ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP185

Effect of Humic Acid Application Methods on Nutrients Availability and Growth and Yield of Okra(*ABELMOSCHUS ESCULLANTUS L.*)

Amin Hussain Jabal[1]*
Soil Sci. Water Res. Dept. Coll. Agri. Univ. Basrah. Basrah. Iraq.

Corresponding Author: Amin Hussain Jabal[1]*

Abstract:- A field experiment was conducted at the Agricultural Research Station, College of Agriculture, University of Basrah during the growing season of 2021-2022 to study the effect of adding humic acids either to soil or spraying on plant along with recommended chemical fertilizers(NPK) on availability of N, P, and K and EC and pH of soil as well as growth and yield of okra. The results showed an increase in the availability of N,P and K by adding humic acid to the soil while spraying of humic acid had no clear differences with chemical fertilizers treatments. Addition of humic acid to soil decreased EC while addition as foliar application increase EC of soil. Addition of humic acid along with chemical fertilizers to soil or spraying on plant led to an increase in concentrations of N, P, and K in the leaves and their uptake with superiority of spraying treatment over soil application treatments. Increasing humic acid level spraying on plant from 0.5 to 1.0gL^{-1} significantly decreased N,P and K concentrations and uptakes. Similar findings were obtained for dry matter and fruits yield. The lower the level of humic acid ,The higher the dry matter and yield. The highest value of okra fruit yield 2791.06 kgha^{-1} was obtained with treatment involved spraying of 0.5gL^{-1} humic acid plus full recommended chemical fertilizers.

Keywords:- Humic Acid ,Okra, Yield ,Available N,P,K.

I. INTRODUCTION

From the above ,one can be certain that humic acid may be used as an alternative source to chemical fertilizers at least supple mentally. Nadia *et al*.,(2015) found that humic acid had a significant increasing effect on the N, P, K, fruits number, fruit weight and yield per hectare. (Haider *et al*., 2017). In conclusion it was noticed that using 20 kgha^{-1} of humic acid significantly increased fruit weight and yield. The present study was designed to demonstrate the ability of humic acid adding either to soil or foliar method to replace apart of chemical fertilizers to okra plant.

Okra [*Abelmoschus esculentus* (L.) Moench] is an annual vegetable crop in tropical and sub-tropical parts of the world. It is one of the important nutritious vegetable in Iraq, as well as it considered as an economically vegetable. Each 100g of green pods contains 1.8g protein,6.4g carbohydrate,1.2g fibre, 18 mg vitamin C and 90 mg Ca (Rashid, 1999). It is one of the most well adapted vegetable fruit to tropical conditions, and it has excellent nutritive value. Okra crop production in Iraq was 27.2 thousand tons in 2010, and decrease by 29.2% compared to last year's production, On the other hand, the production of okra in the world was 8,689;499 tons in 2013(FAO,2015).A number of studies were conducted to improve the growth and production of Okra by following several strategies , the most important of which is providing a plant's need for nutrients, especially nitrogen, which, if it works, increases the growth and yield of the plant. through the biological and chemical humification of plant and through the biological activates of microorganisms (Anon., 2010). Humic acid directly affects the vegetative growth and uptake of N, Ca, Mg, P and K by plant (Vanitha and Mohandass, 2014). Humic acid which has hormone like activity not only enhancing plant growth and nutrient uptake, but also improve stress tolerance. The importance of humic acid is not limited to their function as a reservoir of nutrients to plant (Yildirim, 2007) Moreover, Humic acid can improve plant growth by enhancing soil structure and water holding capacity as well as microorganisms activity as a source of C and other nutrients .

II. MATERIALS AND METHODS

A field experiment was conducted during the growing season of 2021-2022 with okra(Abelmoschus esculents (L.) Moench), a local variety in a greenhouse (25m*6m) at the Agricultural Research Station , College of Agriculture, University of Basra, located in the Karmat- Ali region (47º44'40"E and 30º33'44"N), 9.78 km away from Basrah center.Theinitial properties of the greenhouse soil were estimated according to the methods adopted in Richards (1954) and Page et al .(1982) after taking a composite sample (Table1). The experiment was carried out in Randomized Design with eight treatments and three replications. The treatments were T1 (Control). T2 (recommended chemical fertilizers), T3 (Humic acid +1/2 of recommended chemical fertilizers, T4 (foliar humic acid +full recommended

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP185

chemical fertilizers,T5 (foliar humic acid 0.5 gL-1+1/2 recommended chemical fertilizers,T6 (foliar humic acid 0.5 gL-1+full recommended chemical fertilizers,T7 (foliar humic acid 1.0 gL-1+1/2 recommended chemical fertilizers and T8 (foliar humic acid 1.0 gL-1+full recommended chemical fertilizers.

