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Morphochemical Response of Scurf Pea (*Psoralea corylifolia* L.) To Indole Acetic Acid (IAA) and Nitrogen (N)

[1]*Khalid Hussain,* [2]*Mumtaz Hussain,* [1]*Abdul Majeed,*
[1]*Khalid Nawaz,* [1]*M. Farrukh Nisar and* [3]*Shahid Afghan*

[1]Department of Botany, University of Gujrat, Pakistan
[2]Department of Botany, University of Agriculture Faisalabad, Pakistan
[3]Shakarganj Sugar Research Institute, Jhang, Pakistan

Abstract: A pot experiment was conducted to evaluate the morphochemical response of scurf pea (*Psoralea corylifolia* L.) to different levels of IAA and N. Different concentrations of IAA and N were applied thirty days after germination. IAA was applied as a foliar spray and nitrogen in the form of urea. The design used for this study was Completely Randomized Design (CRD). Indole Acetic Acid and nitrogen significantly increased all the growth parameters as shoot and root lengths, shoot fresh and dry weights, number of leaves and yield per plant in scurf pea. Similarly, NPK concentrations were increased with IAA and N applications as compared to control. IAA x N interaction showed that low levels of IAA with nitrogen increased the growth and yield parameters and ion accumulations. It was concluded that IAA and nitrogen was useful for the increase of growth and yield of scurf pea. High concentrations of IAA had adverse affect on plant growth, while low concentrations with nitrogen combination were helpful for increasing growth and yield of plants.

Key words: Growth · Ion accumulation · IAA · Nitrogen · Scurf pea

INTRODUCTION

Scurf pea (*Psoralea corylifolia* L.) belongs to family leguminosae that is native to South Eastern Asia and it is cultivated in China. It has long been considered a tonic remedy [1]. It is a bitter, astringent, diuretic, warming herb that stimulates kidney and has antibacterial effects. Injection of scurf pea has been used with considerable success to treat alopecia [2]. Seeds of Scurf pea are anthelmintic, diuretic, stomachic, used in leprosy, febrile condition, skin diseases and scorpion or snake bite. Seed yields essential oil, psoralen, isopsoralin, psoralidin resin and terpenoid oil [3].

Indole acetic acid (IAA) stimulates cell enlargement that is a necessary step in the growth of a cell. The application of IAA to plants not only promotes vegetative and reproductive growth but also improves the protein content [4]. Exogenously applications of indole-3-acetic acid (IAA) strongly promoted stem elongation over the long term in intact light-grown seedlings of pea (*Pisum sativum* L.), with the relative promotion being far greater in dwarf plants. The magnitude of growth promotion correlated with the applied IAA concentration from 10^{-6} to 10^{-3} M, particularly over the first 6 h of application [5]. Barbieri *et al*.[6] suggested major involvement of IAA in promoting the development of root system. IAA increased number of spike/pot and weight of spikes and tiller growth [7].

Nitrogen is vital nutrient for plant and crop growth. It constitutes 78% of earth's atmosphere. It occupies conspicuous place in plant metabolism. All vital processes in plants are associated with protein of which nitrogen is an essential constituent. It is also present in many other compounds of greater physiological importance as chlorophyll, nucleotides, enzymes, hormones and vitamins [8]. Nitrogen increased vegetative growth and this resulted in higher yields in soybeans. If nitrogen is applied at appropriate levels and growth periods it may substantially improve the crop production [9].

In view of these studies, the principal objective to carryout the present study was to assess the morphochemical response of scurf pea to different concentrations of IAA, N and IAA+N in relation to growth, yield and ions accumulations.

MATERIALS AND METHODS

The experiment to evaluate the morphochemical response of scurf pea to different concentrations of IAA

Corresponding Author: Khalid Hussain, Department of Botany, University of Gujrat, Pakistan

and N was conducted at Qarshi Herb Garden, Hattar Dist. Haripur and University of Agriculture Faisalabad. Sowing of seeds was done in earthen pots. In each pot 12 seeds were sown at equal distances which were embedded in the soil about 1cm deep with the help of a wooden stick. Thinning was carried out after 10 days of germination and five plants were maintained in each pot for recording of data.

