EFFECTS OF ABT-4 ON SEED GERMINATION, SEEDLING GROWTH AND ROOT DEVELOPMENT OF JUTE PLANT (*CORCHORUS OLITORIUS* L.JRO 632)

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ABSTRACT

Effect of ABT-4, a unique plant growth regulator developed in China, on seed germination, seedling growth and root development were studied on jute plant (*Corchorus olitorius* JRO 532). ABT-4 in very low concentration (2-4 ppm) stimulated radicle elongation whereas in higher concentrations strongly inhibited it. Hypocotyl length was slightly increased by the treatment. There was no significant effect on seed germination. Root length and the number of secondary roots were increased up to the flowering stage of the plant and there after, there was no significant effect.

INTRODUCTION

ABT-4 (Auxin Bequeathed with a Third component) is a series of plant growth regulators developed by Prof. Wang Tao, The Chinese Academy of Forestry, Beijing, China. It is available in a series including from No. 1 to No. 5 with broad spectrum effects on various crop plants (Tao, 1992). The differences among the members of this series lie in the third component whose chemical composition together with the type of auxin contained in it is not disclosed yet ABT-4 is a type particularly more effective as a growth promoter in fibre crops (Liang, 1992; 1993), although it has been reported to effect seedling growth, chlorophyll and certain amino-acid contents of buckwheat as well (Prasad and Paudel, 1996).

Jute is one of the important cash crops of Eastern Nepal. In recent years production of jute fibres in the region has been declined and now a part of the domestic needs of the country, particularly the raw materials' demand of the jute factories, is being fulfilled by importing the fibres from India (Anonymous, 1997). In this context an increase in production and productivity of the crop is highly desired. Our work on jute with the application of ABT-4 has shown a positive effect of this growth regulator and different growth parameters as well as on its production in terms of the quantity of fibre produced (Rai & Dhakal, 1999). In an attempt to find out the primary effect of ABT-4 on growth enhancement, present paper deals with the effects of this growth regulator on seed germination behaviour, seedling growth and the development of roots on this plant.

MATERIALS AND METHODS

Breeders seeds of jute (*Corchorus olitorius* L JRO 632) were obtained from the erstwhile Jute Development and Trade Corporation (JDTC), Itahari (now under National Agricultural Research Council, Sunsari Branch, Tarahara), Nepal and ABD-4 from Dr. K.K. Joshi, the Vice-President of the International Organisation of ABT.

Treatment with ABT-4: The seeds were surface sterilized by washing in 70% alcohol for about 2 minutes and thoroughly washed with sterile distilled water. Then the seeds were presoaked for 2, 4 and 6 hours in different concentrations of the growth regulator. Two sets of independent experiments were conducted for the lower (0, 2, 4, 6 and 8 ppm) and higher (10, 20 and 30 ppm) concentration ranges of the hormone. The seeds were germinated on moistened filter papers in petriplates placed in a germinator at 28-2° C. 50 seeds were placed in each petriplate and there were three replicates for each treatment. Measurements were made after 48 hours of germination by taking ten plants selected randomly from each petriplate. As the ABT solutions were prepared in 50% ethanol, the control (0 ppm) also contained the same amount of the alcohol.

Cultivation and root development: For the study of root development seeds were presoaked in the treatment solutions for 4 hours and following Randomized Block Design (RDB), sown in the field inside the compound of the Science Building of the Post Graduate Campus, Biratnagar. Preparation of the land and methods of cultivation were the same as described earlier (Rai & Dhakal, 1999; Rai, 1995). For the measurement of root length and number of secondary roots 10 plants were selected randomly and uprooted taking care not to damage the roots. Measurements were made on 30th, 60th and 90th days of sowing.