The field was plowed perpendicularly, smoothed, leveled, and four rows was opened, Each row contains six experimental units of 2 m x 1 m, The recommended chemical fertilizers were urea (46%N) at a level of 250kgNha-1,concentrated super phosphate (20.21%p) at a level of 120kgP2O5ha-1, and potassium sulfate (46%K) at a level of 400kgKha-1. Okra seeds were sowed in holes on both sides of the row at a distance of 40cm plant to plant. After thinning, the number of plants in each experimental unit becomes 10 plants. Solid Humic acid, the properties of which are shown in Table (1), was used in the experiment at a level of 1.5 tons ha-1 for soil application method and at concentrations of 0.5 or 1.0 gL-1 for foliar methods. Humic acid was added in five doses starting 30 days after sowing.

Table 1: Some Characteristics of Humic Acid Used

Property	Value
Water-Solubility (Dry Basis)	100%
Humic acid (dry basis)	60.0%min
Moisture	15.0%max
Total Trace Elements	2.0%min
pH	8.0-10.0
Sieve residue (0.5mm)	5.0 % max

Randomly soil and plant samples were selected at the flowering-early maturity stage, and the pH, EC, and available N, P, and K were estimated in soil. The concentration and uptake of N, P, and K in leaves were measured .Shoot dry weight of the plant and total pod yield were recorded. The soil pH was estimated in suspension 1:1 using a pH-meter (Page *et al*., 1982), then the suspension was filtered and the soil salinity (EC) was measured using a Conductance-meter (Page *et al*., 1982). Available Nitrogen was extracted with a 2M KCl solution (Bremner and Keeney, 1966), then estimated using a steam distillation procedure according to the method of Bremner and Edwards (1965). As for available phosphorus, it was extracted from the soil using a 0.5*M* $NaHCO_3$ solution and estimated calorimetrically using spectrophotometer using the blue color method (Murphy and Riley,1962).

Table 2 : Some Chemical and Physical Properties of the Greenhouse Soil

Property		Value	Unit
pH (1:1 in Water)		7.70	-
electrical conductivity (EC)		5.22	dsm^{-1}
total nitrogen		21.0	$g\ kg^{-1}$
Available phosphorus		39.3	$mg\ kg^{-1}$
Available potassium		105.40	$mg\ kg^{-1}$
Soil particles Size	sand	36.80	%
	loam	42.00	
	clay	21.20	
Soil texture		loam	

Available potassium was extracted with a 1*N* NH_4OAC solution and estimated using a flame photometer stated in (Page *et al*. (1982). The leaves sample were digested with an acid mixture of 4% $HClO_4$ + H_2SO_4 (Cresser and Parsons, 1979), and the total nitrogen in the digestion solution was estimated using a steam distillation and total phosphorus using the blue color method (Murphy and Riley,1962) and potassium using a flame photometer (Page *et al*. (1982). The average dry weight of the vegetative part of two plants from each plot was estimated after drying at 70°C. The uptake of N,P and K were calculated. The weights of the okra pods for all the harvests in the entire plot were collected to calculate the total yield.

The experiment was carried out as a factorial experiment on the effect of Humic acid interacted with chemical fertilization in a Completely Randomized Design .The data were analyzed using ANOVA by the GenStat program. The Means were compared using a modified least significant difference (RLSD) test at the probability level of 0.05 (Al-Rawi and Khalaf Allah, 1980).

