Studying the comparison of the ground addition and spraying with humic acid in some growth traits of wheat (*Triticum aestivum* L.)

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ABSTRACT

This study is conducted to know the effect of ground addition and spraying with humic acid and their interaction on the growth and yield of wheat (*Triticum aestivum* L.) in one of the agricultural fields belonging to Karbala province (Ayn Al-Tamr) during the winter season in loamy sand soil. It included three levels of ground addition which are (0, 20 and 40 $kg.ha^{-1}$) representing the first factor which are symbolized (H0, H1, H2) and spraying with humic acid representing the second factor which is symbolized (F0, F1, F2), with three concentrations are (0, 5, 10 $ml.L^{-1}$). Thus, the number of treatments became two treatments with three replicates, so the number of experimental units became 27 experimental units, and the experiment was conducted according to the Randomized Complete Block Design (RCBD). Wheat (IPA-99 cultivar) was cultivated in January 2018. At maturity, the height of the plant, the leaf area, the chlorophyll index, and the number of branches were measured. The results showed:

1- The ground addition treatment of humic acid (H2) has excelled compared to the control treatment with a significant increase in most traits of the growth for the wheat crop which amounted to (102.83 cm, 52.10 cm^2, 10 branches, and 54.04 Spad unit) for the plant height, leaf area, number of branches, and the chlorophyll index, respectively.
2- The interaction treatment between ground addition and spraying with humic acid (F2H2) gave the highest values for all growth traits (106.30 cm, 61.30 cm^2, 57.80 Spad unit) for the plant height, leaf area, and the chlorophyll index, respectively.

Keywords: wheat, ground addition, humic acid, traits of growth.*Research paper from thesis for the second author.

دراسة مقارنة الإضافة الأرضية والرش بحامض الهيوميك في بعض صفات النمو لنبات الحنطة Triticum aestivum L.

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المستخلص

تتم هذه الدراسة لمعرفة تأثير الإضافة الأرضية والرش بحامض الهيوميك والتداخل بينهما في نمو وحاصل الحنطة (Triticum aestivum L.) في احد الحقول الزراعية التابعة لمحافظة كربلاء المقدسة-عين التمر خلال الموسم الشتوي في تربة مزيجة رملية تضمنت ثلاث مستويات من الإضافة الأرضية وهي 0 و20 و40 كغم هـــ$^{-1}$ تمثل العامل الأول ويرمز لها برمز (H_0 وH_1 وH_2) والرش بحامض الهيوميك تمثل العامل الثاني ويرمز لها برمز F_0 و F_1 و F_2 وبثلاث تراكيز هي 0 و 5و10 مل .لتر بالتتابع، وبذلك أصبح عدد المعاملات معاملتين بثلاث مكررات بحيث أصبح عدد الوحدات التجريبية 27 وحدة تجريبية، ونفذت التجربة ضمن تصميم القطاعات العشوائية الكاملة RCBD ، زرعت الحنطة صنف أباء 99 في كانون الثاني 2018، عند النضج قيس ارتفاع النبات والمساحة الورقية ودليل الكلوروفيل وعدد التفرعات وأظهرت النتائج:

1- تفوقه معاملة الإضافة الأرضية لحامض الهيوميك H_2 قياساً بمعاملة المقارنة بزيادة معنوية في اغلب صفات نمو لمحصول الحنطة وبلغت (102.83سم ارتفاع النبات، 52.10سم^2 لمساحة الورقية،10تفرعات و54.04 Spad unit).
2- أعطت معاملة التداخل مابين الإضافة الأرضية والرش بحامض الهيوميك والمتمثلة (F_2H_2)أعلى القيم لجميع الصفات النمو بلغت (106.30سم ارتفاع النبات 61.30سم^2 المساحة الورقية 57.80 Spad unit).

الكلمات المفتاحية: الحنطة ، الإضافة الأرضية، حامض الهيوميك ، صفت النمو*البحث مستل من رسالة الباحث الثاني.

