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Effects of Different Biogas Manures and Their Extracts on Dry Matter Yield and Nutrients Uptake by Faba Bean *(vicia faba* l.*)* Grown on Sandy Soil Conditions.

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Abstract

The current study evaluates the feasibility of amending a sandy soil with three different types of biogas manure (cattle dung alone BMC, cattle dung + jaw's mallow wastes BMJ and cattle dung + mango wastes BMM) and their extractions (potassium humate HK, humic acid HA and fulvic acid FA) at two different rates (2 and 4%) to increase NPK uptake by faba bean plants and enhance their growth. To attain this aim, a pot experiment was conducted for 60 days during the winter season of 2019 following a randomized complete block design (RCBD). A control treatment, that received the recommended dose of NPK mineral fertilizers, was also considered for data comparison. Results reveal that the BMC biogas manure recorded the highest increases in faba bean dry weights (6.40g/pot) comparing with the results of other biogas manures. Generally, biogas manures seemed to be more efficient than their extracts on improving NPK uptake by plants and hence increase plant dry weights. Moreover, increasing the rate of application from 2 to 4% recorded further significant increases in this concern. On the contrary, BMM biogas manure was the least efficient organic treatment that increased faba bean growth when applied at a rate of 2% (4.72 g/pot). Thus, it can be deduced that different biogas manures enhanced the uptake of N P K by plants and increased their growth vs the control, especially when applied at a rate of 4%; yet the behavior of the organic amendments in soil varied considerably among the source of the organic amendment**.**

Keywords: Biogas manures, nutrients uptake, faba bean, sandy soil.

Introduction

Legume plants play key roles in sustainable agriculture **(Jia and Gray, 2008).** Faba bean (*Vicia faba* L.), in particular, is one of the most important legumes in Egypt **(Cazzato et al., 2012)** and probably in many areas around the world **(Crepon et al., 2010 and Boghdady etal., 2017)**. Its symbiotic relation with N-fixers can raise nitrogen content within different plant parts **(Franche et al., 2009)**, especially protein in grains **(Denton et al., 2013)**. These grains are consumed by both human and animals **(Altuntaş and Yıldız, 2007)** while crop residues can be used for fodder, silage purposes and to produce green manure **(Sharaan et al., 2004; McVicar *et al.*, 2013; and Nasser *et al.*, 2016).**

Organic matter (OM) is the life of soil **(Reddy and Reddi, 1992)** because it acts as a reservoir for macro- (N, P, K) and micro-nutrients **(Farid et al., 2014 and 2018; Elshony et al., 2019).** Also, organic amendments lessen nutrients losses by leaching from the top soil **(Buckman and Brady, 1980; Pardo et al., 2014)**. Accordingly, it is recommended to amend soils with organic amendments to increase their fertility and supply plants with nutrient needed for their growth **(Gomaa. and Attia, 1998 and Rizk and Shafeek, 2000)** e.g. faba beans **(Mohamed, 2001)** and wheat **(Farid et al., 2014).** Moreover, organic amendments may effectively control soil-borne diseases and pests **(Lazarovits et al., 2001; McSorley, 2011),** stimulate the activities of beneficial microbes **(Liu et al., 2009)** and increase plant tolerance to water stress **(Quilty and Cattle, 2011).** Generally, organic amendments (OA) can be categorized into two main groups: (1) compost-based amendments that include composts, vermicomposts, and their teas and (2) non-compost-based ones include biostimulants such as humic extracts and seaweed extracts **(Du Jardin, 2015 and Macdonald et al., 2018).** These amendments are used commercially in plant production worldwide **(Ameri and Tehranifar, 2012)**. Biogas is one of the most economically viable and environmentally friendly renewable energy resources **(Deublein and Steinhauser, 2011).** It is produced during anaerobic digestion (AD) of organic materials through multiple complicated biochemical reactions **(Rajaeifar et al., 2017).** The current study considers the production biogas from different sources i.e. cattle dung alone and/or food preserving industry wastes to study their impacts on plant growth. We assume that the outcomes of the investigated organic amendments vary considerably according to the sources of these amendments. In case of cattle dung, it compost can positively improve growth parameters of different plants **(Boghdady et al., 2017),** The ability of humic substances to improve plant growth and development is widely investigated by many researchers (**Olaetxea et al., 2019)** and humic acid, in particular, can induce plant resistance against soil borne pathogens **(Eid et al., 2019)**.

Large volumes of solid wastes are generated annually during food processing industry and these wastes present one of the serious problems in developing countries **(Ozmen and Aslanzadeh, 2009)**. According to the **FAO (2019)**, about 33% of the human food, (≈ 1.3 billion tons), is wasted annually worldwide. Production of food wastes occurs during all stages of food supply, including agricultural processing, sorting, storing, transporting, distributing, selling, preparing, cooking, and serving **(Xu et al., 2018).** These wastes are thought to have direct economic consequences of about US$ 750 billion annually **(Santos et al., 2020).** Finally, future challenges and prospects of biogas production from food wastes are promising **(Mirmohamadsadeghi et al., 2019).**

The aim of the current work is to study the effects of three types of biogas manures (cattle dung alone BMC, cattle dung + jaw's mallow processing wastes BMJ and cattle dung + mango processing wastes BMM) as well as their extracts (potassium humate- humic acid – fulvic acid) amended at 2 different rates (2 and 4%) on faba bean yield and NPK uptake by plants grown on a low fertile sandy soil.

3.1- Materials and Methods:

3.1.1-Soil of study: -

Surface soil samples (0-30 cm depth) were collected from El-Dair, Qalubia Governorate, Egypt. These samples were air dried, finely grounded to pass through a 2mm sieve then thoroughly mixed to be homogenous and stored in plastic bags for experimental work., Chemical and physical properties of soil were investigated aa outline by **Page et al. (1982)** and **Klute (1986)** and the results are presented in Table 1.

Table 1. Chemical and physical properties of the investigated soil.

pH (1:2.5)		**EC (dS/m)**		**O.M (g/kg)**
7.85		1.20		0.43
Soluble Ions (mmolc/L)				
Cations		**Anions**		
Ca^{2+}	5.6	**CO_3^{2-}**	0.00	
Mg^{2+}	3.6	**HCO^{3-}**	6.31	
Na^{+}	1.45	**Cl^{-}**	1.28	
K^{+}	1.35	**SO_4^{2-}**	4.41	
Available nutrients (mg/kg)				
N	**P**	**K**		
950	0.81	52.08		
Field capacity%	**Wilting point%**	**Available Water**		
13.1	6.24	6.86		
Particle size distribution (%)				
Sand	**Silt**	**Clay**	**Texture**	
89.20	4.65	6.15	Sandy	

Preparation of the different types of biogas manures.