III. RESULTS AND DISCUSSION

A. Effect of Humic Acid and Chemical Fertilizer on the Available N, P, and K In Soil.

Table (3) showed the effect of adding humic acid and chemical fertilizers on the amounts of available N, P, and K. soil addition of humic acid belong with chemical fertilizers signification increased the available N as compared with traditional treatment (T2) with an average value of 372.17 $mg.kg^{-1}$. while ,addition of Humic acid by foliar method significantly decreased the available N in soil compared to traditional treatment(T2) with an average value of 302.16 $mg.kg^{-1}$ soil . That was true for all foliar treatment. It can also be noted that the insignificant differences between T3 and T2

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP185

treatment clearly indicated the benefits effect of humic acid combined chemical fertilizer in increasing the available amount of nitrogen with adding half dose of chemical fertilizers. That mean humic acid can reduce fertilizer cost and ensuring a safe environment. The results of Table 3 indicated that all treatment involved of addition of humic acid combine with chemical fertilizers were significantly superior in increasing the amount of available phosphorus compared to the control treatment but not differ with conventional treatment(T2),except that of (T8). Moreover, there was no clear difference between soil application treatments and foliar treatments. Increasing chemical fertilizers amount with humic acid increase N,P and K availability at soil addition treatments , whereas they were not changed at foliar application treatments. This means , spraying of humic acid on plant have little or no effect on soil nutrient in availability under study conditions. The result of available K (table 3) showed insignificant differences among the different treatments of humic acid and chemical fertilizers. However , the superiority of treatments involved humic acid over conventional treatment, can be observed. Gihan A. Mohamed (2020) found that adding humic acid to the soil led to an increase in the availability of N, P, and K , While spray humic acid on plant did not affect the availability of these elements. Petrovic *et al*.(1982) explained this by increasing the microbiological activity in the soil as a result of adding humic acid to the soil.

Table 3: Effect of Humic Acid and Chemical Fertilizers on Nutrient Availability ,EC and pH

Treatment	**N mg.kg^{-1}**	**P mg.kg^{-1}**	**K mg.kg^{-1}**	**EC dSm^{-1}**	**pH**
T1	324.33 ±28.29	30.66 ±5.42	539.53 ±5.86	4.72±0.35	7.81±0.04
T2	350.09 ±12.49	39.36 ±2.90	545.64±41.50	5.60±0.46	7.77±0.06
T3	348.83 ±12.29	37.73 ±2.21	592.37±50.92	3.32±0.30	7.71±0.11
T4	395.50 ±10.50	40.56 ±2.85	643.00±24.79	4.07±0.31	7.83±0.03
T5	317.33 ±58.70	42.26 ±3.10	600.16±41.03	5.75±0.38	7.69±0.01
T6	319.66 ±11.83	38.00± 4.9	584.58±67.45	5.94±0.28	7.78±0.11
T7	297.50 ±43.00	41.66 ±1.3	569.00±42.12	5.90±0.36	7.80±0.13
T8	274.16 ±7.28	33.43 ±4.16	569.00±30.91	6.49±0.11	7.81±0.12
R.L.S.D$_{0.05}$	**29.75**	**3.93**	**NS**	**0.29**	**NS**

T1: Control T2: Complete Chemical Fertilizer T3: Soil HA+1/2 Chemical Fertilizer T4: Soil HA + Complete Chemical Fertilizer T5: Foliar HA (0.5 g.L^{-1}) + 1/2 Chemical Fertilizer T6: Foliar HA (0.5 g.L^{-1}) + Complete Chemical Fertilizer T7: Foliar HA (1 g.L^{-1}) + 1/2 Chemical Fertilizer T8: Foliar HA (1 g.L^{-1}) + Complete Chemical Fertilizer

Urrutia *et al.* (2014) also explained that humic acid blocking the adsorption sites of these elements and thus Increasing the amount dissolved in soil solution then increasing its availability. The positive effect of soil application of humic acid may be due to improved root growth and up take of nutrients (Samavat and Malakoti, 2010). Moreover, Canellas *et al* .(2002) indicated that adding humic acid increases the appearance of lateral root sites in corn plants.

B. Effect of Humic Acid and Chemical Fertilizer on Soil Salinity (EC) and Soil pH

The results of Table 3 showed a decrease in soil salinity, explained as E.C. in all treatments evolved adding humic acid to the soil compared with traditional chemical fertilization (T2) (3.32 and 4.07 dSm^{-1} for T3 and T4 treatments) with a decrease percentages of 40.71 and 27.32% , respectively. A Similar result was observed by Gihan A. Mohamed (2020). Pena-Mendez, *et al*. (2005) stated that adding humic acid to the soil improved soil aggregates and thus reduced soil salinity by leaching . On the other hand, addition of humic acid by foliar method resulted in a significant increase in soil salinity, and the highest value reached 6.49 dSm^{-1} for T8 treatment. There was no significant change in soil pH values when adding humic acid or chemical fertilizers(table 3) . The reason may be due to the presence of high amount of calcium carbonate (table 1) and increasing resistance of the soil to the change in pH values at alkali range (Helyar and porter,1989). Similar results was observed by fincherira-Robles *et al*.(2016) who found no change in soil pH after addition of 4L.kg^{-1} soil of humic substances.

