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Full Length Research Paper

Effect of plant growth regulators and chemical fertilizers on growth and productivity of *Chlorophytum tuberosum* and *Pergularia daemia*

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Plants need several elements for their healthy growth. Over the recent years, several scales of physiology have been applied to the study of the response of plant growth regulators and chemical fertilizers on medicinal plants. During present investigation, the effect of plant growth regulators and various chemical fertilizers on growth and productivity of *Chlorophytum tuberosum* and *Pergularia daemia* are studied at various concentrations.

Key words: *Chlorophytum tuberosum, Pergularia daemia*, plant growth, regulators, chemical fertilizers.

INTRODUCTION

Plant growth regulators are organic substances, which in low concentration promote or inhibit growth. Growth regulators are defined as chemical substances which are produced naturally in plants and are capable of translocation and regulating one or more physiological reactions when present in low concentration (Bhatia and Parashar, 1996).

Shoot and root apical meristems are important sites of auxin synthesis, especially as the roots elongate and mature, although the root is still dependent on the shoot for much of its auxin (Ljung et al., 2005). Indole-3-acetic acid (IAA) promotes the enlargement of cells in all or in one direction. Root formation is promoted by the application of IAA. Thus IAA inhibits the shoot length and promotes the root length. Indole-3-butyric acid (IBA) produces inverse effect; it promotes the shoot length and inhibits the root length. α-Naphtalene acetic acid (NAA) inhibits the shoot length and promotes the root length. Gibberrellic acid (GA_3) application to the shoot enhances both shoot and root elongation (Fu and Harberd, 2003).

Soil amendments are made by adding fertilizers to the soil but there are different types of fertilizers. The different types of chemical fertilizers are usually classified according to the three principal elements, namely nitrogen, phosphorous and potassium. Nitrogen, phosphorus and potassium are the most important chemical fertilizers for growth of plants under both *in vivo* and *in vitro* conditions (Johari and Kumar, 1992). These are essential elements, an essential element is defined as one that is an intrinsic component in the structure or metabolism of a plant or whose absence causes severe abnormalities in plant growth, development, or reproduction (Epstein and Bloom, 2005). Many other factors like radiation, growth regulators, organic nutrients affect biomass production considerably (Johari and Kumar, 1994a, b; Wahab and Alla, 1996; Jain and Gupta, 2000; Vilela and Ravetta, 2000). Chemical fertilizers get to be available to the plant relatively quickly when incorporated as part of the plant-food constituents. Urea has the highest nitrogen content of all solid nitrogenous fertilizers in common use. In irrigated crops, urea can be applied dry to the soil, or dissolved and applied through the irrigation water. More than 90% of World production of urea is destined for use as nitrogen-release fertilizers (Greenan et al., 1995). This type of fertilizer usually is available to the public in a white, crystalline, organic form. It is a highly concentrated nitrogenous fertilizer and fairly hygroscopic. This also means that this fertilizer can be quite difficult to apply. Urea is also produced in granular

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Abbreviations: IAA, Indole-3-acetic acid; **IBA,** indole-3-butyric acid; **NAA,** α-Naphthalene acetic acid; **GA_3,** gibberrellic acid.

Plate 1. *C. tuberosum*: Effect of different plant growth regulators at various concentrations (A) Effect of GA_3, (B) Effect of IAA, (C) Effect of IBA, (D) Effect of NAA.

or pellet forms. It is highly soluble in water and therefore, subject to rapid leaching. It is, however, quick-acting and produces quick results. When applied to the soil, its nitrogen is rapidly changed into ammonia. Similar to ammonium nitrate, urea supplies nothing but nitrogen and the application of urea as fertilizer can be done at sowing time.

Super phosphate is a fertilizer type that most gardeners are familiar. It is a fertilizer produced by the action of concentrated sulfuric acid on powdered phosphate rock. Muriate of potash is a gray crystal type of fertilizer that consists of 50 to 60% potash. All the potash in this fertilizer type is readily available to plants because it is highly soluble in water. Even so, it does not leach away deep into the soil since the potash is absorbed on the colloidal surfaces. The majority of the muriate of potash produced is used for making fertilizers, since the growth of many plants is limited by their potassium intake.

The effect of foliar application of fertilizers on nodulation, root and shoot length has so far been studied by few workers (Shaukat, 1994; Singh et al., 1995; Jain and Gupta, 2001). However, little understanding is gained about the physiological basis in terms of growth and productivity under plant growth regulators and nutrients treatment. (Nair et al., 2009).