Food industries wastes.

Food industry wastes (Jew's mallow and mango wastes) were collected from The United Company for Food Industry, Montana and Qaha food industries, Qalubia Governorate, Egypt. These wastes were air dried, chopped into small pieces (1-2 cm) before being used. Characteristics of the used organic residues are shows in Table 2.

Animal wastes.

Cattle dung was collected from the experimental station of faculty of agriculture at Moshtohor, Benha University. The animal wastes were air dried, shredded and prepared for an anaerobic fermentation experiment. Its characteristics are shown in Table 2.

Cuttle dung was then fermented for 60 days under anaerobic conditions either solely or in combination with food wastes mixed at a rate of 1:1) to attain the following (each treatment replicated twice):

1- Biogas manure produced from cattle dung alone (BMC).

2- Biogas manure produced from cattle dung alone + Jew's mallow (BMJ).

3- Biogas manure produced from cattle dung + mango processing wastes (BMM).

Analysis ofthree biogas manures produced from different raw materials as shown in Table 3.

Table 2. Chemical and physical analysis of raw materials in the study.

Type of analysis	Raw material		
	Cattle dung	Jew's mallow wastes	Mango wastes
PH (1:10)	7.30	6.5	6.18
EC dSm-1 (1:10)	4.15	2.51	3.85
NH_4—N mg kg^{-1}	444.46	184	116
NO_3—N mg kg^{-1}	24.70	78	32
Total-N %	1.61	1.13	1.05
Total-P %	0.75	0.60	0. 47
Total-K%	1.70	0.46	0.26
Organic matter%	58.41	73.50	95.0
Organic carbon%	33.88	42.6	55.1
C/N ratio	21.04:1	37.70:1	52.5:1
Total coliform cfu/g	35×10^3	31×10^3	29×10^3
Fecal coliform cfu/g	24×10^2	17×10^2	15×10^2
Salmonella and shigella cfu/g	12×10^2	11×10^2	7×10^2

Table 3. Physical, chemical and biological analyses for three different biogas manures after fermentation of the raw materials**.**

Type of analysis	Type of biogas manures		
	BMC	BMJ	BMM
PH (1:10)	7.51	8.27	7.39
EC dSm-1 (1:10)	3.75	2.72	2.25
NH4—N mg kg-1	250	336	403
NO3—N mg kg-1	521	580	648
Total-N %	1.64	1.79	2.11
Total-P %	0.52	0.98	0.91
Total- K %	0.73	0.32	0.33
Organic matter%	50.9	57.8	64
Organic carbon%	29.5	37.1	45.8
C\N ratio	18:1	20.7:1	21.7:1
Ash gkg-1	49.1	21.2	54.0
Total coliform cfu/g	nd*	nd*	nd*
Fecal coliform cfu/g	nd*	nd*	nd*
Salmonella and shigella cfu/g	nd*	nd*	nd*
Nematode larva	nd*	nd*	nd*
Parasitic	nd*	nd*	nd*
Weed seed	nd*	nd*	nd*

Note: nd: not detected, BMC: Cattel dung, BMJ: "Cattel dung + Jews mallow wastes" and BMM: "Cattel dung + Mango processing wastes".

Extraction and purification of humic and fulvic acids.

Extraction of humic and fulvic acids.

Extraction of humic substances was carried out according to the method described by **Sanchez – Monedero etal. (2002)**, as follow: humic substances were extracted from biogas manures by treating them with 0.5 *N* KOH solution. Precipitates were known as potassium humate while the supernatents were then acidified with HCl to reach pH 2.0, then left overnight. Humic acid precipitates were then separated from soluble fulvic acids by centrifuging at 6000 rpm for 15 minutes.

Humic acid purification.

Humic acid precipitates were washed several times with cold 0.05 *N* H_2SO_4 until the filtrate became colorless. Humic acid was then transferred to cellophane bags and dialyses against distilled water until the leachate became free of Cl^- ions, then humic acid was left to dry in air **(Chen et al., 1978).**

Fulvic acid purification

Purification of fulvic acid was carried out as described by **Kononova (1966) and Susilawti et al. (2007)** as follows: the supernatant containing fulvic acid was passed through activated charcoal followed by elution of charcoal. The solution was concentrated and then transferred to the membrane filter and electrodialysis to set the dialysate free from chloride. Elementary analysis of humic and fulvic acids extracted from different biogas manures are shown in Table 4.

Table 4. Elementary analysis of K-humate, humic acid (HA) and fulvic acid (FA) extracted from different samples.

	C%	N%	H%	O%	S%	C/N ratio	C/H Ratio	C/O Ratio	O/H Ratio	N/H Ratio
						K-humate				
BMC	48.4	2.86	3.35	4.79	40.6	16.9	14.4	10.1	1.42	0.85
BMJ	51.04	2.37	2.24	4.85	39.5	21.5	22.7	10.5	2.16	1.05
BMM	50.5	3.27	1.96	3.71	40.5	15.4	25.7	13.6	1.89	1.6
						Humic acid (HA)				
BMC	57.1	5.6	5.1	30.1	2.1	10.2	11.2	2.0	5.9	1.1
BMJ	53	4	7	34	2	13.2	7.5	0.13	4.8	0.57
BMM	63	3	8	24	3	15.7	7.8	2.7	2.8	0.5
						Fulvic acid (FA)				
BMC	48.6	2.8	4.3	42	2.3	17.3	11.3	1.15	9.7	0.65
BMJ	39	3	5	52	1	13	7.8	0.75	10.4	0.6
BMM	45	2	5	46	2	22.5	9	0.97	9.2	0.4

See footnote in Table 3.

The green house experiments.

