Tikrit Journal for Agricultural Sciences (2022) 22 (4):54-61
https://doi.org/10.25130/tjas.22.4.8

IRAQI Academic Scientific Journals

ISSN:1813-1646 (Print); 2664-0597 (Online)
Tikrit Journal for Agricultural Sciences
Journal Homepage: http://www.tjas.org
E-mail: tjas@tu.edu.iq

TJAS
Tikrit Journal for Agricultural Sciences

Effects of Adding NPK fertilizer and Spraying Glutamic Acid on the Growth of *Tecoma stans*

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KEY WORDS:

Tecoma stans, Spraying Glutamic Acid, Adding NPK fertilizer..

ARTICLE HISTORY:

Received: 20/05/2022
Accepted: 26/06/2022
Available online: 31/12/2022

ABSTRACT

This study was carried out at the College of Agriculture \ Horticulture Department \ Tikrit University for the 2021 growing season, in order to show the effect of spraying glutamic acid in different in three concentrations, and adding a balanced fertilizer (NP K) (20 20 20) in three quantities, on some characteristics of the mineral content of Tecoma stans. Spraying plants with three concentrations of glutamic acid (0.50, 0.25, 0) mg L -1, and adding a balanced fertilizer (NP K) in three quantities (1, 0.5, 0) grams of fertilizer / anvil and the interaction between them to show their effect on the characteristics of the mineral content in the leaves For Tecoma stans, according to a randomized complete block design. The results of the study indicated that the plants treated with a concentration of (0.50) mg L -1, and the addition of (1) g/anvil of (NP K) fertilizer for Tecoma tree recorded a significant increase in all studied traits compared to With the control treatment, the percentage of the mineral content characteristics was (1.975%) for the nitrogen concentration in the leaves, and (12.493%) for the protein content, and the phosphorous concentration was (1.841%) and (1.84%) for the potassium concentration, while the electrolyte concentration was (7,925%). Compared with the lowest values recorded by the control treatment of no spraying with acid and without adding fertilizer, it was (1.850%) and (11.303%), (1.723%), (1.752%), (6.64%) in the leaves. for (nitrogen, protein, phosphorous, potassium and carbohydrates) respectively.

INTRODUCTION

Tecoma stans belong to the family Bignoniaceae, which includes many species are mostly evergreen trees (Singh et al., 2021). Original home of this tree is South America and has spread to many other countries, which indicates the ability to incur different climatic conditions (Mesquida et al., 2017). It is also considered as an ornamental plant that can be cut and shaped and can be arranged in arcs inside gardens (Verma, 2021, Singh et al., 2016). Tecoma stans are planted in groups to highlight its aesthetic value as a flowering ornamental tree with a light aromatic smell (Anandand et al, 2021). In addition to the botanical importance of tecoma as an ornamental tree, it is considered a medicinal plant as it is contain active ingredients that have been used in many medical fields (Gonçalves et al., 2022). Amino acids have an important role on plant growth and yield by being a biostimulant that has positive effects on these traits, as well as their role in

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reducing the damage caused by external stresses and limiting its causes (Sh Sadak et al., 2015). In addition to its role in increasing the absorption of mineral fertilizers, such as increasing the absorption of nitrogen, phosphorous and potassium, and the ability of plants to absorb and use the amino acids themselves (Hua-Jing et al., 2007). Also in protein formation and increasing plant chlorophyll content (Dromantiene et al., 2013, Baqir and Zeboon, 2019). Glutamic acid is one of these important amino acids, which have many roles within the plant cell, as it contributes to the construction of carbohydrates and protein and contributes to improving the physiological characteristics of plants (Saburi et al., 2014). It was also found that NPK fertilizer provides important nutritional elements for the plant, and each of these three elements has its own function to do so, by increasing the photosynthetic activity, strong vegetative growth, dark green color, and the use of carbohydrates (Rolaniya et al., 2017). NPK are considered the primary macronutrients which their use leads to an improvement in plant production by about 50%, but it must be added at rates of absorption balanced with growth rates (Al-Shahat 2007).

