INTERACTION BETWEEN INDOLE-3-ACETIC ACID AND PHENOLIC COMPOUNDS ON RHIZOGENESIS IN *PHASEOLUS VULGARIS* HYPOCOTYL CUTTINGS

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ABSTRACT

Coumarin and α-naphthol enhanced, while hydroquinone, gallic-, salicylic-, cinnamic-, coumaric-, and chlorogenic acid at 10^{-5} M concentration inhibited rooting of hypocotyl cuttings of *Phaseolus vulgaris* L cv Kentucky wonder when applied individually. *p*-Coumaric acid and chlorogenic acid exhibited synergism with IAA (10^{-5} M) while others antagonized it, in causing rooting. However, *p*-coumaric acid, caffeic acid and chlorogenic acid significantly promoted total root length, over auxin alone treatments.

INTRODUCTION

PHENOLS are generally considered to be growth-inhibiting substances in plants[1,2]. Besides, they indirectly influence the auxin content. Synergistic effects of phenolic compounds and auxins in root initiation are known[3–5]. Some monophenols viz α-naphthol, salicylic acid and ferulic acid enhanced rooting of hypocotyl cuttings of *Impatiens balsamina* L[6]. The extent of synergism varies with the nature of phenol and is reported to decline in the sequence: mono-, di-, tri- and polyhydroxyphenols[7]. Keeping in view the above findings, it was of interest to study the effects of phenols alone and their interaction with indole-3-acetic acid on rooting of hypocotyl cuttings. The present paper describes the effects of mono-, di-, and polyphenols alone and with indole-3-acetic acid on rooting of hypocotyl cuttings of *Phaseolus vulgaris* L cv Kentucky wonder.

MATERIALS AND METHODS

Seeds of *P. vulgaris* L cv Kentucky wonder were procured from the Department of Agriculture, Himachal Pradesh. Seedlings were raised in petri-dishes at 25 ± 2°C under continuous illumination provided by three 20 watt flourescent tubes. Five-day old seedlings were excised below the cotyledons and cuttings (30 mm hypocotyl) were placed in glass vials containing 10 ml of appropriate solutions. Wherever necessary, the level of solutions was maintained by daily addition of distilled water or appropriate solution. During treatment, cuttings were maintained under the same conditions as used for raising seedlings, and hypocotyl length grew to ca 80 mm. Cuttings showed some epicotyl growth, but no clear-cut effect of treatments was observed. The number of roots and root primordia, length of rooting zone and total root length (mean root length × no. of roots) were recorded after 5 days of incubation. Rooting was confined to hypocotyl only. Ten cuttings were considered for each treatment. The experiment has been repeated twice and data analyzed using students *t* test.

RESULTS AND DISCUSSION

Phenolic compounds variably affected the rooting on hypocotylar cuttings of *P. vulgaris* (table 1). Coumarin and α-naphthol enhanced rooting, whereas hydroquinone, gallic-, salicylic-, cinnamic-, coumaric- and chlorogenic acid all at 10^{-5} M concentration inhibited the adventitious root formation. Other phenolics applied, however, had no significant effect on rooting. Interaction studies undertaken with IAA (10^{-5} M) and various phenolic compounds (table 2) reveal that different phenolic compounds affect the rooting of hypocotylar cuttings differentially. Some being synergists of IAA while others were antagonistic. *p*-Coumaric acid and chlorogenic acid proved to be IAA synergists, while others either showed antagonism or were without effect with IAA. Total root length, suggestive of overall root growth, was significantly altered by auxin phenolic interactions. 4-Hydroxybenzoic acid, vanillic acid and ferulic acid, when applied alone increased total root length but inhibited the same in the presence of IAA. While *p*-coumaric acid, caffeic acid and chlorogenic acid promoted total root

Table 1 *Effect of phenolics (10^{-5} M) on rhizogenesis of Phaseolus vulgaris L cv Kentucky wonder hypocotyl cuttings after 5 days*

Treatment	Total number of roots and root Primordia	Total root length mm	Length of the rooting zone mm
Control	19.4±3.2	117.6±9.9	12.8±0.9
Cinnamic acid	14.2±0.7**	98.0±2.6**	9.8±1.8**
Coumarin	24.6±4.7*	88.5±8.5**	10.2±2.5*
4-Hydroxybenzoic acid	19.2±1.1NS	164.6±2.4**	14.4±2.2NS
Vanillic acid	19.2±0.9NS	244.5±3.6**	15.6±1.5**
Salicylic acid	13.8±1.7**	122.5±6.6NS	10.8±2.0*
m-Hydroxybenzoic acid	21.4±2.2NS	202.6±7.2**	20.4±1.5**
Ferulic acid	22.0±1.2NS	229.7±5.7**	14.6±2.0*
p-Coumaric acid	16.6±1.2*	221.2±4.3**	5.2±0.7**
α-Naphthol	23.6±1.3**	98.4±6.3**	9.2±1.0**
Hydroquinone	13.7±1.7**	50.4±3.2**	3.8±0.7**
Caffeic acid	20.0±1.2NS	223.8±5.0**	16.0±1.1**
Gallic acid	15.0±1.2**	121.4±3.4NS	14.2±3.4NS
Chlorogenic acid	16.6±1.2*	328.4±6.4**	11.6±0.8*

* significant $P \leq 0.05$; ** $P \leq 0.01$; NS – not significant.

