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Original Research Article

Study of Different Potting Mixture on Hardening of Banana Tissue Culture Plantlets Its Field Performance

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Keywords

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A B S T R A C T

An experiment was conducted on primary hardened banana plantlets cv. Grand Naine at Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, in the year 2015-16. This experiment was conducted to find out suitable potting mixture on secondary hardening in shade net. In which different potting mixture of garden soil (control), garden soil+cocopeat (3:1), garden soil+ farm yard manure (3:1), garden soil+vermicompost (3:1), garden soil+ cocopeat+ FYM+ vermicompost (2:1:1:1) and garden soil+ sand+ FYM+ cocopeat (2:1:1:1) were used for secondary hardening. The in-vitro rooted plantlets were hardened and acclimatized by using different treatments. Plantlets were transplanted from primary hardening after 45 days primary hardening gave maximum survival (100%) during transplanting in the field. These plants were hardened in polythene bags singly. The maximum survival during hardening (100%) was observed in shade net with maintained relative humidity and light intensity. Various potting mixtures were tried, the potting mixture containing garden soil and FYM (3:1) gave maximum height and survival of plantlets and shows outstanding performances in field condition.

Introduction

Banana is giant perennial herb and provides an essential food source for more than 400 million people throughout the developing countries of the tropics and the subtropics. It is the most important and most widely grown fruit crop in the world. It ranks as the fourth major crop after rice, wheat and maize and is considered as 'the poor man's apple' in tropical and subtropical countries. Generally, banana cultivars are good sources of carbohydrates, proteins, vitamins and minerals. As the banana cultivars are having high degree of sterility and polyploidy, the conventional breeding methods are difficult in banana improvement. Many pests and diseases are also threatening the good production of banana cultivars. In order to augment conventional breeding and to avoid constraints imposed by pests and pathogens, transgenic and *in vitro* approaches are being considered (Jain and Swennen, 2004). Therefore, plant tissue culture or micro-propagation of banana has been extensively used for rapid production of high quality, disease free and uniform planting material irrespective of the season and weather. However a large scale application of this technology is hindered by high mortality experienced by micro propagated plantlets

when transferred to *ex vitro* conditions. During in vitro conditions, plantlets grow under special conditions in relatively air-tight vessels i.e., air humidity is higher and irradiance is lower than in conventional culture (Uzaribara *et al.,* 2014).

Grand Naine (*Musa accuminata*) is one of the most popular cultivars which is known for its unique aroma and fruit quality, because of its qualities and taste it is internationally accepted and most suitable for the export. After ripening, the fruit develop excellent aroma and good bright yellow colour, which attracts people widely. Now days, the major source of planting material is tissue culture companies and is most widely accepted by the farmers because of the superiority of the tissue culture plants over the conventional rhizome sucker plantation (Singh 2014).

During *in vitro* conditions, plantlets grow under special conditions in relatively air-tight vessels i.e., air humidity is higher and irradiance is lower than in conventional culture. Microshoots, upon transfer to *ex vitro* conditions are exposed to abiotic stress (altered temperature, light intensity and humidity conditions) and biotic stress conditions i.e., soil microflora (Deb and Imchen 2010). High mortality is observed upon transfer of microshoots to *ex vitro* conditions as the cultured plants have non-functional stomata, weak root system and poorly developed cuticle (Mathur *et al.*, 2008). The physiological and anatomical characteristics of micro-propagated plantlets necessitate that they should be gradually acclimatized to the environment of the greenhouse or field (Hazarika, 2003). Development of cuticle, epicuticular waxes, and effective stomatal regulation of transpiration occurs leading to stabilization of water potential of field transferred plantlets. (Silova *et al.,* 1999). Therefore Primary and Secondary hardening is an integral and vital activity of the whole process of tissue culture technology. Improper hardening leads to the failure of whole technology and the industry itself. Success in hardening is a must for an industry for its survival (Radheshyam and Subramani, 2008).

In micro-propagation, it is desirable to produce plantlets that can grow better after transplanting into the soil. So, acclimatization is the most crucial process during banana micro-propagation as the *in vitro* raised plantlets are not readily adapted for *in vivo* conditions (Vasane *et al.,* 2006). Acclimatization is the most crucial process during banana micro-propagation as the *in vitro* raised plantlets are not readily adapted for *in vivo* condition (Vasane 2006). The success in acclimatization of *in vitro* produced banana plantlets largely depends not only on the post transfer growth conditions but also on the pre-transfer culture condition (Allam *et al.,* 2000). Since the tissue cultured plants are very poorly adapted to external environmental condition. The present investigation was carried out to study the different potting mixture for secondary hardening acclimatization treatments on micro propagated banana plantlets for better vegetative growth and field survival. Keeping these facts in a view, the proposed study will plan.