A pot experiment was conducted at the Training Center for Recycling of Agriculture Residues (TCRAR) at Moshtohor, Qalubia Governorate (Soils, Water and Environment Research Institute (SWERI), Agricultural Research Center (ARC)) to investigate the impacts of amending a light textured soil with the three different biogas manures and their extracts (potassium humate- humic acid – fulvic acid) on faba bean dry weights and NPK uptake by plants. To attain this aim, two kilograms of air dried soil were packed in plastic pots (16 cm height and 21cm diameter) while considering the following treatments: Factor A: source of the organic amendment. Each pot received one of the following amendments: cattle dung (BMC), “cattle dung + Jews mallow wastes (BMJ)” and “cattle dung + Jews mallow wastes (BMM) or their extracts (HA, FH and HK) at two different rates (2 and 4%). Four seeds of fabe been (*Vicia faba*,c.v Giza-2) were planted in each pot and the factorial experimental (3 factors) was arranged in a randomized complete block design with three replicates .All treatments received urea(46%N)at a rate of 30 kg Nha^{-1} as a starter dose for microbial activation. Calcium calcium superphosphate (8.5%P) and potassium sulphate(48%K) were also incorporate into soil before planting at rates of 75kgP ha^{-1} and 48kg K ha^{-1}, respectively.

After 10 days from cultivation, seedlings of faba beans were thinned to 3 plants per pot and the moisture content was kept at the field capacity during the experimental study by daily compensation of water loss with distilled water. After 60 days from germination, plants were harvested, oven dried at 70C for 48h and the dry matter yield was recorded.

Methods of analyses

Soil analyses

Particle size distribution was determined by pipette method as described by **Piper (1950).** Organic matter content was estimated according to the method of Walkely and Black,outlined by **Jackson (1973),** soil pH was measured in 1:2:5 soil water suspension using pH meter (EA920)electrical conductivity (EC) was measured in soil paste extract. Soluble cations and anions were determined in the soil paste extract according to the procedures followed by **Page et al. (1982)** as follows: calcium and magnesium by versenate method, sodium and potassium by flame photometer Model (ILAE201), carbonate and bicarbonate by titration against HCl and chloride was determined volumetrically using silver nitrate method. Sulphate was calculated as the differences between cations and anions. Soil moisture contents were determined according to **Klute (1986).**

Plant analyses.

Dried plant samples were finely ground in a porcelain mortar and subsamples of 0.5g were acid digested using a mixture of sulphoric and perchloric acids (1:1) according to **Page et al. (1982).** Nitrogen was measured in plant extract by micro kjeldahl method, phosphorus was determined colormetrically by spectrophotometer (model6705 UV/Vis JENWAY) and potassium estimated by flame photometrically (model ILAE201) **(Chapman and Pratt,1961).**

Biogas manures analyses.

Electrical conductivity (EC) measurements were carried out in 1:10 biogas: water extract suspension **(Richards, 1954)** using EC meter (ICM Model 71150). Organic matter content of biogas manure was determined by glowing the biogas dried at 550 C to a constant weight as recommended by **Page etal. (1982).** pH values of biogas manures were determined in 1:10 (manure: water) suspension using a glass electrode of Orion expandable ion analyzer EA920 according to **Jodice et al. (1982)**. Total nitrogen was determined in the biogas manure using micro Kjeldahl method as described by **Jackson (1973).** Total phosphorus was determined using ascorbic acid method as outlined by **Page et al. (1982).** Total potassium of biogas manure digested was measured by flame photometer according to **Chapman and pratt (1962).** The number of total viable bacteria and fungi was determined by **Reinhold et al. (1985)**. Ammonia and nitrate contents were determined according to **Page et al. (1982).**

Statistical analysis

The obtained results were subjected to analysis of variance according to **Ryan and Joiner (1994)** and the treatments were compared by using L.S.D at 0.05 level of probability.

Results and Discussion.

Dry matter yield of faba been plants grown on sandy soil as affected by different types of biogas manures and their extracts.

Three biogas manures (BMC, BMJ and BMM) and their extracts (HA, FA and HK) were tested for their effectiveness to increase the growth of faba bean plants (*Vicia faba L.*) grown on a sandy soil during winter season 2019 vs the non-amended control that received the recommended NPK doses as mineral fertilizers.

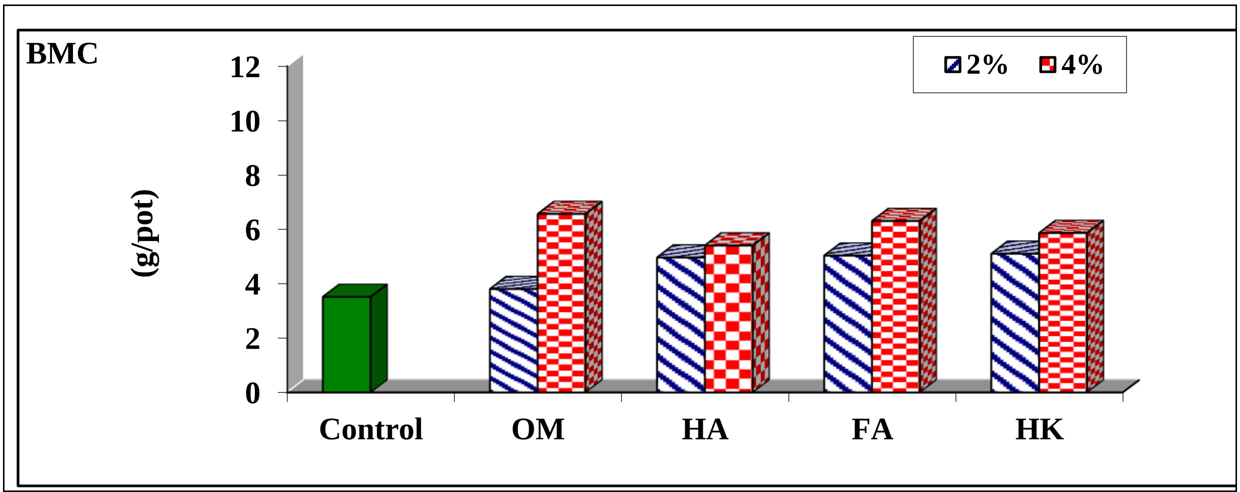
Data presented in **Table 5** and illustrated in **Fig 1** revealed that application of the three biogas manures and their extractives significantly increased the bean dry weight as compared with the control treatment. Where the values of this yield increased from 3.51gpot^{-1} up to 8.23, 8.86 and 5.18 gpot^{-1} upon application of the BMC, BMJ and BMM, respectively. It could be concluded that the use of organic manures significantly increased the dry matter of faba bean plants grown on the tested sandy soil when compared the control treatment. These results stand in well agreement with those obtained by **(Afifi,2010 and Lamhy,2004)**

