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Effect of different amino acids on the morphology and bio-chemical attributes of Chilli (*Capsicum frutescens* L.)

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Abstract

Amino acids have become a crucial part of feed for better growth and yield of Solanaceous vegetables. Economically accessible Amino acid stimulants can enhance the fertilizer absorption and maximize the uptake of water and nutrients. The experimental trial was carried out to find the impact of foliar feeding of Ezabian and Imino-x on flourishment and production of green chilli (*Capsicum frutescens* L.). Experiment was designed according to Randomized Complete Block Design (RCBD). Moreover, seven treatments and four replications will be considered. Each treatment will contain ten plants. Vegetative, reproductive and biochemical parameters of chilli Wonder Hot, variety will be observed for data collection. Results revealed that Maximum plant height (63.5cm), highest fruit weight (5.39g), highest TSS value (11.51 Brix°) and highest pH value (5.68) was observed in T_6 while T_6 had maximum number of branches (28), highest value of fruit length (12.49cm), maximum fruit yield/plant (1113g), maximum fruit yield/ hectare (51.15tons), highest fresh root weight is 8.18, highest dry root weight 5.88, highest fresh shoot weight 77.7, highest dry shoot weight 33.57, highest value of 100 seeds weight (0.325g), and maximum chlorophyll concentration (75.68). However, highest concentration of Titratable acidity (0.3593g/L), maximum value of electrical conductivity (3.98S/m) highest value of fruit firmness (7.1 lb) as compared to other treatments Hence, it was concluded that foliar application of Ezabian and Imino-x @ Ezabian20mL+Imino-x20mL per liter of water increased yield characters up to maximum and this dose can be recommended to farmers to get more yield and profit.

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Introduction

Chilli (*Capsicum frutescens* L.) locally known as "Mirch" is a member of family Solanaceae, also known as nightshade family. Chilli has been originated in Mexico and is considered to be naturalized more than five times by ancient peoples in various regions of Southern, Central and Northern America (Kraft *et al*., 2013). Species name "annuum" is a Latin word which means annual. Chilli plant is not annual but it is very sensitive to frost. It can live in multiple seasons and can grow up into a large perennial herb in the absence of winter frost (Katzer and Gernot, 2012). Hotness and pungency in chilli is because of different biochemical and antioxidant compounds found in it. The most prominent of these compounds is capsaicin which varies in quantity variety by variety. Chilli plants which face water stress produce very strong pods and concentration of capsaicin increases in these pods (Nancy *et al.,* 2011). Capsaicin produced in chilli fruit is actually a defensive weapon against mammals and microbial organism particularly fusarium fungus that attack on some species of peppers. Chilli enhances concentration of capsaicin to compensate the damage caused by fungus. However, birds cannot feel this pungency character of chilli (Tewksbury *et al*., 2008). Capsaicin also protects chilli fruit from insect pests and molds. Moreover, man has been using this character for the treatment of different infectious disease as well as for preservation of food (Ziglio and Goncalyes, 2014).

Pakistan stands in top twenty countries of the world in term of green chilli production. While Pakistan holds 4th position in dry pepper production cultivated on an area of 65.1 thousand hectares with annual production of 148.13 thousand tons among pepper producing countries (Pakistan Economic Survey 2017-18). In our homeland, as in other chilli growing areas of the world, the yield of chilli fruit is not satisfactory. Irregular management of nutrients is primarily responsible for low performance, because no attention is paid to the application of various nutrients in the necessary amount. The requirement of critical quantities of amino acids is well established as a means of the yield and morphology, the overall crop quality. It has been reported that yield of chilli (*Capsicum frutescens* L.) Is affected because of unavailability of required amount of amino acids if they need (Anonymous, 2014). Role of Amino acids is well-known for its beneficial effects on growth, development and productivity of crop. Amino acid can reduce Nitrate consumption, different amino acids perform different functions when use as fertilizer source (Liu *et al*., 2003). Amino acids are fundamental ingredients in the process of protein synthesis, formation of vegetable tissue and chlorophyll synthesis (Yunsheng *et al*., 2015). Each amino acid has its own specific role in growth and production like Tryptophan is precursor of IAA (Auxin) which has major regulatory authority in early growth and development of plants. Amino acids is the nitrogenous organic compound that is the main constitute in the preparation of proteins. By the process in which ribosomes organize the polymerization of amino acids, proteins are formed. Many theorems have been proposed to elaborate the role of amino acids in the growth of plants. Many evidences suggests and available several different way of IAA synthesis in plants that all start from amino acids. Some researchers also purpose like that the regulatory impact of certain amino acids just like phenylalanine and ornithine on plant growth is through by their impact on GA (Sarojnee *et al*., 2009).

