EFFECT OF EXOGENOUSLY APPLIED L-TRYPTOPHAN AND CHEMICAL FERTILIZER ON TUBER FORMATION OF RADISH

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ABSTRACT: A pot experiment was carried out from August to September 2015 at the Crop Farm, Eastern University Sri Lanka to find out the effect of concentration of L-Tryptophan (L-TRP) on tuber formation in radishunder different fertilizer treatments. There were six treatments with three replicates laid out in a Completely Randomized Design with factorial arrangement. The treatment combinations were rates of fertilizer (recommended fertilizer rate by the Department of Agriculture and half of their recommendation) and concentration of L-TRP (0 M, 10^{-3} M, 10^{-4} M). Measurements were taken at 45 days after sowing of radish. There was a significant interaction ($p<0.05$) between the concentration of L-TRP and fertilizer rate on tuber length, tuber diameter and tuber yield per plant of radish. At recommended fertilizer rate and L-TRP of 10^{-4} M, the tuber yield per plant (1.57 fold)alongwith length (1.12 fold) and diameter (0.76 fold) significantly increased over the control. Simultaneously, at half of recommended fertilizer rate, all the parameters such as tuber length (1.31 fold), tuber diameter (0.66 fold) and tuber yield per plant (1.89 fold) were significantly high at 10^{-3} M of L-TRP over the control. The results indicated that as recommended fertilizer reduced to half of the rate, the concentration of L-TRP increased by 10 foldin order to improve the tuber formation of radish. Therefore, it can be concluded that the application of L-TRP as a phytohormone precursor can be used to increase the tuber formation in radish at different fertilizer rate.

Keywords: Interaction, L-Tryptophan, Radish, Fertilizer rate, Tuber formation

1. INTRODUCTION

Food production is a very rigorous trade and is related to better quality and better yield leading to better profitability.Every farmer’s dreams to achieve this goal. However to achieve this goal with advancement of technology, use of fertilizer and pesticides are not enough and not safe for human being as well as nature.Now is the time to look at bioenergetics and biochemical aspects of plants, to achieve the goal of farmers. Every living organism including plants requires protein for their growth. The basic building block of protein is amino acids.The requirement of amino acids in essential qualities is well known as a means to increase yield and overall quality of crops. At the same time amino acids are precursors or activators of phytohormones and growth substances for plant growth.

Plant hormones are organic molecules which have the potential to influence the growth and development of plants (Sajjad *et.al*., 2014). They are being naturally produced by the plants itself as well as by the microbes in the rhizosphere (Kravchenko *et. al*., 2004). Production of phytohormones can also be improved by the provision of suitable precursors to the rhizobial microbes.

L-Tryptophan (L-TRP)is an essential amino acid that performs as a physiological precursor of auxins in higher plants. Exogenous application of L-TRP as phytohormones’ precursors is a way of dealing with present situation of declining soil quality due to over usage of synthetic fertilizers to increase the crop production in order to satisfy the demand for food, worldwide. Many species of microbes in the rhizosphere enhance the nutrient uptake of plants by producing Indole Acetic Acid (IAA) that expands root growth (Kevin, 2003; Khalid *et. al*.,2004).

The IAA is the most active form of auxin in majority of plants. It is, a significant phytohormone involved in the activities such as root initiation, cell enlargement, vascular tissue differentiation, cell division, apical dominance, leaf and fruit abscission, flowering, leaf senescence and fruit setting.The growth and yield of diverse crops in response to soil application of L-TRP has been documented in maize (Arshad *et. al*., 2004) and radish (Asghar *et. al*., 2006).

Tuberization is a morphogenetic process associated with the vegetative reproductive development of radishplants.Generally plant hormones play an important role in the regulation of the growth. Secondary growth of radish is controlled by auxin and cytokinin (Torrey, 1976).Auxins apparently determine the sink activity of the tubers by controlling cell division and cell enlargement (Melis and Van Staden, 1984). Available IAA content and their effect on tuber formation have positive relationship (Kolachevskaya*et al*., 2015).