MATERIALS AND METHODS

This study was carried out in the lath house of Horticulture Department and Landscape \ College of Agriculture \ Tikrit University, for the growing season 2021-2022 . Two factors were used in this study, the first factor: spraying glutamic acid for four times with three different concentrations (0, 0.25,0.50) $mg.L^{-1}$and the period between each foliar application was 15 days. The second factor was adding the balanced (NPK) fertilizer (20 20 20) in quantities of (0, 0.5,1) g pot-1 and the addition was repeated four times and the period between each time of add was 15 days. The plants were planted in pots with a diameter of 33 cm and a depth of 39 cm, and using river soil mixed with compost 1:1. The experiment conducted according to Randomized Complete Block Design (RCBD) and the number of treatments was 9 within three replicates (three plants for treatment), and the total number of plants in this experiment was 81 plants. The results analyzed statistically according to Duncan's test at a probability level of 0.05.

Measurements

1- Percentage of nitrogen (N%):

According to A.O.A.C, (1970), Micro-kildahl has been used to measure the content of nitrogen in leaves.

2- Estimation the content of total protein in the leaves

The percentage of protein has been estimated by the percentage of nitrogen according to (A.O.A.C, 1970) and to the following equation:

Protein percentage = nitrogen percentage x 6.25

3- **Percentage phosphorous (P%):**

Percentage of phosphorous in the leaves of plants was estimated by chromatography using a spectrophotometer according to the method mentioned by Sommers and Olsen (1982).

4- **Percentage of potassium (K%):**

Potassium percentage was estimated by Flam Photometer as mentioned by Al-Sahaf (1989).

5- **Determination of carbohydrates in plants**

The carbohydrate content was estimated by taking the weight of 1g of dried leaves and then estimating the carbohydrate content according to the method Herbert et al., (1971).

RESULTS AND DISCUSSION

1-Estimation of leaves nitrogen content (N%)

Table (1) shows that spraying with glutamic acid had a significant effect on the average percentage of nitrogen in the leaves of tecoma, as the G2 treatment of spray acid at a concentration of (0.050 $mg.L^{-1}$) was superior by highest percentage of nitrogen in the leaves (1.949%) compared with control treatment which gave lowest amount (1.875%) . The same table shows that the addition of balanced fertilizer (NPK) gave a significant difference in the percentage of nitrogen concentration in the leaves, as the treatment of P2 was superior: adding (1) g.pot-1 gave the highest concentration of (1.931%) compared to the treatment of P0 without adding of fertilizer, which recorded concentration rate (1.871%), as the same table showed that the interaction treatments gave significant differences compared with control, as the interaction treatment G2P2 (spraying with glutamic acid at a concentration of 0.050 mg.L^{-1}+ adding (1 g .pot-1) recorded the highest concentration of nitrogen in the leaves (1.975%) compared with control G0P0 which gave the lowest concentration (1.850%).

Table (1): Effect of spraying glutamic acid and addition of balanced fertilizer (N: P: k) (20: 20: 20) and their interactions on concentration of nitrogen in *Tecoma stans* leaves

P \ G		Glutamic acid 0 mg.L^{-1} G0	Glutamic acid 25 mg.L^{-1} G1	Glutamic acid 50 mg.L^{-1} G2	Effect of NPK
NPK: 0 g	P0	1.850 e	1.860 de	1.903 bc	1.871 c
NPK: 2g	P1	1.878 cde	1.888 cde	1.970 a	1.912 b
NPK: 4g	P2	1.898 bc	1.920 b	1.975 a	1.931 a
Effect of acid		1.875 b	1.889 b	1.949 a	

*Numbers with the same letters don't have significant differences between them according to Duncan's multiple range test at 5% probability level.

2-Estimation of leaves protein content %

Table (2) shows the effect of foliar application of glutamic acid on the percentage of protein in the leaves. Spraying acid treatment (G2) with a concentration (0.050 mg.L^{-1},) outperformed by giving the highest percentage of protein (12.326%) compared with control treatment (G0) which gave the lowest percentage (11.413%). Also, the same table indicated that the addition of balanced fertilizer (NPK) recorded a significant superiority to the percentage of protein in the leaves, as the treatment of P2: adding (1) gram of fertilizer.pot-1 distinguished by gave the highest percentage (12.037%) compared to P0 treatment without adding the fertilizer which recorded the lowest percentage of protein (11.544%). The same table showed that the interaction treatments achieved significant differences for the treatments compared with control treatment, as the interaction treatment G2P2 (spraying with glutamic acid at a concentration of 0.050 mg.L^{-1}+ (1) g of Fertilizer.pot-1) recorded the highest percentage of protein in the leaves (12.493%) compared to the lowest percentage for the control treatment G0P0 (11.303%).