1. INTRODUCTION

Humic acid is considered one of the main products for the decomposition of organic matter (humus), which affects the growth of plants through its effect on the processes of photosynthesis and respiration, where it activates the work of some enzymes, including phosphorylase, phosphatase, and oxidase while activating the work of other enzymes such as Fitase, peroxidase, and oxidase IAA (Dantas, 2007), which reflects positively on the vegetative growth of the plant by increasing the stem length, number of branches, number of leaves and leaf area. The use of humic acid as spraying is very effective because the humic particles can enter the cell stream and making the cell membrane more permeable and this facilitates the movement of the elements and cell division, as well as increasing plant growth and absorption of nutrients. Zhang and Ervin, (2004) demonstrated that adding humic acid to the plant increases the internal Cytokinins by increasing the oxygen. Wheat (Triticuma estivum L.) is considered the first grain crop in the world, where it is the main food for more than a third of the world's population. Its importance is attributed to the fact that grains contain gluten, which is the basic material for producing a suitable quality for manufacturing the bread (Jamali et al., 2000). For the importance of the topic and as a result of the effective roles of humic acids, the research aims to know the effects of ground addition and spraying with humic acid on some growth traits, wheat yield, and comparison between the two methods.

2. MATERIALS AND METHODS

Location of experiment

A field experiment was conducted in one of the agricultural fields belonging to the holy Karbala province, Ayn Al-Tamr district during the winter season, 40 km north of Karbala in order to cultivate the wheat crop (*Triticum aestivum* L). The location of the experiment is characterized by a flat planar topography previously cultivated with wheat and yellow corn in loamy sand soil classified to the level of the great groups (Typic Torrifluvent) according to the modern American classification.

Physical and chemical soil properties for field soils before cultivating

Several samples were taken from the field soil for depth (0-30 cm). The soil samples were mixed and a mixed sample was obtained and the soil samples were dried aerially and then ground and sieved with a 2 mm diameter mesh sieve. These samples were used to estimate some of the physical and chemical properties for the field soil, as shown in Table (1).

Table 1: Chemical and physical properties for the field soil before cultivating.

Traits	Units	Value
Electrical conductivity	$dS.m^{-1}$	4.20
PH	------	7.43
Organic matter	$g.kg^{-1}$	7.33
Carbonate minerals	$g.kg^{-1}$	225.17
cation exchange capacity	$Cmol.q.kg^{-1}$	30.25
Gypsum		6.99
Magnesium (Mg^{+2})	$mmol.L^{-1}$	9.30
Calcium (Ca^{+2})		10.20
Sodium (Na^{+2})		5.16
Potassium (K^{+1})		0.44
Chloride (CL^{-1})		12.50
Sulfate ($SO4^{=}$)		11.40

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Carbonate (CO_3)		Nill
bicarbonate (HCO_3)		7.59
Nitrogen availability N	mg.kg^{-1} soil	38.35
Phosphorous availability P		16.18
Potassium availability K		197.50
Sand	g.kg^{-1}	385
Silt		177
Clay		438
Soil texture	**Loamy sand**	
Apparent density	μg.m^{-3}	1.34

The treatments of experiment and statistical design

The experiment included studying the effect of two factors

The first factor: Adding humic acid by ground fertilization method

1- Adding humic acid H1 with a rate of (20 kg.ha^{-1})
2- Adding humic acid H2 with a rate of (40 kg.ha^{-1})

The first factor: Adding humic acid by spraying the fertilization method

1- Adding humic acid F0 with a rate of (0 kg.ha^{-1}) (control treatment)
2- Adding humic acid F1 with a rate of (5 kg.ha^{-1})
3- Adding humic acid F2 with a rate of (10 kg.ha^{-1})

Thus, the number of treatments became 3 x 3 = 9 treatments, with three replicates, so the number of experimental units became 3 x 3 x 3 = 27 experimental units.

