Effect of certain plant growth regulators on the seedling survival, biomass production and proline content of *Bambusa arundinacea*

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ABSTRACT

A study was carried out to investigate the effect of plant growth regulators (PGR) on certain morphological and biochemical parameters of *Bambusa arundinacea*. The hormones (IAA, IBA and 2-4-D) were applied individually in 10µM and 100µM concentrations. All the hormones in both the concentrations enhanced the seedling survival percentage, seedling biomass production but the proline content decreased markedly. 100µM concentrations were proved beneficial for the biomass production while as 10µM concentration were proved more beneficial for seedling survival. Results of this study may serve as useful information in the production and improvement of this species.

Key words: plant growth regulators, seedling survival, biomass, proline, *Bambusa arundinaceae*.

INTRODUCTION

Plant growth regulators are the chemical which enhance the plant growth when applied in very minute quantity (Naeem *et al*. 2004). Many investigations showed that pre- sowing treatment of growth regulators could lead to increase in tissue hydration, redistribution of nutrient reserves, higher respiratory activities and enhancement of seedling growth, dry matter production, early flowering and yield. (Abraham and Atanga 1981, Onyebunchi 1981, Chippa and Lal 1988, Shen *et al*. 1988).

IAA exerts influence on plant growth by enlarging leaves and increasing photosynthetic activities in plants (Naeem *et al*. 2004). IAA also activates the translocation of carbohydrates during their synthesis (Awan *et al*. 1999; Ritenour *et al*. 1996). It has been observed that IAA in combination with Kinetin caused a decrease in length and number of internodes, expansion of main stem diameter and increases the number and area of leaves (Naeem *et al*. 2004). Pilot and Saugy (1985) reported that the application of IAA decreases the length of shoot. Auxin is known to affect GA_3 biosynthesis and deactivation in several plants including pea, tobacco and barley (van Huizen *et al*. 1995, 1997, Ross 1988, O'Neill and Ross 2002, Wolbang *et al*. 2001).

Several reports on regulatory effects of growth regulators on plant growth and development show that some of them can be used to enhance crop yield (Audus 1972, Bhardwaj and Dau 1974, Tiliberg 1977). Bamboos are the most diverse group of plants in the family poaceae. They are distinguished by having woody culms and lateral branching, a complex and generally robust rhizome system and infrequent flowering. It has a cosmopolitan distribution, reaching an elevation of 4000 in the Himalayas and parts of China (Anonymous 1978). The world largest bamboo reserves exist in India with 29 genera spread over 100 species (Gaur 1987). Of these, only about 10 species have so far been commercially exploited. Cultivation of bamboo in India is still at infancy stage. Almost 99% of natural bamboo production in the country comes from the natural stands in the forest and only 1% is derived from plantations (Agnihotri and Nandi 2009).

One of the most important contributions of bamboo to the modern society is in the production of paper. Its use as a long fiber containing raw material in the pulp and paper industry is well known. Apart from industrial use, bamboos are utilized in the making of mat boards, roofing, furniture, agricultural implements, baskets, for construction, and for numerous traditional uses (Rao *et al*. 1990)

MATERIALS AND METHODS

An experiment was conducted under laboratory conditions (humidity 72 ± 5 and temperature 30 ± 2˚C) in Agra between November July 2009. Seedling survival ware observed during the seedling growth period, the seedlings were daily observed and the number of dead seedlings were counted and discarded from the Petri plates (Agnihotri 2002)

In order to determine the fresh weight and dry weight (Biomass) of seedlings, 30 days old seedlings (root and shoot tissue) were taken out from the Petri plates, washed with running tape water. Then these seedlings were dried between the blotting papers and weighed and after that these were dried at 70˚C in oven for 3 days and weighed until the constant values were observed (Cicerali 2004). For the determination of praline concentration the sample were extracted and quantified in calorimeter at 520 nm as described by Bates *et al.* (1973).

