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Effect of L-Tryptophan on the Growth and Yield of Potato cv. Pars-70

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ABSTRACT

Four levels (10^{-3} M, 10^{-4} M, 10^{-5} M and 10^{-6} M) of L-tryptophan were applied to cv. PARS-70 plants at tuber formation stage in the root zone. In control, same amount of water was applied. The tuber yield was maximum (11.29) when L-tryptophan was applied @ 10^{-5} M and it was 20.01% higher than that of control. The plant height was maximum both at day 30 (67.25 cm) and 45 (67.10 cm) post application of L-tryptophan @ 10^{-5} M. Maximum (11.29) and minimum (9.55) number of tubers was observed at 10^{-3} M and 10^{-5} M L-tryptophan concentrations being 25.41 and 6.14% higher than the control, respectively. Likewise, the maximum (3.794 cm) and minimum (3.374 cm) diameter of tubers was recorded at 10^{-5} M and 10^{-3} L-tryptophan concentrations being 16.66 and 3.75% higher than the control, respectively. It is concluded that the potato plants responded well to the L-tryptophan concentrations of 10^{-5} M and 10^{-6} M, respectively.

Key Words: L-tryptophan; Potato; Yield; Growth

INTRODUCTION

L-tryptophan is an essential amino acid that acts as a physiological precursor of auxins in higher plants (Frankenberger & Arshad, 1995). Application of L-tryptophan to soil may improve growth and yield of plants most likely via its conversion into auxins by soil indigenous microbiota (Arshad & Frankenberger, 1993). Zahir *et al.* (1997) reported 47.8% increase in potato yield with the application of L-tryptophan and *Azatobacter* in a pot experiment. Similarly, in a pot experiment conducted on potato plants treatments with indole acetic acid (IAA) at 75 mg L^{-1} solution helped to enhance the potato yield by increasing tuber number and tuber size (Frankenberger *et al.* 1990). Mixture of IAA at 40 mg L^{-1} + Butyric acid (BA) at 4 mg L^{-1} solution gave higher yield than control (Al-Farhan, 1990). Likewise, Ulevicience and Novickiene (1994) noted that treatment of potato plant with the synthetic auxin TA-12 at the optimal concentration of 10^{-3} M inhibited stolon elongation and induced tuber formation at stolon apices. This paper describes the effect of L-tryptophan on the growth and yield of potato cv. PARS-70, an indigenous variety in Pakistan.

MATERIALS AND METHODS

This experiment was conducted at Experimental Vegetable Area, Department of Horticulture, University of Agriculture, Faisalabad, Pakistan. Potato cv. PARS-70 was sown in the last week of October. Ten healthy and uniform plants were selected for each treatment and different concentrations of L-tryptophan (40 ml solution/plant) were applied at tuber formation stage in the root zone. In case of control, same amount of water was applied. The treatments T_1, T_2, T_3, T_4 and T_5 included application of L-tryptophan at 0, 10^{-3}, 10^{-4}, 10^{-5} and 10^{-6} M concentrations, respectively.

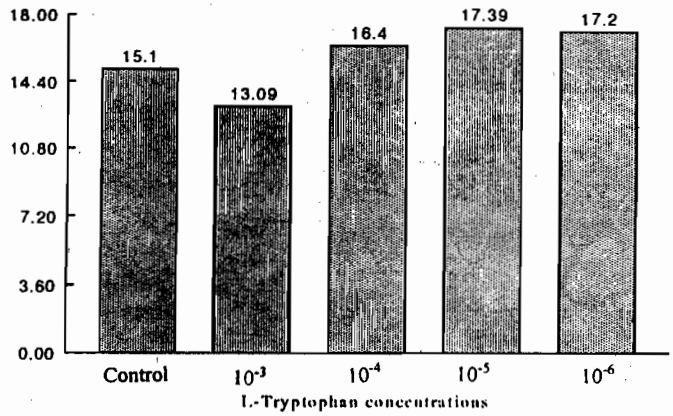
The treatments were replicated four times in the field using a randomized complete block design. All other agronomic practices were kept normal and uniform for all treatments. The data collected were analyzed statistically using the Dunnett's test (Steel & Torrie, 1980).

RESULTS AND DISCUSSION

Tuber yield. It is evident from Fig. 1 that three levels of L-tryptophan significantly increased tuber yield. Maximum value of tuber yield (17.390 tons ha^{-1}) was recorded where 10^{-5} M L-tryptophan was applied and it was 20.01% more than the control. Minimum tuber yield (13.09 tons ha^{-1}) was found where L-tryptophan @ 10^{-3} M was applied and it was 9.15% lower than control. The lower concentration of L-tryptophan restricted the mechanism of photosynthesis which ultimately reflected in the form of lower yield. Similar findings, using different growth regulators, have also been reported by Maharana *et al.* (1990) and Haeder and Bringer (1983) who used different growth regulators on their precursors and got more yield than control. Higher levels of L-tryptophan increased the tuber yield by activating the endogenous level of hormones, thus found higher than control.

