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# Effect of Mineral Fertilization and Humic Acids on Availability of NPK in Soil and Maize Growth

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## ABSTRACT

This experiment were conducted to study the effect of NPK fertilizers, humic acid and their interaction on soil N, P, K availability and growth of "Baghdad" Maize *(Zea mays* L.) variety. This study was conducted in field experiment , College of Agricultural Engineering Sciences, Univ. Baghdad, Al- Jadriya during 2020 growing season, included two treatments: four levels of humic acid application to soil at 0 ($H_0$), 20 kg.$H^{-1}$($H_{20}$) , 40 kg.$H^{-1}$($H_{40}$) and 60 kg.$H^{-1}$($H_{60}$) and three levels of NPK fertilizers, 0 ($M_0$), 50 %($M_{50}$) and 100 % ($M_{100}$) From the fertilizer recommendation (240 kg N $H^{-1}$, 80 kg P $H^{-1}$ and 120 kg K $H^{-1}$) and their interaction. Treatments were replicated three times at factorial experiment in a RCBD. The results showed that, humic acid at 60 kg.$H^{-1}$($H_{60}$) gave highest soil nitrogen content of 125.1 mg.$kg^{-1}$**,** highest soil phosphor content of 22.82 mg.$kg^{-1}$**,** highest soil potassium content of 327.1 mg.$kg^{-1}$, highest plant height of 184.28 cm and highest plant dry weight of 182.1 gm. Results also showed that NPK fertilizer at 100 % ($M_{100}$) gave highest soil nitrogen content of 127.8 mg.$kg^{-1}$**,** highest soil phosphor content of 26.29 mg.$kg^{-1}$ , highest soil potassium content of 326.9 mg.$kg^{-1}$, highest plant height of 183.44 cm and highest plant dry weight of 198.2 gm. The interactions between NPK and humic acid addition significantly affected in all traits especially the interaction treatment ($H_{60}M_{100}$).

Keywords: Mineral Fertilization, Humic Acids, NPK

## INTRODUCTION

Challenge facing those interested in agricultural production is the proper diagnosis of all factors determining production and the removal or reduction of them through proper management and adoption of modern technologies to ensure increased yields per area. One of the important matters in this field is the availability of plant nutrients in quantities and at appropriate times (Havlin et al., 2014). Because of vital role of fertilization, use of chemical fertilizers has increased without considering any other considerations because irrational additions to chemical fertilizers are economically costly and there is a possibility of negative impact on the environment.Therefore, there are attempts to reduce mineral fertilization as much as possible through the adoption of good agricultural practices, especially balanced and environmentally fertilization and adoption of organic and mineral fertilization, thus ensuring high productivity and quality products and reducing negative impact on environment.

Humic acids are main component of decomposed organic matter (humus) in soil and have multiple positive effects that contribute to plant growth and development (Ali, 2012). Humic acids play an effective role in improving the soil's physical and chemical properties and fertility, especially soil building and water holding capacity.In addition to increasing the availability of some nutrients and thus having a positive effect on plant growth such as increasing the permeability of cell membranes, stimulating enzymatic reactions, improving cell division, increasing plant enzymes production and increasing vitamins A, D, E and K (El-Sharkawy and Abdel-Razzak, 2010; Al-Marsoumi and Al-Hadethi, 2020).There are several studies conducted by researchers on more than one crop that show the effectiveness of organic acids and their effect on the growth and production of these crops. Rezazadeh et al. (2012) indicated that adding humic acids to maize plants in combination with mineral fertilizer increased plant dry weight and other growth parameters. Abdulameer and Ahmed (2019) revealed that the addition of humic acid to the soil at levels 0, 40, 60 and 80 $kg^{-1}$ caused a significant increased in plant height, number of leaves, leaf area and dry matter especially at 80 $kg^{-1}$. In another study conducted by Rosa (2019) to investigated effect of adding humic sources on elements availability and maize growth , found the application of humic acid increased P, K and Zn concentration in soil nutrient solution; SPAD index increased about 50% for all humic sources.