Materials and Methods

The present study was carried out at the Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola in the year 2015-16. Primary hardened plantlets of tissue culture banana cv. Grandnaine were collected from tissue culture nursery. The *in vitro* produced plantlets were subjected to different hardening treatments which include polythene bags kept in shadenet for getting

maximum growth and survival. Different potting mixtures combinations were tried which include soil, FYM, cocopeat, vermicompost and sand. The experiment was carried out using RDB design with three replications. The Data were recorded for different treatment with parameters and analyzed by statistically as per Panse and Sukhatme).

Results and Discussion

Treatment given to raise plantlets; so as to make them adapted to the natural environment is a critical process due to their anatomical and physiological peculiarities. Excessive water loss from plantlets was prevented by giving various treatments. These treatments were found to influence greatly the survival and growth of plantlets. Out of different treatments (Table 1) the adapted percent plantlets survived when they were kept polythene bag in shadenet with maintained condition (i.e. relative humidity and light intensity). According to them plantlets develop their stomatal control mechanism during this period.

Influence of potting mixture

The data pertaining to the influence of different potting mixtures on survival and growth of plantlets are presented in Table 1 and (Plate a). 100 per cent survival was obtained in the potting mixture containing garden soil+ FYM (3:1) and garden soil+ vermicompost (3:1) which was superior to all other treatments. Only 94.23 per cent survival was recorded in potting mixture containing garden soil only. The maximum height of plantlet (30.86 cm) was recorded in potting mixture containing garden soil+ FYM which was closely followed by mixture containing garden soil+ vermicompost (3:1) (28.08 cm) as well as garden soil+ FYM+ sand + cocopeat (2:1:1:1). The potting mixture containing garden soil was significantly inferior to other potting mixtures. Physical, chemical and biological properties of potting mixture are important for the establishment of in vitro produced plantlets. (Kansara *et al.,* 2013) worked on Castor and found the reason for better hardening in vermicompost may be due to presence of rich organic matter source providing strength and essential nutrients for survival to the in vitro raised plants. Better performance of FYM may be attributed to its ability to improve biological properties of soil. On the other hand, sand may be responsible for producing sufficient aeration. Hence, garden soil + FYM and garden soil+ vermicompost might have helped in giving better grip for roots, ample aeration and sufficient organic matter. Reports of (Rahman *et al.,* 2005) and Ali *et al.,* 2011) support the result as they obtained better survival and growth of banana plantlets in the potting mixture containing soil: sand: FYM (2:1:1 v/v/v).

The growth parameter like plant height was significantly maximum throughout in the secondary hardening (18.31, 24.01 and 30.86 cm at 15, 30 and 40 days, respectively) in T_3 - garden soil + FYM (3:1). Whereas, minimum plant height was recorded in T_1 - garden soil (control) (13.91, 15.16 and 18.05 cm at 15, 30 and 45 Days, respectively).Significantly maximum pseudostem girth of plantlets were observed throughout in secondary hardening the growth period (1.65, 1.9 and 2.15 cm at 15, 30 and 45 days, respectively) in T_3 - garden soil+ FYM. Whereas, minimum pseudostem girth was recorded in T_1- garden soil (control) (1.14, 1.28 and 1.35 cm at 15, 30 and 45 days, respectively).Significantly maximum number of leaves per plant was observed throughout secondary hardening in the growth period (5.53, 6.95 and 7.15 at 15, 30 and 45 days, respectively) in T_3 – garden

soil+ FYM (3:1).

Table.1

Treatments	Plant height (cm)	Pseudo stem girth (cm)	Number of leaves	Leaf area (cm^2)	Root length (cm)	Root mass (g)	Survival (%)
T_1 - Garden soil	18.05	1.35	6.40	403.58	19.02	22.52	94.23
T_2 - Garden soil+ cocopeat	20.01	1.55	6.45	405.54	20.42	23.14	98.07
T_3 – Garden soil+ FYM	30.86	2.15	7.15	417.63	28.20	29.17	100
T_4 - Garden soil+ vermicompost	28.08	1.85	6.69	413.84	25.83	27.60	100
T_5 -Garden soil+ coco+ FYM+ vermin	21.82	1.60	6.53	409.84	21.79	24.69	98.07
T_6 - Garden soil+ FYM+ sand+ coco	25.28	1.65	6.65	411.98	24.99	25.91	94.22
CD at 5 %	1.812	0.193	0.214	2.305	1.813	1.704	7.335

