Proc. Indian Acad. Sci. (Plant Sci.), Vol. 91, Number 3, June 1982, pp. 183-188.


# Interaction of kinetin with B group vitamins on the seedling growth of green gram (*Phaseolus radiatus* L.)

P GOPALA RAO and J KODANDARAMAIAH
Department of Botany, Sri Venkateswara University, Tirupati 517 502, India

MS received 17 November 1981 ; revised 13 May 1982

**Abstract.** Kinetin (50 and 100 mg $l^{-1}$) inhibited both the shoot and the root growth. Inhibition of root growth by kinetin is considered to be mainly due to inhibition of protein synthesis. Vitamins of the B group *viz.*, riboflavin, thiamin, niacin and pantothenic acid are found to be antagonistic to kinetin in reversing the inhibition of protein synthesis of the root. Vitamins, probably by acting as inducers of protein synthesis, antagonized the action of kinetin. The response of kinetin to shoot protein content is different from that of the root.

**Keywords.** Kinetin ; B-vitamins ; root protein ; green gram.

## 1. Introduction

Our knowledge of cytokinins and their possible functions in root growth is extremely limited. That cytokinins inhibit root growth was shown by Gaspar and Xhaufflaire (1967). But how they inhibit root growth was not categorically explained. Hussain *et al* (1980) working on nutsedge with vitamins of B group and kinetin have noticed that riboflavin and pyridoxin up to 100 mg $l^{-1}$ promoted root and shoot growth of the plantlets, whereas kinetin produced short, thick shoots and inhibited root growth, with increasing concentration.

The present study has been designed to understand the interaction of vitamins and cytokinins which might throw some light on the growth of root and shoot systems of intact seedlings. Only inhibitory concentrations (50 and 100 mg $l^{-1}$ ) of kinetin were used in order to find out the efficacy of vitamins to counteract the influence of kinetin. Earlier report by Gopala Rao *et al* (1975) indicated that riboflavin can effectively reverse the chloramphenicol inhibited growth of green gram seedlings. It is a well-known fact that chloramphenicol is a potent inhibitor of protein synthesis. Interaction of auxins and riboflavin in growth reactions in plants was studied by Artamonov (1974). The present study is intended to find out the capacity of vitamins to counteract the effect of kinetin in shoot or root growth inhibition.

## 2. Materials and Methods

Seeds of green gram (variety G.G 525) were surface sterilized with 0.1% mercuric chloride for 3 min, washed thoroughly with distilled water and allowed to grow

in petridishes. The seeds were subjected to presowing soaking for 24 hr with kinetin (50 and 100 mg $l^{-1}$) and vitamins of the B group *viz.*, riboflavin, thiamine, niacin and pantothenic acid, each at a concentration of 100 mg $l^{-1}$ since it was found to be effective in reversing the kinetin inhibited protein synthesis. Then the seeds were allowed to grow in distilled water in diffuse light in the laboratory up to 8 days. Growth in length of the seedlings was measured for shoot and root separately. Ten replications, each replications representing five seedlings were maintained for growth measurements. The protein content was estimated separately in the shoot and the root portions using the method of Lowry *et al* (1951) at 2 day intervals. Three replications were maintained for protein estimations.

## 3. Observations

### 3.1 *Extension growth*

With kinetin (50 and 100 mg $l^{-1}$) treatment both the root and shoot growth were inhibited (table 1). The results discussed pertain to 100 mg $l^{-1}$ concentration alone. On the eighth day, for example, the root growth of control seedlings was 8.0 cm while that of kinetin treated seedlings was 3.5 cm with 50 mg $l^{-1}$ and 1.03 cm with 100 mg $l^{-1}$ respectively. The shoot growth of control seedlings was 17.5 cm while that of kinetin treated seedlings was 16.1 cm with 50 and 0.8 cm with 100 mg $l^{-1}$ respectively (table 1).

