World Wide Journal of Multidisciplinary Research and Development

WWJMRD 2020; 6(12): 10-13
www.wwjmrd.com
International Journal
Peer Reviewed Journal
Refereed Journal
Indexed Journal
Impact Factor MJIF: 4.25
E-ISSN: 2454-6615

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Turnip plants response to spraying potassium humate under compost fertilization

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Abstract
A research experiment was carried out at the experimental farm of the National Research Center in the two seasons 2018 and 2019, with the aim of studying the effect of spraying with potassium humate (2, 4 and 6%) under compost fertilization conditions (0, 2.5 and 5 ton fed^{-1}) on the growth and yield as well as the nutritional status of turnip plants.
The results indicated the following:Spraying with a higher concentration of potassium humate (6 %) with a higher ground addition of compost (5 ton fed^{-1})improved significantly for all growth and yield characteristics compared to the rest of the other experimental treatments.Also, the same previous treatment gave the best values in the content of turnip roots of carbohydrates and protein and the higher uptake of nitrogen, phosphorous and potassium, which indicates that this treatment surpassed all other experimental treatments in improving the quality of the turnipyield.
From the previous results it becomes clear the importance and role of potassium humate in improving the growth, quantity and quality of the turnipyield with the presence of compost fertilization in appropriate quantities.

Keywords: Turnip plants, Growth, Yield, Nutrient uptake, K-humate, Compost

1. Introduction

The turnip crop (*Brassica rapa*) is a member of cruciferous family of the vegetables. It is known as a field of mustard or the turnip mustard and it is a plant widely cultivated as leaf vegetables, root vegetables and oilseeds (**Duke and Ayensu 1985**) Moreover, turnip extract is also useful in lowering uric acid and extracting kidney stones and increasing visual acuity and is used to treat night blindness, **(Khashayar, 2007)**.
Potassium humate is a commercial product contains many elements needful to the development of plant life **(Abdel-Razzak, 2010)**. The foliar application of K-humate is increasingly used in agricultural practice, it is the mechanism of potential effect to promote growth, which is usually attributed to the hormone-like effect, activate photosynthesis, accelerate cell division, increase the permeability of plant cell membranes and improve nutrient absorption, and reduce the absorption of nutrients Toxic and improve plant response to salt, **(Verlinden *et al*. 2009)**. In addition, the potassium humate could be used as an inexpensive source of potassium and can be used as the soil dressing, the drenching, or the foliar applications.
The use of compost is a natural and ecologicalmeans of improving soil fertility for improved crop yield **(Ouédraogo*et al*, 2001)**. Incorporation of compost into the soilserves as a basis for the nutrition of soilmicrobes, and therefore increases their activities (**Bastida *et al*, 2008)**.
The paper aimed to study the effects of the spraying different concentrations of K-humate on the vegetative growth and the turnip yield parameters (*Brassica rapa*), under different rates of compost.

Material and Methods:

The field experiment was conducted at the experimental station at the National Research Center in Nubaria in Beheira Governorate, Egypt, during the two growing seasons 2018 and 2019, to study the effect of adding different levels (0, 2.5, 5 tons acre^{-1}) of fertilizer containing different concentrations of K-humate (2 and 4 and 6%) on vegetative growth, root yield characteristics, and root quality of rapeseed (my Brassica. The physical and chemical properties of compost are shown in Table 1 using the standard procedures described by **Cottenie (1980)**.

Table 1: Some physical and chemical analysis of the compost used.

Compost	pH	EC dSm^{-1}	Organic carbon	Organic matter	Total N	C/N ratio	P	K	Fe	Mn	Zn
			%				%		ppm		
	7.5	3.2	22	37.8	1.40	1.15.7	0.40	1.20	1200	100	40

Some physical and chemical properties of the soil used in the experiments are shown in Table (2) using the standard procedures outlined by **Cottenie (1980)**.

Table 2: Some physical and chemical analysis of the soil used.

