.67	426.7
	H+100% NPK	10.25	4.66	15.36	75.30	13.65	419.0
L.S.D at 0.05%		N.S	0.27	N.S	N.S	11.27	27.25

Table 6 b. Dry seed yield and its components of common bean as affected by the interaction between cultivars and some NPK fertilizer levels with humic acid during the second season of 2014.

Treatments		No. of pods/plant	No. of seeds/pod	Seed index 100 seeds wt. (g)	Shell out	Dry seed yield (g/plant)	Dry seed yield (kg/Fed)
Nebraska	Control(NPK)	9.23	2.91	48.40	73.84	29.51	899.3
	H+0 NPK	7.70	2.76	47.42	71.66	27.34	833.2
	H+50% NPK	11.08	3.42	50.89	76.64	32.08	977.6
	H+75% NPK	10.00	2.98	47.77	75.60	30.17	919.1
	H+100% NPK	10.31	3.25	49.60	76.67	30.00	901.8
Bronco	Control(NPK)	9.21	4.12	16.18	71.56	16.18	493.1
	H+0 NPK	7.16	4.02	14.83	69.95	14.02	437.2
	H+50% NPK	10.78	4.54	19.31	76.73	18.00	548.6
	H+75% NPK	9.62	4.27	16.87	72.13	16.79	511.6
	H+100% NPK	9.38	4.25	17.80	74.71	17.00	518.0
L.S.D at 0.05%		N.S	N.S	N.S	N.S	3.73	63.99

3- Chemical composition of dry seeds:

Data on the differences between the common bean cultivars in its chemical composition of dry seeds are presented in Table (7), data showed that N, P and K as well as crude protein (%) of dry seeds were increased in cv. Nebraska compared with Bronco cultivar. Such data also indicated that the increment in K% content was significant in both season .whereas, N, P and crude protein content were significantly increased only in one season.

As for the effect of fertilizer application on N, P, K contents and crude protein of common bean dry seeds, results in the same Table (7) revealed that fertilized common bean plants with humic acid +50% of NPK improved N, P, K and crude protein content of dry seeds than the control. This improvement was significant in both tested seasons.

Regarding with the response of common bean cultivars to NPK fertilizer levels application on the chemical composition of dry seeds, data Table in (8) clearly illustrated that fertilizing common bean plants with HA +50% from recommended NPK gave the highest values of N, P, K and crude protein content in common bean dry seeds compared with the other tested treatments during both seasons. It can be also said that, cv. Nebraska was more responses to this treatment than cv. Bronco. In addition, the superior treatment i.e. HA +50% from NPK recommendation with cv. Nebraska led to a significant increment in P % in both seasons While, N, K and crude protein were significantly increased only in one season.

The promotive effect of adding humic acid +50% from NPK recommendation may be referred to when adequate humic substances present within the soil, the requirement for nitrogen, phosphorus and potassium fertilizer applications may be reduced (Pettit, 2004) . Humic substances are major components of organic matter often constitute 60-70% of the total organic matter. Humic substances have a very profound influence on the growth of plant roots. When humic acids and fulvic acids are applied to the soil, they enhancement of root initiation and increased root growth which observed by (Pettit, 2004). The stimulatory effects of humic substances have been directly correlated with enhancing uptake of menirals, such as nitrogen, phosphorus and sulfur (Chen and Aviad, 1990) and micronutrients, such as Fe, Zn, Cu and Mn.

The encourage effect of adding the superior treatment; HA+50% of NPK recommendation on N, P, K and crude protein % in common bean dry seeds is in agreement with results obtained by Muharrem Kaya *et al.*, (2005); Zaki *et al*., (2006); Saruhan *et al* (2011) and Waqas *et al*., (2014) on common bean they found that N, P and K content of dry seeds were markedly increased by spraying plants with humic acid. Also, El-Ghamry *et al.*,(2009) on faba bean they indicated that adding humic acid at 2000 ppm significantly increased N, P and crude protein of faba bean seeds. Furthermore, Büyükkeskin *et al*.,(2015) on broad bean reported that adding HA increased the content of N, P and K of broad bean seeds. Moreover, Gad El-Hak *et al*.,(2012) working on pea, they mentioned that N, P, K % obviously show highest values by spraying pea plants with humic acid at the high rate of 2.0 g/L .Similar results were obtained by Senesi and Loffredo (1994) on pea and Neri *et al.*,(2002) and El-Hefny (2010) on cowpea.

Table 7. N, P, K and protein % contents of common bean dry seeds as affected by cultivars and some NPK fertilizer levels with humic acid applications during the two seasons of 2013 and 2014.