**Table 1.** Effect of kinetin on growth (cm) and protein content (mg/g. dry wt.) of the seedlings.

| Treatment | Observation | Part of the seedling | Age of seedling | | | |
|---|---|---|---|---|---|---|
| | | | 2 days | 4 days | 6 days | 8 days |
| Control | Growth | Root | 2.55 ±0.05 | 6.46 ±0.91 | 760 ±0.66 | 8.00 ±0.65 |
| | | Shoot | 1.30 ±0.03 | 9.25 ±0.27 | 9.75 ±0.81 | 17.50 ±0.41 |
| | Protein | Root | 109.5 ±7.6 | 124.5 ±7.3 | 117.0 ±9.1 | 82.5 ±1.8 |
| | | Shoot | 124.5 ±1.9 | 172.5 ±3.8 | 127.0 ±1.8 | 90.0 ±2.6 |
| Kinetin (50 mg $l^{-1}$) | Growth | Root | 0.55 ±0.03 | 0.70 ±0.02 | 1.13 ±0.04 | 3.45 ±0.25 |
| | | Shoot | 0.63 ±0.03 | 2 53 ±0.07 | 2.63 ±0.03 | 16.15 ±0 29 |
| | Protein | Root | 153.0 ±1.63 | 96.5 ±1.51 | 90.0 ±0.87 | 70.5 ±0.88 |
| | | Shoot | 208.5 ±2.91 | 182.0 ±4.15 | 159.0 ±1.35 | 102.0 ±2.01 |
| Kinetin (100 mg $l^{-1}$) | Growth | Root | 0.43 ±0.06 | 0.6 ±0.08 | 0.8 ±0.09 | 1.03 ±0.04 |
| | | Shoot | 0.6 ±0.09 | 2.53 ±0.07 | 4 30 ±0.46 | 8.03 ±0.21 |
| | Protein | Root | 109.5 ±1.25 | 60.0 ±0.62 | 51.0 ±0.57 | 45.0 ±0.69 |
| | | Shoot | 187.5 ±3.56 | 185.5 ±2.25 | 163.5 ±1.79 | 79.5 ±1.27 |

### 3.2 *Protein content*

The root protein content was reduced with both concentrations of kinetin (50 and 100 mg $l^{-1}$). There was only an initial increase with 50 mg $l^{-1}$ kinetin on the second day of seedling growth. On the eighth day, for example, the root protein content of control seedlings was 82.5 mg while that of kinetin treated seedlings was 70.5 mg with 50 mg $l^{-1}$ and 45.0 mg with 100 mg $l^{-1}$ respectively (table 1).

It is tempting to note that the shoot protein content was enhanced with kinetin (100 mg $l^{-1}$) except on the eighth day (table 1).

### 3.3 *Interaction of kinetin (100 mg $l^{-1}$) with vitamins on protein content*

There was about 50% reduction in root protein content with kinetin treatment when compared to that of control seedlings (from 80 mg to 40 mg) on the eighth day. Although there was an initial raise with riboflavin treatment up to fourth day, it was followed by a steep fall during later stages. The interaction of kinetin with riboflavin enhanced protein content of the root from 40 mg to about 140 mg on the eighth day (250%) or a 3 fold increase. Thiamine, niacin and pantothenic acid could raise the protein level from 40 mg to 80 mg not exceeding the control level when they interacted with kinetin (figure 2).