It is important to point out that the inducing effect of organic manuring on the productivity of light textured soils is due to the hums formed in the soil, which improved the physical and chemical properties of soil and supplies with some nutrient. These nutrients are like to be released from the organic matter after the decomposition by the microorganisms and then become available to plants. Theses organics increase soil fertility in light textured soils **(El-Ghozoli, 2018).** Generally, as the rate of different types of biogas manures and their extracts applied increased from 2% to 4%, the dry weight of bean plants also increased. Regarding the effect of types of humic substances applied which derived from different biogas manures, data indicated also that significant increases occurred due to manuring by humic substance, with no significant variation among between HA and FA treatments. In brief, the investigated treatments can be arranged according to their effect on dry matter yield of faba bean plants grown on the tested sandy soil in the following descending order: OM>HK>FA>HA. The positive effect of humic substances applied on dry matter yield productivity **(Turan et al., 2011, Sani, 2014 and EL-Ghozoli, 2018)**

Table 5. Dry mater yield (gpot^{-1}) of faba been plants grown on sandy soil as affected by different biogas manures and their extracts.

Source (S)	BMC			BMJ			BMM			Grand mean		
Rate(R) / Treatment (T)	2%	4%	Mean	2%	4%	Mean	2%	4%	Mean	2%	4%	Mean
O.M	3.80	6.56	5.18	8.46	9.26	8.86	6.43	10.03	8.23	6.23	8.57	7.40
HA	4.96	5.40	5.18	4.66	5.53	5.09	4.83	5.93	5.38	4.81	5.62	5.21
FA	5.03	6.30	5.67	4.93	4.73	4.83	5.90	5.60	5.75	5.28	5.54	5.41
HK	5.10	5.86	5.48	5.86	5.76	5.81	5.00	7.44	6.23	5.32	6.36	5.84
Mean	4.72	6.03	5.38	5.97	6.32	6.15	5.54	7.25	6.40	5.41	6.52	5.96
Control	3.51											
LSD at 0.05	S=0.36	T=0.42	R=0.26	R×S=0.51	S×T=0.59	R×T=0.72	S×T×R=1.02					

Note: O.M=Organic Manure, HK= Potassium Humate, HA= Humic Acid and FA= Fulvic Acid.



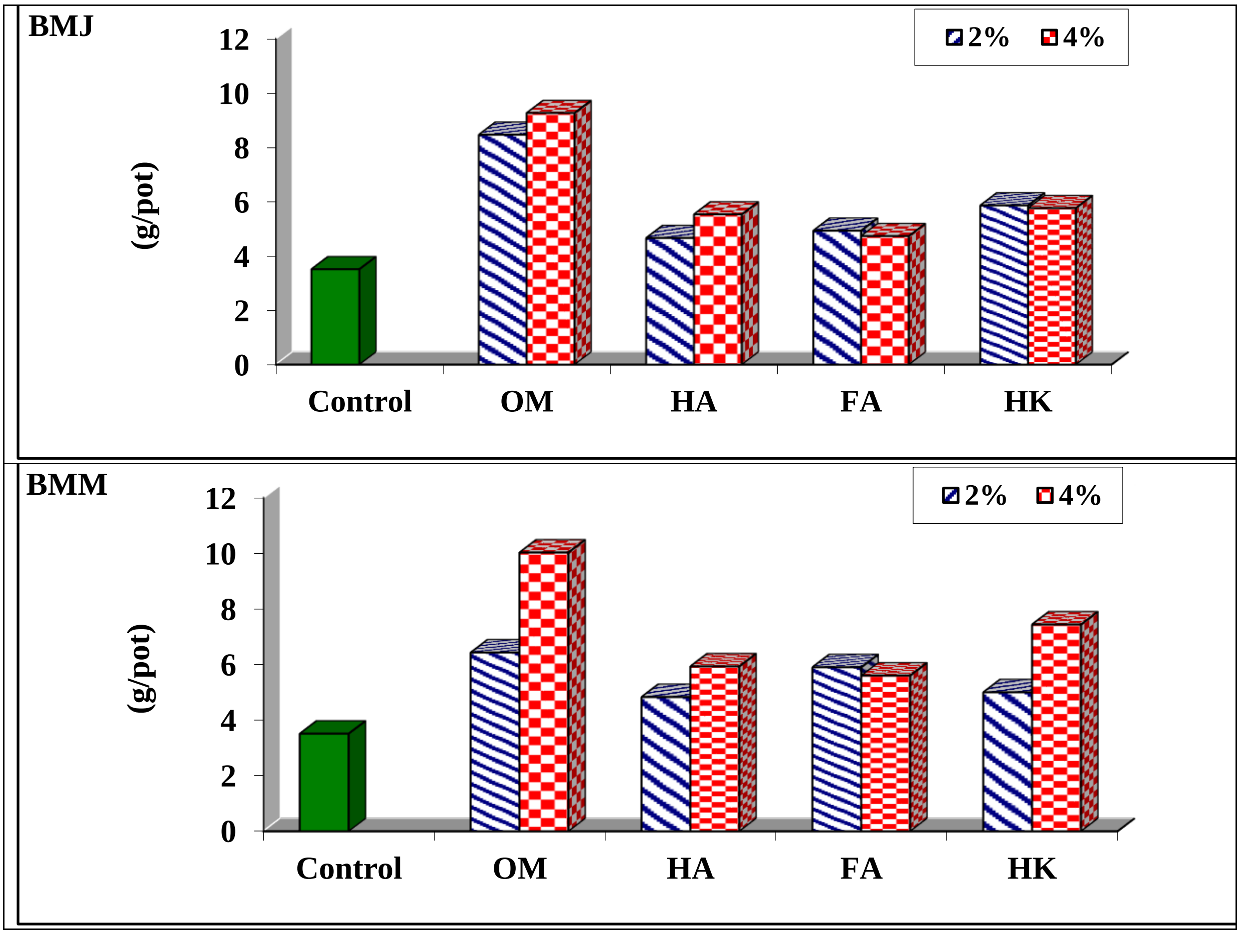


Figure (1): Dry mater yield (gpot^{-1}) of faba been plants grown on sandy soil as affected by different types of biogas manure and extracts.