Table (2): Effect of spraying glutamic acid and addition of balanced fertilizer (N: P: k) (20: 20: 20) and their interactions on concentration of protein in *tecoma stans* leaves

P \ G		Glutamic acid 0 mg.L^{-1} G0	Glutamic acid 25 mg.L^{-1} G1	Glutamic acid 50 mg.L^{-1} G2	Effect of NPK
NPK: 0 g	P0	11.303 d	11.323 d	12.006 b	11.54 b
NPK: 2g	P1	11.331 d	11.972 b	12.479 a	11.927 a
NPK: 4g	P2	11.604 c	12.013 b	12.493 a	12.037 a
Effect of acid		11.413 c	11.769 b	12.326 a	

*Numbers with the same letters don't have significant differences between them according to Duncan's multiple range test at 5% probability level.

3-Estimation of leaves phosphorous content (P%)

It is noticed from Table (3) that the glutamic acid spraying treatment had a significant effect on the phosphorous concentration in the leaves, as G2 treatment (glutamic acid spraying with a concentration of 0.50 mg L^{-1},) gave a significant increase in phosphorous concentration amounted (1.823%) compared with control G0 (without spraying the acid), which gave a concentration of (1.749%). In addition, the same table showed that balanced fertilizer (NPK) affected significantly on concentrations of phosphorous in leaves, as the P2 treatment (adding 1 g of fertilizer.pot-1) distinguished by gave a (1.809%) compared with P0 treatment which showed lowest concentration rate (1.770%). The same table showed that the interaction treatments gave significant differences compared with the control treatment, as the interaction treatment G2P2 (spraying with glutamic acid at a concentration of 0.050 mg.L^{-1}+ addition of (1) g of Fertilizer.pot-1) by giving the highest concentration (1.841%) compared to the lowest concentration with control treatment G0P0 (1.723%).

Table (3): Effect of spraying glutamic acid and addition of balanced fertilizer (N: P: k) (20: 20: 20) and their interactions on concentration of phosphorous in *Tecoma stans* leaves

P \ G		Glutamic acid 0 mg.L^{-1}	Glutamic acid 25 mg.L^{-1}	Glutamic acid 50 mg.L^{-1}	Effect of NPK
		G0	G1	G2	
NPK: 0 g	P0	1.723 g	1.776 e	1.812 bc	1.770 c
NPK: 2g	P1	1.743 f	1.797 d	1.817 b	1.786 b
NPK: 4g	P2	1.781 e	1.805 cd	1.841 a	1.809 a
Effect of acid		1.749 c	1.793 b	1.823 a	

*Numbers with the same letters don't have significant differences between them according to Duncan's multiple range test at 5% probability level.

4-Determination of the percentage of potassium in leaves (K%)

Table (4) shows that spraying glutamic acid had a significant effect on the concentration of potassium in leaves, as the G2 treatment of glutamic acid spraying with a concentration of (0.50 mg.L^{-1}) achieved a significant superiority of potassium concentration in plant leaves which reached (1.824%) compared with control treatment G0that gave lowest concentration (1.769%). Table (4) indicated that the addition of balanced fertilizer (NPK) gave superiority to the nitrogen concentration in leaves, as P2 treatment: adding (1) g of fertilizer.pot-1 gave highest concentration (1.823%) compared to treatment P0 which gave the lowest concentration rate (1.782%). The same table showed that the interaction treatments between acid and fertilizer gave significant differences compared with control. The interaction between spraying glutamic acid 0.050 mg.L^{-1}+ 1g fertilizer.pot-1 (G2P2) showed highest concentration (1.844%) compared with lowest concentration resulted by control treatment G0P0 (1.752%).