Nutrient elements such as N, P and K are exposed to leaching, sedimentation, volatilization or stabilization processes, especially in Iraqi soils with a high content of carbonate minerals, which are mainly responsible for alkalinity reaction (Ali et al., 2014). plant needs nitrogen and phosphorous and potassium in larger quantities compared to other nutrients, as (Ali, 2012) showed the most important functions of major nutrients, as nitrogen enters the building of plant tissues and amino acids formation, which are the basis for protein formation for plant and enters the formation of the chlorophyll molecule, which is necessary for the formation of enzymes and vitamins in increasing root growth plant size, which is positively reflected in the increase in plant yield. As well as phosphorous and potassium, which have an important role in plants growth and yield. Gul et al. (2015) found when adding three levels of mineral fertilizer N, P and K (17, 17, 60), (25, 22, 75) and (33, 26, 90) kg $.H^{-1}$ that the growth and yield characteristics of maize increases with increasing fertilizer levels. This study aims to know the effect of mineral fertilization levels and humic acids on soil availability of nitrogen, phosphorous and potassium and maize (*Zea mays* L.) growth, and studying possibility of reducing mineral fertilization by adding humic acids to the soil.

## MATERIALS AND METHODS

This experiment were conducted to study the effect of NPK fertilizers, humic acid and their interaction on soil N, P, K availability and growth of "Baghdad" Maize *(Zea mays* L.) variety. This study was conducted in field experiment , College of Agricultural Engineering Sciences, Univ. Baghdad, Al- Jadriya during 2020 growing season, included two treatments: four levels of humic acid application to soil at 0 ($H_0$), 20 $kg.H^{-1}$($H_{20}$) , 40 $kg.H^{-1}$($H_{40}$) and 60 $kg.H^{-1}$($H_{60}$) and three levels of NPK fertilizers, 0 ($M_0$), 50 %($M_{50}$) and 100 % ($M_{100}$) From the fertilizer recommendation (240 kg N $H^{-1}$, 80 kg P $H^{-1}$ and 120 kg K $H^{-1}$) and their interaction. Treatments were replicated three times at factorial experiment in a RCBD. Maize seeds were planted on 25/7/2020, which were obtained from the Agricultural Research Department in Abu Ghraib, 3 seeds per hole, and a plant density of 66,666 plants. Then it was reduced after germination to one plant and the distance between one plant and another was 25 cm. Insecticide added to plants as Diazinon (10% effective ingredient) with rate of 6 kg.ha-1 applied to shoot-tips at stage of 6 leaves and hand weeding was practiced manually when needed.

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Humic acid was added in three stages; the first stage in vegetative growth stage, second batch is in tasseling stage and third batch is in the flowering stage. The mineral fertilizer was added in two equal batches, first in vegetative growth and second in tasseling phase. Soil analyzes were carried out at flowering stage, nitrogen was estimated using micro-kjeldahl according to method of (Page et al., 1982). Phosphorous was estimated by a spectrophotometer at a wavelength of 882 nm according to Olsen's method reported in Page et al. (1982). Estimation of prepared soil potassium using a flame photometer as mentioned in Page et al. (1982). Leaves chlorophyll content in flowering stage was measured by a German-made CCM-200 chlorophyll content meter (SPAD). Average heights of 5 plants of each experimental unit were measured along with the total dry weight of plant vegetative parts at harvesting stage. The obtained results were subjected to analysis of variance according to (Elsahookie and Wuhaib, 1990) using L.S.D 0.05 for comparing differences between various treatment means.

## RESULTS AND DISCUSSIONS

**Effect of Mineral Fertilization and Humic Acids on Availability of NPK in Soil**: Data concerning the effect of treatments on availability of nitrogen, phosphor and potassium in soil during 2020 seasons are listed in Table (1). The data cleared that, humic acid at 60 kg.$H^{-1}$($H_{60}$) gave the highest soil nitrogen content of 125.1 mg.$kg^{-1}$**,** highest soil phosphor content of 22.82 mg.$kg^{-1}$ and highest soil potassium content of 327.1 mg.$kg^{-1}$. Table (1) also shows that NPK fertilizer at 100 % ($M_{100}$) from the fertilizer recommendation gave the highest soil nitrogen content of 127.8 mg.$kg^{-1}$**,** highest soil phosphor content of 26.29 mg.$kg^{-1}$ and highest soil potassium content of 326.9 mg.$kg^{-1}$.The interaction between humic acid and NPK significantly affected all studied soil content. The reason may be explained by the fact that this complex substance (humic acid) increases biomass activity, including nitrogen-fixing organisms, and humic acid is a storehouse of nutrients, including nitrogen. Increase in soil phosphor availability is also due to role of humic acid in reducing the processes of deposition and adsorption of phosphor on colloids surfaces of clay minerals through competition for adsorption sites, which increases phosphor release into soil solution as well as slow and continuous dissolution of phosphor minerals in soil by adding Humic acid (Akinci et al, 2009). These results are in harmony with those reported by Al-Bahrani (2015) and AL-Barakat (2016) in soil planted with maize.