C. Effect of Humic Acid and Chemical Fertilizers on the Concentration of N, P, K In Leaves and Uptake .

The results of Table 4 indicated that adding humic acid to the soil or spraying on the plant and chemical fertilizers led to a significant increase over control in the concentration of N, P, and K in leave and N,P and K up take in okra shoot. Higher values associated with treatments involved spraying humic acid compared with soil addition treatments which had in significant differences with T2 treatment. The maximum N,P and K concentrations (62.28,6.28 and 60.02gkg^{-1}) respectively were recorded under T6 treatment foliar application of HA0.5 gL^{-1} + full chemical fertilizers and also the maximum N,P and K up take (84.64,8.55 and 81.83 kgha^{-1}) were recorded under T6 treatment . These findings clearly indicated that the plant benefits from the humic acid more when it is spraying on the leaves than it is incorporated in to soil. Humic acid significantly improved N,P and K in plant might be due to stimulatory effect with enhancing uptake of nutrients through the effect of humic acid on expanded cell membranes, photosynthesis,

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP185

Table 4: Effect of Humic acid and Chemical Fertilizers on Leave Concentrations and Uptake 0f N,P and K (± Stander Deviation)

Treatment	N g.kg^{-1}	P g.kg^{-1}	K g.kg^{-1}	N	P	K
				Uptake kg.ha^{-1}		
T1	28.11 ±2.48	1.73 ±0.41	20.12 ±1.82	20.93 ±3.42	1.26 ±0.15	14.99 ±2.45
T2	55.35 ±2.68	4.50 ±0.67	49.47 ±1.92	45.13 ±4.65	3.74 ±1.13	40.41 ±5.01
T3	50.50 ±3.55	4.81 ±1.13	46.12 ±1.93	54.41 ±8.79	5.25 ±1.74	49.48 ±5.05
T4	54.26 ±1.22	5.13± 0.26	48.35 ±2.63	61.34 ±7.51	5.80 ±0.71	54.65 ±7.21
T5	61.51 ±4.95	5.50 ±0.59	51.70 ±7.02	72.88 ±9.54	6.63 ±1.76	62.51 ±18.24
T6	62.28 ±3.16	6.28 ±0.38	60.02 ±5.17	84.46 ±5.80	8.55 ±1.13	81.83 ±12.76
T7	47.07 ±4.89	5.36 ±1.11	48.35 ±3.34	54.79 ±9.48	6.23 ±1.44	56.13 ±7.28
T8	58.74±7.48	5.55± 1.02	48.36 ±1.36	70.36 ±7.88	6.71 ±1.65	58.11 ±5.01
R.L.S.D 0.05	3.89	2.23	3.24	6.88	1.28	8.53

T1: Control T2: Complete Chemical fertilizer T3: Soil HA+1/2 Chemical fertilizer T4: Soil HA + Complete Chemical fertilizer T5: Foliar HA (0.5 g.L^{-1}) + 1/2 Chemical fertilizer T6: Foliar HA (0.5 g.L^{-1}) + Complete Chemical fertilizer T7: Foliar HA (1 g.L^{-1}) + 1/2 Chemical fertilizer T8: Foliar HA (1 g.L^{-1}) + Complete Chemical fertilizer

