Euroasia Journal of Mathematics, Engineering, Natural & Medical Sciences
International Indexed and Refereed
ISSN 2667-6702

# Effect of Humic Acid and Foliar Application of Potassium on Growth and Yield of Melon

## Humik Asit ve Yapraktan Potasyum Uygulamasının Kavun Büyümesi ve Verimine Etkisi

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*Geliş Tarihi /Received: 20.09.2022*
*Kabul Tarihi /Accepted: 23.10.2022*
*Araştırma Makalesi/Research Article*
*DOI: 10.5281/zenodo.7364656*

## ABSTRACT

The increased use of chemical fertilizers as a sole input for production of horticultural crops has destructed the soil architecture and suppressed product quality. Therefore, a field experiment was implemented in the vegetable research field of research center Duhok province / Iraq at the summer growing season of 2019 to inspect the impact of soil drenching of humic acid at four levels (0, 500, 1000, and 2000 mg $l^{-1}$) and foliar spraying of potassium at four levels (0, 0.3, 0.6, and 0.9 mg $l^{-1}$) and their interactions on the growth and yield of melon. Both humic acid and potassium fertilizer increased the phosphorus (P) content significantly compared to the control. The results obtained from hot climatic condition displayed also no significant amelioration in vegetative traits [canopy height, leaf area, chlorophyll content (SPAD), and stem diameter] and yield traits [number of fruits per plant and total yield ] with soil drench application of humic acid and foliar feeding of potassium fertilizer as compared to control.

**Keywords**: Humic acid, Melon, Potassium, Growth, Yield

## ÖZET

Bahçe bitkilerinin üretimi için girdi olarak kimyasal gübrelerin artan kullanımı, toprak yapısını tahrip etmekte ve ürün kalitesini baskılamaktadır. Bu nedenle, humik asidin dört dozu (0, 500, 1000 ve 2000 mg/l) ve potasyumun yapraktan uygulamasının dört dozunun (0, 0.3, 0.6 ve 0.9 mg/l) kavun büyümesi ve verimi üzerindeki etkileşimlerini incelemek amacıyla 2019 yılı yaz yetiştirme sezonunda Duhok/Irak araştırma merkezi sebze araştırma alanında bir tarla denemesi yürütülmüştür. Hem hümik asit hem de potasyum gübresi, kontrole göre önemli ölçüde fosfor (P) oranını artırmıştır. Yüksek sıcaklık koşullarında elde edilen sonuçlar, vejetatif özelliklerde [kanopi yüksekliği, yaprak alanı, klorofil içeriği (SPAD) ve gövde çapında] ve verim özelliklerinde de [bitki başına meyve sayısı ve toplam verim] topraktan ıslatmayla humik asit uygulaması ve potasyumlu yaprak gübrelemesinin kontrole kıyasla önemli bir farklılık yaratmadığını göstermiştir.

**Anahtar Kelimeler:** Hümik asit, Kavun, Potasyum, Büyüme, Verim

## INTRODUCTION

Melon (*Cucumis melo* L.) is the foremost tasty and well known warm season vegetable crop having great diversity (Erdinc et al., 2021; Hatipoğlu and Şensoy, 2022) and a member of Cucurbitaceae family including other cucurbits such as cucumber (*Cucumis sativus* L.), watermelon [*Citrullus lanatus* (Thunb.) Matsum. & Nakai] and squash (*Cucurbita* spp.). It is native to tropical Africa and is widely expended as a desserts or fresh fruit. The melon is common with their enriched component of bioactive compounds including phenolic flavonoids and indispensable vitamins such as vitamin A and C, β- carotene as well as carbohydrates and minerals. Melon production may be very high and profitable with a promising cultivation practices (Mohamed and Ali, 2016). Extensive utilization of chemical fertilizers and pesticides specifically impact the soil, microbial community structures and fall apart structure and mineral supplement substance of soils and cause hazards to human wellbeing (Caesar-TonThat et al., 2010). In contrast, cultivation using natural inputs is entirely secure and can provide high quality and complete nourishment without bringing any harm to soil and the environment as a whole. Natural fertilizers are at first defined from either plant or creature leftovers (Shafeek et al., 2015).