Table (4): Effect of spraying glutamic acid and addition of balanced fertilizer (N: P: k) (20: 20: 20) and their interactions on concentration of potassium in *Tecoma stans* leaves

P \ G		Glutamic acid 0 $mg.L^{-1}$ G0	Glutamic acid 25 $mg.L^{-1}$ G1	Glutamic acid 50 $mg.L^{-1}$ G2	Effect of NPK
NPK: 0 g	P0	1.752 f	1.782 de	1.812 bc	1.782 b
NPK: 2g	P1	1.762 ef	1.802 cd	1.816 bc	1.793 b
NPK: 4g	P2	1.794 cd	1.831 ab	1.844 a	1.823 a
Effect of acid		1.769 c	1.805 b	1.824 a	

*Numbers with the same letters don't have significant differences between them according to Duncan's multiple range test at 5% probability level.

5-Determination of the carbohydrate content of the leaves

Table (5) shows that spraying glutamic acid had a significant effect on the carbohydrate content of leaves, as (G2) spray acid treatment with concentration (0.050 $mg.L^{-1}$) outperformed by recording the highest carbohydrate content (7.516%) compared to treatment G0 without spraying acid, which gave less carbohydrate content reached (6.881%), as the table below shows that the addition of (NPK) balanced fertilizer achieved a significant increase in carbohydrate content of leaves, as P2 treatment (adding 1g of fertilizer.pot-1) gave 7.441% compared with control treatment (P0) which gave the lowest content (7.025%). The same table showed that the interaction treatments between glutamic acid and balanced NPK fertilizer had a significant effect on carbohydrate content compared with control treatment. It shows that G2P2 treatment (spray with glutamic acid 0.050 $mg.L^{-1}$+ Addition of 1 g fertilizer.pot-1) recorded the highest content of carbohydrate (7.925%) compared to the lowest concentration with control treatment G0P0 (6.644%).

Table (5): Effect of spraying glutamic acid and addition of balanced fertilizer (NPK) (20:20:20) and their interactions on estimating content of carbohydrate in *Tecoma stans* leaves

P \ G		Glutamic acid 0 $mg.L^{-1}$ G0	Glutamic acid 25 $mg.L^{-1}$ G1	Glutamic acid 50 $mg.L^{-1}$ G2	Effect of NPK
NPK: 0 g	P0	6.644 d	7.20 bc	6.644 d	7.025 c
NPK: 2g	P1	7.00 c	7.300 b	7.000 c	7.229 b
NPK: 4g	P2	7.00 c	7.400 b	7.00 c	7.441 a
Effect of acid		6.881 c	7.300 b	6.881 c	

*Numbers with the same letters don't have significant differences between them according to Duncan's multiple range test at 5% probability level.

DISCUSSION

In general, amino acids have an effect on increasing the vegetative growth indicators of plants, and it is noted from the results of this research there is a significant superiority in the vegetative growth characteristics represented by the percentage for (nitrogen, phosphorous, potassium, protein and carbohydrates) content of plant leaves, for plants treated with greater rates of glutamic acid. The reason may be due to the role of glutamic acid in the biosynthesis of proline (which is a source of nitrogen and carbon and has an important role in maintaining the metabolism), and other nitrogen-containing compounds that increase plant vegetative growth, mineral content, and chlorophyll formation (Okumoto et al., 2016, and Ghosh et al., 2022). In addition to the role of proline in organizing the osmotic effort, which increases the ability of cell to absorb water from the grown media, and its role as a source of nitrogen, and its contribution in building of protein and supplying plants with energy (Yasin, 2001). Glutamic acid is also the bass of building pyrrole, glutathione, and folic acid, and the key pass for synthesis of aminobutyric acid which plays an essential role in balancing carbon-nitrogen interactions and various cellular processes (Liao et al., 2022). These results agreed with Makki, (2021), who stated that glutamic acid had a significant effect on the mineral content of the gold stick plant when it was added at a concentration of (200 mg) which it gave significant differences in most of the mineral content characteristics of leaves (NP K) that recorded the highest values compared with the control treatment.. As indicated by (Naif 2021), that spraying with glutamic acid at a concentration of (200 mg.l-1) had an effect on the characteristics of the mineral content of Matthiola incana .plant, where the treatment showed significant effect on nitrogen, phosphorous and potassium concentrations in plant leaves. The results indicated a significant superiority in the values of mineral content of the plant that were treated with greater amount of NPK fertilizer compared with control treatment. The reason of this superiority is due to the increase in the main components that make up the plant cell structure that includes nitrogen in its composition, as well as the role of nitrogen in increasing plant metabolism (Wang et al., 2017 and Pan et al., 2019). The response of plants to nitrogen uptake remains limited until the plant obtains its full requirements of phosphorous (Goulding et al., 2008). Moreover, the role of potassium in the physiological processes, the regulation of photosynthesis, the activation of enzymes, and the process of transporting nutrients inside the plant, considering it the main element affecting controlling opening and closing stomata process (Rawat et al., 2022). These results agreed with Imam, (2016), who indicated that the treatment of almond trees with different concentrations of chemical fertilizer NPK (18, 18, 18) (0, 15, 30, 45, 60) kg.dunum-1, was shown that the addition of 45 kg .dunum-1 gave significant increase in the mineral content in leaves (general content of chlorophyll , nitrogen ratio, phosphorous, and potassium in the leaves).