The present investigation was undertaken to study the effect of certain plant growth regulators and chemical fertilizers on growth and productivity in *Chlorophytum tuberosum and Pergularia daemia*. Both the plants are important medicinal plants in Rajasthan, by increasing growth and productivity one can increase the yield of crude drugs.

MATERIALS AND METHODS

One month old plants of *C. tuberosum* and *P. daemia* are grown in earthen pots containing 4 kg of soil. Treatment with different concentrations, that is 10, 20, 50 and 100 ppm of different growth regulators that is IAA, IBA, NAA, and GA_3 were given. Solutions with these concentrations were prepared separately and a total of two sprays were applied. The first spray was done on one month old plants and the second spray was done after 15 days of the first spray. Control plants were sprayed with sterilized distilled water. Home spray atomizer was used as sprayer. Solution was sprayed at the rate of 100 ml per plant. After 15 days of second spraying plants were harvested in general by uprooting. Effect of growth regulators on growth and productivity at various concentrations were studied.

To study chemical fertilizers effect, rhizomes of *C. tuberosum* and seeds of *P. daemia* were sown in earthen pots containing 4 kg of soil at different concentrations, that is 20, 40, 80, 160 and 320 $mg.kg^{-1}$ of urea, muriate of potash and super phosphate were taken. Control plants were devoid of fertilizers. Plants were grown for two months and were harvested. Effect of chemical fertilizers on growth and productivity at various concentrations were studied.

Effect of plant growth regulators on growth and productivity of *C. tuberosum* and *P. daemia*

C. tuberosum: Effect of plant growth regulators

Different concentration of plant growth regulators differentially affected the plant growth of *C. tuberosum* (Plate 1A to D). Among the different concentrations of GA_3 and NAA applied, the best results were recorded for 100 ppm concentration as compared to the control (Plate 1A and D). However in IAA and IBA treatments higher concentrations resulted in reduced plant growth as compared to lower concentrations used (Plate 1B and C). Induction of flowering was recorded at 100 ppm GA_3 treatment whereas adventitious plantlet formation was observed at 50 ppm treatment of IBA as compared to the control (Plate 2A and B).

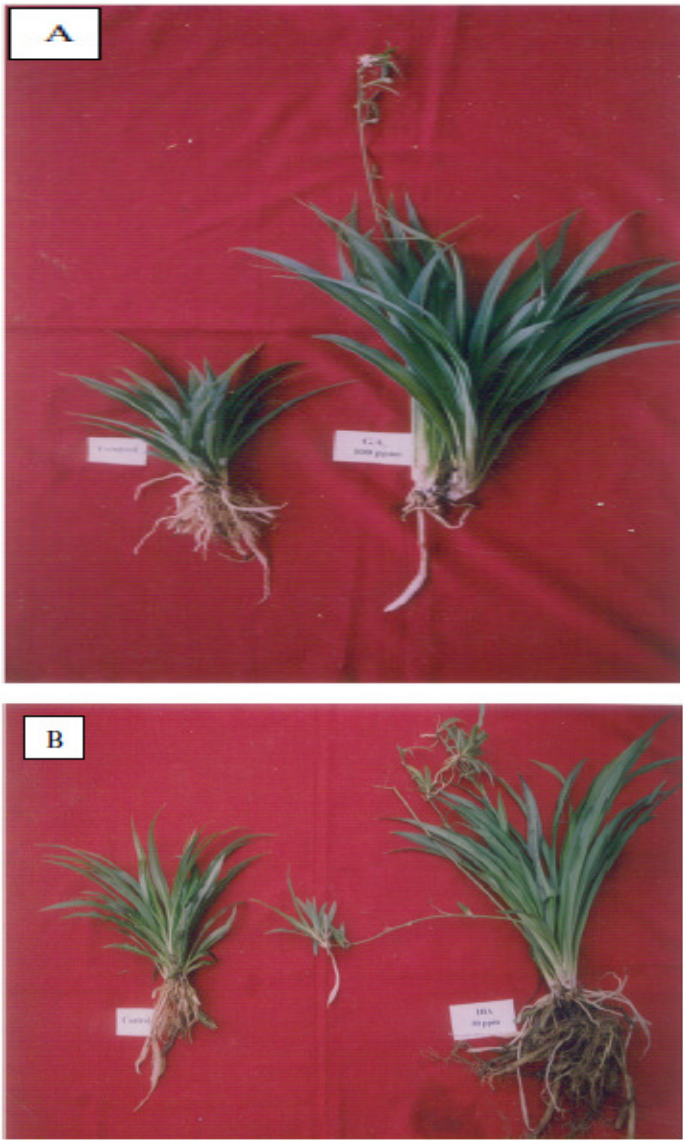

Plate 2. *C. tuberosum :* (A) Early flowering in GA_3 treated plants, (B) Showing adventitious plantlet formation in IBA. treated plant

***P. daemia:* Effect of growth regulators**

The effects of different growth regulators treatments on growth of *P. daemia* were studied. Among, the different growth regulators treatments, the growth were best supported by IBA and NAA at 100 ppm concentration as compared to control (Plate 3A and B). However, in IAA treated plants, growth was recorded best at 50 ppm treatment as compared to the control (Plate 3C).