According to numerous studies, the application of organic fertilizers created amelioration in soil fertility, suppressed soil-borne diseases, strengthened microbial flora structure, thus decreased continuous barriers for the crop growth. Humic acid is defined as an organic matter derived from animal and plant residues that decomposed and transformed by microorganisms. Humic acid, in combination with various inorganic fertilizers can actively improve soil quality, enhance efficiency of fertilization process, and stimulate crop yield and quality (Sensoy et al., 2013; Selladurai et al., 2016; Kandil et al., 2017; Suman et al., 2017; Khan, et al., 2018). Mohamed and Ali (2016) displayed that treating cantaloupe crop with humic acid significantly ameliorated vegetation and harvest traits and mineral content of crop relative to control. Abd El-Hai et al. (2019) observed that giving melon plants a mixture of humic acid and amino acids caused a prominent increment in vegetative characters, biochemical parameters and fruit yield of crop. Abd El-Baky et al. (2018) reported that foliar treating cucumber plants with humic acid with concentration (3 g $l^{-1}$) drove to the increased uptake and content of minerals like N, P, K, Ca and Mg in comparison with control. Esho and Saeed (2017) have illustrated a positive impact of humic acid on three cultivars of squash and cleared that treating plants with humic acid prominently increased yield traits like fruit length, number of fruits /plant and total yield as well as number of male and female flowers of the plant and sex ratio.

Soil application of mineral fertilizers results in the leaching of most given elements. Hence, feeding plants using foliar spraying is an effective method for supplementation of requested macro and micro nutrients particularly during critical stages of active plant outgrowth since such method can elevate plant mineral content and rise crop harvest (Kadu et al., 2018). Potassium is the third major plant nutrient coming after nitrogen and phosphorus that is required by plant in large amounts and is commonly given to the plant via fertilizers. In order to be available for the plant, it should be in the form of cation ($K^{+}$). The significance of potassium is favored to its essentiality for a variety of process i.e. photosynthesis, fruit formation, winter hardiness and disease resistance. It also plays an important role in protein synthesis especially in grain filling (Shafeek et al., 2015).

Various studies unveiled a profound impact of potassium application on cucurbit crops. Merghany et al. (2015) have demonstrated that the premium vegetative and harvest parameters of melon were recorded due to fertilization with K element. Bouzo (2018) studied the influence of potassium and calcium on melon and illustrated that the potassium fertilization surpassed calcium one in producing the best quality and yield of harvested fruits. Abd-Elaziz et al. (2019) showed that providing squash plants with potassium silicate importantly increased foliage, yield and leaf mineral content over control. Dunsin et al. (2019) executed a field research on the impact of organic fertilizers and NPK fertilizer yield and fruit mineral content of squash (*Cucurbita pepo* L). The trial data indicated that the application of NPK increased the fruit mineral content of Mn, K, Fe and Ca. Al-Moshileh et al. (2017) indicated that supplying cucumber plants with four levels of potassium sulfate gave excellent marketable yield and its quality relative to control. So as long no similar studies have been executed in Dohuk governorate, the aims of the study are to investigate the effect of humic acid and potassium fertilization and their interactions on the growth and yield of melon crop to enhance the quality and productivity of melon and to upraise the nutrient obtainability and absorption of some nutrients with deteriorating the architecture of soil devoted for agriculture in Dohuk governorate.

## MATERIALS AND METHODS

### *Materials*

The field experiment was conducted in a field of in The Vegetable Research Field At The Research Center, General Directorate of Agriculture, Duhok Province, North of Iraq during summer season of 2019. The below table displays analysis of some physical and chemical properties of the study soil:

**Table 1.** Some physical and chemical properties of the field soil

| Properties | Sand (g kg$^{-1}$) | Silt (g kg$^{-1}$) | Clay (g kg$^{-1}$) | Texture | pH | EC (dS m$^{-1}$) | Organic Matter (g kg$^{-1}$) | N (g kg$^{-1}$) | P (mg kg$^{-1}$) | K (mmol L$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Value | 24.03 | 42.50 | 33.48 | Clay loam | 7.84 | 0.92 | 3.4 | 74 | 6.11 | 15.99 |

The monthly meteorological data during the study period are demonstrated in Table (2):