Soil property	Value	Soil property	Value
Particle size distribution %		**pH (1:2.5 soil suspension)**	**7.70**
Sand	92.65	**EC ($dS\ m^{-1}$), soil paste extract**	**1.60**
Silt	5.07	**Soluble ions ($mmol\ L^{-1}$)**	
Clay	2.28	**Ca^{++}**	**8.02**
Texture	Sandy	**Mg^{++}**	**3.23**
$CaCO_3$ %	2.20	**Na^{+}**	**3.92**
Saturation percent %	22.50	**K^{+}**	**0.91**
Organic matter%	0.11	**CO_3^{--}**	**nd**
Available N ($mg\ kg^{-1}$)	20.2	**HCO_3^{-}**	**2.20**
Available P ($mg\ kg^{-1}$)	3.50	**Cl^{-}**	**3.98**
		SO_4^{--}	**9.90**
Available K ($mg\ kg^{-1}$)	66.4	**CEC ($cmol\ kg^{-1}$)**	**7.00**

Seeds of turnip were sown in hills 10 cm apart on one side of dripper lines and two seeds per hill. The regular cultivation practices for turnips were followed under a drip irrigation system as per the recommendations of the Ministry of Agriculture.

In the vegetative growth phase, five plants were randomly sampled from each plot 60 days after planting to determine plant height (cm), number of leaves per plant as well as, dry weight (g) of leaves /plant. Also, root dry weight and some physical properties of root (diameter and length) were measured.Total crude protein % and total carbohydrate % was extracted and determined according to **A.O.A.C (1975).**Total nitrogen content was estimated by modified Kjeldahl's methods **Motsara and Roy, (2008)**.Phosphorus was determined calorimetrically by NH_4-Metavanidate method **(Motsara and Roy, 2008**). Potassium was flame-photometrically estimated **(Motsara and Roy, 2008**).

All data were subjected to statistical analysis using Mstatc software. The comparison among means of the different treatments was determined, as illustrated by **Snedecor and Cochran (1982).** Means of the treatments were compared by the Least Significant Differences Test at (0.05) level of significance.

Results and Discussion:

The results in (Table, 3) show the effect of growth and yield characteristics of turnip plants for each of the different additives of compost and sprayed with different concentrations of potassium humate at two growth seasons.The results indicate that spraying potassium humate with its different concentrations increases its stimulating effect for the growth of turnip plants. Consequently, this is due to the high productivity, which is when the amounts added to the soil from ripe compost increase.Whereas, the values obtained for the characteristics of growth and yield actually increased significantly when the rates of addition of compost increased from zero per feddan to 5 ton per feddan.The highest values of growth and yield parameters of turnip plantsobtained were when using the highest addition of compost (5 to fed^{-1}) and the highest spray concentration of potassium humate (6 %).

Table 3: Effect of different rates of compost and K-humate on growth and yield parameters of turnip plants (combined data of two seasons).

Compost ton fed^{-1}	K- Humate (%)	Plant height (cm)	No. of leaves	Leaves dry weight/plant (g)	Root dry weight/plant (g)	Root length (cm)	Root diameter (cm)
0	2	15.5	4.48	6.50	12.7	5.20	4.44
	4	18.2	5.20	7.17	14.0	6.22	5.12
	6	19.7	5.60	7.69	16.6	7.30	5.56
2.5	2	16.9	5.60	7.29	14.5	7.61	5.86
	4	20.4	7.21	8.22	16.3	8.04	6.03
	6	22.7	8.30	9.10	19.2	8.55	6.60
5	2	20.3	7.11	8.00	20.4	8.86	7.03

	4	22.8	9.33	9.10	22.1	9.33	7.22
	6	28.3	10.2	9.72	28.6	10.1	7.47
L.S.D.0.05%		1.21	0.42	0.30	1.70	0.48	0.51

Compost treatment increased soil fertility and the nutrient uptake of plants which caused enhancing growth, yield and yield component, (**Zhang *et al*., 2016)**. Potassium humate is the component improve soil fertility and increase the nutrients availability, to enhance the plant growth, yield, and the decrease of the harmful effect of stresses through the various mechanisms inside plants and soil, **(Moraditochaee, 2012)**. Potassium humate plays an important roles on plants through stimulation of root growth and increase of water and nutrients uptake by the vegetable crops, **(Cimrin and Yilmaz, 2005)**. K-humate also provides growth regulators to regulate and control hormone levels in plants and stimulates production of plant enzymes and hormones, **(Mart, 2007)**. These mechanisms refer to the direct influence of K-humate on plants and its influence on soil fertility is also very important, **(Fahramand *et al*., 2014)**.