Respiration ,O_2 and P uptake and root cell development (fahramand *et al* .,2014). This finding is in agreement with Barakat *et al*.(2015) and Nadia *et al*.(2015) who examined the effect of humic acid on okra plant. Increase in nutrient concentrations and uptake in plant at foliar method compared with soil application might be due to the direct effect of included mineral and organic substances which act as hormones like activity as well as it nutrients content that involve in plants bioactivities and then uptake induction . Khalid and fawy(2011) stated that humic acid spraying on plants had positive effect on root growth by adding essential organic substances necessary for water retention so, improving the growth of root and uptake capacity. The data displaying in table(4) indicated that increasing chemical fertilizers dose increased N,P and K concentrations and uptakes. This was true for all humic acid treatments. However , increasing level of humic acid added as foliar from 0.5gL^{-1} to 1.0gL^{-1} significantly decreased N,P and K concentrations and uptakes. The mean values of N,P and K concentrations were 61.78,5.89 and 55.86 gkg^{-1} at 0.5gL^{-1} ,while they were 52.90,5.45 and 48.35 gkg^{-1} at 1.0gL^{-1} ,respectively. On the same context ,the mean values of N,P and K uptake were 78.69, 7.59 and 68.98 kgha^{-1} at 0.5gL^{-1}, while they were 62.57 ,6.47 and 57.12 kgha^{-1} at 1.0gL^{-1}, respectively. This finding is in agreement with that of Mohammed and saeid(2020). However ,value of nutrient concentrations and uptake at 1.0 gL^{-1} level were in bare or over that of T2 treatment (completely chemical fertilizers).The response of plant bioactivities to humic substances mainly depend on it concentration ,source and particle size (molecular weight) which in turn controls the plasmalema functions(Nardi *et al*.(2002).

D. Effect Of Humic Acid And Chemical Fertilizers On Shoot Dry Weight And Yield Of Okra:

Result in table (5) showed that there was a significant differences between the treatments of humic acid or chemical fertilizers on shoot dry weight and fruits yield of okra compared with control treatment (T1) . Data also revealed that treatments involved humic acid give a highest values over chemical fertilizers treatment (T2) at both parameters . For humic acid treatments, the mean dry weight and yield were 1185.26 kgha^{-1} And 1912.80 Kg ha^{-1} ,respectively .while there were 819.41 kg ha^{-1} and 1201,74 kg ha^{-1} for T2 treatment ,The increase in dry weight at humic acid application can be attributed to increases in plant height ,number of branches and leaf area. The increase in plant height might be due to calcium uptake improvement which plays a main role in metabolic division of apical meristems of cells (Haider et al.,2017), while the improvement in number of branches might be attributed to the role of humic substances as hormone like activity similar to auxins which increasing number of branches (Pizzeghello *et al*.,2001). Furthermore, increasing root development and nutrients up take such as nitrogen , the main responsed element for vegetative growth (Haider *et al*.,2017) . Similar results were found by pasha *et al*.(2021) who noticed that humic acid increased plant height ,number of branches and leaf area of okra plants. The higher yield of okra under the impact of humic.

Table 5: Effect of Humic and Mineral Fertilizers on Yield and Dry Weigh

Treatment	Dry weight Kg.ha^{-1}	Yield Kg.ha^{-1}
T1	743.33 ±91.06	792.23 ±75.67
T2	819.41 ±124.86	1201.74 ±263.97
T3	1073.75 ±116.69	1084.73 ±34.35
T4	1128.94 ±114.15	1524.29 ±103.63
T5	1191.94 ±197.49	2667.71 ±101.36
T6	1358.05 ±107.46	2791.06 ±248.27
T7	1158.39 ±82.70	1677.70 ±108.19
T8	1200.50 ±72.89	1731.71 ±102.84
R.L.S.D $_{0.05}$	**114.95**	**133.47**

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP185

T1: Control T2: Complete Chemical fertilizer T3: Soil HA+1/2 Chemical fertilizer T4: Soil HA + Complete Chemical fertilizer T5: Foliar HA (0.5 $g.L^{-1}$) + 1/2 Chemical fertilizer T6: Foliar HA (0.5 $g.L^{-1}$) + Complete Chemical fertilizer T7: Foliar HA (1 $g.L^{-1}$) + 1/2 Chemical fertilizer T8: Foliar HA (1 $g.L^{-1}$)+ Complete Chemical fertilize