RESULTS AND DISCUSSION

Seedling survival was recorded daily up to 30 days from the start of experiment. Application of the plant growth regulators greatly increased the seedling survival percentage. Seedling survival percentage was increased 50, 42 and 38% by 10µM IAA, IBA and 2,4-D respectively and 46, 42 and 38% by 100µM IAA, IBA and 2, 4-D respectively (fig.1.1).

Application of plant growth regulators in minute quantities enhanced the biomass production of *Bambusa arundinacea* expressed as fresh and dry weight. 10µM concentration 0f IAA were observed most effective in enhancing the biomass production. Fresh weight was increased 56, 36 and 27% by 10µM IAA, IBA and 2,4-D respectively. And 48, 69 and 37% by 100µM IAA, IBA and 2,4-D respectively (fig.1.2) Similarly dry weight was increased 56, 35 and 26% by 10µM IAA, IBA and 2,4-D respectively. And 47, 40 and 37% by 100µM IAA, IBA and 2,4-D respectively (fig.2-b). Application of plant growth regulators decreased the proline content of the studied species. Proline content decreased over the control by 27, 04, and 21% by 10µM IAA, IBA and 2,4-D respectively. And 35, 76 and 21% by 100µM IAA, IBA and 2,4-D respectively (fig.1.3).

Table 1 : Effect of various plant growth regulators on seedling survival, biomass and proline content

Hormones	Concentration	Seedling survival	Fresh weight (g/plant)	Dry weight (g/plant)	Proline content (mg g^1 FW)
Control	-	40%	1.06 ± 0.43	0.64 ± 0.26	0.23 ± 0.01
IAA	10 µM	80%	2.46 ± 0.14	1.74 ± 0.09	0.18 ± 0.02
	100 µM	75%	2.06 ± 0.07	1.23 ± 0.08	0.17 ± 0.04
IBA	10 µM	70%	1.66 ± 0.16	0.99 ± 0.09	0.22 ± 0.09
	100 µM	70%	1.80 ± 0.12	1.08 ± 0.08	0.13 ± 0.02
2-4-D	10 µM	65%	1.46 ± 0.15	0.87 ± 0.09	0.19 ± 0.03
	100 µM	65%	1.70 ± 0.17	1.02 ± 0.09	0.19 ± 0.07

Data Represent average percentage values of 3 replicates having 15 seedling in each.
Values represent mean ± standard error.

Fig. 1.1: Effect of plant growth regulators on seedling survival of *Bambusa arundinaceae*