The results in Table (4) indicate the effect of experimental treatments on the content of protein and carbohydrates in the turnip roots at two growth seasons. It was observed that all the protein and carbohydrates in turnip roots were not significantly affected by the increase in both compost rates and potassium humate spray concentrations. It was possible to reach the highest values of protein and carbohydrates when adding the high rate of compost and spraying with the highest concentration of potassium humate.

Table 4: Effect of different rates of compost and K-humate on content of protein and carbohydrate in turnip roots (combined data of two seasons).

Compost ton fed^{-1}	K- Humate (%)	Protein	Carbohydrate
		%	
0	2	9.25	15.5
	4	10.5	15.9
	6	11.1	16.1
2.5	2	11.2	16.8
	4	11.8	17.1
	6	11.9	17.6
5	2	12.9	17.2
	4	13.4	18.0
	6	14.0	18.2
L.S.D. 0.05%		0.36	0.26

Potassium humate could also influence cell division **(Chen *et al*., 2004)** and enhance of the protein synthesis **(El-Ghamry *et al*., 2009 and Patil 2010)**, which result in enhancing total protein content in plants **(Nardi *et al*., 2002)**. **El-Hefny, (2010)** reported that the humic acid application up to 6 kg.fed^{-1} increased to the highest N, P and K uptake, the protein and the carbohydrates contents of the cowpea plants.

It is evident from Table (5) that increasing the addition of compost to the soil from zero to five ton fed^{-1} led to the significant increase in uptake of nutrients (N, P and K) in turnip roots with an increase in potassium humate spraying from 2 to 6%. This indicates the effective and stimulating role of compost and potassium humate in increasing the content of nitrogen, phosphorus and potassium within the tissues of plants.It is evident from the results that the best experimental treatments that gave the highest uptake of the three nutrients are the treatment that added compost at a rate of 5 ton fed^{-1} with spraying with the highest concentration of K-humate (6 %).

The use of the organic inputs such as crop residues, compost and compost has great potential for improving soil productivity and crop yields by improving the physical, chemical and microbiological properties of the soil as well as the nutrient supply **(Stoneand Elioff, 1998)**.

Table 5: of different rates of compost and K-humate on N, P and K uptake of turnip roots (combined data of two seasons).

Compost ton fed^{-1}	K- Humate (%)	N	P	K
0	2	19.2	1.01	28.1
	4	24.6	1.11	32.2
	6	30.5	1.62	41.6
2.5	2	27.6	1.17	33.5
	4	30.1	1.47	40.1
	6	37.6	1.90	51.5
5	2	36.2	2.45	53.6
	4	42.1	2.81	61.7
	6	50.8	3.40	87.0
L.S.D. 0.05%		0.05	0.01	9.10

Negm *et al.* (2003) who indicated that the use of compost improved soil properties as well as increased availability of soil macronutrients, and the simulated effect of humic acid on macronutrient concentrations could be explained by **David et al., (1994)** who indicated that humic acid enhances cell permeability which in turn led to minerals entering more quickly into root cells and thus resulting in increased absorption of phytonutrients. **Katkat *et al*., (2009)** reported that the foliar applications of K-humate had a significant effect on the N, P and K uptake of the wheat plants under the calcareous soil conditions.

Conclusion:

Spraying turnip plants with an optimal concentration of potassium humate with attention to organic fertilization, especially compost, and adding the appropriate amount will help a lot in achieving the desired goal, which is to obtain good growth and a crop of high quantity and quality from turnip plants grown in the sandy soil.

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