Seasons	1st season				2nd season			
Treatments	**N%**	**P%**	**K%**	**Protein%**	**N%**	**P%**	**K%**	**Protein%**
Cultivars								
Nebraska	3.67	.725	1.64	22.92	3.68	0.746	1.66	23.03
Bronco	3.53	.689	1.56	22.04	3.56	0.719	1.58	22.24
L.S.D at 0.05%	.12	N.S	.07	.65	N.S	N.S	.46	N.S
Fertilizer application								
Control (100% of NPK)	3.37	.609	1.34	21.09	3.43	0..691	1.52	21.47
H+0 NPK	3.21	0.609	1.33	20.07	3.23	0.674	1.36	20.22
H+50% NPK	3.90	0.795	1.82	24.39	3.92	0.797	1.83	24.41
H+75% NPK	3.77	0.729	1.65	23.54	3.80	0.742	1.69	23.67
H+100% NPK	3.73	0.734	1.66	23.33	3.73	0.760	1.70	23.40
L.S.D at 0.05%	.73	.03	.04	.46	.09	.43	.06	.57

Table 8. N, P, K and protein % of common bean dry seeds as affected by the interaction between cultivars and some NPK fertilizer levels with humic acid during the two seasons of 2013 and 2014

	Seasons	1st season				2nd season			
Treatments		**N%**	**P%**	**K%**	**Protein%**	**N%**	**P%**	**K%**	**Protein%**
Nebraska	Control (100% of NPK)	3.52	.691	1.58	22	3.58	.705	1.6	22.35
	H+0 NPK	3.29	.646	1.39	20.58	3.35	.682	1.42	20.96
	H+50% NPK	3.9	.81	1.86	24.91	3.96	.812	1.87	2474
	H+75% NPK	3.81	.73	1.71	23.78	3.8	.760	1.72	23.77
	H+100% NPK	3.74	.746	1.66	23.36	3.75	.777	1.73	23.48
Bronco	Control (100% of NPK)	3.23	.637	1.43	20.18	3.3	.678	1.48	20.61
	H+0 NPK	3.13	.574	1.28	19.56	3.12	.664	1.33	19.5
	H+50% NPK	3.82	.78	1.8	23.89	3.86	.782	1.8	24.17
	H+75% NPK	3.74	.73	1.63	23.3	3.77	.726	1.67	23.58
	H+100% NPK	3.77	.724	1.68	23.32	3.73	.744	1.68	23.37
	L.S.D at 0.05	N.S	0.06	N.S	N.S	0.09	0.03	0.06	0.57

4- Seed germination tests:

Regarding to the behaviour of seed germination tests as affected by common bean cultivars, i.e. seed germination ratio (%) and germination rate are shown in Table (9). Such data revealed that either cvs. Nebraska or Bronco did not differ significantly by both seed germination ratio and rate and the differences between the two cultivars in this concern don't show any significant responses in both seasons.

As for the influence of some NPK levels with humic acid application on seed germination ratio and rate, it can be notice from the data Table (9) that adding HA+50% from NPK recommendation for common bean plants led to an increase in seed germination ratio compared with the other treatments and the control. In this concern, the increment in seed germination ratio % was positive and significant in both seasons. While, there was non significant values in germination rate in both seasons.

According to the interaction effect between cultivars and NPK fertilizer levels with humic acid application on seed germination ratio and rate, data Table (10) obviously showed that, the plants of cv. Nebraska received humic acid +50% of NPK fertilizer recommendation gave the highest values in both seed germination ratio and rate .This treatment led to a significant increases in germination ratio in both seasons .While, the germination rate did not reach to significant level in both tested seasons.

Table 9.Germination ratio (%) and germination rate (day) of common bean dry seeds as affected by cultivars and some NPK fertilizer levels with humic acid applications during the two seasons of 2013 and 2014

Seasons	1st season		2nd season	
Treatments	**Germination ratio (%)**	**Germination rate**	**Germination ratio (%)**	**Germination rate**
Cultivars				
Nebraska	94.4	2.16	96.00	2.13
Bronco	90.4	2.2	93.00	2.14
L.S.D at 0.05%	.N.S	N.S	N.S	N.S
Control (100% of NPK)	92.5	2.22	95.5	2.16
Fertilizer application				
HA+0 NPK	89.5	2.12	91.50	2.17
HA+50% NPK	95.5	2.15	97.50	2.16
HA+75% NPK	93.0	2.20	94.50	2.17
HA+100% NPK	91.5	2.21	93.50	2.16
L.S.D at 0.05	5.26	N.S	5.04	N.S

Table 10. Germination ratio (%) and germination rate (day) of common bean dry seeds as affected by the interaction between cultivars and some NPK fertilizer levels with humic acid during the two seasons of 2013and 2014.