Nutrients Uptake (NPK) by faba bean plants grown on a sandy soil as affected by different biogas manures and their extracts.

Data presented in **Tables 6** and illustrated in **Fig 2** revealed that N – uptake is influenced by the fertilization treatments under study. Results indicated that the control treatment resulted in N-uptake of bean plants grown on the tested sandy soil of about 46.9 mgpot^{-1}. Treating this soil with, the different biogas manures significantly affected N-uptake in the plants grown thereon. The effect seemed more obvious upon using BMC where the induced N-uptake in the plants was about 198.6 mgpot^{-1}. The N-uptake in the plants treated with the BMM was the least compared with those attained due to the other biogas manures. It is about 139.3 mgpot^{-1}, however, this uptake exceeded that of the control treatment by about 197%.

The investigated biogas manures can be arranged according to their effect on N-uptake in the faba bean plants in the following descending order: BMC>BMJ>BMM.

Regarding the effect of biogas manures and their extracts on N-uptake by faba bean plants, data in table 6 revealed that significant increases occurred due to manuring. The uptake was highest with the OM where it reached 171.1 mg pot^{-1}. On the other hand , N-uptake by the plants in case of HA was the lowest value giving about 94.4 mg pot^{-1}, however this value is still far higher than that of the control treatment which was about 46.9 mg pot^{-1}. The effect of HK and FA values of N-uptake were about 100.7 and 119.1 mgpot^{-1}.

Data also showed that as the rate of humic substances applied increased from 2 to 4%, the N-uptake also increased. Organic fertilizer plays major roles on available N and have greater effect on plant growth and nutrients uptake under different soil conditions **(Mahmoud, 2017; Abdel-Aal, 2018; Farid et al., 2018 and Adegbite et al., 2021)**. According to **Baris and Ali (2013)**, potassium humate as product of HA increases the release of primary macronutrients N, P and K. The liquid organic fertilizers had a promotive effect on all growth parameters including the vegetative growth, plant height, plant dry weight number, plant productivity and nutrients content N, P and K in the plants **(Afifi et al., 2014; Hashem, 2016 and Kumar Sootahar et al., 2019).**

Table 6. N-uptake (mgpot^{-1}) by faba bean plants grown on sandy soil as affected by different biogas manures and their extracts.

Source(S)	BMC			BMJ			BMM			Grand mean		
Rate(R) Treatment(T)	2%	4%	Mean	2%	4%	Mean	2%	4%	mean	2%	4%	mean
O.M	147.9	249.4	198.6	131.8	219.1	175.5	100.10	178.40	139.3	126.6	215.6	171.1
HA	25.40	90.00	57.70	91.40	145.0	118.2	103.5	111.1	107.3	73.43	115.3	94.41
FA	105.80	144.8	125.3	86.70	123.4	105.0	88.33	165.4	126.8	93.61	144.5	119.1
HK	111.30	145.2	128.5	83.10	114.0	98.55	43.70	107.5	75.60	79.36	122.2	100.7
Mean	98.3	150.4	124.4	98.25	150.4	124.3	83.90	140.6	112.2	93.25	149.4	121.3
Control							46.90					
LSD=0.05	S=13.85	T=16.00		R=9.80	R×S=19.59		S×T= 22.62		R×T= 27.70		S×T×R= 39.18	