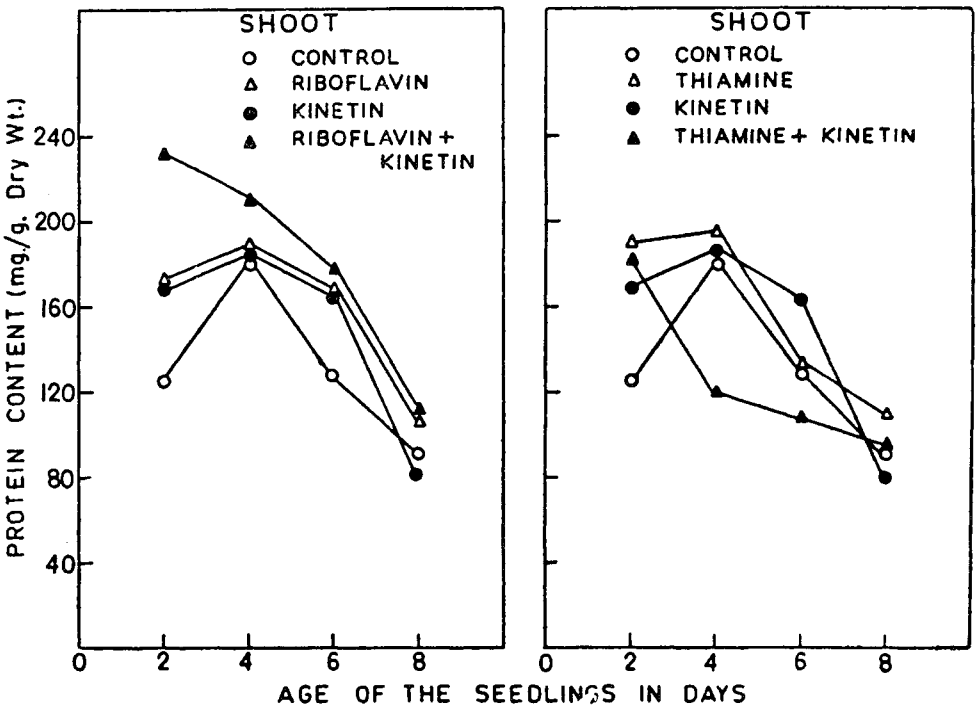


Figure 1A.

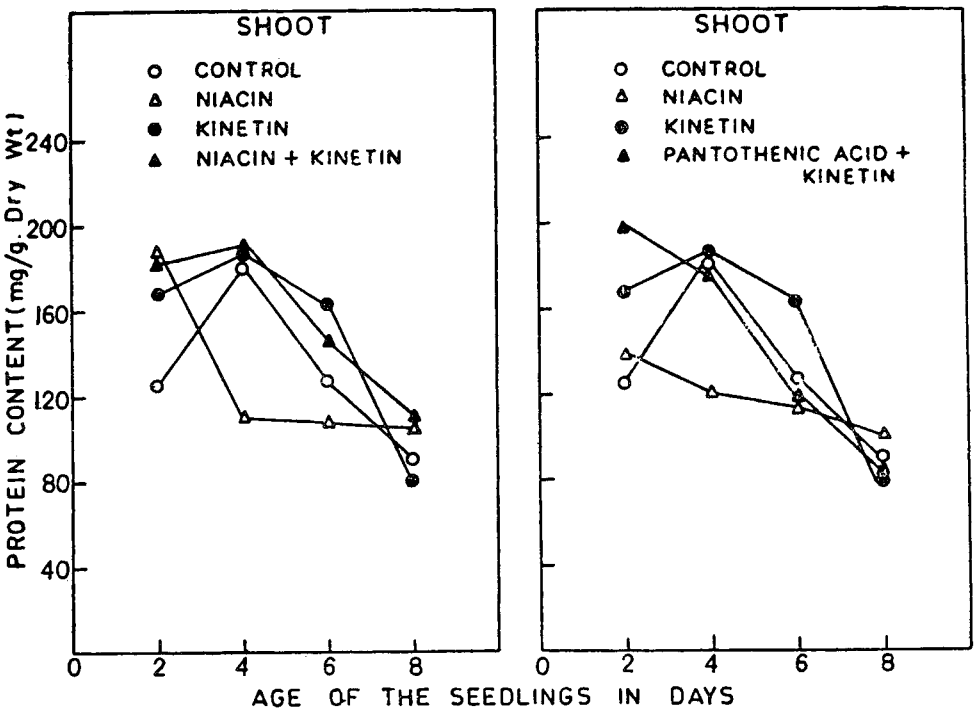


**Figure 1B.**

In the case of shoot, riboflavin (figure 1A) increased the protein content from a value of 124.5 mg to 172.5 mg (38%) on the second day and from a value of 90 mg to 105 mg (16%) on the eighth day. Thiamine also increased the protein content of the shoot. Niacin and pantothenic acid (figure 1B) could not increase the protein as effectively as the former two vitamins except on the second day. As opposed to the response of the root, shoot protein content was not reduced by kinetin, but instead, increased up to the sixth day at least. The interaction of riboflavin with kinetin caused a significant increase in protein content of the shoot. Thiamine interaction with kinetin caused an initial increase only, followed by a gradual reduction. Interaction of pantothenic acid with kinetin was quite similar to that of thiamine. Interaction of niacin with kinetin was almost similar to that of riboflavin in that it caused an additive effect in increasing the protein content of the shoot (figure 1B). The behaviour of riboflavin and niacin on the one hand and that of thiamine and pantothenic acid on the other hand were found to be similar in their interaction with kinetin.