Acid may be because of best growth parameters and nutrients uptake which resulted in significant improvement in some yield parameters such as number of fruits and consequently reflected in to yield . Our data showed that the humic acid increased plant dry weight (table 5) and nutrients uptake (table 4) over chemical fertilizers treatment. Aboohanah(2016) reported that the foliar spraying of humic substances promote growth and increased yield and quality at least partially through the increasing nutrient uptake . He stated also that humic acid is so important for chloroplast system through increasing rate of photosynthesis and then production of photosynthetic materials, that increasing plant growth . Mohammed and saeid(2020) found that humic acid increased yield of okra probably because of humic acid affected the respiration ,amino acids , the amount of sugar ,NO_3 accumulation and made plants resistant against diseases and increment fruit number of plant , Similar data were obtained by Kumar et al.(2015) and Haider *et al*.(2017) who noticed that humic acid increased number of fruits and yield of okra. The data in table (5) demonstrated that the humic acid spraying on plants had a significant increases in dry weight and yield over soil application method with a main values of 1101.34 and 1227.22 $kgha^{-1}$,respectively for dry weight and 1304.51 and 2217.04 $kgha^{-1}$, respectively for fruits yield. Moreover, increasing chemical fertilizers dose significantly increased shoot dry weight and fruits yields, however ,increasing humic acid concentration in spraying solution from o.5 to 1.0 gL^{-1} decreased shoot dry weight and fruits yield. These finding were as the same as findings reported for all nutrients concentration and uptake(table 4).

IV. CONCLUSION

The results obtained in the present study revelds that humic acid improved nutrients availability in calcareous soil ,nutrients uptake, growth and yield of okra. Spraying humic acid at rate o.5 gL^{-1} at five doses resulted in highest soil and plant parameters as compared with application to soil at rate of 1.5 ton ha^{-1} .

REFERENCES

[1]. Rashid, M.M. 1999. Sabji Biggan (Vegetables Science). 2' edition, Rashid Publishing House, Dhaka.

[2]. FAO,2015. Food and Agriculture Organization of the United Nation.2015.

[3]. Anonymous. 2010. Humic and fulvic acids: The black gold of agriculture. Retrieved from www.humintech.com/pdf/ humic fulvic acids.pdf

[4]. Vanitha, K. and S. Mohandas. 2014. Effect of humic acid on plant growth characters and seed yield of drip fertigated aerobic rice (Oryza sativa L.). J. The Bio scan, 9(1): 45-50.

[5]. Yildirim, E. 2007. Foliar and soil fertilization of humic acid affect productivity and quality of tomato. Acta Agric. Scand. Sect. B- Soil Plant Sci., 57: 182-186.

[6]. Nadia, G., M.R. Abdel- Moez and H. Kandil. 2015. Response of okra (Hibiscus esculantus) growth and productivity to cobalt and humic acid rates. Int. J. Chem. Tech. Res., 8(4): 1782-1791.

[7]. Haider, N., M. Alam, H. muhammed, I. Gul, S. Ul Haq, S. Hussain and A. Rab. 2017. Effect of humic acid on growth and productivity of okra (Abelmoschus esculentus) cultivars. Pure & App. Biol., 6(3): 2304-2478.

[8]. Richards L.A. (ed.) (1954): Diagnosis and improvement of saline and alkaline soils. USDA Handbook 60, Washington.

[9]. Page, A.L. ;R.H. Miller and D.R. Keeney(1982). Methods of soil analysis part(2).2nd.E.d. Pub . J. Agron. Soc.

[10]. Bremner, J.M. and D.R.Keeney (1966). Determination and isotope-ratio analysis of different forms of nitrogen in soils. 3. Exchangeable ammonium, nitrate and nitrite by extraction-distillation methods. Soil Sci. Soc. Am. Proc. 30: 577-582.

[11]. Bremner, J.M . and A.P. Edwards (1965) . Determination and isotope-ratio analysis of different forms of nitrogen in soils: I. Apparatus and procedure 159 for distillation and determination of ammonium. Soil Sci. Soc Amer. Proc.,29:504- 507 .

[12]. Murphy, T. and J. R. Riley (1962). A modified single solution method for the determination of phosphate in natural waters .Anal .Chem. Acta., 27:31-36.

[13]. Cresser ,N.S. and G.W.Parsons (1979) . Sulphuric , perchloric acid digestion of plant material for determination N , P , K , Ca and Mg . Analytical chemical Acta.109:431-436.

[14]. Al-Rawi, K. M. and A. A. Khalaf Allah. 1980. Design and Analysis of Agricultural Experiments. Directorate of Dar Al Kutub for Printing and Publishing. University of Al Mosul. pp:488.