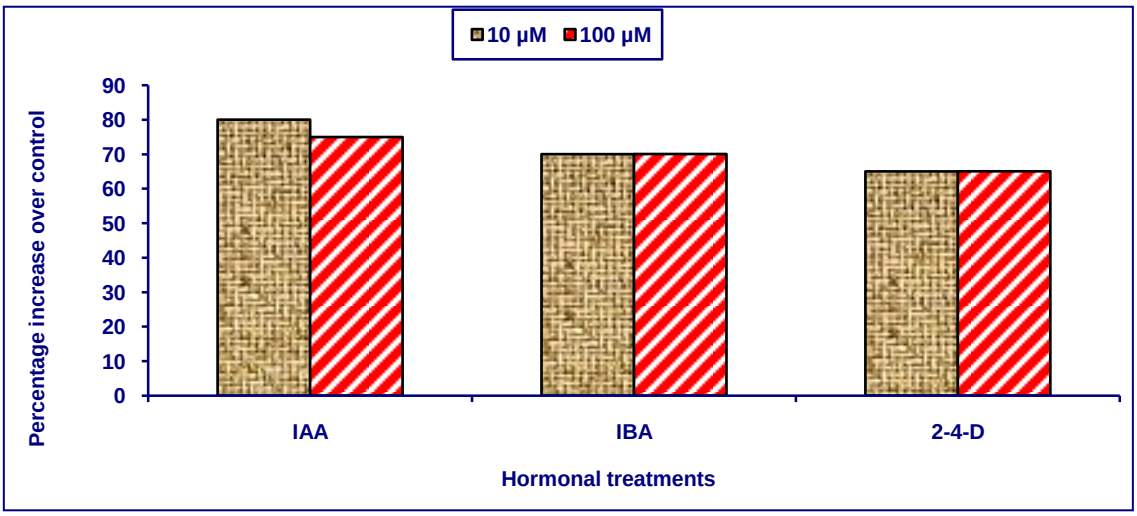
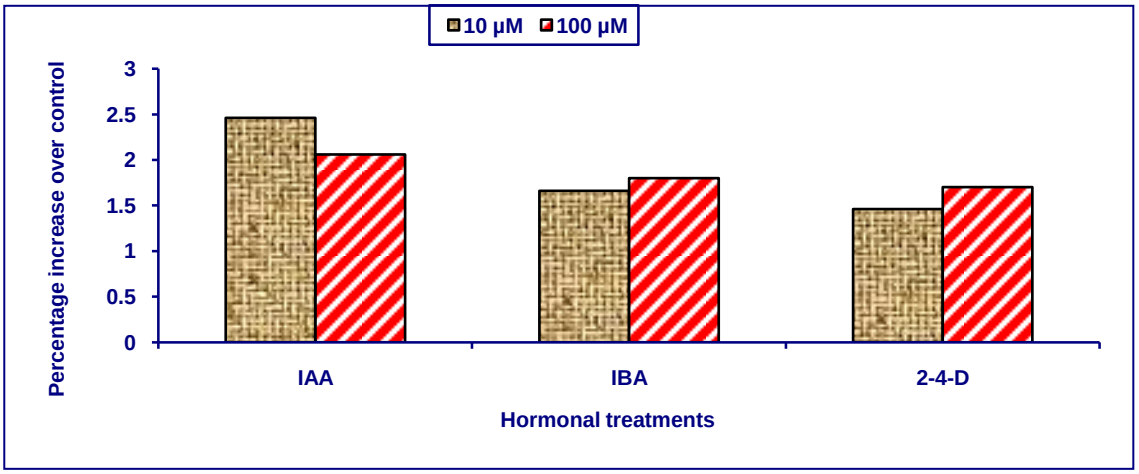
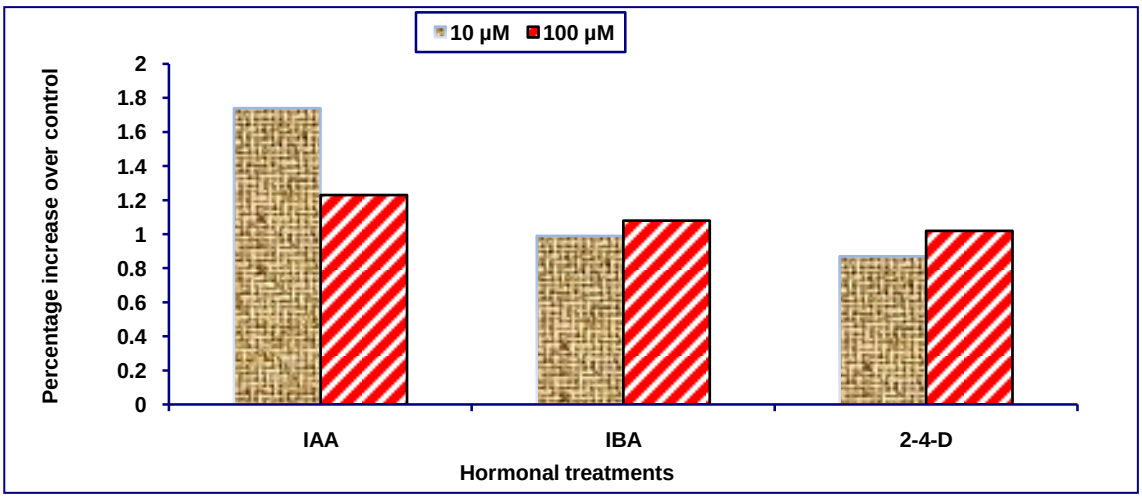


Fig. 1.2 : Effect of plant growth regulators on biomass production of *Bambusa arundinaceae*.