## 4. Discussion

Kinetin at 50 and 100 mg $l^{-1}$ is inhibitory to both the shoot and the root growth. One of the main causes of root growth inhibition (table 1) by kinetin is the reduction in protein content. Since all the B vitamins used in the present study were able to effectively reverse the inhibition of protein synthesis by kinetin, it might be

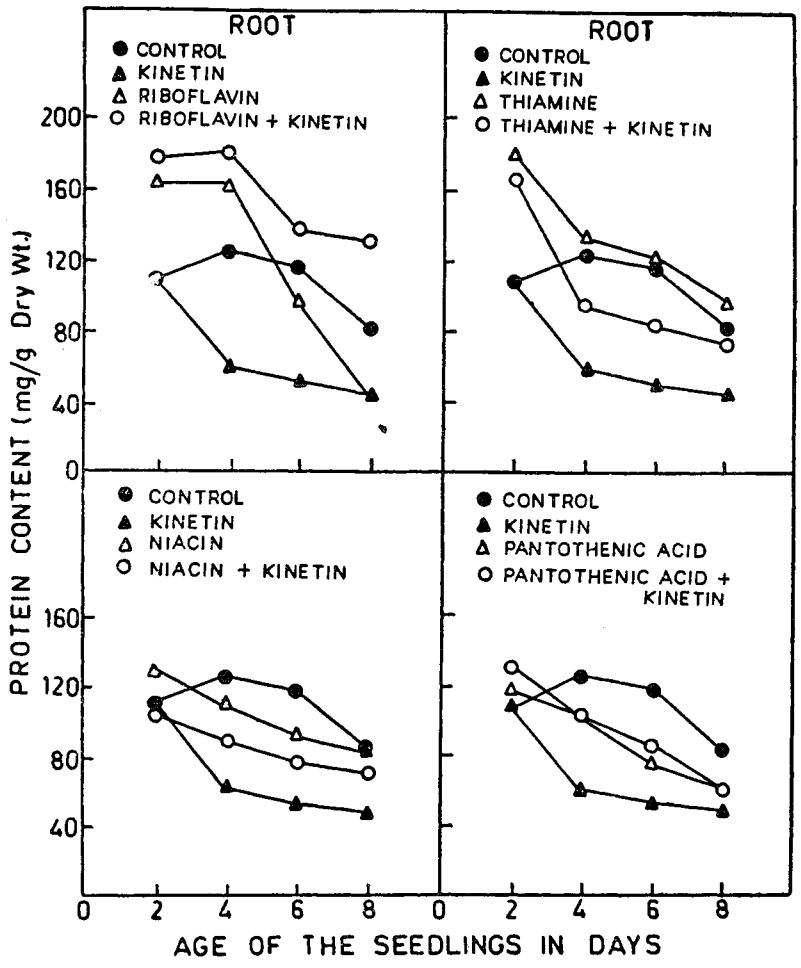


**Figure 2.**

assumed that vitamins increase protein synthesis by operating either at transcription or translation level. This assumption can be corroborated by the observation made by Srivastava (1967) that cytokinins can also inhibit RNA synthesis. A consequence of the inhibition of RNA synthesis is inhibition of protein synthesis. Gopala Rao *et al* (1975) earlier reported enhanced protein synthesis by B vitamins in green gram. It is a well-known fact that chloramphenicol is an effective inhibitor of protein synthesis. Gopala Rao *et al* (1976) observed that riboflavin can effectively reverse the chloramphenicol inhibited growth of green gram. Basing on these observations it can be assumed that a probable site of action of vitamins of the B group could be at transcription or translation level.

The present study also reveals that the response of kinetin to root protein might be different from that of shoot protein since the root protein content was significantly reduced and that of the shoot was significantly enhanced. The present study forms the basis for future work on the role of vitamins at molecular level.

**Acknowledgements**

The authors are grateful to Prof. V S Rama Das for his encouragement and suggestions. One of the authors (JK) is highly thankful to the UGC for providing financial assistance.

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