**Table 2.** Monthly climatologically data during May to September 2019.

| Months | Air temperature (C) | | | Average of soil Temperature (C) | | Average of Relative Humidity (%) | Average of sum of Rain (mm) |
|---|---|---|---|---|---|---|---|
| | Max | Min | Average | Deep of 10 cm | Deep of 30 cm | | |
| May | 31.148 | 18.274 | 24.719 | 17.5 | 16.3 | 45.93 | 14.5 |
| Jun | 38.616 | 24.233 | 31.425 | 21.7 | 19.8 | 31.829 | 0.4 |
| July | 39.5 | 24.083 | 31.796 | 23.5 | 22.4 | 30.802 | 0 |

The seeds of a local muskmelon cultivar (cv. Mloky) was used as plant material. The fertilizer (NPK 20:20:20) was added to the soil (200kg ha$^{-1}$) to elevate nutrient obtainability in the soil. The experiment treatments were arranged in a factorial Randomized Complete Block design (RCBD) with two factors. The seeds of muskmelon were sown in the field on March 19$^{th}$ 2019 through sowing process with row spaces of 100 cm x 90 cm. The cultural practices were performed in each experimental unit such as weeding and hoeing of soil around seedlings in addition to continuous observation of diseases and pests.

### *Methods*

The experiment encompassed foliar feeding of potassium fertilizer with four levels (0, 0.3, 0.6, and 0.9) mg l$^{-1}$ and soil addition of humic acid at four levels (0, 500, 1000, and 2000) mg l$^{-1}$ with three replicates. The humic acid solution was prepared by mixing certain humic milliliters with tap water and the mixture was shaken well. The prepared solutions were applied three times. The first spray was carried out on May 27$^{th}$ 2019 with ten days' interval between each spray.

### Vegetative Growth parameters

The vegetative growth parameters were measured for five plants in each experimental unit. The canopy height was recorded using measuring bar. The leaf area plant$^{-1}$ (mm) used determined by leaf area meter device. The chlorophyll content was measured using Chlorophyll Meter (SPAD-502, and Konica Minolta). The stem diameter (cm) was measured with measuring bar.

### Mineral Contents in Leaves

The total nitrogen percentage was determined following the modified method of Kjeldahl using the Microkjeldahl equipment for element analysis (AOAC, 1980) that cited by Black (1965). The Phosphorus content (%) was estimated in leaves of muskmelon relying on the colorimetric methods and the spectrophotometer instrument was employed for analysis (John, 1970) while the potassium percentage (%) was determined according to flame method by operation of Flame photometer instrument (AOAC, 1970 and Al-Sahaf, 1989).

### Yield Parameters

Number of fruit plant was counted starting from the first harvest till the end of the growing season. The total yield was measured from each experimental unit and converted to yield per hectare.

### Statistical analysis

The experiment treatments were arranged in a factorial Randomized Complete Block design (RCBD). The study comprised of (16) treatments (4×4=16) each treatment was replicated three times and each replicate were represented by five plants. The data analysis was conducted by SAS (2010) statistic program.

## RESULTS AND DISCUSSION

*Vegetative Growth Parameters*

*Canopy height*

The effects potassium (K) and humic acid (HA) on canopy height of melon plants were illustrated in Table 3. The K and HA doses and their interaction did not have a measurably marked impact on the canopy height of melon plants. Still the tallest plants (59.933cm) were observed in the HA3xK3 interaction succeeded by K1xHA1 interaction (57.567 cm). The shortest plants were those obtained from HA2xK3 interaction (Table 3).

**Table 3.** Effect of HA and potassium fertilizer and their interaction on canopy height of melon (cm)

| Applications | $HA_1$ (0 mg $l^{-1}$) | $HA_2$ (500 mg $l^{-1}$) | $HA_3$ (1000 mg $l^{-1}$) | $HA_4$ (2000 mg $l^{-1}$) | Mean |
|---|---|---|---|---|---|
| $K_1$ (0 mg $l^{-1}$) | 57.567 | 44.200 | 50.033 | 53.256 | 51.264 |
| $K_2$ (0 .3mg $l^{-1}$) | 57.467 | 52.933 | 55.500 | 56.200 | 55.525 |
| $K_3$ (0.6 mg $l^{-1}$) | 52.467 | **49.400** | **59.933** | 55.400 | 54.300 |
| $K_4$ (0.9 mg $l^{-1}$) | 50.633 | 54.733 | 53.600 | 54.200 | 53.292 |
| **Mean** | 54.533 | 50.317 | 54.767 | 54.764 | |

**HA:** Humic acid; **K:** Potassium.

*Leaf area* ($cm^2$)

The table 4 shows the effect of humic acid (HA) and the potassium (K) fertilizer and their interaction on the leaf area of melon crops. The different doses of HA and K did not significantly increase the leaf area relative to control. Still the melon plants of the HA1xK2 interaction possessed the maximum value (72.22 3 $cm^2$) of leaf area followed by plants of the HA4xK4 interaction which had a leaf area of 71.494 $cm^2$.