RESULTS

There was no effect of ABT-4 on seed germination of the plant, as almost all the seeds germinated after 12 h of incubation at 28° C. (data not shown). In higher concentration of the growth regulator (10-30 ppm) radicle growth was highly inhibited whereas there was slight stimulation in growth of the hypocotyl. There was no significant effect of presoaking on radicle length, although a slight increase was observed on the length of the hypocotyl (Fig. - 1 and 2). In lower concentrations, ABT-4 increased the length of both the radicle and hypocotyl, maximum response being seen in 2-4 ppm concentrations (Fig. - 3).

Effect of ABT-4 on root length in field grown plants are presented in table 1 and 2. In higher concentrations (10-30 ppm) ABT-4 showed no effect on root development whereas significant increase in root length was observed in earlier developmental stages (up 60 days of sowing) in lower concentrations (2-8 ppm) of the growth regulator. Similarly number of secondary roots was greatly increased in lower concentration range (Table - 3), but there was no significant effect in higher concentrations (Table - 4).

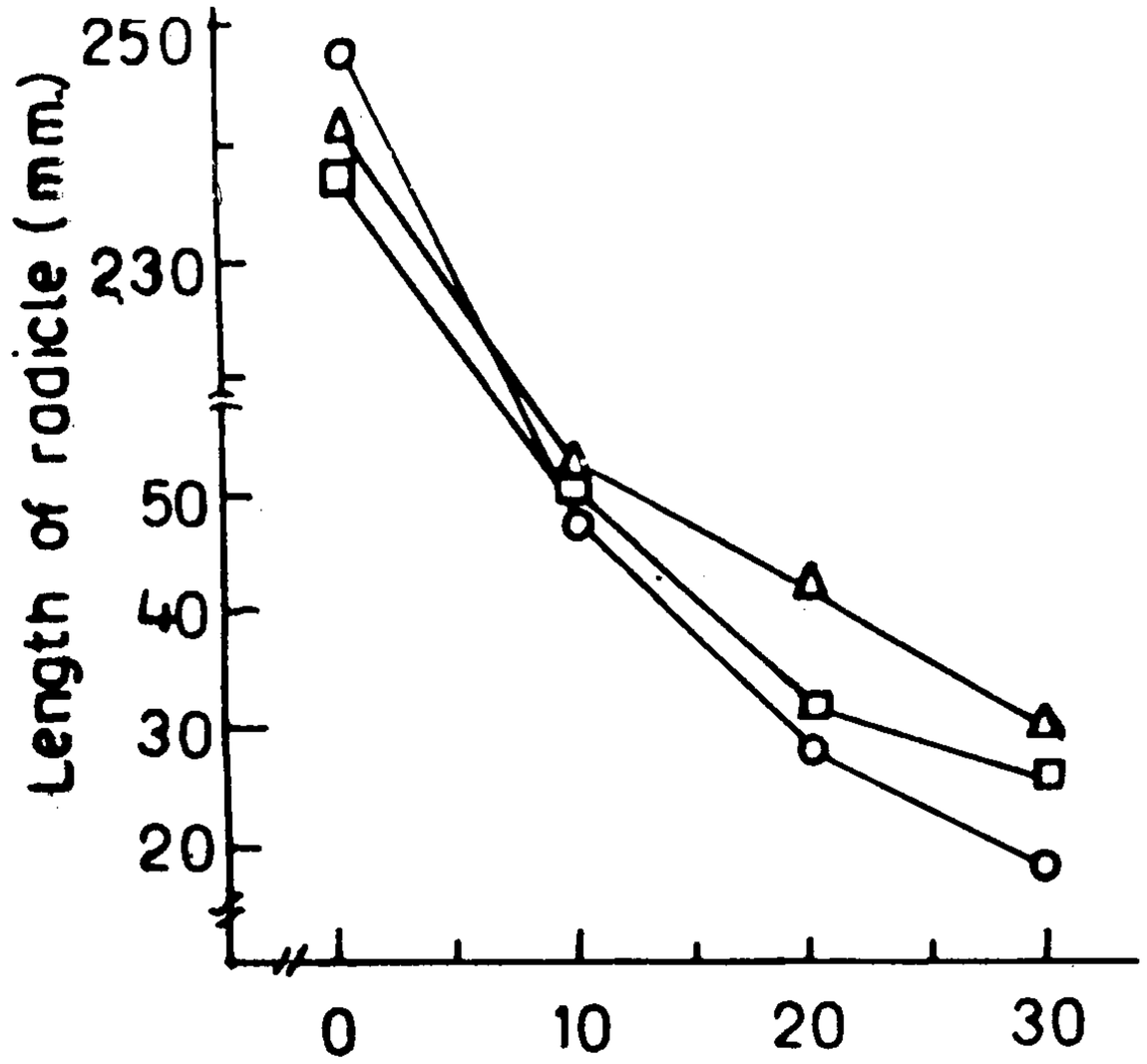

Figure - 1: Concentrations of ABT - 4

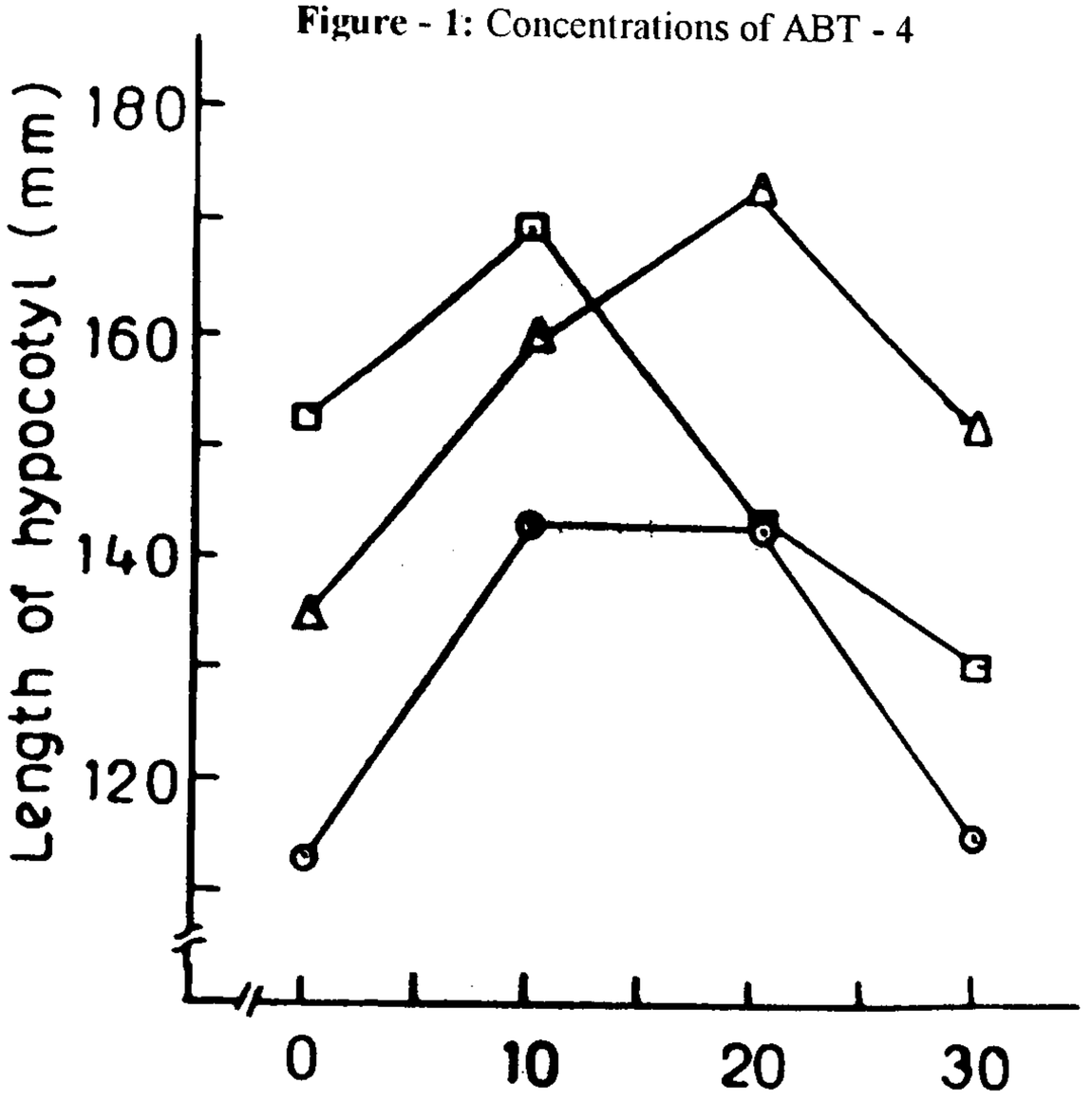

Figure - 2: Concentrations of ABT - 4

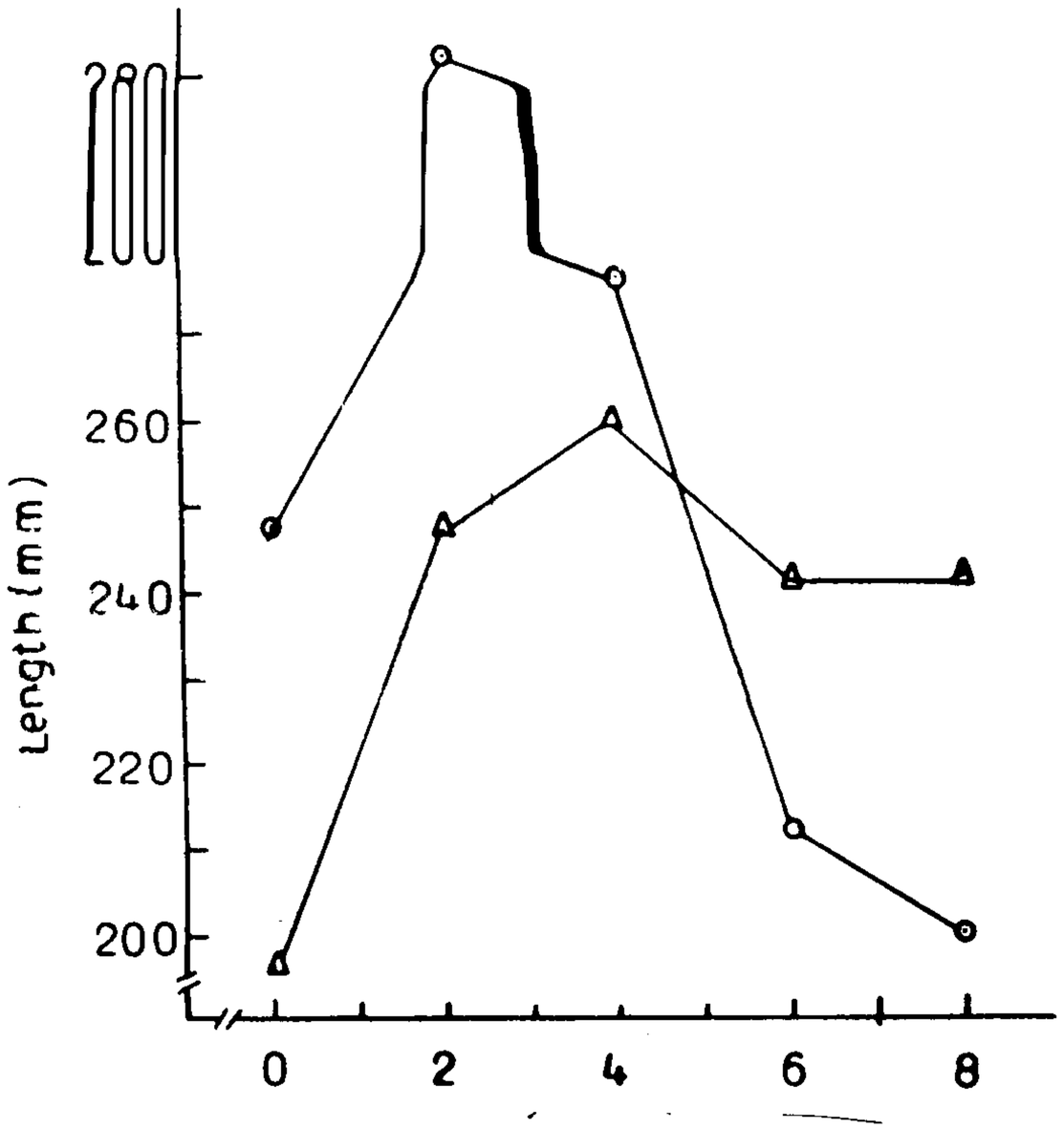

Figure - 2: Concentrations of ABT - 4

LEGENDS TO THE FIGURES

Figure - 1: Effect of presoaking and ABT-4 treatment on the growth of the radicle.

Prosoaking: 0 = 2h; Δ = 4h; □ = 6h. Measurements were done after 48 hours of sowing. ±SD do not exceed 8% of the mean.

Figure - 2: Effects of ABT-4 and presoaking treatments on the growth of the hypocotyl.

Symbols as in Fig. - 1. ±SD do not exceed 10% of the mean.

Figure - 3: Effects of ABT-4 on the growth of the seedling in lower concentration range, Seeds were presoaked in treatment solutions for 4 hours. O = radicle and =Δ hypocotyl. ±SD do not exceed 5% of the mean.

Table 1: Effect of ABT-4 on root length (in cm) of the field grown plants

Concentration of ABT-4 (ppm)	0	2	4	6	8
30 days	06.90±0.96	08.70±1.00	08.40±1.08	08.70±0.40	08.00±0.37