L-Tryptophan is an amino acid is having the physiological precursor of the plant hormone and bacteria used these for production of IAA. L-tryptophan on foliar application to the soil increases the growth and production of crops because through soil microbes it is converted into the auxin. IAA is very important plant hormone and that perform main role in the initiation of root and cell increasement and differentiation of vascular tissue division of cells, apical dominance, fruit setting and leaf senescence in most plant IAA is the most active form of auxin. In the rhizosphere too many species of microbes increase the uptake of nutrient in plants by producing IAA that increase root growth (Raza *et al*., 2014). In Pakistan, yield and quality of chilli is very low as compared to developed countries. Unbalanced amino acids application and unfair nutrient's application

methods are mainly responsible for low production. Through foliar application, uptake of amino acids occurs rapidly and accurately. Keeping in view the needs of chilli producers and exporters this study was planned to provide some of the necessary information related to amino acids requirement of chilli crop in order to maximize their production and profitability.

Materials and methods

Research trial was organized at Vegetable Research Area, Institute of Horticultural Sciences, University of Agriculture, and Faisalabad. Nursery of Wonder Hot variety chilli was raised January 20 at vegetable Research Area UAF, Faisalabad. It was transplanted on 9th of April, 2019 on both sides of the beds. Seven treatments with different doses of Ezabian and Imino-x with four replications were implicated. Ezabian and Imino-x were applied in the form of foliar spray in different concentrations dissolved in one liter of water i.e. T_0 (control), T_1 Ezabian 10ml, T_2 Ezabian20ml, T_3 Imino-x 10ml, T_4 Imino-x 20ml, T_5 Ezabian 10ml+Imino-x10ml, T_6 Ezabian20ml + Imino-x 20ml. Three foliar sprays were done. Amino acids were applied as foliar after 15 days interval starting from 45 days after transplanting. Recommended doses of irrigations and fertilizers were given to the crop when required. Moreover, according to requirement standard plant protection measures were employed to keep insects and diseases controlled. When fruit got ready to harvest, they were picked with the interval of one month and other quality parameters were analyzed and recorded.

Experimental Design and Statistics:

Research trial was accompanied by using Randomized Complete Block Design (RCBD) with four replications and each replication contains fourty plants while each treatment contains ten plants. Data was analyzed statistically using LSD test at 5% probability level (Steel *et al*., 1997).

Results and discussion

Growth contributing traits of chilli

Plant height

Plant height (cm) represents the growth rate of hot pepper as it is one of the main growth contributing factors. The characteristic affiliated with this trait (plant height) are presented in given table 1 which denoted significant difference among plant height of all treatments. It was seen that treatment T_6 (Ezabian20mL + Imino-x20mL /L of water separately) expanded plant height up to 63.5cm which was most extreme while control treatment T_0 delivered plants with plant stature of 50.28cm. Generally, it was observed that five treatments produced plants having plant height less than 60cm while remaining treatments produced plants having plant height more than 60cm and less than 70cm. (Fig. 4.1c). Therefore, it was observed that there was a great variation among most of the treatments in term of plant height (cm) which would be very beneficial for vegetable growers. Hot pepper plants with more plant height (cm) produces more flowers; thus ultimately producing more yield per plant. Therefore, peasants growing pepper crop would apply dose of Ezabian and Imino-x (T_6) which would increase plant height (cm) up to maximum. El-Mohsen *et al.* (2007) applied amino acids @ 1g/ L on chilli crop in foliar form and found the increase in plant height and number of leaves per plant. Moreover, research findings of Baloch *et al.* (2008) in case of plant height supported to my results.

Number of branches per plant:

The characteristic affiliated with this trait (branches per plant) are offered in given table 1. From the analysis of variance table, the result revealed that there is significance result of treatments. And all the treatment means are not equal. After analysis of variance result which treatment is the highest mean and lowest mean.

From the multiple mean comparison table it was revealed that T_6 (28) has the highest mean value and the treatment T_0 (18) has lowest value. In the mean comparison test we draw the rank order of the mean. Hence, it was observed that there was a great variation among most of the treatments in term of number of branches per plant which would be very beneficial for vegetable growers. Hot pepper plants with more branches produces more flowers; thus ultimately producing more yield per plant.

It is remarkable to pronounce that obtained results are according to the findings of El-Mohsen *et al.* (2007) and Baloch *et al.* (2008).

Number of leaves per plant

Average number of leaf/plant data were significantly analyzed. Significant variability was observed for this trait (Number of leaves) among all the treatments. Results showed that maximum number of leaves was recorded 71 while minimum number of leaves 49 was observed 3.24g (Table. 4.1).