[15]. Gihan A .Mohamed (2020). Phosphate Fertilizer – Humic Acid Interaction and Its Effect on Soil Properties and Fertility As Well As Quality and Quantity of Maize Production .Annals of Agric. Sci., Moshtohor. Vol. 58(1) (2020), 79 – 88.

[16]. Petrovic,P.,D.Vrrorovic and M.Jabianovic (1982).Investigation of biological effects of humic acids. Acta Biologiaeet Medicine Experimentails,7: 21-25.

[17]. Urrutia,O(2014).Physico-chemical characterization of humic –metal-phosphate complexes and their potential application to the manufacture of new types of phosphate –based fertilizer's .Journal of Plant Nutrition and Soil Science ,177(2) :128- 136.

[18]. Samavat, S. and M. Malakoti (2010). Necessity of produce and utilization of organic acids for increase of quality and quantity of agricultural products. J. of Agroecol., 2(1): 111-118.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP185

[19]. Canellas, L.P.;F.L.Olivares ;A.LOkorokovhaFacanha and A.R.Facanha (2002). Humic acids isolated from earthworn compost enhance root elongation, lateral root emergence and plasma membrane H+ATPase activity in maize root. Plant Physiol., 130:1951-1957.
[20]. Pena-Mendez,E.M.,J.Havel and J. Patocka (2005). Humic substances compounds of still unknown structure : applications in agriculture , industry, and environment biomedicine. Journal of Applied Biomedicine 3:13-24.
[21]. Helyar,K.R. and W.M. Porter (1989). Soil acidification, its measurements and the processes involved. In Robson, .A.D., (Eds) Soil Acidity and Plant Growth, Academic Press, Sydney,pp 61-101.
[22]. Fincheira-Robles, P.; M. Salgado; R.O. Blu and M. Janssens (2016). Compost and humic substance effects on soil parameters of Vitis vinifera L cv Thompson seedless. Scientia Agropecuaria 7(3):291–296.
[23]. Fahramand, M., H. Moradi, M. Noori, A. Sobhkhizi, M. Adibian, S. Abdollahi and K. Rigi. 2014. Influence of humic acid on increase yield of plants and soil properties. Int. J. Farm. & Alli. Sci., 3(3): 339-341.
[24]. Barakat, M.A.S., A.S. Osman, W.M. Semida and M.A.H. Gyushi. 2015. Influence of potassium humate and ascorbic acid on growth, yield and chemical, composition of common bean (Phaseolus vulgaris L.) grown under reclaimed soil conditions. J. Acad. Res., 7(1): 192-199.
[25]. Khaled H., Fawy H.A. 2011. Effect of different levels of humic acids on the nutrient content, plant growth, and soil properties under conditions of salinity. Soil and Water Research 6: 21–29
[26]. Mohammed.G.H and Abdul jebbar ihsan saeid.2020. Evaluation of apical pinching ,humic acid and plastic mulch on different characters of okra (*ABELMOSCHUS ESCULANTUS* L.). Pak. J. Bot., 52(1): 139-146, 2020.
[27]. Nardi, S., Pizzeghello, D., Muscolo, A. and Vianello, A., (2002). Physiological effects of humic substances on higher plants. Soil Biology and Biochemistry, 34(11), pp.1527-1536.
[28]. Pizzeghello, D., Nicolini, G. and Nardi, S., 2001, Hormone-like activity of humic substances in Fagus sylvaticae forests. New Phytologist., 51: 647-657.
[29]. Pasha.N , R. Vasanthakumari, B. G. Hanamantharaya, K.S. Nirmala and A. Vidya.2021. Effect of Humic Acid on Growth of Okra (Abelmoschus esculentus L.) cv. Arka Anamika. International Journal of Current Microbiology and Applied Sciences .V. 10: N. 02 (2021) .
[30]. Aboohanah, M. A. (2016). The Effect of Spraying Ascorbic and Humic acid on Growth Parameters andYield of Okra Plant (Abelmoschus esculentusL.Moench.). Journal of Stress Physiology & Biochemistry, 7(1): 55-65.
[31]. Kumar, P., D.K. Rana, V. Singh and N. Shah. 2015. Effect of humic acid on growth, yield and quality of okra (Ablemoschus esculantus (L.) Moench) cv. Arka Anamika under subtropical conditions of Garhwal Himalaya. Int. J. Innov. Res. in Sci. & Technol., 1: 2349-6010