Effect of chemical fertilizers on growth and productivity of *C. tuberosum* and *P. daemia*

***C. tuberosum*: Effect of fertilizers**

The different fertilizers at various concentrations exhibited different effects on overall growth of *C. tuberosum* (Plate 4A to D). The

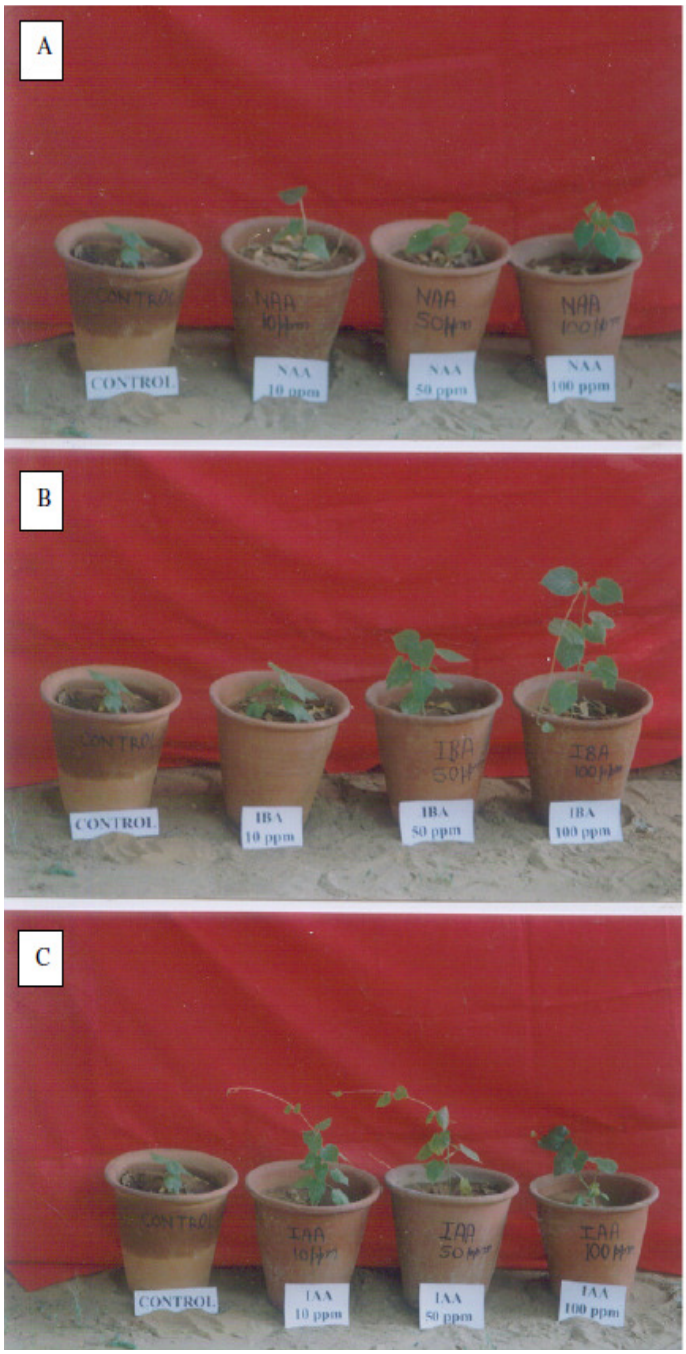

Plate 3. *P. daemia*: Effect of different plant growth regulators at various concentrations (A) NAA, (B) IBA, (C) IAA.

nitrogen applied in the form of urea resulted in better vegetative growth and the best growth was recorded at 160 $mg.kg^{-1}$ soil of urea applied as compared to the control. Similarly, different concentrations of super phosphate affected the plant growth variably. The growth was best supported at 80 $mg.kg^{-1}$ soil concentration of super phosphate as compared to the control (Plate 4B). Likewise, different concentration of potash had varying influence over the growth of *C. tuberosum*. Best growth of plant was recorded at 40 $mg.kg^{-1}$ soil of muraite of potash as compared to the control (Plate 4D).