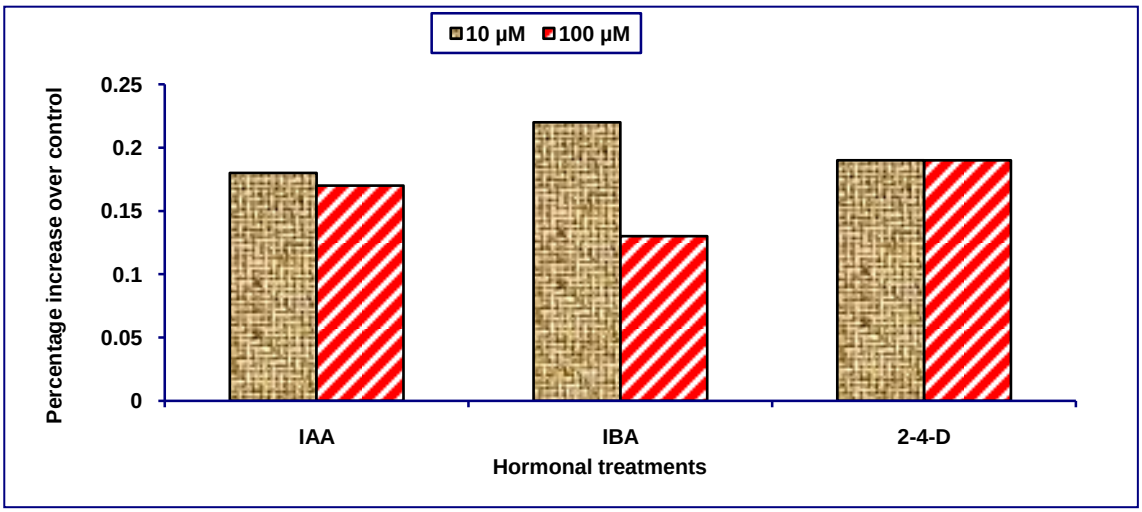


1.2 (A) Fresh weight



1.2 (B) Dry weight

Fig.1.3: Effect of plant growth regulators on proline content in *Bambusa arundinaceae*.



Bamboo is often advocated as an ideal renewable resource for biomass, useful for wood and paper industry. Positive arguments thus also include ecological arguments, indeed in the future forest and agriculture, water conservation and carbon cycle will become very important criteria (Gielis *et al.* 2002). However, the classical economic criteria will remain very important. Moreover, if bamboo is to be used as a source of biomass, it will have to compete with other plants, not to speak about competitions with industrial powers. This will certainly impose much pressure on bamboo, regarding selection of elite genotypes, silviculture method and new approaches for harvesting and production of quality biomass. So the time horizon of mass scale bamboo utilization may be quite for beyond what the advocate of bamboo hope for at present.

Plant growth regulators exert for reaching effect on plant growth, the precise action depending on the concentration of the substances present and the sensitivity of the organ concerned. It has been observed that application of certain plant growth regulators enhance the biomass production expressed as fresh weight and dry weight. Similar results were observed by Abraham and Ataga 1981, Onyebuchi 1981, Chipa and Lal 1988, Radakrishan *et al.* 2008, Cavusoglu *et al.* 2007 while working in various crop plants. Application of plant growth regulators also enhanced seedling survival percentage.

One of the most important mechanisms exerted by higher plants under environmental-stress conditions is the accumulation of compatible solutes such as proline. The environmental stress induces an increase in proline concentration in plants. Proline accumulation under environmental stress may contribute to osmotic adjustment, protecting cell structure and function or may serve as metabolic or energetic reserve in plants (Hsu and Kao 2003, Dalvi *et al.* 2007).

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