Agricultural operations:

Preparing the study location

The experiment was conducted on a land area of 162 m2, with dimensions of 12.5 m x 13 m. The experiment location was plowed perpendicular tillage with a moldboard plow, the leveling and smoothing operations were then performed and the field was divided into three main replicates according to the order of the split-split plots within the Randomized Complete Block Design (RCBD) and with a rate of 9 experimental units per one replicates where each sector was divided into plots represented by the control treatment (H0F0). The main plots are represented by the ground addition treatment, which is symbolized by (H) and with a rate of three treatments per one replicate, which is (H1) addition of 12 g per experimental unit and (H2) addition of 24 g per experimental unit. As for the sub-plots are represented by the spraying treatment, which is symbolized by (F) and with a rate of two treatments per one replicate, which is (F1) the addition of humic acid with a rate of 5 ml per experimental unit and (F2) the addition of humic acid with a rate of 10 ml per experimental unit. Irrigation is conducted with plastic tubes connected to an electric water pump.

Cultivation and fertilization

Wheat seeds (IPA-99 cultivar) were cultivated on November 22, 2018, with a seed quantity of (120 kg.ha^{-1}), and the cultivation was in lines. A distance of 25 cm has left between the lines, where each experimental unit contained 9 lines. Dab fertilizer was added in the amount of (200 kg.ha^{-1}) containing 18% nitrogen and 46% phosphorus in one batch mixed with the soil during cultivating. Urea fertilizer was also added with a rate of 200 kg per hectare containing 46% nitrogen in three batches, the

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first batch is 30 g at the branching stage, the second batch is 60 g at the elongation stage and the third batch is 30 g in the booting Stage and The wheat weeds were manually controlled and harvested in May 2019.

Growth indicators

Plant height (cm)

The average plant height was measured for twenty plants in each experimental unit using a tape measure from the soil surface to the end of the awns for the spike of the main stem (Donaldson, 1996).

Number of branches

The number of spike bearing branches was calculated as an average for 10 plants per experimental unit.

Area of flag leaf (cm^2)

It was calculated as an average for ten flag leaves for the main stems for each experimental unit according to the following formula:

Area of flag leaf (cm^2) = length of the flag leaf x width at the center x 0.95.

Percentage of chlorophyll in leaves (Spad unit)

It was measured by (SPAD-502 Chlorophyll meter) and was estimated as an average of ten readings per experimental unit by placing the top group of leaves between the jaws of the device (Reyohds et al., 1998).

3. RESULTS AND DISCUSSION

The effect of ground addition and spraying with humic acid and their interaction on the growth and production of wheat.

Plant height (cm)

The results of the statistical analysis indicated that there was a significant effect for both ground addition and spraying with humic acid and their interactions on plant height (cm). Spraying humic acid has a significant effect on this trait by giving it the highest value when treated with the F2 treatment, which amounted to (106.30 cm) compared to two treatments (spraying with humic acid), which amounted to (102.71 and 95.33 cm), respectively. As for the effect of the ground addition for humic acid, it had a significant effect on this trait and its increase, and the highest value was at the ground addition treatment (H2), whose value amounted to (102.83 cm) compared to control treatment that amounted to (99.77 cm) and the ground addition treatment (H1), whose value amounted to (101.75 cm), respectively. As for the effect of the interaction between the ground addition and spraying with humic acid, it significantly affected the increase of the plant height (cm) and the highest value was at interaction treatment (H2F2), which significantly affected this trait by giving it the highest value to the height of wheat, which amounted to (106.90 cm) compared to the control treatment (without spraying or ground addition of humic acid) (H0F0), which amounted to (93.10 cm) and with an increase of (14.82%), While the other interaction values between the ground addition and spraying with humic acid by giving other values close to the interaction treatment (H2F2), the value of the interaction treatment (H2F1) reached a value close to the mentioned interaction treatment, which amounted to (105.70 cm), with an increase of (13.53%), as indicated in Table (2).

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Table 2: the effect of ground addition and spraying with humic acid and their interaction on the plant height of the wheat (cm).

