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Research Article

INFLUENCE OF *PSEUDOMONAS FLUORESCENS* AS BIOFERTILIZER IN SECONDARY HARDENING OF TISSUE CULTURED BANANA VAR. POOVAN

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Abstract

The present study brings out the effects of *Pseudomonas fluorescens* in secondary hardening of tissue cultured banana var. Poovan. Two concentrations (1% & 2%) of liquid medium grown *Pseudomonas fluorescens* (3×109 cells/ml) were used in bore well water and the growth performance of the banana plantlets was assessed. Seven different growth parameters were studied viz. shoot weight, height and girth, leaf length, leaf width, no. of leaves and chlorophyll content. Best results were obtained in1% *Pseudomonas fluorescens* (T2) treatment with average of 10.79gm for weight, 10.25cm for height, 5.3 for no. of leaves, 1.3mm for girth, 14.96cm for leaf length and 36.6 spad units of chlorophyll content per plantlet compared to treatment (T3) with 2% liquid *Pseudomonas fluorescens.*

Key words: Banana; *Pseudomonas fluorescens*; *PGPR*.

Introduction

Banana has played an interesting and important role in the history of human civilization. It is one of the oldest, commonest and cheapest among Indian fruits. It is very rich in carbohydrates, vitamin A, C and some vitamin B with several important minerals including potassium, copper, magnesium, calcium and iron. Though it is considered as an article of food in the western countries, in India and particularly in South India banana fruits and plants form articles of great and diverse utility (Cherian Jacob, 1952).

Banana plant requires huge amount of nitrogen, phosphorus and potassium during its growth phase to maintain high yield which are supplied mostly through inorganic chemical fertilizers. To avoid the residual toxicity of chemical fertilizers, application of biofertilizers-microbial inoculants which can promote plant growth and productivity are accepted globally as alternative sources of eco-friendly N-fertilizers. Some of the associative and free-living rhizosphere bacteria exert beneficial effects and enhance growth of many crop plants; hence they are called Plant Growth Promoting Rhizobacteria (PGPR) (Kloepper *et al*., 1980; Bashan & Holguin, 1998; Shrivastava, 2013). *Pseudomonas fluorescens* is one among PGPR which promotes plant growth, leaf nutrient contents and yield of banana (Singh, 2013). In this paper, the effects of *P.fluorescens* on growth parameters of tissue cultured banana var. Poovan during secondary hardening is brought out.

Materials and Methods

Tissue culture raised primary hardened healthy banana plantlets (var**. Poovan**) of uniform size were used for this experiment. All the secondary hardening trials were carried out in Green house of Tissue culture laboratory station of Perunthalaivar Kamaraj Krishi Vigyan Kendra, Kurumbapet, Puducherry. The shade of Green house contains 50%+25% cut out of sunlight by shade net (11,500 - 21,200 Lux). The micro propagated banana clones of similar weight were planted in black poly bags (15×9.5cm) containing the soil mixture comprising red soil and organic coco pith compost in the ratio of 1:1 at the rate of 450 gm/poly bag. The compost was pre-sterilized in an autoclave at 121ºC (30 min) to ensure elimination of microbes in the organic compost. A total of ten plantlets per treatment were planted in poly bags carefully without disturbing the root-ball of the plants.

Preparation of treatment solution

Treatments were categorized according to the combination of biofertilizer (*Pseudomonas fluorescens)* with borewell water. Liquid *Pseudomonas fluorescens* (3×10^9 cells/ml) was procured from Green World eco-friendly Bioproducts, Ariyur, Puducherry. From this, 1% and 2% solutions of *Pseudomonas fluorescens* solution was prepared by mixing

10ml and 20ml of liquid *P. fluorescens* in 990ml and 980ml of bore well water respectively. These treatments were labeled as T2 and T3. Bore well water served as control (T1).Each plantlet was given 50ml of their respective treatment solutions at weekly intervals. In addition, 50ml of bore well water was poured for each plantlet daily. All the plantlets were kept at equal spacing and ground wetting was done regularly around the plants in order to maintain humidity.

