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## ORIGINAL ARTICLE

# Evaluating the Effectiveness of different levels of Humic acid on the yield of different Greenhouse Cucumber Cultivars

**Amirabbas Yousefi**
Department of Agronomy, Karaj Branch, Islamic Azad University, Karaj, Iran.
*Corresponding E-mail address: aaysfi@gmail.com

**ABSTRACT**
*Cucumbers, Cucumis sativus L. is one of highly consumed melons in the world. To evaluate the effect of humic acid on the yield of different cucumber cultivars, a factorial experiment in a completely randomized design with three replications was carried out during 2014-15 in greenhouses located at the Research Institute for Plant Protection aiming at implementation of basic studies for the cultivation and production of greenhouse organic cucumbers in Iran in the near future. The first factor including three varieties of cucumber Saturn, 29, and 195, the second factor including three humic acid concentrations (15, 30, and 60 g), and no acid use as a control were selected. The traits measured were plant height, stalk diameter, fruit length, fruit diameter, fruit weight, and number of flowers per plant. The results showed that the different varieties of cucumber were significantly different in the stalk height and the number of flowers ($p < 0.01$); however, different levels of humic acid significantly affected both the fruit diameter and weight at a probability level of 5%. The effects of humic acid on different cucumber cultivars were not significant on all traits. The above results show the increasing influence of humic acid on the fruit weight.*
***Keywords:*** *Greenhouse cucumbers, humic acid, performance, organic, different varieties.*

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## INTRODUCTION

The production of cucumbers ranks the fourth place among the vegetables in the world after tomatoes, cabbage page and onion; Iran produces 1,819,000 tons of cucumbers being the world's second-largest producer [6]. The development of new methods to improve its performance and quality can play an important role in increasing the productivity of the active greenhouses in the production of this product.

With regard to the current water crisis in Iran, particularly in provinces such as Tehran and Karaj, the farmers tend to establish more greenhouses instead of the use of tree-lined gardens, and cucumber is one of the most popular plants in this industry. Increasing the yield per unit area and also identification of the best variety are the most important approaches to increase production without consumption of cost and doubled energy. The Saturn, 29 and 195 are relatively high-flowering cultivars that have little sensitivity to fungal diseases. Additionally, the appearances of these cultivars enhance the marketability of this product.

Humic acid is a hormone-like substance that affects the growth and development of plants. Humic acid can also be used to enhance production of vegetables through suitable production conditions. According to [7], the use of humic acid in vegetables can cause significant increases in vegetative growth and performance characteristics of the potato variety, Desireh [6]. Recently, an Iranian humic acid brand, "Pars humic" obtained from mineral sources and offered as granulated has had mass production; nonetheless, it is not still as popular as it deserves, hence humic acid imports from other countries is still increasing in Iran (information from Yazd Golsang Kavir).

Today, eliminating or reducing the use of chemical fertilizers is a requirement of sustainable agricultural development program in order to produce organic products [8]. Therefore, the use of organic fertilizers is increasing. Accordingly, careful use of such organic fertilizers as vermicompost and humic acid can solve soil problems to some extent. The composting process involves the breakdown and transformation of

organic remains of plants and animals, municipal sewage, and urban waste into a useful material named compost; the organisms such as insects, microorganisms (fungi and bacteria) and earth worm help transform organic matter into compost eventually to the final product namely vermicompost (1). The present study was to evaluate the effects of different humic acid levels on the yield of three varieties of cucumbers.

## MATERIALS AND METHODS

This factorial experiment in a completely randomized design with 3 replications was carried out under organically-managed conditions of greenhouses located at the Research Institute for Plant Protection from early March 2014 until late May 2015. The research aimed at studying the basic examinations for the cultivation and production of greenhouse organic cucumbers in Iran in the near future. The first factor including three varieties of cucumber Saturn, 29, and 195, the second factor including three humic acid concentrations ( 15, 30, and 60 g), and no acid use as a control were selected in order to evaluate the effects of humic acid on the three varieties studied. The traits measured were plant height, stem diameter, fruit length, fruit diameter, fruit weight, and number of flowers per plant.

An Iranian organic humic acid (Pars Humic) was used, which is recently produced by Gosamng Kavir Yazd Co., Iran.

This product is granulated, and is usually used as a mix with humic acid based on the requirements of organic production to provide the greenhouse bed with fertilizer (compost) and vermicompost in order to compensate for the lack of some elements in vermicompost, in addition, to raise the absorption of soil elements by the plant.

A total of 24 baskets (25 × 50 × 75) were applied with a fixed bed (for 24 baskets equals 33 L or 18 kg) ready for organic planting produced by Gilda Co. Statistical analyses, variance of data, and comparison of the measured traits were carried out by the SAS software.

## RESULTS AND DISCUSSION

Table 1 shows that the plant height and the number of flowers have significant differences among the different varieties of cucumbers ($p<0.01$). Also, different levels of humic acid significantly affected both fruit diameter and weight ($p<0.05$). The interaction between humic acid and the different varieties of cucumbers were not significant in all of the traits (Table 1).