Different concentrations of IAA and N were applied thirty days after germination. IAA was applied as a foliar spray. N was given in the form of urea. There were following treatments of IAA and IAA+N.

T_0 = 0 (control)
T_1 = 50 ppm IAA
T_2 = 100 ppm IAA
T_3 = 150 ppm IAA
T_4 = N @ 40kg/ha
T_5 = 50 ppm IAA+ N @ 40 kg/ha
T_6 = 100 ppm IAA + N @ 40 kg/ha
T_7 = 150 ppm IAA + N @ 40 kg/ha

For Nitrogen there were also separate treatments.

N0 = (0 kg nitrogen)
N1 = (40 kg N/ha)

The design used for this study was Completely Randomized Design (CRD). The experiment comprised of ten treatments (including control) with six replications of each treatment.

Shoot and root lengths (cm) were measured with the help of a meter rod from stem base to the top. Shoot fresh weight (g) was calculated with an electrical balance.

Relative growth rate was determined using the following formula [10] (Shennan *et al*. 1987).

$$RGR = \frac{1}{W} X \quad \frac{\Delta W}{\Delta t} gg^{-1}day^{-1}$$

Where:

W = Dry weight of shoot of the initial harvest.
ΔW = Dry weight of shoot at final harvest- dry weight of shoot of the initial harvest
Δt = Number of days between initial harvest and the final harvest.

Total yield per plant was calculated by weighing of seeds of each replicate.

Plants were uprooted carefully and washed in distilled water at maturity. Plant samples were placed in oven at 75°C. After 4-days shoot and root dry weight (g/pot) was calculated with the help of electric balance at final harvest. Dried plant material was finely ground and digested with a nitric-perchloric mixture. In shoot plus leaves ion contents of N, P and K^+ were determined. Total nitrogen was estimated by Kjeldhal procedure [11] and K^+ was determined with a flame photometer. A graded series of standards (ranging from 10 to 100 mg/L) of K^+ were prepared and standard curve for K^+ was drawn. K+ contents were determined by emission spectrophotometry by determining optical density was read at 460nm as described by Jackson [12].

Statistical Analysis: Analysis of variance technique was employed for carrying out statistical analysis of data collected [13]. Various treatment means were compared with Duncan's New Multiple Range (DMR) Test.

RESULTS

The results obtained from morphochemical response of scurf pea to Indole acetic acid (IAA) and nitrogen has been discussed under.

Shoot Length (cm): Data regarding the shoot length in scurf pea as affected by different concentrations of IAA and nitrogen can be observed from Table 1. Analysis of variance showed highly significant effects for IAA and N. Comparison of treatment means with DMR among IAA treatments showed that maximum shoot length (76.7cm) in T_2 (100ppm IAA) differs significantly from control (Table 1). Applications of N significantly increased shoot length. IAA combination with N showed maximum shoot length in T_5 (50 ppm IAA+40 kg N/ha). It was noted that low concentrations of IAA and IAA+N showed higher shoot length as compared to higher concentrations (Table 2)

Root Length (cm): Analysis of variance showed highly significant differences among IAA treatments, nitrogen levels as well as N x IAA interactions (Table 1). A comparison among IAA treatments in scurf pea showed that maximum root length (14.7cm) in T_2 (100ppmIAA) differs significantly from T_0 (9.1cm), which was 62% higher than control (Table 1). A comparison between nitrogen levels showed that root length (12.1cm) was 33% higher in nitrogen treated plants as compared to untreated plants (Table 2). In scurf pea, maximum root length (14.4cm) was observed in T_5 while minimum was recorded in T_7 (11.5cm).