The analysis of variance table revealed that there is significance results among the treatment. Significant mean all the treatments are not same. It is clear from the existing results is that T_6 (71) value is the highest value from all the other treatment mean. And the lowest value of the treatment from mean comparison table is T_0 (49). So, it was observed that there was a great variation among most of the treatments in term of number of leaves which would be very beneficial for vegetable growers. Hot pepper plants with more number of leaves produces more yield per plant; thus ultimately producing more yield per hectare. Therefore, peasants growing pepper crop would apply dose of Ezabian and Imino-x (T_6) which would increase number of leaves up to maximum. It is interesting to describe that attained results resemble with the findings of Shil *et al.* (2013).

Fruit length (cm)

Fruit length (cm) expresses marketability rate of hot pepper fruit as it is a main yield contributing factor. It was observed that treatments are not same. It is clear from exixting results T_5 (12.49) value is the highest value from all the other treatment mean. And the lowest value of the treatment from mean comparison table is T_0 (6.82). Generally, it was found that three treatments produced fruits having length less than 10cm fruit length while remaining treatments produced fruits with fruit length greater than 10cm and less than 12.50cm. Shil *et al.* (2013) applied amino acids on chilli crop in addition to NPK application and observed increase in fruit length which interestingly supported to my results.

Fruit diameter (cm^2)

Center of fruit was focused for calculation of chilli fruit diameter. Significant difference was observed in case of mean fruit diameter (center) of different treatments (Table 1). However, it was clearly revealed from the existing results that from the multiple mean comparison table it was revealed that T_2 (1.45) has the highest mean value and the treatment T_0 (1.01) has lowest value. In the mean comparison test we draw the rank order of the mean. Hot pepper plants with more fruit diameter (cm) produces more weighed fruits; thus ultimately producing more yield per plant. Shil *et al.* (2013) applied Ezabian and Imino-x on chilli crop in addition to NPK application and observed increase in fruit length which interestingly supported to my findings.

Fruit firmness (Ib)

Results showed that maximum value of fruit firmness obtained was 7.1 lb while minimum value obtained was 5.75 lb while treatment T_5 gave minimum fruit firmness value of 5.75 lb under given climatic conditions (Table 1). Hot pepper plants with high fruit firmness (lb) produces fruits which can afford more injury stress during transportation and storage; thus ultimately reducing transportation and storage losses. Research findings of Agarwal (2018) are similar to my findings in term of fruit firmness.

Yield contributing traits of chilli

Fruit weight (g)

Results showed that maximum fruit weight was recorded 5.39g while minimum fruit weight was observed 3.24g (Table. 2). Generally, it was estimated that fruit weight of only two treatments (T_0 & T_1) was found less than 4g while remaining cultivars produced fruits with fruit weight more than 4g. However, treatment T_6 produced fruits with highest fruit weight of 5.39g while treatment T_0 produced fruits with minimum fruit weight of 3.24g under the climatic conditions of Faisalabad, Punjab. Hot pepper plants with more fruit weight (cm) produces more yield per plant; thus ultimately producing more yield per hectare. Our findings are in accordance with the findings of Shil *et al.* (2013).

Table 1. Growth contributing traits of Chilli effected by Ezabian and Imino-x.

Treatments	Plant height(cm)	No. of branches/plant	Number of leaves/plant	Fruit length (cm)	Fruit diameter (cm)	Fruit firmness (Ib)
Control	50.28^{A}	18^{A}	49^{B}	6.82^{AC}	1.01^{AC}	7.1^{AC}
Ezabian 10ml	52.24^{B}	18^{A}	59^{AC}	7.84^{C}	1.36^{B}	6.92^{B}
Ezabian 20ml	57.39^{AB}	21^{B}	62^{C}	9.83^{BC}	1.45^{BC}	5.75^{BC}
Imino-x10ml	51.24^{C}	22^{AB}	59^{AC}	10.02^{C}	1.31^{D}	6.73^{D}
Imino x 20ml	59.05^{AC}	24^{C}	68^{B}	10.57^{B}	1.42^{AC}	6.32^{AD}
Ezabian 10ml+Imino x 10ml	62.04^{BC}	26^{AC}	69^{AC}	12.49^{AC}	1.28^{B}	6.35^{C}
Ezabian 20ml+Imino x 20ml	63.5^{C}	28^{BC}	71^{C}	12.11^{BC}	1.32^{C}	6.75^{B}

Fruit yield per plant (g)

Average fruit yield (g) data were significantly analyzed. Significant variability was observed for this trait (fruit yield) among all the treatments. Results showed that maximum fruit yield obtained was 1113 g while minimum fruit yield obtained was 820.5g (Table. 2). However, treatment T_5 gave maximum fruit yield of 1113 g while treatment T_0 gave minimum fruit yield of 820.5g under these climatic conditions. Therefore, peasants growing pepper crop would apply dose of Ezabian and Imino-x (T_8) which would increase fruit yield (g) up to maximum. Shil *et al.* (2013); Naga-Sivaiah *et al.* (2013); Manna (2013) and Ali *et al.* (2015) observed increase in fruit yield per plant with the application of Ezabian and Imino-x on chilli crop. Hence, their findings added a support in my results obtained for this trait.