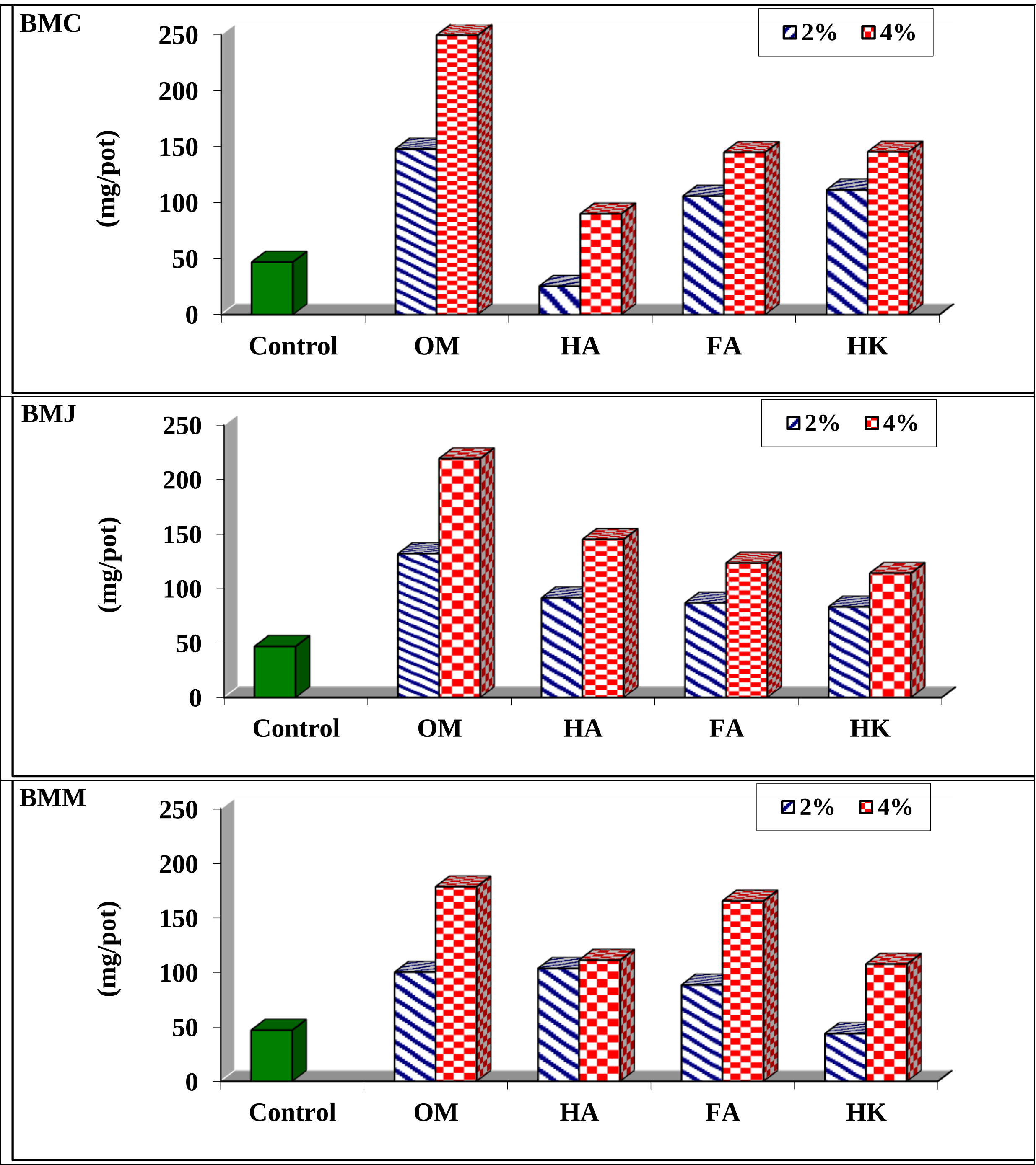


Figure (2): N-uptake (mgpot^{-1}) of faba bean plants grown on sandy soil as affected by different biogas manures and their extracts.

P-uptake by faba bean plants grown on a sandy soil as affected by different biogas manures and their extracts.

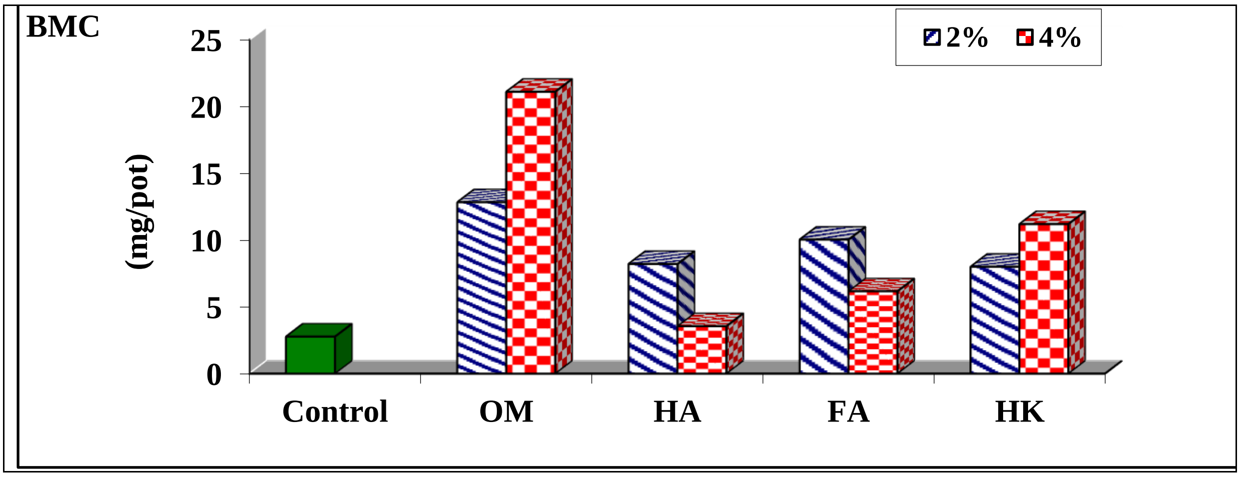
Data present in table 7 and illustrated in fig 3 showed that the P-uptake of faba bean plants increased by treating the tested sandy soil with the three biogas manures and their extracts as compared with the control treatment. The different biogas manures can be arranged to their effect on P-uptake in the following descending order: BMC>BMM>MBJ. The corresponding values were 17.0, 9.41 and 6.26 mgpot^{-1}, respectively .it can be deduced from the above-mentioned results that the BMC was the most efficient manure in inducing P-uptake, while BMJ was the least in the three biogas manures.

Regarding the effect of different humic substances types on P-uptake by faba bean plants, data indicated that significant increases occurred due to manuring except HA and HK with no significant variations between these two treatments. The uptake was highest with the OM where it reached 10.9 mg pot^{-1}. On the other hand, P-uptake in case of HA was the lowest value giving about 6.19 mg pot^{-1}.

Results revealed that OM was more efficient than their different extracts in increasing P-uptake by faba bean plants. Also, as the rate of biogas manures and their extracts applied increased, from 2 to 4%, the P-uptake also increased. Organic manure source and compost play major roles on plant growth and sandy soil contents of available p and its uptake by plants **(Lee, 2016; Mahmoud, 2017 and Abdel-Aal, 2018).** Humic acids have also demonstrated significant efficiency for increasing P availability **(Tahir et al., 2011)** and uptake by plants through minimizing P fixation by Ca in calcareous soils **(Arjumend et al., 2015**; **Abd El-Aziz et al., 2020)**. This might take place via binding and electron transfer **(Lee et al., 2019)**.

Table 7. P-uptake (mgpot^{-1}) by faba bean plants grown on sandy soil as affected by different biogas manures and their extracts**.**

Source(S)	BMC			BMJ			BMM			Grand mean		
Rate(R) / Treatment(T)	2%	4%	Mean	2%	4%	Mean	2%	4%	mean	2%	4%	mean
O.M	12.8	21.1	17.0	3.39	9.13	6.26	5.90	12.9	9.41	7.37	14.38	10.87
H.A	8.21	3.55	5.88	5.12	4.20	4.66	6.94	9.18	8.06	6.75	5.64	6.19
F.A	10.03	6.16	8.10	7.88	8.51	8.20	5.03	11.30	8.17	7.64	8.65	8.14
H.K	8.00	11.2	9.60	5.76	9.37	7.57	1.53	6.44	3.99	5.09	9.24	7.16
Mean	9.77	10.50	10.13	5.53	7.80	6.67	4.85	9.96	7.40	6.71	9.47	8.09
Control	2.80											
LSD=0.05	**S=1.12**		**T=1.29**	**R=0.79**		**R×S=1.59**	**S×M= 1.83**		**R×T=2.24**		**S×T×R= 3.17**	