Table 1: Comparison of treatment means with DMR Test for morphochemical response of scurf pea to IAA

Treatments	Shoot length (cm)	1.Root length (cm)	Shoot fresh weight (g)	Shoot dry weight (g)	Relative growth rate (RGR)	Yield/ plant(g)	N contents (mg/g)	Pcontents (mg/g)	Kcontents (mg/g)
$_0$ (0 ppm IAA)	56.8c	9.1c	8.99c	3.78c	0.017c	3.03b	21.30c	1.11d	11.34c
T_1 (50 ppm IAA)	64.7b	11.9b	13.19b	9.29a	0.021bc	4.76a	22.45c	1.76c	12.49c
T_2 (100 ppm IAA)	76.7a	14.7a	18.45a	8.66a	0.028a	4.86a	27.31b	2.11b	17.35b
T_3 (150 ppm IAA)	61.7b	10.4bc	9.47c	5.40b	0.022b	5.14a	32.30a	2.96a	22.35a
LSD (5 %)	8.1	2.2	3.5	2.0	0.12	1.0	3.6	0.45	4.4

Table 2: Comparison of treatment means with DMR Test for morphochemical response of scurf pea to IAA and N

Treatments	Shoot length (cm)	1.Root length (cm)	Shoot fresh weight (g)	Shoot dry weight (g)	Relative growth rate (RGR)	Yield/ plant(g)	N contents (mg/g)	Pcontents (mg/g)	Kcontents (mg/g)
T_4 (40kg N/ha nitrogen)	66.1	12.1b	11.69c	5.91b	0.021b	4.17b	22.36b	2.45c	12.38b
T_5 (50 ppm IAA+40 kg N/ha)	80.7a	14.4a	17.24a	8.06a	0.027a	5.34a	26.31b	3.77b	16.33b
T_6 (100 ppm IAA+40 kg N/ha)	73.1b	13.2a	13.88b	8.91a	0.020c	4.52b	34.40a	4.25a	24.32a
T_7 (150 ppm IAA+40 kg N/ha	52.6d	11.5c	8.69d	4.12c	0.018d	3.21c	35.11a	4.11a	25.23a
LSD (5 %)	6.6	1.2	2.3	1.3	0.03	1.1	4.2	1.4	3.2

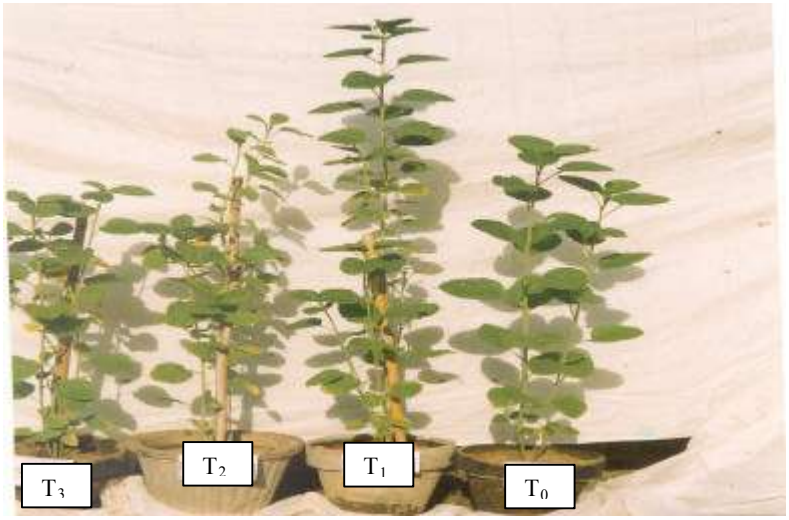

Fig. 1: Effect of different concentrations of Indole Acetic Acid (IAA), T_0(0ppm), T_1(50ppm), T_2(100ppm) and T_3(150ppm) on Scurf pea