Table.2

Treatments	Plant height (cm)	Pseudostem circumference	Number of functional leaves	Leaf area(dm^2)	Number of suckers	Chlorophyll content (mg/g)	Survival (%)
T_1 - Garden soil	176.49	17.36	8.03	229.84	1.50	1.035	85.41
T_2 - Garden soil+ cocopeat	178.97	18.89	8.97	230.71	2.00	1.075	89.58
T_3 – Garden soil+ FYM	185.68	23.90	13.83	238.93	2.75	1.405	93.75
T_4 - Garden soil+ vermicompost	183.45	21.83	11.88	237.92	2.55	1.250	91.66
T_5 -Garden soil+ coco+ FYM+ vermin	180.94	19.88	9.08	232.16	2.00	1.350	83.33
T_6 - Garden soil+ FYM+ sand+ coco	182.05	20.99	10.89	234.39	2.25	1.363	87.49
CD at 5 %	2.132	1.910	1.701	2.200	0.424	0.107	12.469

A) Primary Hardened Plantlets

B) Secondary Hardened Plantlets

Whereas, minimum number of leaves per plant was recorded in T_1- garden soil (control) (4.8, 6.35 and 6.40 at 15, 30 and 45 days, respectively). Significantly maximum leaf area per plant was observed throughout secondary hardening in the growth period (231.78, 332.22 and 417.63 in cm^2 at 15, 30 and 45 days, respectively) in T_3 – garden soil+ FYM (3:1). Whereas, minimum leaf area was recorded in T_1 – garden soil (control) (215.40, 292.08 and 403.59 in cm^2 at 15, 30 and 45 days, respectively). Significantly maximum root length was observed throughout secondary hardening in the growth period (15.16, 22.08 and 28.20 in cm at 15, 30 and 45 days, respectively) in T_3 - garden soil + FYM (3:1). Whereas, minimum root length was recorded in T_1 - garden soil (control) (12.78, 15.20 and 19.02 at 15, 30 and 45 days, respectively).Significantly maximum root mass was observed throughout secondary hardening in the growth period (12.08, 22.01 and 29.17 in gm at 15, 30 and 45 days respectively) in T_3 – garden soil+ FYM (3:1). Whereas, minimum root mass was recorded in T_1- garden soil (control) (7.95, 15.09 and 22.52 in gm at 15, 30 and 45 days, respectively).

The survival percentage in secondary hardening was recorded minimum in T_1 - garden soil (control) 94.23 per cent whereas, maximum survival percentage was recorded in T_3 - garden soil + FYM (3:1) 100 per cent throughout the growth period (45 days). The data represented in Table 1.

Initial Field performance of Banana

The observations were recorded of initial growth period for 120 days after planting on growth parameter aspects viz., height of plant, circumference of pseudo stem, number of leaves, leaf area, root mass, root length, The observations were recorded during 15 days interval from September to January in secondary hardening and January to May at its initial field performance. From overall assessment of results obtained it may be concluded that potting mixture of garden soil and FYM (3:1) may prove better survival in hardening and also field condition. The observations were based on the results of experiment conducted for vegetative growth and their survival in main field therefore these results are suggestive. The results were found significant.

The initial field performance of the plantlets the plant height was significantly maximum 185.68 in cm at 120 DAP in T_3 - garden soil+ FYM (3:1) Whereas, minimum plant height was recorded in T_1 - garden soil 176.49 cm. The performance of the plantlets the pseudostem girth was significantly maximum 23.90 cm at 120 DAP in T_3 - garden soil+ FYM (3:1) whereas, minimum

plant height was recorded in T_1 - garden soil 17.36 cm. The number of functional leaves was significantly maximum leaves 13.83 at 120 DAP in T_3 - garden soil+ FYM (3:1). The initial leaf area was significantly maximum 238.93 dm^2 in T_3 - garden soil+ FYM (3:1). The number of suckers influenced by different potting mixture was recorded significantly minimum in T_1 - garden soil (control) throughout the growth period (1.50). Whereas, maximum number of suckers were recorded in T_3 - garden soil + FYM (3:1) (2.75).Chlorophyll content in leaf was significantly maximum 1.405 mg/g in T_3 - garden soil+ FYM (3:1). Whereas, minimum chlorophyll content was recorded in treatment T_1 - garden soil 1.035 mg/g. The data pertaining to the influence of different potting mixtures on survival and growth of plantlets are 93.75 per cent survival was obtained in the potting mixture containing garden soil and FYM (3:1) which was superior to all treatment. Only 85.41 per cent survival was recorded in potting mixture containing garden soil in initial field performance. The data represented in Table 2.

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