**Table 4.** Effect of HA and potassium fertilizer and their interaction on leaf area of melon

| Applications | $HA_1$ (0 mg $l^{-1}$) | $HA_2$ (500 mg $l^{-1}$) | $HA_3$ (1000 mg $l^{-1}$) | $HA_4$ (2000 mg $l^{-1}$) | Mean |
|---|---|---|---|---|---|
| **$K_1$ (0 mg $l^{-1}$)** | 70.381 | 63.497 | 69.731 | 62.076 | 66.421 |
| **$K_2$ (0 .3mg $l^{-1}$)** | **72.223** | 66.895 | 66.990 | 62.033 | 67.035 |
| **$K_3$ (0.6 mg $l^{-1}$)** | 66.404 | 66.772 | 62.803 | 67.083 | 65.766 |
| **$K_4$ (0.9 mg $l^{-1}$)** | 68.026 | 62.286 | **61.158** | 71.494 | 65.741 |
| **Mean** | 69.259 | 64.863 | 65.170 | 65.672 | |

**HA:** Humic acid; **K:** Potassium.

*Chlorophyll content mg 100 $g^{-1}$*

The data in Table 5 showed no important variations regarding chlorophyll content in response to the application of humic acid and potassium (K) along with their interactions in comparison with control. Both fertilizers did not ameliorate the chlorophyll content in melon. Still the highest content of chlorophyll (58.210 mg 100 $g^{-1}$) was recorded in leaves of plants of the HA3xK4 interaction followed by the HA3xK1 interaction. The lowest value (49.430 mg 100 $g^{-1}$) of chlorophyll content was obtained from the HA4xK4 interaction.

**Table 5.** Effect of HA and potassium fertilizer and their interaction on the Chlorophyll Content mg 100 $g^{-1}$ in melon

| Applications | $HA_1$ (0 mg $l^{-1}$) | $HA_2$ (500 mg $l^{-1}$) | $HA_3$ (1000 mg $l^{-1}$) | $HA_4$ (2000 mg $l^{-1}$) | Mean |
|---|---|---|---|---|---|
| **$K_1$ (0 mg $l^{-1}$)** | 53.063 | 49.760 | 56.513 | 52.042 | 52.845 |
| **$K_2$ (0 .3mg $l^{-1}$)** | 55.700 | 54.497 | 53.517 | 52.313 | 54.007 |
| **$K_3$ (0.6 mg $l^{-1}$)** | 51.590 | 56.410 | 54.300 | 54.817 | 54.279 |
| **$K_4$ (0.9 mg $l^{-1}$)** | 52.723 | 55.373 | **58.210** | **49.430** | 53.934 |
| **Mean** | 53.269 | 54.010 | 55.635 | 52.151 | |

**HA:** Humic acid; **K:** Potassium

*Stem diameter*

The different doses of both fertilizers displayed insignificant differences in the stem diameter. Still the maximum stem diameters (1.00 cm) and (0.99 cm) were measured for melon plants treated with the interactions of HA2xK4 and HA1xK3, respectively, while the minimum stem diameter was measured in plants of the HA2xK1 interaction.

**Table 6.** Effect of HA and potassium fertilizer and their interaction on stem diameter (cm) of melon

| Applications | $HA_1$ (0 mg $l^{-1}$) | $HA_2$ (500 mg $l^{-1}$) | $HA_3$ (1000 mg $l^{-1}$) | $HA_4$ (2000 mg $l^{-1}$) | Mean |
|---|---|---|---|---|---|
| **$K_1$ (0 mg $l^{-1}$)** | 0.850 | **0.700** | 0.927 | 0.924 | 0.850 |
| **$K_2$ (0 .3mg $l^{-1}$)** | 0.907 | 0.880 | 0.933 | 0.840 | 0.890 |
| **$K_3$ (0.6 mg $l^{-1}$)** | 0.990 | 0.843 | 0.847 | 0.847 | 0.882 |
| **$K_4$ (0.9 mg $l^{-1}$)** | 0.897 | **1.000** | 0.923 | 0.960 | 0.945 |

| | | | | | |
|---|---|---|---|---|---|
| **Mean** | 0.911 | 0.856 | 0.908 | 0.893 | |