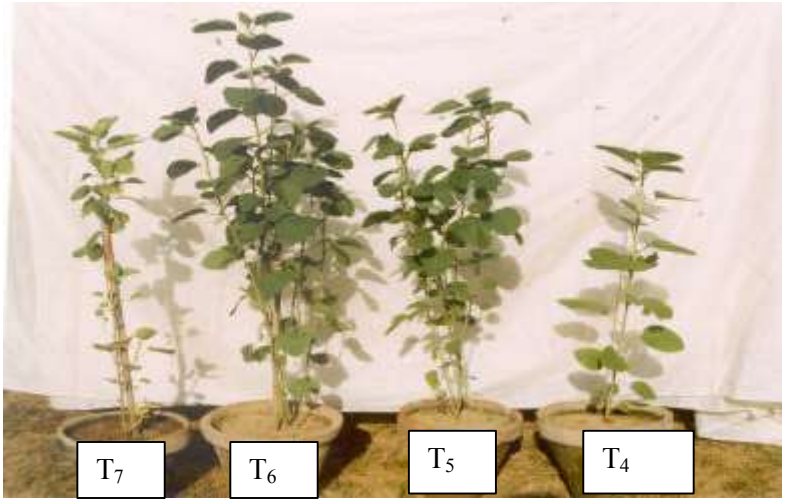

Fig. 2: Effect of nitrogen and IAA x N, T_4(40kg N/ha), T_5(50ppm+N), T_6(100ppm+N) and T_7(150ppm+N) on scurf pea

Shoot Fresh Weight (g): Data interpreted in table-1for shoot fresh weight of scurf pea showed the significant effect of different IAA concentrations, nitrogen levels and IAA x N interactions. A comparison among IAA means in scurf pea showed that the maximum shoot fresh weight (18.45g) was recorded in T_2 (100ppmIAA) which was 105% higher over control (Table-1). Nitrogen applications also significantly increased the shoot fresh weight over control (Table 2). A comparison among IAA x N interactions showed that shoot fresh weight decreased with increase in IAA concentration with nitrogen. In scurf pea maximum shoot fresh weight (17.24g) was present in T_5 and minimum in T_7 that was 8.69g (Table 2).

Shoot Dry Weight (g): Shoot dry weight of scurf pea significantly affected by IAA concentrations, nitrogen levels and IAA x N interactions as well (Table 1). Maximum shoot dry weight (9.29g) was observed in T_1 (50ppm) which was 146% higher over control (Table 1). Nitrogen applications also significantly increased the shoot dry weight in scurf pea 56%, in nitrogen treated plants as compared to untreated plants (Table 1). A comparison among IAA x N interactions revealed that maximum shoot dry weight was present at T_6 in both scurf pea which was 8.9g and lowest shoot dry weight in scurf pea was recorded at T_7 (Table 2). These results indicated that in scurf pea lower IAA concentrations and IAA+N increased the shoot dry weight as compared to high concentrations.

Relative Growth Rate (RGR): Relative growth rate of scurf pea was significantly affected by different IAA concentrations and nitrogen (Table 1). A comparison among IAA treatments showed that higher relative growth rate ($0.028 gg^{-1}day^{-1}$) in T_2 (100ppm IAA) differs significantly from T_0 ($0.0172 gg^{-1}day^{-1}$), which was 65% higher than control (Table-2). A comparison between nitrogen levels in scurf pea showed that RGR ($0.021 gg^{-1} day^{-1}$) was 24% higher in nitrogen treated plants as compared to untreated plants (Table-2). IAA x N interaction was highly significant in scurf pea. Higher relative growth rate ($0.027 gg^{-1}day^{-1}$) was observed in T_5 while minimum was calculated in T_7 (Table-2).

Yield per Plant (g): IAA concentrations, nitrogen treatments and IAA x N significantly affected the yield of scurf pea (Table 1). A comparison among IAA means showed that yield of plants increased with the increase in IAA concentrations. Maximum yield 5.14g was calculated in T_3 (150ppm IAA) in scurf pea. Minimum yield per plant was noted in control that was 3.03g (Table 2). In scurf pea 4.17g yield per plant was noted in nitrogen treated plants while in untreated plants it was 3.03g per plant. It was 38% higher yield than untreated plants (Table 2). IAA x N interactions showed that maximum yield per plant was 5.34g in T_5 while, minimum yield (3.21g) was calculated in T_7 (Table 2).

N Contents (mg/g): Effect of IAA concentrations, nitrogen treatments and IAA x N was significant on N contents in Scurf pea (Table 1). A comparison among IAA means in scurf pea showed that N contents increased with increase in IAA concentrations (Table 1). In scurf pea maximum N contents (32.30 mg/g) were calculated in T_3 (150ppm). In scurf pea upto 34.30 mg/g as N contents were noted as compared to untreated plants that was 22.36 mg/g. It was 33% higher yield than untreated plants (Table 2). IAA x N interactions showed that maximum N contents (35.11 mg/g) were present at T_7 while, minimum were calculated in T_4 (Table 2).