Spraying / Ground	F_0	F_1	F_2	Average
H_0	93.10	100.50	105.70	99.77
H_1	95.50	103.44	106.30	101.75
H_2	97.40	104.18	106.90	102.83
Average	95.33	102.71	106.30	
LSD (0.05)	**F**	**H**	**F×H**	
	0.20	0.20	0.77	

Leaf area (cm^2)

Table (3) shows that each of the ground addition and spraying with humic acid gave a significant effect on the trait of the leaf area for wheat (cm^2). The spraying of humic acid affected significantly on this trait, The highest value at the spraying treatment (F2) amounted to (55.70 cm2) and the lowest value was at the control and spraying treatments (F0 and F1), which amounted to (39.60 cm^2, 44.50 cm^2), respectively. As for the ground addition treatment for humic acid, the H2 treatment affected significantly by giving it the highest value for the leaf area amounted to (52.10 cm^2) compared to the control treatment (H0) and the H1treatment, whose value amounted to (41.40 cm^2, 50.30 cm^2), respectively. As for the effect of interaction between the treatments of ground addition and spraying with humic acid, it significantly increased the trait of the leaf area (cm^2) for the wheat plant and the highest value was at the interaction treatment (H2F2), whose value amounted to (35.15 cm^2) and the ground addition treatment for humic acid at the level (F0H2) which Its value amounted to (50.16 cm^2), with an increase of 74.40%.

Table 3: the effect of ground addition and spraying with humic acid and their interaction on the leaf area for wheat (cm^2).

Spraying / Ground	F_0	F_1	F_2	Average
H_0	35.15	43.70	50.16	41.40
H_1	40.20	46.50	55.70	50.30
H_2	41.70	46.54	61.30	52.10
Average	39.60	44.59	55.72	
LSD (0.05)	**F**	**H**	**F×H**	
	0.015	0.015	0.35	

Number of branches

Table (4) shows that each of the ground addition, spraying with humic acid and their interaction has a significant effect on the number of branches for the wheat plant, where it was observed from the table that the ground addition of humic acid had a significant effect on the number of branches for the wheat plant. the H2 treatment gave the highest value amounted to (10 branches) compared to the two treatments (H0 and H1) which gave the lowest value amounted to (9.7.6 branched) for each of them, respectively, and The percentage of the increase in the H2 treatment over the treatments (H0 and H1) amounted to (30 and 11.11%) for each of them, respectively. It was also observed from the same table that the treatments of

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spraying with humic acid significantly affected the trait of the number of branches for the wheat plant, where the spraying treatment (F2) gave the highest value amounted to (15 branches) compared to the treatments (F0 and F1) which gave the lowest value amounted to (8 and 9 branches) for each of them, respectively, with an increase of (87.5 and 66%) for each of them, respectively. As for the effect of interaction between the treatments of ground addition and spraying with humic acid, it significantly affected the number of branches for the wheat plant and the highest value was at the interaction treatment (H2F2), whose value amounted to (13 branches), The lowest value for the traits of the number of branches was at control treatment (F0H0), which amounted to (5 branches). As for the interaction treatment (F2H1), it gave 12 branches, which did not differ significantly from the interaction treatment (F2H2). As for the percentage increase for the interaction treatment (F2H2) over the control treatment (F0H0), it reached 16%, as shown in the table.

Table 4: the effect of ground addition and spraying with humic acid and their interaction on the number of branches for the wheat plant.

Spraying / Ground	F_0	F_1	F_2	Average
H_0	5	8	10	7.66
H_1	6	9	12	9
H_2	7	10	13	10
Average	6	9	12	
LSD (0.05)	**F**	**H**	**F x H**	
	0.10	0.10	0.28	

Chlorophyll index (spad unit)

Table (5) shows that each of the ground addition, spraying with humic acid and their interaction has a significant effect on the Chlorophyll index (spad unit) for the wheat plant, where it was observed from the table that the ground addition of humic acid had a significant effect on the Chlorophyll index for the wheat plant. the H2 treatment gave the highest value amounted to (54.04 spads unit) compared to the two treatments (H0 and H1) which gave the lowest value amounted to (51. 20 spad unit) for each of them, respectively, and The percentage of the increase amounted to (5.55%). While the percentage of increase for (H2) from (H1) amounted to (3.80%) for each of them, respectively. It was also observed from the same table that the treatments of spraying with humic acid significantly affected the trait of the Chlorophyll index for the wheat plant, where the spraying treatment (F2) gave the highest value amounted to (56.60 spad unit) compared to the treatments (F0 and F1) which gave the lowest value amounted to (47.91 and 50.37 spad unit) for each of them, respectively, with an increase of (18.14% and 12.37%) for each of them, respectively. As for the effect of interaction between the treatments of ground addition and spraying with humic acid, it significantly affected the Chlorophyll index for the wheat plant and the highest value was at the interaction treatment (H2F2), whose value amounted to (57.80 spad unit), The lowest value for this trait was at the control treatment (F0H0), which amounted to (45.60 spad unit), with an increase of (26.32%), as shown in the table.