Parameters Monitored

The growth parameters taken into consideration comprise shoot weight, height and girth, leaf length, leaf width, no. of leaves and chlorophyll content. All the parameters were accessed after secondary hardening. Plantlet weight was measured using electronic microbalance (Uni Bloc).Plantlet height was measured from the base of the pseudo stem to the angle made between the youngest and first open leaf. Girth of the pseudo stem was measured 1 cm above from the base of the pseudo stem using Verniare caliper. Leaf length was measured from petiole to tip of the plantlet. Leaf width was measured at its widest part. Chlorophyll content of the leaf was estimated by using SPAD chlorophyll meter in SPAD units. Average of values of 10 banana plantlets under treatment were taken for the growth parameters presently studied.

Results and Discussion

Though Researchers on PGPR for crop improvement are gaining prominence and their application in banana production system is limited (Mia *et al*., 2010).The present study highlights the effects of *Pseudomonas fluorescens* at 1% and 2% concentrations were studied in secondary hardened tissue cultured banana plantlets var. Poovan for the following growth parameters (Fig. 1).

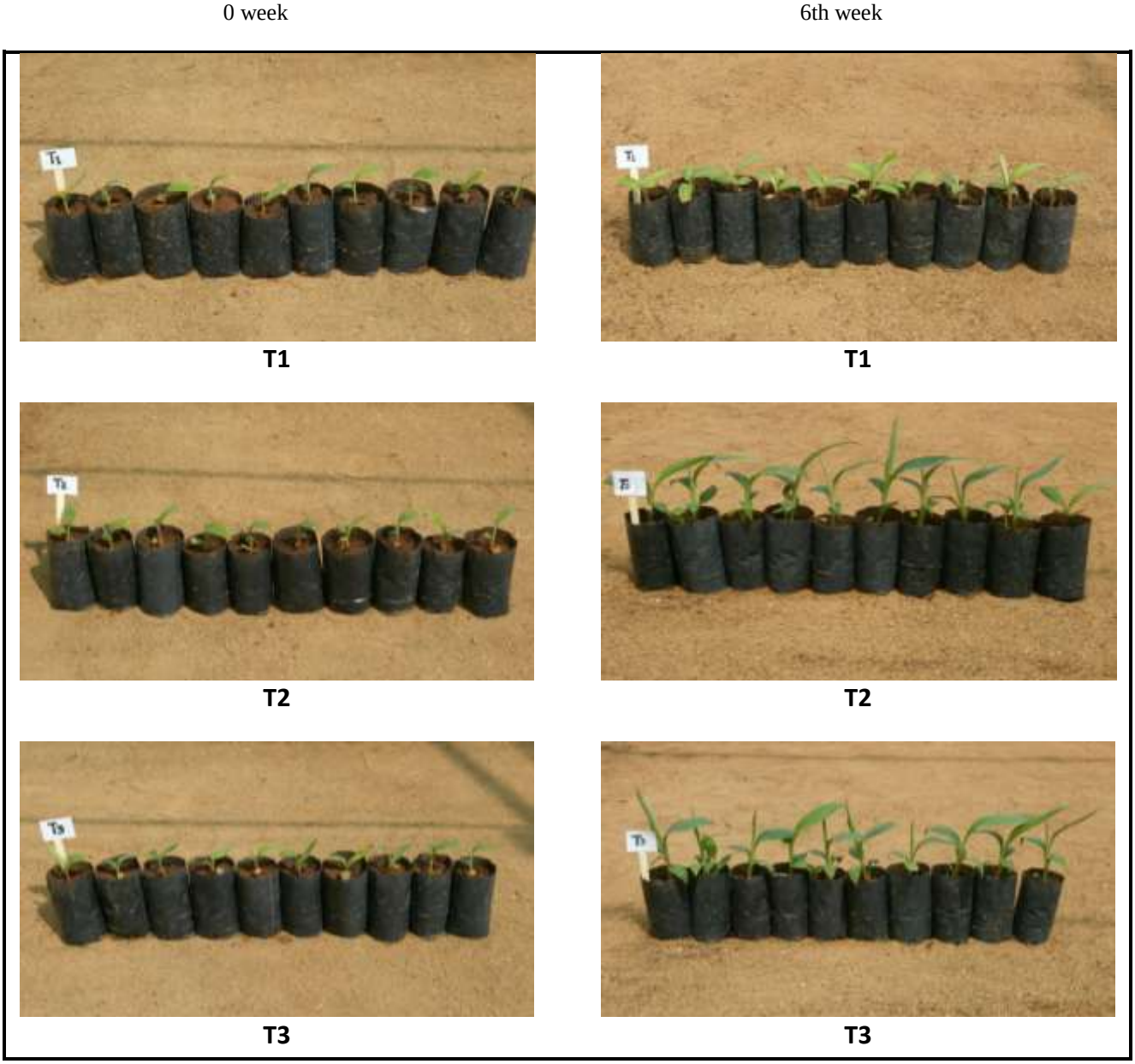

Fig. 1: Effect of *Pseudomonas fluorescens* in secondary hardening of banana var. Poovan

Table 1: Growth response of the plantlets at the end of the 6th week after secondary hardening

Treatments	WEIGHT (gm)	HEIGHT (cm)	GIRTH (mm)	LEAF LENGTH (cm)	LEAF WIDTH (cm)	NO. OF LEAVES	CHLOROPHYLL CONTENT (SPAD units)
T1	4.70	5.60	1.17	8.50	3.04	3.8	28.0
T2	10.79	10.25	1.34	14.96	5.98	5.3	36.6
T3	10.42	10.39	1.20	14.81	6.14	5.0	34.8

Plant Weight

The maximum weight of the banana plantlets was observed in T2 (10.79 gm) followed by T3 (10.42 gm). The lowest plantlet weight (4.70 gm) was noticed in control (T1) (Table 1).

Plant Height

Maximum height (10.39 cm) was observed in plantlets treated with 2% concentration of *Pseudomonas flourescens* (T3). Treatment (T2) with 1% concentration of the bio-fertilizer was all most similar to T3 (10.25 cm) and the plantlets of Treatment (T1) showed only 5.6 cm height (Table 1).

Plant Girth

Results showed that the girth (thickness) of the banana plantlets meagerly varied between the treated and control plantlets. Treatment-T2 ranked first with 1.34 mm followed by T3 (1.20 mm) and T1 (1.17 mm) (Table 1).