**Table 1. Effect of Mineral Fertilization and Humic Acids on Availability of NPK in Soil and growth of "Baghdad" Maize during 2020 season.**

| Humic (H) | Mineral Fertilizer (M) | | | | Mineral Fertilizer (M) | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 | 50 | 100 | mean | 0 | 50 | 100 | mean |
| | N (mg $kg^{-1}$ soil) | | | | P (mg $kg^{-1}$ soil) | | | |
| **0** | 112.4 | 117.4 | 120.8 | **116.9** | 15.87 | 17.28 | 23.64 | **18.93** |
| **20** | 115.6 | 120.6 | 126.6 | **120.9** | 16.36 | 18.84 | 25.27 | **20.16** |
| **40** | 116.8 | 122.2 | 131.8 | **123.6** | 16.82 | 19.00 | 27.44 | **21.09** |
| **60** | 117.8 | 125.6 | 132.0 | **125.1** | 17.10 | 22.56 | 28.80 | **22.82** |
| **mean** | **115.7** | **121.5** | **127.8** | | **16.54** | **19.42** | **26.29** | |
| **L.S.D5%** | **H** | **M** | **Inter** | | **H** | **M** | **Inter** | |
| | 3.43 | 2.97 | 5.94 | | 1.86 | 1.61 | 3.22 | |

| K (mg kg$^{-1}$ soil) | | | | | Leaves Chlorophyll (SPAD) | | | |
|---|---|---|---|---|---|---|---|---|
| **0** | 297.2 | 308.2 | 311.8 | **305.7** | 46.47 | 59.90 | 61.00 | **55.79** |
| **20** | 301.6 | 315.0 | 321.6 | **312.7** | 46.83 | 55.17 | 64.67 | **55.56** |
| **40** | 302.6 | 322.1 | 333.9 | **319.5** | 49.30 | 57.87 | 70.17 | **59.11** |
| **60** | 310.9 | 330.2 | 340.2 | **327.1** | 47.73 | 57.90 | 68.30 | **57.98** |
| **mean** | **303.1** | **318.9** | **326.9** | | **47.58** | **57.71** | **66.04** | |
| **L.S.D5%** | **H** | **M** | **Inter** | | **H** | **M** | **Inter** | |
| | 4.31 | 3.73 | 7.47 | | 2.56 | 2.22 | 4.44 | |
| **Plant Height (cm)** | | | | | **Dry weight (gm)** | | | |
| **0** | 161.22 | 165.89 | 175.24 | **167.45** | 125.6 | 146.4 | 184.0 | **152.0** |
| **20** | 164.67 | 171.12 | 175.49 | **170.43** | 136.2 | 153.8 | 194.2 | **161.4** |
| **40** | 164.93 | 177.17 | 189.27 | **177.12** | 143.6 | 167.8 | 200.0 | **170.5** |
| **60** | 171.11 | 188.00 | 193.74 | **184.28** | 155.5 | 176.2 | 214.6 | **182.1** |
| **mean** | **165.48** | **175.55** | **183.44** | | **140.2** | **161.1** | **198.2** | |
| **L.S.D5%** | **H** | **M** | **Inter** | | **H** | **M** | **Inter** | |
| | 5.40 | 4.68 | 9.36 | | 11.21 | 9.71 | 19.42 | |

**Effect of Mineral Fertilization and Humic Acids on leaf chlorophyll content, plant height and plant dry weight:** The data in Table (1) cleared that, humic acid at 60 kg.H$^{-1}$($H_{60}$) gave the highest plant height of 184.28 cm and highest plant dry weight of 182.1 gm, while humic acid at 40 kg.H$^{-1}$($H_{40}$) gave the highest leaf chlorophyll content of 59.11 SPAD unit. While lower values of these traits was in control treatment ($H_0$). Table (1) also shows that NPK fertilizer at 100 % ($M_{100}$) gave the highest leaf chlorophyll content of 66.04 SPAD unit, highest plant height of 183.44 cm and highest plant dry weight of 198.2 gm. The interactions between NPK and humic acid addition significantly affected in all traits in Table (1) especially the interaction treatment ($H_{60}M_{100}$). Role of humic acid in physiological processes comes through promotion of enzymes and transfer of photosynthesis products as well as a role of division and elongation of cells (Fawzy et al., 2007), leading to increased growth traits. These results are in harmony with those reported by Abd El-Gawad and Morsy (2017), (Gomaa et al., 2019) on maize plants.

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