Table 2 *Effect of indole-3-acetic acid (10^{-5} M) and phenolic compounds (10^{-5} M) on rhizogenesis of Phaseolus vulgaris L cv Kentucky wonder hypocotyl cuttings after 5 days*

Treatment	Total number of roots and root Primordia	Total root length mm	Length of the rooting zone mm
Control	19.4±3.2**	117.6±9.9**	12.8±0.9**
IAA	30.2±3.0	394.4±8.3	22.0±2.7
IAA + Cinnamic acid	23.0±1.7**	233.1±8.7**	17.4±1.7**
+ Coumarin	24.4±2.8*	199.4±11.3**	20.0±4.1NS
+ 4-Hydroxybenzoic acid	21.4±1.4**	210.5±4.5**	22.0±2.7NS
+ Vanillic acid	23.4±0.8**	111.1±1.8**	16.4±1.6**
+ Salicylic acid	19.0±1.5**	145.3±4.1**	18.0±1.2**
+ *m*-Hydroxybenzoic acid	15.4±2.1**	161.4±8.0**	10.2±3.1**
+ Ferulic acid	19.2±3.6**	365.1±14.7**	21.0±2.4NS
+ *p*-Coumaric acid	44.8±3.0**	735.1±13.7**	27.4±3.5**
+ α-Naphthol	26.0±5.5**	181.7±15.3**	19.0±2.4**
+ Hydroquinone	20.0±1.6**	137.3±3.6**	16.0±2.7**
+ Caffeic acid	29.4±3.6NS	578.8±10.7**	24.4±1.3*
+ Gallic acid	16.8±1.9**	113.6±3.3**	13.6±3.4**
+ Chlorogenic acid	60.4±2.2**	1002.5±5.7**	32.4±2.6**

Significance in reference to IAA alone set.
* $P \leq 0.05$; ** $P \leq 0.01$; NS – not significant.

length, both alone and in combination with IAA. Phenolics in interaction with IAA also affected the length of rooting zone. Phenolic acids are known to influence the synthesis, degradation and the activity of IAA. Phenolic compounds can behave as IAA synergists during rhizogenesis when they stimulate tryptophan synthesis and retard peroxidase catalyzed degradation of IAA[8]. To what extent exogenous phenolic compounds regulate auxin levels within the tissues is not yet known. Chlorogenic acid can act as an IAA synergist because it slowly inhibits decomposition of IAA[9]. Increase in the length of rooting zone during phenol–auxin interaction might be linked to nutrient supply from the upper parts of the cuttings. *p*-Coumaric acid and chlorogenic acid act synergistically with IAA. Thus, auxin phenol com-

plex whose synthesis is regulated by polyphenol oxidase might be associated with enhanced root formation as also proposed earlier[10].

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ANNOUNCEMENTS

VII ALL INDIA SYMPOSIUM OF THE INDIAN SOCIETY OF DEVELOPMENTAL BIOLOGISTS

The VII All India Symposium of the Indian Society of Developmental Biologists is being jointly organized by the Society and the Industrial Toxicology Research Centre, Lucknow. The three day symposium to be held at the ITRC Campus, Lucknow in the first week of December 1986 will cover aspects of developmental Biology.

Interested persons are requested to contact Dr Suresh C. Goel, organizing Secretary, Department of Zoology, University of Poona, Poona 411 007.

INDIAN COUNCIL OF CHEMISTS
VIth Annual Conference

The VIth Annual Conference of the Indian Council of Chemists will be held at Madurai Kamaraj University, Madurai on 27th, 28th and 29th December, 1986.

The Principal objective of the Conference will be to provide a forum for wide ranging discussions and critical debate of recent experiement results and theoretical ideas in different fields of chemistry.

The scientific programme will include invited papers, oral presentations, poster sessions and penal discussions. The highlight of the programme will be two symposia on (1) Computer Augmented Instruction in Chemistry and (2) Role of Chemists in integrated rural development. There shall be special lectures by eminent scholars from all over the country.

Further particulars may be had from: Prof. P. V. Raman, Local Organising Secretary, Deptt. of Chemistry, Madurai Kamaraj University, Madurai 625 021 (Tamil Nadu).