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Table 5: the effect of ground addition and spraying with humic acid and their interaction on the Chlorophyll index (spad unit) for the wheat plant.

Spraying / Ground	F_0	F_1	F_2	Average
H_0	45.60	52.40	55.61	51.20
H_1	47.81	53.70	56.39	52.63
H_2	50.33	54.00	57.80	54.04
Average	47.91	50.37	56.60	
LSD (0.05)	**H**	**F**	**F×H**	
	0.25	0.25	2.16	

It is observed from Tables (3, 4, 5, and 6) that both the ground addition, spraying with humic acid, and their interaction have significantly affected the improvement for the traits of vegetative growth for the wheat crop. The ground addition of humic acid has significantly affected all the mentioned study indicators, This confirms the importance of this acid as a ground addition that led to an increase in the availability of the available nutrients for absorbing, especially the macro and micronutrients, by the fact that this acid works to reduce the PH. Thus increasing the availability of these nutrients, which led to the liberation of these nutrients from the soil and then increasing their concentration, and this led to an increase in the building of amino acids, which is the first nucleus for growth and The result is a significant increase in plant height, and consequently an increase in the number of branches, a chlorophyll index, and the leaf area for wheat (Ahmed et al., 2009). As for the effect of spraying with humic acid, it also led to an increase in all study indicators, namely plant height, leaf area, chlorophyll index and the number of branches. The reason for this increase may be attributed to the fact that spraying with humic acid leads to form nitrogenous, phosphatic and other organic compounds that have a role in increasing the growth, development, and division of cells and increasing root growth, which reflects in increasing the number of branches as well as increasing bioprocesses within tissues (Hassan et al., 1990). As for its effect on the content of chlorophyll index, the increase may be due to increase nutrient availability in this acid and its content of N, P and K and micronutrients, which led to increase the absorption by plants that participate in the groups involved in the synthesis of chlorophylls and cytochromes important in the process of photosynthesis (Sinha and pandy, 1981). It is also observed through the interaction between the ground addition and spraying with humic acid to increase all study indicators, and this is due to the positive role of this added acid either by the ground method or by spraying with foliar nutrition and then increasing the amount of available macro and micronutrients for absorption by the plant. which led to the development of vegetative growth and an increase in the effectiveness of the meristems, and then increasing the height of the plant and the chlorophyll index and increasing the area of the flag leaf and the leaf area, which provided an opportunity for the plant to invest in these nutrients leading to increase the rates of photosynthesis, which was also reflected in increasing the chlorophyll index (2010). The effect of the interaction between ground addition and spraying with humic acid increases the susceptibility of the soil to water retention through improving soil construction, which creates an environment conducive to the impact and effectiveness of rehabilitation in stimulating micronutrients (Hussein et al., 2011). and the effective role of humic acids in reducing the process of sedimentation and adsorption of nutrients on colloidal surfaces is due to

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competition for adsorption locations, This affects the increase in the amount of available mineral nutrients for absorption by the plant, especially in the different stages of wheat, which are stages (branching, booting, and grain-filling) (Rennenberg et al., 2009). These results agree with (Al-Jumaili and Salloum, 2010) who found that spraying with humic acids or the ground addition of humic acid led to an increase in the leaf area of the potato crop because these acids have a high increase in nutrients and this leads to an increase in vegetative growth and an increasing the effectiveness of macro and micronutrients and then Increase the leaf area of the plant (Djilani et al., 2013). Humic acid and their interaction with the ground addition led to an increase in the chlorophyll index, due to the good content of these acids from the nutrients N, P and K, and the micronutrients, which led to their absorption by the plant, which is involved in the synthesis of important chlorophyll in the process of carbon metabolization, and this result agrees with (Al-Juburi and Al-Dabbagh, 2011; Abu Nukta, 2007) who discovered that the interaction between ground addition and spraying with humic acid led to an increase in all the indicators of the above study, which is plant height, leaf area (flag leaf area), chlorophyll index, and the number of branches due to the interactive effect between these two factors (Abu Al-Rayyan, 2010).