In Sri Lanka, Radish is one of the vegetables that can be grown in all agro ecological regions throughout the year if adequate wetness is available. It is also used as vegetable or salad and provides significant quantity of nutrients, especially rich in protein, fat, carbohydrate, fiber, ash, calcium, sodium, phosphorus and potassium (Crop Recommendation-Department of Agriculture, 2015).

Therefore, the objective of this research was to determine the effect of concentration of L-TRP on tuber formation of radish under different fertilizer rates.

2. METHODOLOGY

2.1. Experimental Design

Plastic container (25, 24.8 and 23 cm length,width and depth, respectively) was filled with garden soil amended with cattle manure at the rate of 10 ton per ha (pH 6.3). The sievedpotting mixture was distributed uniformly in every container. Two fertilizer treatments n_0: Department of Agriculture (DoA) recommended fertilizer level consisting of urea-180 kg/ha, MOP- 130 kg/ha and TSP- 110 kg/ha per container n_1:Half of DoA recommendedfertilizer level consisting of urea-90 kg/ha, MOP- 65 kg/ha and TSP- 55 kg/ha per container and three levels of L-TRP (control (t_0),10^{-3} M (t_1), 10^{-4} M (t_2)) were considered as treatments.Consequently, six treatment combinations were thus possible using the two main factors. Three replicated containers were prepared for each treatment.

Four germinating Radish seeds of Beeralu raabu were sown into the centre of each soil container andthinned to one after fourteen days. The containers were kept in an open field conditions for 45 days.

2.1.1 Preparation of L-TRP solution

L-TRP stock solution was prepared in distilled water using the L-TRP powder. For the preparation of 1 M stock solution, 204.225 g of powder was dissolved in 1000 ml of distilled water. According to the treatments (10^{-3} M, 10^{-4} M, control), the stock solution was diluted and applied. First and second soil drenching was done at three and four weeks after sowing, respectively. Distilled water was applied to the control treatment. The application volume was 150 ml per container at a time.

2.3. Measurement of tuber

Data on tuber characteristics were collected at 45 days after sowing. Tuber attributes such as tuber length, tuber diameter and yield per plant were taken by destructive sampling method.

2.4. Statistics

The analysis of L-TRP, at threeconcentrations, was combined in a factorial arrangement with two rates of fertilizer treatment. The data were analyzed by General Linear Model to find out the interaction between two main factors followed by one-way analysis of variance (ANOVA) to determine the main effects of two factors on tuber formation. The mean separation was performed using Tukey test when significant effects were detected by ANOVA. All the analysis were carried out by using Minitab 14.

3. RESULTS AND DISCUSSIONS

Effect of Exogenously Applied L-Tryptophan and Chemical Fertilizer on Tuber Lengthof Radish

Tuber length is one of the tuber attributes of radish plant which indicates the degree of tuber formation.

Table 1.Effect of Exogenously Applied L-TRP and Chemical Fertilizer on Tuber Length at 45 Days after sowing of Radish (cv.Beeraluraabu).

Fertilizer (N)	L-TRP(T)	Tuber length (cm)
Recommended rate of fertilizer	10^{-3} M	7.567±0.61 c
	10^{-4}M	10.090±0.29 a
	No L-TRP	4.366±0.08 b
Half rate of recommended fertilizer	10^{-3} M	13.520±0.36 a
	10^{-4}M	6.430±1.12 b
	No L-TRP	6.467±0.31 b
Probability level	N	0.008
	T	0.000
	N*T	0.000

Values within rows having dissimilar letter/letters indicate significant differences at 5% level of significance by Tukey test.

Table 1 showed that, exogenously applied L-TRP and chemical fertilizer significantly ($p<0.05$) influenced on tuber length of radish. And there was significant ($p=0.000$) interaction between the rate of chemical fertilizer and concentration of L-TRP on tuber length. At DoA recommended rate of fertilizer, there were significant differences among the treatments. L-TRP of 10^{-4} M concentration significantly increased (1.12 fold) the tuber length over control followed by 10^{-4} M. At half of DoA recommended fertilizer rate, Application of 10^{-3} M L-TRP significantly ($p=0.000$) increased the tuber length by 1.31 fold. Asghar *et. al*. (2006) stated that addition of L-TRP to organic materials increased the concentration of plant hormone auxin in the organic matter which affected root growth and subsequently plant performances of radish.

