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EFFECT OF L-TRYPTOPHAN ON PLANT WEIGHT AND POD WEIGHT IN CHICKPEA UNDER RAINFED CONDITIONS

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Abstract

Exogenous application of plant growth regulators is an important element in modern day agricultural production technology. The precursor of auxin, L-Tryptophan (L-TRP), is the most important plant growth regulator and is physiologically very vital in modelling plant growth and development. To evaluate the effect of L-TRP on chickpea plant weight and pod weight, a field experiment was conducted during 2003, employing randomised complete block design under rain-fed conditions. The treatments were L-TRP @ 10^{-2}M, L-TRP @ 10^{-3}M, L-TRP @ 10^{-4}M and a control. Analysis showed that L-TRP @ 10^{-3}M had a significant effect on plant and pod weight, suggesting the additional effect of plant growth promoting factor provided by auxin production. The L-TRP improved the crop vegetative and reproductive growth that consequently increases pod weight.

Keywords: Chickpea, Plant weight, Pod weight, L-Tryptophan, Growth regulator.

Introduction

Chickpea (*Cicerarietinum)* belongs to the *Fabaceae* family and is the largest legume pulses crop in Pakistan. Chickpeas are very good source of folate (a water-soluble B vitamin) and protein. Chickpeas are also high in dietary fiber and low in fat and thus are a healthy food source, especially, for persons with insulin sensitivity or diabetes. About 80% of the total dry seed weight of chickpea comprises of carbohydrates and proteins. Total seed carbohydrates vary from 52 to 71%. The crude protein content of chickpea varies from 16 to 24%. Crude fiber, an important constituent of chickpeas, is mostly located within the seed coat. Based on amino acid composition, the proteins of chickpea seed were found on average to be of higher nutritive value than those of other grain legumes. Chickpeas meet adult human requirements for all essential amino acids except methionine and cysteine and have a low level of tryptophan. Chickpeas have a high protein digestibility and are rich in phosphorus and calcium than other pulses. Chickpea consumption stood at 5.7 million tonnes in Pakistan, during 2009-10 (Anonymous, 2009-10).

Exogenous application of plant growth regulators is an important element in modern day crop production technology. L-tryptophan (L-TRP) is a physiological precursor of auxin biosynthesis both in microbes and higher plants. Exogenous application of L-TRP has been reported to improve the growth and yield of various crops (Akhtar et al., 2007; Frankenberger and Arshad, 1995; Zahir et al., 2004, 2005). Zahir et al. (2000) reported that addition of L-TRP as an auxin precursor substantially increased auxin production by microbes present in soil. The amount of auxins released from the precursor, required for better growth, varies with crop type and variety. In higher plants, it has been reported that L-TRP has better effects on seed germination, growth, nutrient uptake and yield as compared to pure auxin (Frankenberger and Arshad, 1991). The effect of L-TRP on growth and yield could be attributed to either: (a) auxin metabolites produced by the rhizosphere micro

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flora which were subsequently taken up by plant roots, or, (b) direct uptake by plant roots with subsequent catabolism in to auxins with the plant tissue or (c) alteration in the balance of rhizosphere microbial community in response to L-TRP addition, which may affect growth and yield (Frankenberger and Arshad, 1995).

Substantial consideration has been lacking in our agricultural research work in Pakistan to determine the impact of L-TRP on crop growth and development, which can evoke a physiological response with the consequences of increased nutrient uptake and hence better plant growth and development. An exogenous supply of phyto-hormones or their precursors may have the ability to affect the endogenous hormonal pattern of the plants, either by supplementation of sub-optimal levels or interaction with synthesis, translocation and inactivation of existing hormone level (Muneer et al., 2009). For this reason, the present study was undertaken to determine whether L-TRP has any significant effect on plant and pod weight of chickpea and if so, what concentration of L-TRP could be beneficial in affecting growth and development in positive direction.

