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Short Communication

Evaluating the effect of humic acid on the yield of three varieties of potato under field conditions

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ABSTRACT:

To evaluate the effect of humic acid fertilizer on potato tubers in 2010, trials were conducted in the Province of Iran. The experiment was conducted on a split plot with randomized complete block design having three replications. Main plots consisted of four levels of humic acid (0, 1, 2, 3 times) solution in water irrigation and sub-factor consisted of three varieties of potato (Marfona, Satina, and Born). During planting the application of humic acid at the rate of nine liters per hectare per load at the beginning and start of creating tuber formation respectively were done. Analysis of variance showed that the smallest and largest tuber weight, number of tubers per plant and yield per plant were not significant. Effect of humic acid on the smallest mean tumor weight at 1% and the number of tubers and yield per plant showed significant difference at 5% level. The largest tuber weight was also not significantly different. Interaction of humic acid fertilizer in any of the measured parameters showed no significant difference in potatoes. Comparison by Duncan test showed that the application of humic acid in all the three stages of growth had shown great impact on tuber weight. The highest number of tubers per plant has been associated with the use of humic acid (27 l/ha). The number of tubers per hectare with the application of 18 litres of humic acid showed no significant difference. The amount of humic acid applied were 18 and 27 litres per hectare, and increased performance is in the range of 13 and 29% respectively.

Keywords:
Potatoes, Humic acid, Yield, Tuber, Potato cultivars.

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INTRODUCTION

Due to the overuse of chemical fertilizers and not using organic fertilizers in the field, Iran is experiencing a dramatic loss of soil organic matter in the recent years (Latifi and Dust, 1998)

On the other hand, excessive use of chemical fertilizers in the agriculture causes environmental problems such as soil-physical degradation and soil-nutrient imbalances (Wang *et al*., 1999). After a long gap, the use of organic fertilizers started increasing nowadays. Humic substances, including mixtures of different organic compounds that are derived from the remains of plants and animals are nowadays used for fertilizing purpose (Maccarthy, 2001).

The effect of humic acid and nitrogen application on wheat were studied previously and the results showed that grain yield and protein content has increased in the treatments. The increase in foliar nitrogen with humic acid increased the Rubisco enzyme activity and thus an increase in the yield (Delfine *et al.,* 2005). Humic acid cause shoot growth, due to the increased absorption of agents such as nitrogen, calcium, phosphorus, potassium, manganese, iron, zinc and copper (Haiper *et al.* 2000). Molecular weight of humic acid is 30000-300000 dalton and folic acid, is less than 30,000 dalton. They form a stable complex with insoluble and soluble micronutrients (Liu *et al.,* 1998). The main advantages of humic acid is its chelating ability by various inorganic ions such as sodium, potassium, magnesium, zinc, calcium, iron, copper, etc. This increases the root length weight and the initiation of lateral roots. (Aiken *et al*., 1985).

Humic acid in the nutrient solution increased shoot growth, root and shoot nitrogen content in the experiments of Tan and Nopamornbodi, (1979). Moreover, their loss creates chlorosis in the leaves of maize, (*Zea mays* L.) (Fernandez, 1968) and Lupin (*Lupinus polyphyllus* L.) in the calcareous soils.

The purpose of this experiment is to investigate the effect of different levels of humic acid on the yield of potatoes.

Generally the advantages of humic acid are:

- The addition of organic matter to the soils with low organic matter
- Increases the power of roots to hold the plant
- Improves absorption of nutrients
- Increases in chlorophyll synthesis
- Seed germination initiation
- Increases productivity
- Stimulates beneficial microbial activity
- Maintains plant health and increases crop

Table 1. Analysis of variance of parameters measured in potato

Parameters	df	Weight of the smallest mean tubers (g)	Weight of the biggest mean tubers (g)	Number of tubers per plant	Tuber yield per plant	Eye of the Potato
Rep	2	17.88	589.31	1.20	3382767.39	1.57^{ns}
Different varieties of potatoes (a)	2	8.25^{ns}	1805.23^{ns}	16.38	1878364.09^{ns}	42.86^{**}
Error (a)	4	25.44	635.94	2.37	802477.66	3.48^{ns}
Different levels of Humic acid (b)	3	49.46^{**}	585.70^{ns}	18.64^{*}	3248835.535^{*}	2.18^{ns}
a*b	6	5.46	114.03^{ns}	4.96^{ns}	1212.95^{ns}	1.62^{ns}
Error	18	3.31	348.35	7.35	789715.29	1.48
CV%	**-**	**9.30**	**15.24**	**26.31**	**22.72**	**8.59**