**HA:** Humic acid; **K:** Potassium

*Leaf mineral content*

*Leaf nitrogen (N) contents (%)*

Table 7 shows that the nitrogen (N) content of melon leaf was not significantly affected by application of HA and K. Still the maximum percentage of nitrogen (2.053%) has been measured in the leaves of melon plants of the HA3xK2 interaction. In contrast, the minimum percentage of the nitrogen (1.344%) was obtained from the HA2*K2 interaction.

**Table 7.** Effect of HA and potassium fertilizer and their interaction on the leaf nitrogen (N) content (%) in melon

| **Applications** | **$HA_1$ (0 mg $l^{-1}$)** | **$HA_2$ (500 mg $l^{-1}$)** | **$HA_3$ (1000 mg $l^{-1}$)** | **$HA_4$ (2000 mg $l^{-1}$)** | **Mean** |
|---|---|---|---|---|---|
| **$K_1$ (0 mg $l^{-1}$)** | 1.512 | 1.456 | 1.437 | 1.493 | 1.475 |
| **$K_2$ (0 .3mg $l^{-1}$)** | 1.661 | **1.344** | **2.053** | 1.400 | 1.615 |
| **$K_3$ (0.6 mg $l^{-1}$)** | 1.643 | 1.512 | 1.419 | 1.400 | 1.493 |
| **$K_4$ (0.9 mg $l^{-1}$)** | 1.699 | 1.643 | 1.587 | 1.652 | 1.645 |
| **Mean** | 1.629 | 1.489 | 1.624 | 1.486 | |

**HA:** Humic acid; **K:** Potassium

*Leaf phosphorus (P) contents (%)*

The phosphorus percentage in the leaf of melon applied with various doses of humic acid and potassium is illustrated in Table 8. The obtained findings demonstrated a prominent action of both fertilizers on the phosphorus percentage in leaves relative to control. The peak percentage of phosphorus (0.257%) was determined in the HA4xK4 interaction, while the lowest value (0.129%) of phosphorus content was recorded in plants of the HA2xK1 interaction. In case of mean values, the highest amount of P contents were obtained from K4 and K3 applications, while the lowest value from K1 (control) application. Moreover, the highest amount of P contents were obtained from H3 and H4 applications, while the lowest value from H2 application

**Table 8.** Effect of HA and potassium fertilizer and their interaction on the leaf phosphorus (P) content (%) in melon

| **Applications** | **$HA_1$ (0 mg $l^{-1}$)** | **$HA_2$ (500 mg $l^{-1}$)** | **$HA_3$ (1000 mg $l^{-1}$)** | **$HA_4$ (2000 mg $l^{-1}$)** | **Mean** |
|---|---|---|---|---|---|
| **$K_1$ (0 mg $l^{-1}$)** | 0.146 | **0.129** | 0.160 | 0.142 | 0.144**C*** ** |
| **$K_2$ (0 .3mg $l^{-1}$)** | 0.173 | 0.170 | 0.190 | 0.179 | 0.178**B** |
| **$K_3$ (0.6 mg $l^{-1}$)** | 0.216 | 0.201 | 0.214 | 0.192 | 0.206**A** |
| **$K_4$ (0.9 mg $l^{-1}$)** | 0.216 | 0.190 | 0.214 | **0.257** | 0.219**A** |
| **Mean** | 0.188**AB*** | 0.173**B** | 0.194**A** | 0.193**A** | |

**HA:** Humic acid; **K:** Potassium

$^{***}$, $^{*}$: there are significant differences among the means by P≤0.001, and P≤0.05, respectively.

*Leaf potassium (K) contents (%)*

The leaf content of potassium element did not exhibit any important increment due to HA and K applications (Table 9). Still the highest content of potassium (1.573%) was obtained in the leaves of melon plants of the HA3xK2 interaction, while the lowest one from the HA2xK1 interaction.