Phosphorus Concentration (mg/g): Data presented in Table-1 showed that IAA concentrations, nitrogen levels and IAA x N interactions had a significant effect on phosphorus concentrations in scurf pea. Maximum phosphorus concentration (2.96mg/g) was recorded in T_3 (Table 1). Nitrogen treatments increased the phosphorus concentration that was 3.87mg/g as compared to untreated plants (Table 2). A comparison among IAA x N interactions in scurf pea revealed that phosphorus concentration significantly increased at T_6 and T_7 (Table 2).

K^+ Concentrations (mg/g): Effect of IAA concentrations, nitrogen treatments and IAA x N was significant on K^+ concentrations in scurf pea (Table 1). A comparison among IAA means in scurf pea showed that K^+ concentrations increased with IAA concentrations. Maximum K^+ concentrations (22.35 mg/g) were calculated in T_3 (Table 2). Nitrogen also significantly increased the K^+ concentrations upto 24.32 mg/g as compared to untreated plants that was 12.38 mg/g. It was 32% higher yield than untreated plants (Table 2). IAA x N interactions shows that maximum K^+ concentrations (25.13mg/g) in at T_7 while, minimum were calculated in T_4 (Table 2).

DISCUSSIONS

It was noted from the above described results that Indole Acetic Acid (IAA) significantly increased all the growth parameters and yield characters in scurf pea. It may be due to the significance of IAA that is the only

naturally occurring major auxins type of growth regulators, which increases stem elongation, cell expansion and growth rate [14]. The increase in growth parameters are in accordance with those found by Jamro *et al*. [15] in soybean and in *Phaseolus vulgaris* by Kakkar and Rai [16].

Increase in growth attributes by IAA resulted in better yield per plant as compared to control. Theses results are in accordance with a number of studies as Reena *et al*.[17] and Khanzada *et al*.[18] in soybean. IAA and nitrogen treatments also affected the NPK concentrations. The increase in morphological parameters and NPK concentrations in both scurf pea by nitrogen treatment may be due to the fact that in the presence of nitrogen plants been able to complete vegetative growth in time and hence due to greater photosynthesis accumulation increased resulting increase in all morphological parameters and yield [19]. All these results are similar with earlier findings from different studies as in soybean [20] and in Chinese cabbage [21].

IAA + N interaction showed that low levels of IAA with nitrogen increased the growth and yield parameters in scurf pea rather than high concentrations of IAA with nitrogen. These results are similar with Wahab and AbdAlla [22] in soybean. This was may be due to the fact that increase in IAA concentrations reduces or inhibit the plant growth. Part of this inhibition has long been assumed to be caused by ethylene because high concentrations of auxins of all types stimulate many kinds of plant cells to produce ethylene. In most plant species ethylene retards elongation of both shoot and root [23]. Due to which yield of plants reduces. Elisson *et al*. [24] reported that high concentrations of IAA inhibit the elongation of attached roots of pea seedlings.

CONCLUSION

It was concluded that IAA and nitrogen was useful for the increase of growth and yield of scurf pea. High concentrations of IAA had adverse affect on plant growth, while low concentrations with nitrogen combination produced good yielding attributes.