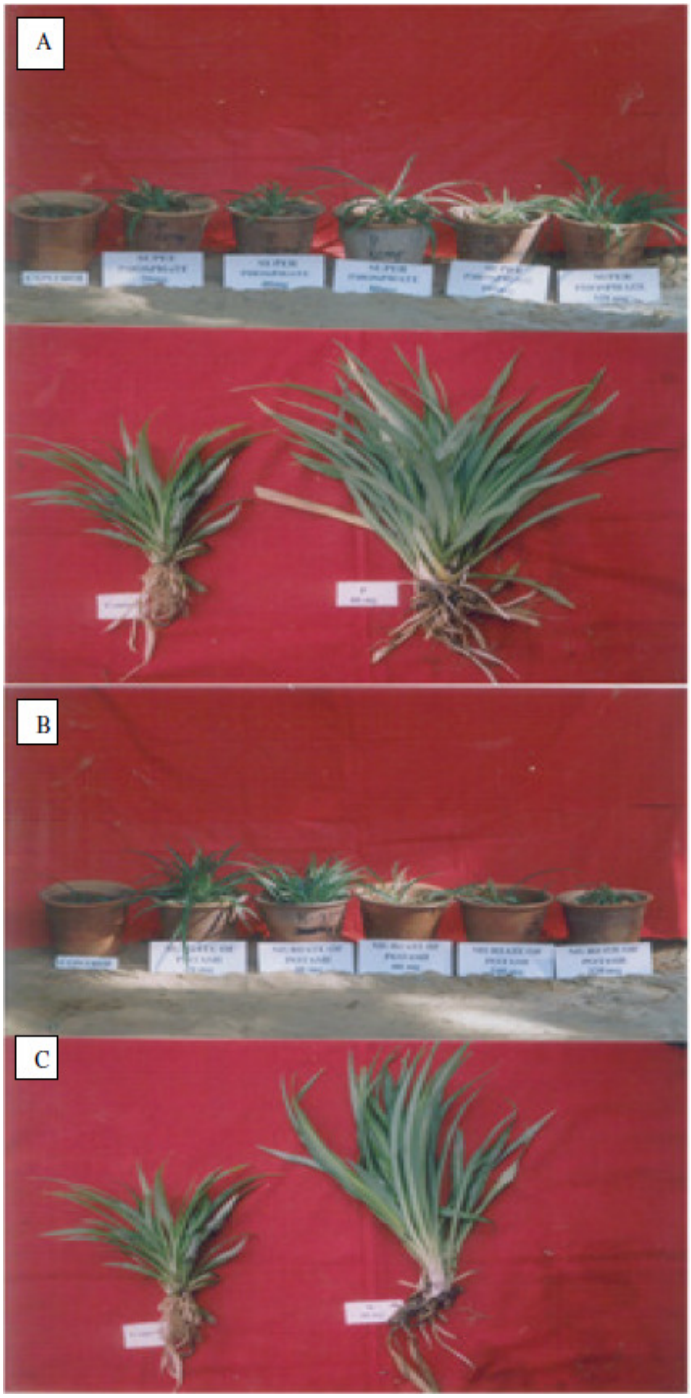

Plate 4. *C. tuberosum*: Effect of different fertilizers at various concentrations (A) Effect of super phosphate, (B) Showing increment in growth by 80 mg.kg^{-1} super phosphate treatment (C) Effect of muraite of potash treatment (D) Showing increment in growth by 40 mg.kg^{-1} muraite of potash treatment.

Pergularia daemia: **Effect of fertilizers**

The effect of different fertilizer treatments on *P. daemia* (Plates 5A to C). The growth of plant increased with the urea treatment and 320 mg.kg^{-1} urea supported best growth as compared to the control (Plate 5A).