60 days	12.00±0.60	13.60±1.80	15.00±0.80	14.40±0.70	15.30±2.70
90 days	14.99±0.63	14.82±1.47	14.68±1.49	14.73±1.05	15.91±0.63

Table 2: Effect of ABT-4 on root length (in cm) in higher concentration range in field grown plants.

Concentration of ABT-4 (ppm)	0	10	20	30
30 days	07.66±1.88	07.85±0.59	07.17±0.98	07.52±1.48
60 days	15.10±1.30	16.80±2.30	15.50±0.70	16.60±1.30
90 days	16.83±0.45	17.10±0.91	17.91±1.78	16.70±0.84

Table 3: Effect of ABT-4 on number of secondary roots in lower concentration range.

Concentration of ABT-4 (ppm)	0	2	4	6	8
30 days	34.20±5.30	48.18.±14.79	44.63±3.04	38.70±5.07	46.68±9.00
60 days	64.20±8.5	75.00±7.90	78.20±6.00	78.60±7.20	80.30±5.60
90 days	90.60±14.62	102.7±7.55	100.68±12.46	104.48±8.57	111.18±10.80

Table 4: Effect of ABT-4 on number of secondary roots in higher concentration range..

Concentration of ABT-4 (ppm)	0	10	20	30
30 days	40.03±7.05	43.65±14..51	43.18±17..86	39.88±12.45
60 days	85.02±12.00	75.90±12.00	90.80±6.40	95.30±12.00
90 days	146.78±19.23	147.93±21.00	131.33±28.41	138.20±11.43

DISCUSSION

Recent reports in the newspapers (Anonymous, 1999) indicate a declining tendency in the cultivation of jute crop in Nepal. However, there is a great need to increase the production of jute in the country particularly for two reasons, a) to fulfill the demand of existing jute factories and thus reduce the import of raw jute fibres from India, and b) to substitute for the environmentally hazardous plastic bags. It has been reported that application of ABT-4 increased the growth and productivity of the jute plant (Rai & Dhakal, 1999). ABT is basically a complex non-poisonous growth regulator highly effective in plants. The purpose of the present work was to find out the basic reason behind the enhancement of jute production by ABT-4. Our result showed that there was no effect of ABT-4 treatment on seed germination of the plant. Jute seeds presoaked for 2 hours or more, if of good quality, easily germinate within 12 hours of sowing in petriplates at 27 ± 2° C and within 48 hours in field depending upon the moisture contents of the soil.