REFERENCES

1. Chevallier, A., 1996. The Encyclopedia of Medicinal Plants. DK Publishers 95 Madison Avenue, New York 10016. pp: 237.
2. Bown, D., 1995. Encyclopedia of Herbs and Their Uses. Dorling Kindersley Publishing Inc., 95 Madison Avenue, New York 10016. pp: 336-337.
3. Baquar, S.R., 1989. Medicinal and Poisonous Plants of Pakistan. Printas Karachi. pp: 368.
4. Singh, K. and S. Rathore,1998. Seed and Protein Yield of Mung in Response to Treatment with Indole Acetic Acid (IAA). Plant Physiol., 32(2): 133-137.
5. Yang, T., D.M. Law and P.J. Davies, 1993. Magnitude and Kinetics of Stem Elongation Induced By Exogenous Indole-3-Acetic Acid in Intact Light-Grown Pea Seedlings. Plant Physiol., 102: 3 717-724.
6. Barbieri, P., C. Baggio, M. Bazzicalupo, E. Galli and G. Zanetti, 1991. Effect of IAA. Proceedings of the fifth International Symposium on nitrogen fixation with non legumes, Florence, Italy, 48: 161-168.
7. Sentelhas, P.C., J.R.G. Caetano and N.T. Teixeira, 1987. The Effect of Indole Acetic Acid (IAA) and Foliar Nitrogen on Wheat (*Triticum aestivum* L.). Ecosistema, 12: 123-128.
8. Asghar, A., M.A. Chaudhry, M.A. Malik, R. Ahmad and Saifullah, 2000. Effect of Various Doses of Nitrogen on the Growth and Yield of Two Wheat (*Triticum aestivum* L.) Cultivars. Pakistan J. Biologi. Sci., 3(6): 1004-1005.
9. Ruza, S. and I. Dominiece, 1995. Spring Wheat Yielding Capacity and Quality of Grains. Trans. Egtonian Agricuture, University Estanic., 182: 101-103.
10. Shennan, C., R. Unt and E.A.C. Macrobbie, 1987. Salt Tolerance in Aster Tripolium L. I. The Effect of Salinity on Growth. Plant Cell Environ., 10: 59-65.
11. Bremner, J. M., 1965. Total Nitrogen and Inorganic Forms of Nitrogen. In “methods of soil analysis.” Ed. C. A. Black. Vol.2. Soc. Agron. Madison. Wisconsin. 1149-1237.
12. Jackson, M.L., 1962. Soil chemical analysis. Constable and Co. Ltd., England.
13. Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics, With Special Reference to Biological Sci. McGraw Hill Book Co., Inc., New York.
14. Arif, M., P. Shah, F. Azam and R. Ahmad, 2001. Effect of Auxin on Different Wheat Varieties. Sarhad J. Agricul., 17(1): 33-40.
15. Jamro, G., H. Memon and K.A. Ibupata, 1990. Effect of Combined Nitrogen on Soybean. Sarhad J. Agricu., 6(2): 107-112.
16. Kakkar, P.K. and V.K. Rai, 1993. Interaction between Indole-3-Acetic Acid and Polyamines on Phaseolus vulgaris L. Pakistan J. Biological Sci., 62(4): 397-400.
17. Reena, T., R.D. Deotale, S. Sunita and C.N. Chore, 1998. Effect of Indole Acetic Acid (IAA) and Kinetin on Biochemical Aspect and Yield of Soybean. J. Soil and Crop., 8(2): 172-175.

18. Khanzada, Aminullah, M. Jamal, M.S. Baloch and K. Nawab, 2000. Effect of Indole Acetic Acid (IAA) on Yield and Yield Contributing Parameters of Soybean. Pakistan J. Biological Sci., 3(5): 856-857.
19. Ishtiaq, M. and Javedullah. 2001. Response of Chinese cabbage cultivars to different levels of N with constant doses of P and K under the agro-climatic conditions of Chilas (Diamer). Sarhad J. Agricul., 17(1): 81-85.
20. Grewal, H.S, J.S. Kolar and Singh, 1994. Effect of Potassium and Nitrogen on Growth and Yield of Soybean. J. Potassium Res., 10(2): 173-177.
21. Hill, I.R., 1991. Effect Of Plant Spacing and Nitrogenous Fertilizer on The Yield And Plant Conformation Of Chinese Cabbage. Australian J. Experimental Agricu., 30(3): 437-439.
22. Wahab, A.M. and M.H. AbdAlla, 1996. Effect of Different Rates of Nitrogen on Soybean. Fertilizer Res., 43: 37-41.
23. Salisbury, F.B. and C.W. Ross, 1992. Plant Physiology. Wadsworth Publishing Company Belmont, California. 4th ed. pp: 366.
24. Eliasson, L., G. Bertell and E. Bolander, 1998. Inhibitory Action of Auxin on Root Elongation not Mediated by Ethylene. Plant Physiol., 91: 310-314.