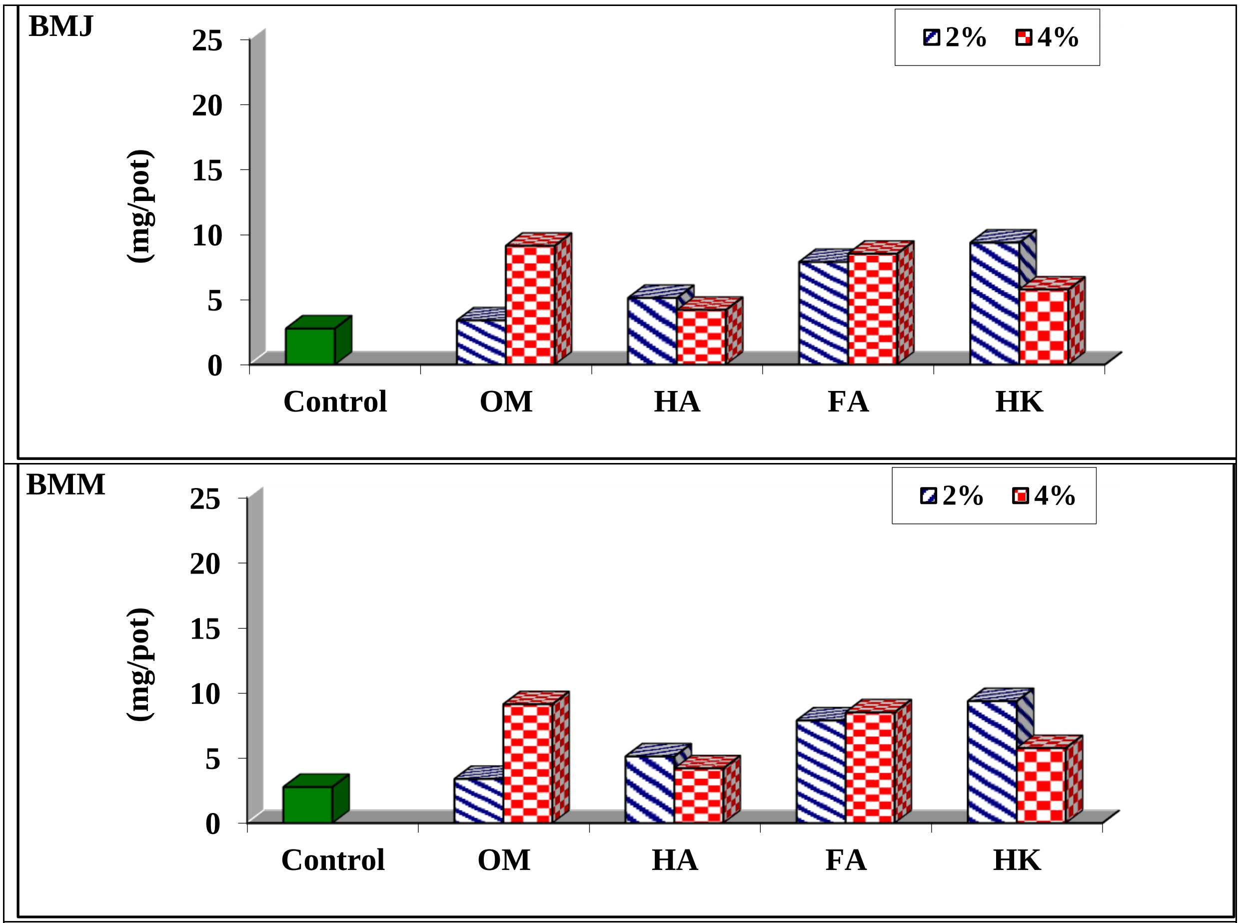


Figure (3): P-uptake (mgpot^{-1}) by faba bean plants grown on sandy soil as affected by different biogas manures and their extracts.

K-uptake by faba bean plants grown on a sandy soil as affected by different biogas manures and their extracts.

Data presented in Tables 8 and illustrated in Fig 4 reveal that application of the different tested organic amendments, generally resulted an increase in K-uptake by faba bean plants grown on the tested sandy soil. The effect seemed to be height upon utilization of the BMM where K-uptake was 217.7 mg pot^{-1} on the other hand, the BMJ resulted in the lowest K-uptake in the plants grown on the sandy soil since its mean value was 112.9 mg pot-1, however, this value is still higher than that of the control treatment which was 41.7 mg pot^{-1} only.

Concerning the effect of different treatments, data showed that significant increases occurred due to manuring. The treatments can be arranged according to their effect on K-uptake by faba bean plants in the following descending order: where the corresponding mean values were 172.3,91.7,76.8 and 55.95 mg pot^{-1}, respectively.

Data also indicated that increasing rate of different biogas manures and their extracts application from 2 to 4 % recorded significant increase in k-uptake by faba bean plants. These results agree with the findings of **EL-Ghozoli (2018), Hashem (2016**) Who found that increasing the rate of biogas manure and their extracts (HK, HA and FA) significantly increase K-uptake by faba bean plants grown on the sandy soil.

Table 8. K-uptake (mgpot[-1]) by faba **been plants grown on sandy soil as affected by different biogas manures and their extracts.**

Source(S)	BMC			BMJ			BMM			Grand mean		
Rate(R) / Treatment(T)	2%	4%	Mean	2%	4%	Mean	2%	4%	mean	2%	4%	mean
O.M	84.8	287.8	186.3	98.9	127.0	112.93	116.6	318.80	217.7	100.1	244.52	172.31
HA	67.10	155.3	111.20	63.9	76.30	70.08	64.6	123.0	93.78	65.19	118.19	91.69
FA	86.13	55.4	70.87	57.43	57.6	57.50	59.3	69.90	64.6	50.95	60.95	55.95
HK	96.50	92.37	94.43	65.10	66.33	65.72	67.30	73.20	70.25	76.30	77.30	76.80
Mean	83.63	147.7	115.67	71.3	81.8	76.55	77.0	146.21	111.58	73.13	125.24	99.18
Control	41.73											
LSD=0.05	S=5.06 T=5.84 R=3.58 R×S=7.15 S×T= 8.26 R×T= 10.11 S×T×R= 14.30											