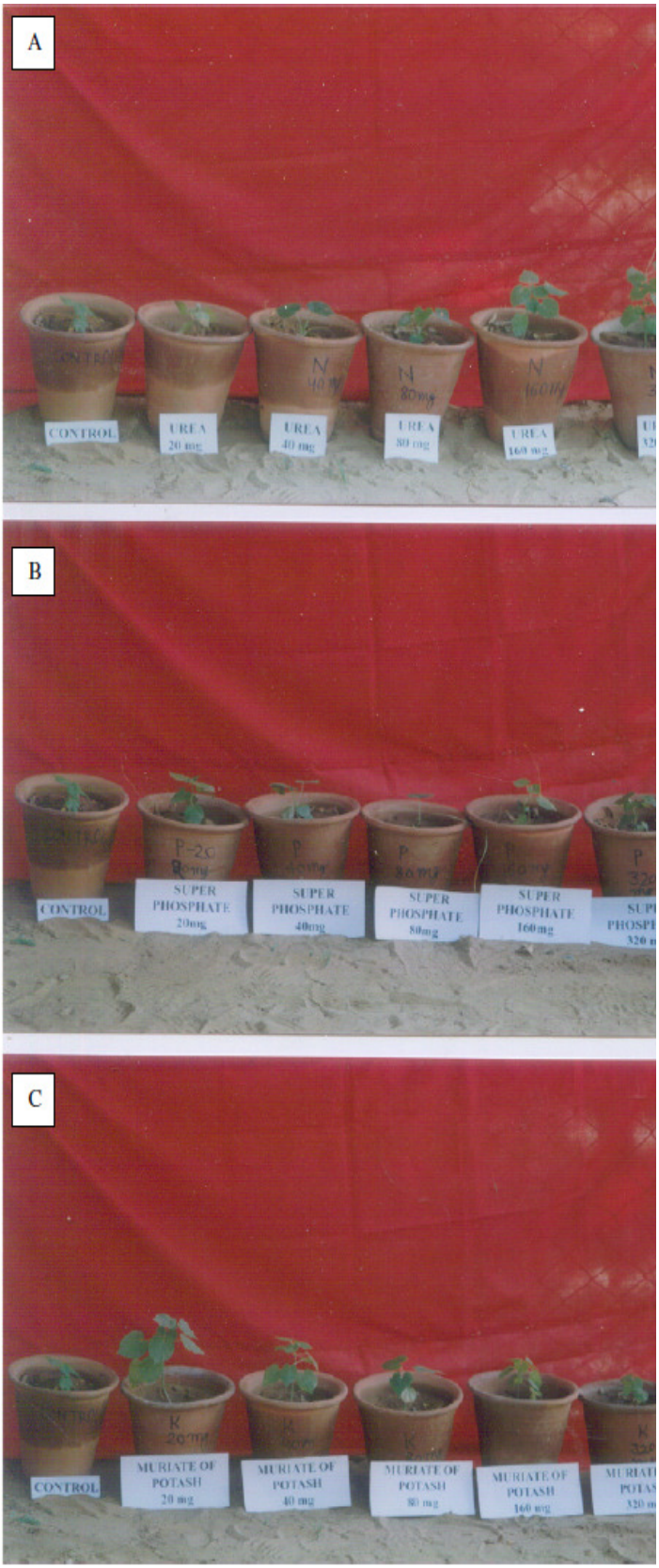

Plate 5. *P. daemia*: Effect of different fertilizers at various concentrations (A) Urea, (B) Super phosphate, (C) Muraite of potash.

Growth of *P. daemia* was variable at different concentrations of super phosphate applied. Lower concentrations were better as compared with higher concentrations of super phosphate. Similarly, variability in growth was observed in plants grown under different concentrations of muriate of potash applied. Although, at low concentrations, muraite of potash supported better growth but increase in concentration resulted in reduced plant growth as compared to the control.

RESULTS AND DISCUSSION

In present investigation, it is observed that in *C. tuberosum* and *P .daemia* low and moderate concentrations of IAA were found suitable for growth and productivity, respectively. In case of IBA, moderate and high concentrations were found suitable for growth and productivity in *C. tuberosum* and *P .daemia,* respectively. In case of GA_3 treatment, high concentration was found suitable for flowering and growth in *C. tuberosum*. In case of NAA treatment, high concentration was found suitable for growth of both the plants.

As far as chemical fertilizers are concern, high concentration of nitrogen in the form of urea was found suitable for growth and productivity in *C. tuberosum* and *P. daemia*. In case of superphosphate, moderate and low concentrations were found suitable for growth and productivity in *C. tuberosum* and *P. daemia,* respectively. As far as muraite of potash is concern, low concentration is found suitable for growth and productivity in both the plants.

Conclusion

In case of plant growth regulators, moderate and high concentrations were found suitable for growth and productivity in C*. tuberosum* and *P. daemia*. As far as, chemical fertilizers are concern, high concentrations of nitrogen in the form of urea found best for both the plants. In case of superphosphate, moderate concentration and muraite of potash at low concentration was found suitable for growth and productivity in C*. tuberosum* and *P. daemia*. In conclusion, suitable treatments of plant growth regulators and chemical fertilizers can increase the growth and productivity of medicinal plants and one can obtain the good yield of crude drugs from these plants.

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