Table 2. Yield contributing traits of Chilli effected by Ezabian and Imino-x.

Treatments	Fruit weight (g)	Fruit yield/plant (g)	Fruit yield/hectare (tons)	100-seeds weight (g)
Control	3.24^{A}	820.5^{C}	36.52^{B}	0.2385^{B}
Ezabian 10ml	3.32^{B}	828^{B}	39.14^{C}	0.2525^{C}
Ezabian 20ml	4.05^{BC}	981.5^{BC}	43.59^{AC}	0.27^{AC}
Imino-x 10ml	5.12^{AC}	1051^{A}	44.95^{B}	0.2825^{BC}
Imino-x 20ml	4.58^{B}	1046^{AB}	46.8^{BC}	0.295^{AD}
Ezabian10ml+Imino-x10ml	4.99^{C}	1113^{C}	51.15^{C}	0.325^{C}
Ezabian20ml+Imino-x20ml	5.39^{C}	1095^{B}	50.33^{B}	0.31^{B}

Fruit Yield/ Hectare (tons)

Results showed that maximum fruit yield per hectare obtained were 51.15 tons while minimum fruit yield obtained was 36.52 tons (Table 3). Hence, it was estimated that fruit yield of seven treatments was found more than 40 tons per hectare while remaining treatments produced fruits with fruit yield less than 40 tons per hectare. However, treatment T_6 gave maximum fruit yield of 51.15 tons per hectare while treatment T_0 gave minimum fruit yield of 36.52 tons per hectare under given climatic conditions. It is interesting to add that obtained results are according to the findings of Shil *et al.* (2013); Naga-Sivaiah *et al.* (2013); Manna (2013) and Ali *et al.* (2015).

Table 3. Bio-chemical traits of Chilli effected by Ezabian and Imino-x.

Treatments	Total Soulable Solids (Brix°)	Titratable Acidity (g/L)	Vitamin C (mg 100 g $^{-1}$)
Control	9.51^{B}	0.3412^{AC}	30.1^{C}
Ezabian 10ml	11.42^{BC}	0.3497^{B}	29.15^{B}
Ezabian 20ml	11.51^{AC}	0.3491^{BC}	33.78^{A}
Imino-x 10ml	8.32^{B}	0.34153^{AD}	40.79^{AC}
Imino-x 20ml	10.57^{AB}	0.351^{D}	29.23^{D}
Ezabian10ml+Imino-x10ml	9.9^{C}	0.3593^{B}	40.44^{B}
Ezabian20ml+Imino-x20ml	10.36^{AB}	0.3561^{C}	35.18^{A}

100 Seeds Weight (g)

Results showed that maximum 100 seeds weight obtained was 0.325 g while minimum 100 seeds weight obtained was 0.2385g (Table 2). On general basis it was estimated that seed weight of only three treatments was found more than 0.300g while

remaining treatments produced seeds with 100 seeds weight less than 0.300g. However, treatment T_8 gave highest seed weight of 0.325g while treatment T_0 gave minimum seed weight of 0.2385g under given climatic conditions. It is remarkable to pronounce that obtained results are according to the findings of Natesh *et al.* (2005) and Sultana *et al.* (2016).

Bio-chemical traits of chilli

Total Soulable Solids (Brix°)

The variations among the different foliar application treatments in terms of total soulable solids (Brix°) were significant. Total soulable solids ranged from 9.51 to 10.36. From the analysis of variance table, the result revealed that there is significance result of treatments. And all the treatment means are not equal. After analysis of variance result which treatment is the highest mean and lowest mean from the multiple mean comparison table it was revealed that T_2 (11.51) has the highest mean value and the treatment T_3 (8.32) has lowest value. It is important to describe that obtained results are according to the findings of Shadia (2014) and Sarkar *et al.* (2018).

Titratable Acidity (g/ L)

The variations among the different foliar application treatments in terms of titratable acidity were significant. Titratable acidity ranged from 0.3412 to 0.3593. All the treatments are not same. From the mean comparison test we reveled that which treatment is best rom the all other treatment. Form the mean comparison table the T_6 (0.3593) has the highest mean value and T_0 (0.3412) has the lowest value. It is interesting to pronounce that obtained results are according to the findings of Shadia (2014); Manas *et al.* (2014); and Sarkar *et al.* (2018).

Vitamin C (mg 100 g $^{-1}$):

Vitamin C (mg 100g $^{-1}$) ranged from 30.1 to 40.79. From the multiple mean comparison table it was revealed that T_3 (40.79) has the highest mean value and the treatment T_0 (30.1) has lowest value. It is interesting to pronounce that obtained results resembles with the findings of Shadia (2014); Manas *et al.* (2014); and Sarkar *et al.* (2018).

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