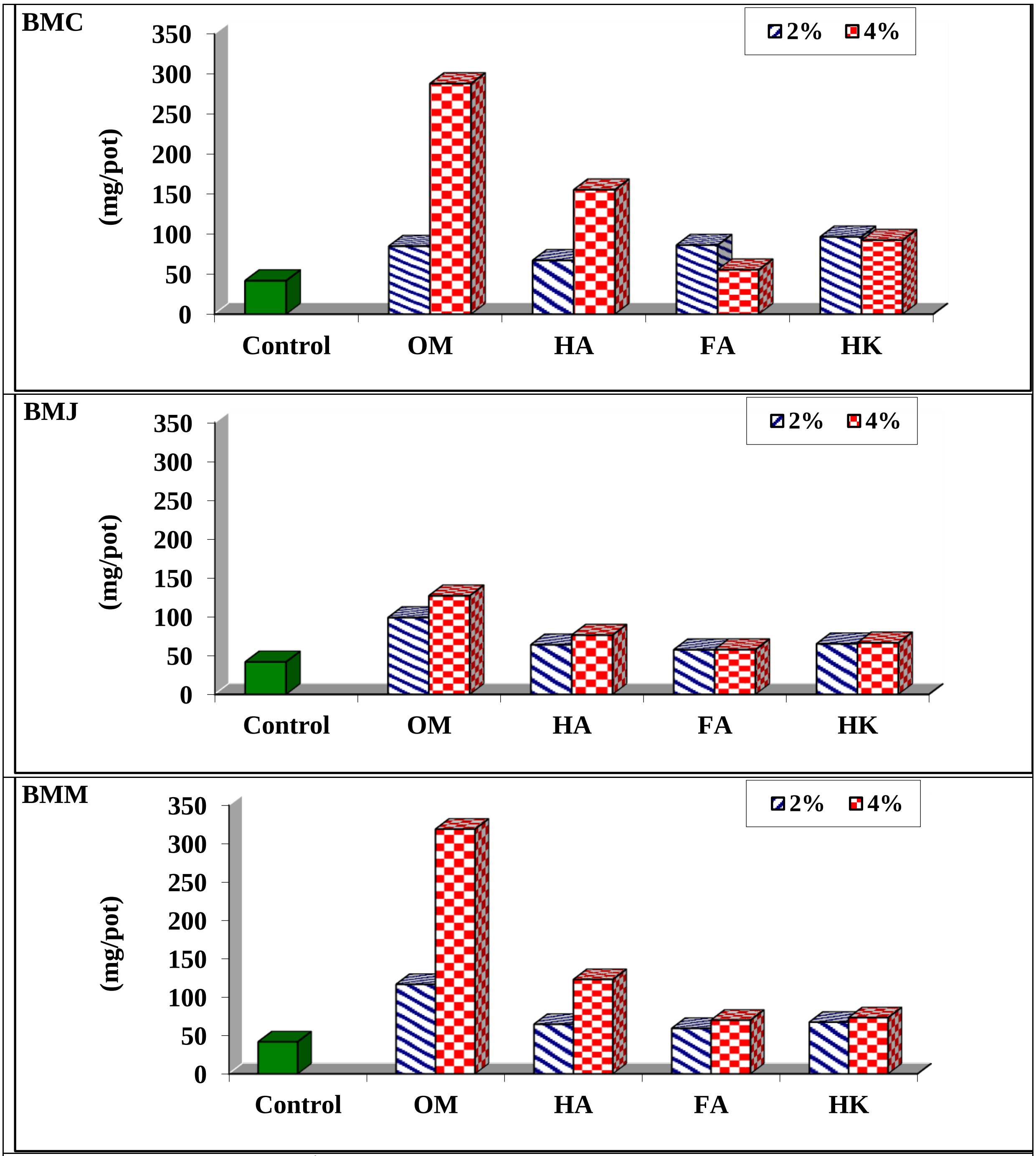


Figure (4): K-uptake (mgpot[-1]) by faba been plants grown on sandy soil as affected by different biogas manures and their extracts.

Conclusion

Application of different types of biogas manures (BMC, BMJ and BMM) and their extracts (HK, HA and FA) increased significantly NPK uptake by faba bean plants and consequently increased plant dry weights. In this concern, biogas manures were more efficient than their extracts on increasing dry matter yield and the nutrients uptake by faba bean plant. The highest increases were attained when applications of organic amendments at a rate of 4% rather than 2%%; yet the behavior of the organic amendments in soil varied considerably among the source of the organic amendment.

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تأثير اسمده البيو جاز المختلفة ومستخلصاتها على محصول المادة الجافه والعناصر الغذائية الممتصة بواسطة الفول البلدي المزروع في ظروف تربه رملية.

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الدراسة الحالية تقييم جدوى إضافة المحسنات الى ارض رملية مع ثلاثة أنواع مختلفه من سماد البيو جاز (روث الماشية فقط BMC – روث الماشية + مخلفات الملوخية BMJ– روث الماشية + مخلفات المانجوBMM) بمعدل اضافه (2% و4%) ومستخلصاتهم (هيومات البوتاسيومHK– حمض الهيوميكHA– وحمض الفالفيكFA) واختبارهم على نبات الفول البلدي لدراسة تأثيرهم على الممتص من عناصر النيتروجين– الفوسفور والبوتاسيوم وتحسين النمو. محصول (المادة الجافه) لنبات الفول البلدي مقارنة النتائج المتحصل عليها مع معامله الكنترول. هذه التجربة صممت في قطاعات كامله العشوائيه باستخدام 3 مكررات اثناء موسم شتاء 2019 واستمرت لمدة 60 يوم ومقارنة النتائج المتحصل عليها مع معامله الكنترول المسمدة معدنيا بالكميات الموصي بها من النيتروجين والفوسفور والبوتاسيوم. وقد اوضحت النتائج ان الماده العضويه لسماد البيوجاز الناتج من روث الماشيه اعطي اعلي محصول من نباتات الفول البلدي 6.4% جم/اصيص مقارنه بأسمدة البيو جاز الأخرى. وايضا توضح النتائج ان اسمدة البيوجاز المختلفة الأكثر تأثيرا من مستخلصاتها لتحسين امتصاص العناصر وزياد الوزن الجاف لنباتات الفول. وعلى الجانب الاخر اعطي سماد البيوجاز الناتج من روث الماشيه ومخلفات المانجو BMM أقل معامله في لزيادة محصول الفول خاصه مع معدل إضافة 2% (4.72 جم/اصيص). اشارت النتائج ايضا الي ان استخدام اسمده البيو جاز المختلفة ادي الي زيادة الممتص من عناصر النيتروجين والفوسفور والبوتاسيوم وبخاصة عند معدل إضافة 4%، حيث ان سلوك المحسنات العضوية في التربة يتغير بتغير مصدرها.