Number of tubers per plant. Maximum number of tubers (11.29) was observed where 10^{-3} M concentration of L-tryptophan was applied and it was 25.41% higher than the control. Minimum number of tubers (9.55) was found where 10^{-5} M concentration of L-tryptophan was applied and it was found 6.14% higher than control (Table I). These results are in accordance with those of Islam *et al.* (1983) and Ahmad and Tahir (1995).

Fig. 1. Effect of L-tryptophan on the tuber yield



Tuber diameter per plant. Maximum diameter of tubers (3.794 cm) was observed where L-tryptophan was applied @ 10^{-5} M concentration and it was 16.66% higher than control, while minimum value (3.374) was recorded where L-tryptophan @ 10^{-3} M was applied and it was 3.75% higher than control, but results were non-significant, statistically (Table I).

Leaf area. Maximum values [108.0 cm^2 (after 30 days) and 109.587 cm^2 (after 45 days)] was obtained from the plants, to which 10^{-5} M concentration of L-tryptophan was applied and it was found 16.75 and 19.96% higher than that of control (Table II), respectively. Islam *et al.* (1983) reported similar results.

Plant height. Different levels of L-tryptophan significantly increased plant height 10^{-5} M L-tryptophan excelled all other treatments which produced 67.25 and 67.10 cm height after 30 days and 45 days, respectively. Other levels of L-tryptopphan i.e. 10^{-3} and 10^{-4} also proved better, however 10^{-6} did not show any promising results. The present findings support those of Ahmad and Tahir (1995) and Maharana *et al.* (1990).

Chlorophyll contents. The highest value of chlorophyll contents (1.15) was observed where L-tryptophan was applied at the concentration of 10^{-5} M and was found 3.6 and 2.4% higher than control, after 30 and 45 days of L-tryptophan application, respectively (Table II). Similar results were also reported by Islam *et al.* (1983).

CONCLUSIONS

Application of growth promoters were found much helpful to increase the yield of crops and was found cheaper and easier technique than traditional methods of fertilizer application. The mechanism of action of applied growth promoters is by activating the endogenous hormones or their precursors which ultimately help to increase the yield. Therefore, use of growth promotes to boost the agricultural production is recommended.

Table I. Effect of L-tryptophan application on the tuber growth of potato plant

Treatments	Tubers per plant		Tuber diameter		Tuber fresh weight per plant	
	a	b	a	b	a	b
Control	9.00	0.00	0.25	0.00	259.42	0.00
10^{-3} M L-tryptophan	11.29*	25.41	3.37	3.75	235.67	9.15
10^{-4} M L-tryptophan	9.95*	10.53	3.47	6.76	278.02*	7.16
10^{-5} M L-tryptophan	9.55	6.14	3.79	16.66	311.33*	20.01
10^{-6} M L-tryptophan	10.84*	20.47	3.68	13.37	298.10*	14.90

*= Means significantly differ from control at P £ 0.05 according to Dunett's Test.
a= Mean average of 4 replications.
b= % increase over control.

Table II. Effect of L-tryptophan application on the growth of potato plant

Treatments	Days after application	Leaf area (cm^2)		Plant height (cm)		Chlorophyll contents	
		a	b	a	b	a	b
Control	30	91.35	0.00	50.38	0.00	1.11	0.0
	45	92.50	0.00	50.00	0.00	1.12	0.0
10^{-3} M L-tryptophan	30	100.90*	10.50	59.80	18.69	1.07	-3.4
	45	100.50*	8.59	63.37	19.43	1.09	-2.4
10^{-4} M L-tryptophan	30	94.30*	3.17	63.37	25.78	1.06	-4.6
	45	93.05	0.59	63.64	26.85	1.08	-3.5
10^{-5} M L-tryptophan	30	108.00	19.96	67.25	33.40	1.15	3.6
	45	109.60*	16.75	67.10	28.93	1.15	2.4
10^{-6} M L-tryptophan	30	105.10*	15.10	55.10	9.36	1.14*	3.3
	45	103.50*	11.89	59.00	11.76	1.15	2.4

*= Means significantly differ from control at P £ 0.05 according to Dunett's Test.
a= Mean average of 4 replications.
b= % increase over control.

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