Table 1. Analysis of variance comparison between three varieties of cucumbers with four levels of humic acid

| S.O.V | df | Stalk height | Stalk diameter | Fruit length | Fruit diameter | Fruit weigh | No. of flowers |
|---|---|---|---|---|---|---|---|
| Repeat | 2 | 85.48ns | 011.0ns | 096.0ns | 391.0ns | 08.9ns | 75.1* |
| Cultivars | 2 | 59.1108** | 517.0ns | 321.0ns | 794.0ns | 73.12ns | 25.16** |
| Humic acid | 3 | 80.32ns | 920.1ns | 904.0ns | 728.0* | 74.91* | 26.0ns |
| * Cultivars humic acid | 6 | 45.22ns | 671.0ns | 0904.0ns | 647.0ns | 61.23ns | 30.0ns |
| Error | 22 | 24.42 | 666.0 | 335.0 | 432.0 | 21.27 | 34.0 |
| C.V (%) | – | 23.8 | 45.8 | 78.3 | 30.2 | 02.7 | 9.60 |

ns, * ,**: Non significant on 1 and 5 % levels of probability, respectively

### *Plant height*

The comparison of means (Table 2) showed that Cultivar 195 with an average of 69.82 cm had the highest height, while Cultivar Saturn with an average of 50.6 cm attained the lowest height compared to the cultivars 29 and 195. According to the Duncan's test, Cultivar 195, 29, and Saturn lie in groups a, b, and c, respectively. Some features of Cultivar 195 are its large leaves and high offshoots while cultivars 29 and Saturn have medium leaves and low offshoots. The large leaves and high offshoots in Cultivar 195 allow the plant to absorb more light leading to increased photosynthesis and ultimately improved the plant's growth rate; such a feature was observed in the height trait of Cultivar 195. The results correspond to (3) and (9).

### *Number of flowers*

The Saturn with an average of 7. 45 flowers was the best cultivar compared to the other treatments, which is grouped as “a” in Duncan’s grouping. The cultivars 29 and 195 each with an average of 5.25 and 5.69 flowers, respectively, were placed in Group b by Duncan's test. Greenhouse cucumbers typically have

more female flowers. In some new varieties of these cucumbers achieved through breeding, the flowers are only females (gynoecious). The plant varieties specific for cultivation in greenhouses produce early cucumber, and the density of flowers and fruits on the plant is higher than the ordinary type, hence are of greater yield. Their fruit is long narrow and often without seeds. The fruits arise through parthenogenesis, that is, without pollination. Of course, this type of cucumber is sensitive to adverse conditions than the other varieties meaning that a slight stress can cause flower loss. This stress can be related to climate, nutrients, pests, or any other factor in the greenhouse. Some features of the Saturn are average leaves and low offshoots whereas Cultivar 195 has large leaves and great offshoots. According to (2), there are features such as medium to broad leaves and low offshoots in greenhouse cucumbers that increase the rate of photosynthesis and completion of the growth period in the plant consequently causing appropriate transport of substances to all parts of the plant; this results in an increased number of flowers in cucumbers. However, cultivars with smaller leaves and greater offshoots are less flowering.

***Fruit diameter***

Table 2 reveals that the use of granular humic acid as much as 60 g per greenhouse cucumber plant allocated the highest average fruit diameter of 29.04 mm placed in Group a of Duncan's test. After that, a level of 30 g with an average of 28.71 mm is located in group ab, and both the control and a level of 15g of humic acid were grouped in Group b of Duncan's test. The levels of humic acid as 30 and 60 g per plant had the greatest impacts on the fruit diameter. Studies show that humic acid and folic acid make the plant genetic system change and evolve to a higher growth phase (4); in addition, it optimizes the absorption of nutrients and water by plants and makes various nutrients easily available to plants. It would also free up calcium carbonate in the soil to be used in photosynthesis (5). Given that granular humic acid used contains 60% of humic acid, 20% of folic acid, and 20% of macro and micro elements, and as folic acid due to its low molecular weight is capable of easily penetration through the cell membranes meanwhile lead the binding elements into the cell, it can be concluded that humic acid has been able to increase the absorption of macro and micro elements, and as a result improve the yield.

***Fruit weight***

A humic acid level of 60 g assigned the highest average fruit weight of 77.91 g placed Group a of Duncan's test. The control and a level of 30 g are in Group ab, and the treatment with 15 g of humic acid is grouped in Group b of Duncan's test. The use of different levels of humic acid revealed that the levels of 30 and 60 g per plant had the greatest impact on the weight of fruit. Studies show that humic acid and folic acid make the plant genetic system change and evolve to a higher growth phase (4); in addition, it optimizes the absorption of nutrients and water by plants and makes various nutrients easily available to plants. It would also free up calcium carbonate in the soil to be used in photosynthesis (5). Given that granular humic acid used contains 60% of humic acid, 20% of folic acid, and 20% of macro and micro elements, and as folic acid due to its low molecular weight is capable of easily penetration through the cell membranes meanwhile lead the binding elements into the cell, it can be concluded that humic acid has been able to increase the absorption of macro and micro elements, and as a result improve the yield.

Table 2. Comparison of the average levels of main effects of the traits studied

| No.of flowers | Fruit weight | Fruit diameter | Fruit length | Stalk diameter | Plant height | Treatment |
|---|---|---|---|---|---|---|
| | | | | | | Cultivar |
| 7.45a | 73.55a | 28.22a | 15.22a | 9.54a | 50.60c | A1(Saturn) |
| 5.69b | 75.42a | 28.67a | 15.49a | 9.51a | 59.70b | A2(29) |
| 5.25b | 73.75a | 28.67a | 15.19a | 9.88a | 69.82a | A3(195) |
| | | | | | | Humic acid |
| 6.02a | 72.77ab | 28.20b | 15.12a | 9.23a | 57.30a | B1=0 |
| 6.18a | 70.63b | 28.12b | 14.95a | 9.31a | 60.21a | B2=15 |
| 6.35a | 75.63ab | 28.71ab | 15.54a | 10.21a | 61.53a | B3=30 |
| 5.97a | 77.91a | 29.04a | 15.60a | 9.84aa | 61.12a | B4=60 |

Similar letters in each column show non-significant differences according to Duncan's Multiple Range Test.

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