However, Liang (1993) observed increase in germination rate of cotton seeds presoaked in 10 ppm ABT-4 solutions for 4 hours. Emergence of wheat seedling became 1 to 2 days earlier and rate of germination was also found to be increased by the treatment with ABT-4 (Quan & Henglu, 1993). It is an established fact that hormonal effect on seeds germination depends not only on the nature and

concentration of the bormone but also on the plant species (Leopold and Kridemen, 1975).

Higher concentrations at ABT-4 (6 ppm and above) always reduced radical elongation of jute seedlings, whereas slight stimulation was observed in lower concentrations. There was slight stimulation of hypocotyl growth except in very high concentration (30 ppm) of the growth regulator. These results showed auxin like nature of ABT-4 in root and shoot elongation. ABT not only supply exogenous growth substances but also promotes the synthesis of endogenous growth substances in plants (Liang, 1992). ABT has also been reported to promote the synthesis of auxin and gibberellin inside the sprouting seed (Tai, 1992). ABT has been used for seedling culture by cutting in various fruit trees, vegetables, flowers, medicinal plants and other economically important plants (Tao, 1992). Treatment of rape seeds with yield enhancer ABT-4 increased their germination rate, improved rooting and growth rate of their seedling (Hongchang, 1992).

In field grown jute plants ABT-4 nearly always increased the root length. In these plants inhibitory effect of ABT-4 on radical growth was somehow compensated with the age of the plant probably by enhanced physiological activities of the sprouting about. The increase in root length was different in different age of the plant. The treatment of ABT-4 was effective up to the flowering stage (60 d of sowing). Measurement on the third month of sowing showed no significant effect on root length. Our experiment on jute showed that the number of secondary roots on the first, second and third months were increased by 21.12%, 27.04% and 35.34% respectively, which agrees with the effects of ABT-4 on number of secondary roots in cotton plants obtained in experiments by various scientists (Liang, 1992; 1993; Tao, 1992).

The treatment of seeds on 25 ppm ABT solution showed that the root system vigor of seedling of *Biota* and *Pinus* were increased by 27.95% and 15.09% respectively (Chongming and Aiquin, 1993). In wheat also ABT treatment increased the number of roots, weight of roots, length of roots and volume of roots. The number of secondary roots in wheat increased by 2.41-2.51% (Liang et al., 1992). Due to the treatment the root system increased in legnth and in number, which enhanced the absorption of water and nutrient and in turn increased the plant fresh weight resulting to the formation of strong seedling (Quan & Henglu, 1993). The experiments performed in Chinese Academy of Agricultural Science indicated that the treatment with ABT accelerated not only the growth and development of root system of plants but also enhanced the root system vigor. Treatment of 30 ppm ABT solution significantly increased the root system vigor of spring wheat in jointing stage by 85.45% (Chongming & Aiquin, 1993). In rape seed ABT treatment increased the length of main root and number of lateral roots at first flowering stage by 1.12 and 72.44% respectively (Hongchnag, 1992).

Earlier experiments on different plants and our results in jute showed that primary effect of the ABT is to promote growth and development of root system, which ultimately results in better development of the shoot system and enhanced productivity. ABT also enhances photosynthesis and enzyme activities in plants (Chong Ming & Aiquin, 1993). It can be said that promotive effect of ABT-4 observed in the development and productivity of jute (Rai & Dhakal, 1999) Is basically due to its promotive effect in the growth and development of the root system. Success of ABT-4 application in increasing productivity of different agricultural crops in China has already attracted the attention of other countries. Application of ABT-4 can be recommended to increase jute production in our country as well.

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