Gaber (2019) explained that using of balanced (NPK) fertilizer 20 20 20 had a key role in enhancing the mineral content of Robert herb (*Geranium robertianum*) during the flowering period, and a positive effect on flower production and quality, and there is a direct proportional relationship between flowering and the use of NPK on plant. Also, there is a significant superiority in the content of chlorophyll and percentage of nitrogen, phosphorous and potassium in leaves.

It is concluded that the addition of stimulants to the soil and the use of foliar spraying with amino acids improved the properties of the mineral content in the leaves and this is agreed with (El-Rahman et al, 2022).

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تأثير اضافة السماد المتوازن (NPK) والرش بالحامض الاميني الكلوتاميك في نمو وانتاج شتلات التيكوما Tecoma stans

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الكلمات المفتاحية:
تيكوما ستانس، رش حمض الجلوتاميك ، إضافة سماد NPKالمتوازن.

الخلاصة

اجريت هذة الدراسة في كلية الزراعة \ قسم البستنة \جامعة تكريت للموسم الزراعي 2021, بهدف بيان تاثير رش حامض الكلوتاميك بثلاث تراكيز, وإضافة سماد (N P K) المتوازن (20 20 20) بثلاث مقادير , على بعض صفات المحتوى المعدني لنبات التيكوما Tecoma stans. تم رش النباتات بثلاث تراكيز من حامض الكلوتاميك (0.50 , 0.25 , 0) ملغم.لتر-1, وإضافة سماد (N P K) المتوازن بثلاث مقادير (1 , 0.5 , 0)غرام سماد \ سندانة والتداخل بينهما لبيان تاثيرهما في صفات المحتوى المعدني في الاوراق لنبات التيكوما Tecoma stans , وفق تصميم القطاعات العشوائية الكاملة.وقد اشارت نتائج الدراسة ان النباتات التي عوملة بتركيز(0.50) ملغرام لتر-1 وإضافة (1) غرام \ سندانة من سماد ال (N P K) لشجرة التيكوما سجلت زيادة معنوية في جميع صفات المدروسة مقارنة مع معاملة السيطرة ومثلت النسبة المئوية لصفات المحتوى المعدني إذ بلغت (1.975%) لتركيز النايتروجين في الاوراق ,و(12.493%) بالنسبة لمحتوى البروتين , وبلغ تركيز الفسفور (1.841%) , و(1.844%) بالنسبة لتركيز البوتاسيوم , اما تركيز الكهربوهدرات بلغ (7.925%) . بالمقارنه مع اقل القيم التي سجلتها معاملة السيطرة عدم الرش بالحامض وبدون إضافة السماد وكانت (1.850%) و(11.303%), (1.723%),(1.752%),(6.64%) في الاوراق. لكل من (النايتروجين والبروتين و الفسفور والبوتاسيوم والكاربوهدرات) على التوالي..