REFERENCES

Abu Al-Rayyan, Azmi Mohammed (2010). Organic farming - its characteristics and importance in human health. First edition - 322 pages.

Abu Nukta, Falah and Rob Parkinson. (2007). Effect of Humic Substances on Micronutrient Availability in Soils. Damascus University Journal for Agricultural Sciences. 232): 163-178.

Ahmed, Samir Mohammed, Sadiq Qasim Sadiq and Falah Hassan Issa. (2009). Effect of covering soil and organic fertilizers on N, P and K concentrations and growth and yield of potato in Integrated agriculture systems. Iraqi Journal of Agricultural Sciences (special issue) volume 14 number 2.

AL-Jumally, Abul whab Abdel-Razzaq and Mohammed Abdel-Salloum (2010). EFFECT OF HUMIC ACID FOLIAR APPLICATION AND POTASSIUM FERTILIZER ON GROWTH AND YIELD OF POTATO (Solanum tubersumL.) UNDER DRIP IRRIGATION SYSTEM. Diyala Agricultural Journal, 4 (1) 205-219.

Al-Qaisi, Shaima Abdul Latif. 2010. The effect of nitrogen fertilizers on growth, some qualitative and quantitative traits, and the accumulation of total steroidal alkaloids in some cultivars of potatoes. Master Thesis. College of Agriculture.

Al-Jubouri, Amer Abdullah Hussein and Abdullah Mohammed Salem Al-Dabbagh. (2011). Effect of spraying with humic acid on the growth and yield of two cultivars of potatoes. Diyala Journal of Agricultural Sciences, 3 (2): 712-721.

Hassan, Nuri Abd al-Qadir, Hassan Yousef al-Dulaimi, and Latif Abdullah al-Ithawi. 1990. Soil fertility and fertilizers. University of Baghdad.

Donaldson, E.1996. Crop traits for water stress tolerance. Amer.J.Altern. Agric.(USA):11,89-94. **Dantas, B.F.; Pereira; M.S.; Ribeiro; L.D.; Mala; J.L.T.and Bassoi, L.H.(2007).** Effect of humic substances and weather conditions on leaf biochemical changes of fertigated Guaratree during orchard establishment Rer. Bras. Frantic, Jabot ticabalsp,29(3):632-638.

Djilani, G.A. and Senoussi, M.M.(2013). Influence of organic manure on vegetative growth and tuber production of potato (Solanum tuberosum L varspunta) in a sahara desert region. I International Journal of agric. And crop Sci. 5-22/2724-2731. Available online at www.ijagcs.com. ISSN 2227-670X ©2013 IJACS Journal.

Zhang, x. and E.H. Ervin (2004). Cytokinin – containing seaweed and humic acid extracts associated with creeping bentgrass leaf .cytokinins and drought resistance. Crop Science, 44: 1737 – 1745.

Hussein, A.H.A.(2011). Impact of swage sludge as organic manure on some. soil, growth yield and nutrient contents of cucumber crop.Journal of applied science (8):1401:1411.

Jamali, K. D., M . A. Arain and M. Mohammed. 2000. Comparative performance of Semi-dwarf wheat (Triticumaestivum.L). genotypes. wheat Information service, 90: 45 – 46.

Pandy .S.N.andB.K.Sinha.(1981). Plant Physiology. Vikas Publishinghouse PVT ,Lth ,P60-62 .

Rennenberg.H.,M.Dannenmann.,A.Gessler.,J .Kreuzwieser.,J.Simon.,andH.Papen.2009. Nit rogen balance in forest soils : Nutritional limitation of plants under climate change stresses.PlantBiol 11:4- 23.

Reynolds,M.P.,P.R.Sing,a.Ibrahim., O.A. Ageeb, A.Larquesaavedra and J.S. Quik.1998. Evaluating physiological traits to complement expirical selection of wheat in warm environments.H.J.Broum et al., (Eds). Wheat Prospects for Global Improvement. 143-152.

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