Effect of Exogenously Applied L-Tryptophan and Chemical Fertilizer on Tuber Diameter of Radish

The effect of L-TRP concentration on tuber diameter of radish was significantly influenced bythe fertilizer rate at 5% of significant level. It confirms that there was an interaction between fertilizer rate and L-TRP level and they were not independent each other on tuber diameter of radish (Table.2).

Table 2.Effect of Exogenously Applied L-TRP and Chemical Fertilizer on Tuber Diameterat 45 Days after sowing of Radish (cv.Beeraluraabu).

Fertilizer (N)	L-TRP(T)	Tuber diameter (mm)
Recommended rate of fertilizer	10^{-3} M	14.64±0.54 b
	10^{-4}M	24.37±1.18 a
	No L-TRP	10.66±0.19 c
Half rate of recommended fertilizer	10^{-3} M	35.22±1.16 a
	10^{-4}M	24.71±1.18 b
	No L-TRP	19.98±0.46 c
Probability level	N	0.000
	T	0.000
	N*T	0.000

Values within rows having dissimilar letter/letters indicate significant differences at 5% level of significance by Tukeytest.

At DoA recommended fertilizer rate, there were significant differences among the treatments ($p<0.05$). Tested parameter of tuber diameter per plant was significantly increased at 10^{-4} M concentration of L-TRP over the control by 0.76 fold followed by 10^{-3} M. At half of DoA recommended fertilizer rate, application of L-TRP on radish significantly increased the tuber diameter by 0.66 fold compared with control that was not received any L-TRP treatment. Similar findings are reported by Frankenberger *et. al.* (1990) in Potato.

Effect of Exogenously Applied L-Tryptophan and Chemical Fertilizer on Tuber yield per plant of Radish

It is evident from table. 3 that different rate of chemical fertilizers and concentrations of L-TRP significantly (p=0.000) increased the tuber yield per plant. At the same time there was significant interaction betweendifferent rate of chemical fertilizers and concentrations of L-TRP on tuber yield. Maximum value of tuber yield was recorded at 10^{-4} M where DoA recommended rate of fertilizer was applied and it was 1.57 fold more than the control followed by 10^{-3} M while at half of DoA recommended fertilizer rate, application of L-TRP at 10^{-3} M increased the tuber yield per plant by 1.89 fold over control at 5% level of significant.

Table 3.Effect of Exogenously Applied L-TRP and Chemical Fertilizer on Tuber Yield per plant at 45 Days after sowing of Radish (cv.Beeraluraabu).

Fertilizer (N)	L-TRP (T)	Tuber yield per plant (g)
Recommended rate of fertilizer	10^{-3} M	15.670±1.77 b
	10^{-4}M	29.580±1.28 a
	No L-TRP	10.220±0.91 c
Half rate of recommended fertilizer	10^{-3} M	61.670±5.79 a
	10^{-4}M	40.967±0.77 b
	No L-TRP	23.911±1.18 c
Probability level	N	0.000
	T	0.000
	N*T	0.000

Values within rows having dissimilar letter/letters indicate significant differences at 5% level of significance by Tukey test.

Tuber yield of plant directly associated with length and diameter of tuber. The highest length and diameter of tuber attributed to highest tuber yield per plant. This was confirmed that tuber formation was markedly influenced by the application of L-TRPon radish at different fertilizer rate. Further it was confirmed by Mumtaz *et. al*.(1999) who proposed that application of L-TRP with the concentration range between 10^{-3} M to 10^{-5} M significantly increased the tuber yield of potato when incorporated with chemical fertilizer.

4. CONCLUSION

The L-TRP with 10^{-4} M was the best at DoA recommended level of fertilizer while L-TRP with 10^{-3} M was the best at half of DoA recommended level of fertilizer.Further it can be concluded that when the recommended fertilizer was reduced to half of the rate, the concentration level of L-TRP increased by 10 fold. Therefore, this experiment confirmed that application of L-TRP as phytohormone precursor enhanced the tuber formation and yieldin radish at different fertilizer levels.

5. REFERENCES

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