Leaf Length

The banana plantlets treated with 1% concentration of *Pseudomonas fluorescens* (T2) showed enhanced leaf length (14.96 cm) followed by T3 (14.81 cm) and T1 (8.50 cm) (Table 1).

Leaf Width

Maximum leaf width was noticed in the Treatment (T3) with 6.14 cm followed by Treatment (T2) with 5.98 cm. Lowest leaf width (3.04 cm) was recorded in control (T1) (Table 1).

Number of Leaves

Number of leaves per plantlet varied significantly in control group (T1) with 3.8 per plantlet than the treatment groups T2 (5.3) and T3 (5.0) (Table 1).

Chlorophyll Contents

Maximum chlorophyll content (36.6 SPAD units) was observed in plantlets treated with 1% concentration of *Pseudomonas fluorescens* (T2) followed by T3 (34.8). The lowest chlorophyll content (28.0) was noticed in control (T1) (Table 1).

The present study clearly reveals that the treated plantlets (T2 and T3) showed better response than the control (T1). Significantly the values are 100% or more than the control. However, when compared, the treated banana plantlets between T2 & T3, the T2 treatments showed better results in all the parameters studied except plantlet height and leaf width for which treatments T3 showed better performance (Table 1). Similar results were reported by Rajesh (2014) in his study in Maize, black gram and green gram and Thankamani *et al.* (2005) in black pepper. Glick (1995) also reported that phosphorus solubilisation, biological nitrogen fixation, improvement of other plant nutrients uptake and phytohormone production like Indole-3- acetic acid (IAA) are some mechanisms that directly influence plant growth by plant growth promoting rhizobacteria (PGPR). Significant enhanced uptake of nitrogen, potassium and enhanced nutrient mobilization was also recorded due to application of *Pseudomonas fluorescens* in black pepper (Paul *et al.*, 2001). It is presumed that the similar reasons as discussed above may be attributed for the enhanced values for the growth parameters presently studied in tissue cultured banana var. Poovan treated with *Pseudomonas fluorescens* during secondary hardening.

The effects presently reported in this communication believed to have sustained effects till yielding stage. However, the future works in this regard will have to be undertaken before drawing a final conclusion.

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