**Table 9.** Effect of HA and potassium fertilizer and their interaction on the leaf potassium (K) content (%) in melon

| Applications | $HA_1$ (0 mg $l^{-1}$) | $HA_2$ (500 mg $l^{-1}$) | $HA_3$ (1000 mg $l^{-1}$) | $HA_4$ (2000 mg $l^{-1}$) | Mean |
|---|---|---|---|---|---|
| **$K_1$ (0 mg $l^{-1}$)** | 1.300 | **1.077** | 1.389 | 1.360 | 1.282 |
| **$K_2$ (0 .3mg $l^{-1}$)** | 1.336 | 1.383 | **1.573** | 1.187 | 1.370 |
| **$K_3$ (0.6 mg $l^{-1}$)** | 1.259 | 1.265 | 1.431 | 1.241 | 1.299 |
| **$K_4$ (0.9 mg $l^{-1}$)** | 1.348 | 1.312 | 1.330 | 1.398 | 1.347 |
| **Mean** | 1.300 | 1.259 | 1.389 | 1.360 | |

**HA:** Humic acid; **K:** Potassium

*Yield Parameters*

*Number of fruits. plant$^{-1}$*

The HA and K applications did not have a notable effect on the number of fruit per plant relative to the control plants (Table 10). Still the most remarkable number of fruits per plant was measured in the HA4xK3 (3.188 fruit.plant$^{-1}$) interaction followed by HA1xK2 (2.917 fruit.plant$^{-1}$). In contrast, the least number of natural product per plants (2.25 fruit.plant$^{-1}$) was obtainable from HA4xK2 interaction.

**Table 10.** Effect of HA and potassium fertilizer and their interaction on the number of fruit

| Applications | $HA_1$ (0 mg $l^{-1}$) | $HA_2$ (500 mg $l^{-1}$) | $HA_3$ (1000 mg $l^{-1}$) | $HA_4$ (2000 mg $l^{-1}$) | Mean |
|---|---|---|---|---|---|
| **$K_1$ (0 mg $l^{-1}$)** | 2.750 | 2.562 | 2.813 | 2.611 | 2.684 |
| **$K_2$ (0 .3mg $l^{-1}$)** | 2.917 | 2.667 | 2.896 | **2.250** | 2.682 |
| **$K_3$ (0.6 mg $l^{-1}$)** | 2.500 | 2.375 | 2.750 | **3.188** | 2.703 |
| **$K_4$ (0.9 mg $l^{-1}$)** | 2.625 | 3.000 | 2.687 | 2.750 | 2.766 |
| **Mean** | 2.698 | 2.651 | 2.786 | 2.700 | |

**HA:** Humic acid; **K:** Potassium

*Total yield (ton ha$^{-1}$)*

The melon total yield (ton ha$^{-1}$) was not statistically different from that of control relative to the various doses of humic acid and potassium (Table 11). Still the maximum value of total yield was obtained for melon plants provided from the HA4xK4 interaction followed by HA4xK3, hile the lowest yield was measured from the HA2xK2 interaction.

**Table 11.** Effect of HA and potassium fertilizer and their interaction on the total yield ton Ha in melon (ton $ha^{-1}$)

| Applications | $HA_1$ (0 mg $l^{-1}$) | $HA_2$ (500 mg $l^{-1}$) | $HA_3$ (1000 mg $l^{-1}$) | $HA_4$ (2000 mg $l^{-1}$) | Mean |
|---|---|---|---|---|---|
| **$K_1$ (0 mg $l^{-1}$)** | 19.357 | 19.870 | 19.483 | 18.333 | 19.261 |
| **$K_2$ (0 .3mg $l^{-1}$)** | 18.525 | **16.150** | 19.767 | 17.410 | 17.963 |
| **$K_3$ (0.6 mg $l^{-1}$)** | 18.233 | 19.467 | 18.227 | 20.217 | 19.036 |
| **$K_4$ (0.9 mg $l^{-1}$)** | 19.700 | 19.000 | 16.650 | **25.450** | 20.200 |
| **Mean** | 18.954 | 18.622 | 18.532 | 20.353 | |

**HA:** Humic acid; **K:** Potassium

According to obtained results, the application of humic acid and K fertilizer exhibited some but not high improvement in the vegetation and yield traits of melon plant as compared to untreated plants (control). This could attribute to the negative impact of extreme hot weather and drought stress in the production season that might greatly suppressed the efficiency of humic acid and potassium fertilization. As it is well known, the productivity of plants is firstly dependent on environmental circumstances. Water stress is one of the most serious environmental stresses that can restrain plant outgrowth and harvest. The insignificant vegetative growth and yield traits may also attribute to the leaching of humic acid through soil drenching or to the impact of daytime on the potassium absorption through foliage feeding. In dry hot weather, the foliar application of fertilizers may be ineffective due to increased evaporation rate as generated from high temperature and low relative humidity. Zareian et al. (2013) reported that foliar K application did not improve plant vegetation parameters and the net photosynthesis, stomata conductance was decreased under drought stress.