Note: *: Significant at 5% level; **: Significant at 1% level; ns: not significant

Table 2. Measured characteristics of different varieties of potatoes

Parameters	Weight of the smallest mean tubers weight (g)	Weight of the biggest mean tubers weight (g)	Number of tubers per plant	Tuber yield per plant	Dry weight	Eye of the Potato
(Marfona)	20.30[a]	136.61[a]	9.62[a]	2453.4[a]	41.81[ab]	13.25[b]
(Satina)	18.68[a]	114.96[a]	9.90[a]	4119.3[a]	45.87[a]	12.93[b]
(Born)	19.66[a]	115.81[a]	11.77[a]	3453.4[a]	38.26[b]	16.35[a]

*Average of common letters in each column are not significantly different at 5% level

productivity (potatoes, wheat, tomatoes, corn and beet)

- Safe for animals, plants and humans
- Stimulating plant hormone and enzyme
- Suppresses the disease, heat stress and cold injury
- Increases antioxidant activity

MATERIALS AND METHODS

The experiment was conducted in field conditions at the city of Hamadan in Iran.

To evaluate different doses of humic acid on the different varieties of potato, experiments with split plot randomized complete block design having three replications were used. Main plots consisted of four levels of humic acid (0, 1, 2, 3-time use) and subplots consist of three varieties of potato that is Marfona, Satina, and Born. The use of humic acid at the rate of nine liters per hectare per time induced the growth of stolons and tubers.

The parameters such as average weight of the smallest tuber in the plots, the average weight of the largest tuber in the plots, the number of tubers per plant and tuber yield per plant were measured. Samples from the middle of each plot treatments at a distance of half a meter from the ground and 60 cm between each plot was measured and the plants were collected. Depending on the results of experiments comparisions were done and statistical analysis were performed using SAS (9.1). Duncan's test at 5% level was also carried out to compare the samples (Mosa, 2001).

RESULTS AND DISCUSSION

Effect of humic acid on the smallest mean tubers were weighed at 1%, and the number of tubers per plant and yield were counted at 5%, and the mean weight of the tubers showed no significant difference (Tale 1). Interaction of humic acid fertilizer and varieties in any of the measured parameters showed no significant difference in potatoes (Table 2).

Comparison according to the Duncan's test showed that

Table 3. Effect of humic acid on measured characteristics in potato

Parameters	Weight of the smallest mean tubers weight (g)	Weight of the biggest mean tubers weight (g)	Number of tubers per plant	Tuber yield per plant	Dry weight	Eye of the Potato
Control	16.41[c]	111.007[a]	9.16[b]	3373.1[b]	38.42[a]	14.82[a]
One time	19.46[b]	123.25[a]	9.31[ab]	616.8[b]	43.23[a]	13.71[a]
Two time	21.60[a]	129.61[a]	11.15[ab]	3897.1[a]	44.124[a]	14.27[a]
Three time	20.74[ab]	125.96[a]	12.11[a]	4751.8[a]	42.14[a]	13.89[a]

* Average of common letters in each column are not significantly different at 5% level

the double application of humic acid (during planting and early stolones speciation) had the greatest impact on small gland weight (Abd-El-Kareem *et al*., 2009).

The highest number of tubers per plant is propotional to the use of humic acid in our experimental setup (at the time of planting, stolones and gland begins-three times). The number of tubers are also compared with the humic acid concentrations which showed no significant difference. The amount of humic acid consumption is twice and thrice to use most of the function by themselves (Table 3). The results showed that the humic acid can have positive effects on potato tuber yield; the effect may be the result of physiological effects.

Application of humic acid during planting and early tuber stage have created better economic performance than other known treatments. The yield showed increased tuber number and weight of small tubers. The application of humic acid can decrease the use of chemical fertilizers and reduce the environmental pollution and also due to lower consumption of fertilizers that leads to lower costs. Finally, it can be said that the use of humic acid in addition to increase the yield of potatoes, can have an important role to play in achieving the goals of sustainable agriculture.

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