Material and Methods

To evaluate the effect of L-Tryptophan on plant weight and pod weight of chickpea (dasht) under rainfed conditions, a field experiment was conducted during 2002-03 at research area of Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi (Lat. 33.4^{o}N, Long. 44°30'E). There were four replications. The treatments were three different levels of L-TRP (10^{-2}, 10^{-3} and 10^{-4} M) and a control. The L-TRP concentrations were applied before sowing the seeds. The quantity 2.04g of L-TRP was dissolved in 1000ml of distilled water to make 10^{-2} M as stock solution. Then, 0.1ml L-TRP was taken from above stock solution and was dissolved in 10 and 100ml of water to have 10^{-3}M and 10^{-4}M concentrations. Seed rate was 55kgha^{-1}. For inoculation, chickpea seeds were coated with slurry. Slurry was prepared by mixing 30ml of 15% sugar solution, 60ml liquid culture and 200g of sterilised peat plus clay. L-Tryptophan solution was applied in above narrated different concentrations on inoculated chickpea seeds. The seeds were then placed overnight for drying before sowing. The experiment was laid out using randomised complete block design (RCBD). The plot size was 20×25 square ft. The seeds were sown with a seed drill.

Data on root length (cm), number of nodules/ plant, fresh weight of nodules (g), dry weight of nodules (g), number of pods/plant, weight of pods/plant (g) and final plant weight (g) were recorded and analysed statistically, using a computer software package ‘Statistix’ and the means were compared on least significance difference basis as described by Steel et al. (1997).

Results and Discussion

The weather conditions for the period under study are summarised in Table 1. Non-significant differences were recorded among the treatments regarding the root length, number of nodules per plant, nodule (fresh and dry) weights and number of pods per plant.

Table 1.Weather data during the period under crop growth and development

Month	Min. Temp. (^{0}C)	Max. Temp. (^{0}C)	Rainfall (mm)	Relative Humidity (%)
October, 2002	14.4	29.8	47.1	61.5
November, 2002	8.1	25.5	0.0	61.8
December, 2002	4.4	20.0	25.3	65.8
January, 2003	2.3	18.6	54.8	65.4
February, 2003	6.0	18.5	190.9	73.0
March, 2003	9.6	23.3	89.6	62.8

Plant weight was significantly affected by different L-TRP concentrations. Maximum plant weight (332.5g) was achieved at L-TRP level 10^{-3} M, whereas, minimum (116.2) was recorded in control (Table 2). These fundings are in line with those of Zahir et al. (2010), who determined significant increase in plant biomass with different L-TRP concentrations. The increase in plant weight might be induced owing to the positive influence of L-TRP on the cellular division, during the development process (Muneer et al., 2009).

Significant effect of L-TRP concentration was recorded on pod weight per plant. Maximum pod weight (84.49g) was produced at L-TRP @ 10^{-3}M, whereas the minimum (47.22g) was recorded with the control (Table 2). The increase in pod weight might owe to the production of phytohormones, e.g., auxin (Sevilla et al., 2001; Zahir et al., 2010).

These results are in consistency to those of Ahmad et al. (2008), who determined that L-TRP treated nitrogen enriched compost enhanced biomass and crop yield. Parvez et al. (2000) concluded that L-TRP improved the crop vegetative and reproductive growth that ultimately increases pod weight.

Table 2.Effect of L-TRP on various growth and development attributes of chickpea

Treatments	Root length (cm)	Number of nodules plant^{-1}	Nodule fresh weight	Nodule dry weight	Number of pods plant^{-1}	Plant weight (g)	Pod weight plant^{-1}
T_0 (Control)	18.9^{NS}	83.5^{NS}	0.62^{NS}	0.18^{NS}	133.8^{NS}	116.2 c	47.22 c
T_1 = L-TRP @ 10^{-2}M	16.4	118.5	0.98	0.23	135.0	216.4 b	52.88 bc
T_2 = L-TRP @ 10^{-3}M	16.2	81.0	0.86	0.25	188.0	332.5 a	84.49 a
T_3 = L-TRP @ 10^{-4}M	16.8	75.2	0.56	0.14	181.8	277.7 ab	73.28 ab

Conclusion

Exogenous application of L-TRP @ 10^{-3}M played a physiologically very vital impact in modelling chickpea plant growth and development. Using L-TRP @ 10^{-3}M had a significant effect on plant and pod weight per plant of chickpea under rain-fed conditions. The increase in plant and pod weight might ow to production of phytohormones, e.g., auxin. The L-TRP improved the crop vegetative and reproductive growth that consequently increases the pod weight.

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