Water insufficiency results in many endogenous disorders such as increase in cell shrinkage, the cytoplasm viscosity and cell wall folding, which in turn leads to membrane destruction and protein denaturation (Flexas et al., 2000). The major significant impact of water limitation is on the photosynthesis rate and stomata conductance for gas exchange. Either the assimilation rate or conductance is strongly affected by environmental changes like water deficit, hot weather condition and internal plant conditions more than any other parameter. In this context, water-use efficiency is not constant, increasing progressively with decreasing soil water availability (Turner, 1997). Water stress primarily reduces the canopy expansion (Jefferies, 1995; Wang *et al.*, 2003). Long-term drought conditions can reduce leaf area index and canopy longevity (Fleisher et al., 2008). Furthermore, permanent or temporary water deficit stress limits the growth and distribution of natural and artificial vegetation and the performance of cultivated plants more than any other environmental factor (Fereres and Soriano, 2006). Selim et al. (2012) showed that the water-stressed potato plants were less performance than the unstressed one (control). In this context, our results are not in agree with those of Abd El-Hai et al. (2019) and Merghany et al. (2015) on melon plant.

The melon leaf content of nitrogen and potassium did not importantly enhanced with soil drenching of humic acid and foliar application of potassium. This could refer to the leaching of nutrients provided by humic acid leading to reduced uptake of nutrients by roots in the soil of the experiment. Nutrient leaching may be induced by vertical macro pore (formed in bulk dried soils) or bypass flow after the surface application of fertilizers, as a result of a solution with high nutrient concentration then infiltrates quickly into the soil with little contact with the soil matrix (Cameron and Haynes, 1986; van et al., 1991). Nitrate is very prone to leaching because it has a neglect interaction with the negatively charged matrix of most topsoil and is, therefore, very mobile in the soil. Nitrate leaching is also considered as a significant source of soil acidification. Agricultural activities can greatly increase leaching losses (Havlin et al., 1999). Foliar application of potassium, on the other hand, also did not significantly improve some leaf nutrient content of melon, especially potassium content. This effective role of potassium fertilization maybe due to the influence of dry weather and high temperature stress that can harm plants plant during the summer season (Vollenweider and Gunthardt-Goerg, 2005). This may have drove to investing potassium in in the drought tolerance by melon plants as potassium plays an important role in the opening and closing of stomata and turgidity of guard cells during hot dry conditions. Our findings are in line with those of Abd-Elaziz et al. (2019) on squash and Abd El-Baky et al. (2018) on cucumber.

The phosphorus percentage in leaves of melon was significantly ameliorated by humic acid and potassium fertilization. This could favor to the immobility of this element in the soil that prevented it from washing away into the subsoil and provision of humic acid. Mohamed and Ali (2016) displayed that treating cantaloupe plants with humic acid markedly elevated leaf phosphorus content. In contrast to nitrate and sulphate, phosphate is always immobile in most soils owed to its tendency for precipitation and adsorption to mineral surfaces, and leaching is therefore far from occurrence, except in certain very sandy and organic soils (Wild, 1988).

## CONCLUSION

In the modern farming systems, the use of natural inputs that are secure and ecofriendly along with the integrated inorganic fertilization has increased quickly to raise up the crop productivity and quality. However, our findings revealed little prominent increment in the vegetation and yield of melon plant ascribed to the soil drenches of humic acid and foliar feeding of potassium fertilizer for which hot weather condition and water stress and leaching may be blamed. In case of leaf mineral content, both fertilizers did not result in any improvement in leaf content of N and K, but only P content improved in response to the application of humic acid and potassium. For that reason, it is necessary to execute more studies on the impact of those kind ofnatural fertilizers along with inorganic ones on melon with increasing the dosages of such fertilizers and depending on proper fertilization management programs to make a notable improvement in the outgrowth and harvest of the crop in hot weather condition.

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