Treatments	Seasons	1st season Germination ratio (%)	1st season Germination rate	2nd season Germination ratio (%)	2nd season Germination rate
Nebraska	Control (100% NPK)	94	2.14	97	2.21
	H+0 NPK	93	2.1	94	2.09
	H+50% NPK	97	2.22	98	2.15
	H+75% NPK	95	2.17	96	2.15
	H+100% NPK	93	2.3	93	2.2
Bronco	Control (NPK)	91	22	94	2.17
	H+0 NPK	86	2.15	89	2.12
	H+50% NPK	94	2.08	97	2.06
	H+75% NPK	91	2.34	93	2.2
	H+100% NPK	90	2.13	91	2.12
	L.S.D at 0.05	5.3	N.S	N.S	N.S

5-Economical study:

Table 11. Economical studies of NPK fertilization and humic acid application.

Treatments.	Fertilizer coasts L.E/fed.	Average total dry seed yield (kg/ fed.)	Total income with Egyptian pound	net income with Egyptian pound	Ranking of treatments
Control (100% of NPK)	1020	728.35	18208.75	17188.75	4
H+0 NPK	480	695.55	17388.75	16908.75	5
H+50 %NPK	480+510=990	868.0	21700	20710	1
H+75% NPK	480+765=1245	838.35	20958.75	19713.75	2
H+100% NPK	480+1020=1500	828.55	20713.75	19213.75	3

Where:

The price of one package from ammonium sulphate, 50kg=80 L.E

The price of one package from calcium super phosphate, 50kg =50 L.E

The price of one package from potassium sulphate, 50kg =250 L.E

The price of one kg from humic acid=30 L.E then, the price of 12 kg from humic acid=40×12=480 L.E

The cost of 100% NPK recommendation (200kg of ammonium sulphate +200kg calcium super phosphate +100kg potassium sulphate)= (4×80) + (4×50) + (2×250) =320+200+500=1020L.E.

The cost of 75% NPK recommendation (150 of ammonium sulphate +150kg calcium super phosphate +75kg potassium sulphate = (3×80) + (3×50) + (1.5×250) =240+150+375=765L.E

The cost of 50% of NPK recommendation (100kg of ammonium sulphate +100kg calcium super phosphate +50kg potassium sulphate) = (2×80) + (2×50) + (1×250) =160+100+250=510L.E

The price sell of one kg from common bean dry seed=25 L.E

According to the economical point of view it could be concluded from the previous Table that, plants fertilized with humic acid +50% of NPK fertilizer recommendation of common bean required (100kg of ammonium sulphate +100kg calcium super phosphate +50kg potassium sulphate) +12kg of humic acid had coasted 990 L.E . This treatment produced 868.0kg of dry seed yield /fed. as an average for the two seasons, its price sell 21700 L.E and it produced 20710 L.E of net income.

CONCLUSION

Regarding to the results of this study, it can be concluded that fertilizing common bean plants cv. Nebraska as a type of dry seed yield or cv. Bronco as a type of green yield but it cultivated in this experiment for the purpose of seed production, it could be recommended that fertilizing common bean plants with humic acid at the rate of 12kg/fed +50% from NPK recommendation) in order to increase plant growth, dry seed yield/fed and improve yield components. These treatments also led to save 50% of the NPK for common bean requirements.

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دراسه علي بعض العوامل التي تؤثر علي المحصول البذري ومكوناته في الفاصوليا.

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اجريت هذه التجربه لدراسه تأثير التسميد بمستويات مختلفه من عناصر النيتروجين والفوسفور والبوتاسيوم وهذه المستويات هي (صفر,٥٠%,٧٥%, ١٠٠%) من السماد المعدني الموصي به لتسميد الفاصوليا بالاضافه لاضافه حمض الهيوميك بمعدل ١٢كجم/فدان اثناء تجهيز التربه وتاثير ذلك علي النمو الخضري والمحصول البذري الجاف ومكوناته وجوده البذور الجافه وكذا المحتوي الكيميائي لبذور الفاصوليا صنفي نبراسكا وبرونكو وقد تم اجراء التجارب بمزرعه بحوث قها التابعه لمعهد بحوث البساتين –مركز البحوث الزراعيه بمحافظه القليوبيه- مصر خلال الموسمين الصيفيين ٢٠١٣ و٢٠١٤ .
وقد اوضحت النتائج ان اضافه حمض الهيوميك مع مستوي ٥٠ % من السماد المعدني الموصي به لنباتات الفاصوليا لكل من صنف نبراسكا وايضا صنف برونكو والذي تم زراعته تحت هذه الدراسه بغرض انتاج التقاوي. كما ادي الي الحصول علي اعلا قيم لصفات النمو الخضري المدروسه والمحصول البذري ومكوناته وكذلك المحتوي الكيميائي له وقد أدت هذه المعاملة أيضا إلي توفير ٥٠% من كميه السماد المعدني الموصي به للفاصوليا.