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EFFECT OF DIFFERENT SUBSTRATES ON *IN VIVO* ESTABLISHMENT OF *IN VITRO* CULTURED POTATO PLANTLETS

S.A.K.U. Khan[a]* and M.G. Rabbani [b]

[a]*Agrotechnology Discipline, Khulna University, Khulna-9208*
[b]*Department of Horticulture, Bangladesh Agricultural University, Mymensingh - 2202*

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Abstract: An experiment was conducted to investigate the effect of three different substrates on field establishment of *in vitro* generated plantlets of three potato varieties *viz.* Lalpakri, Cardinal and BARI TPS-I. Substrate comprised of 50% sandy-loam soil and 50% cowdung found suitable for plant establishment and subsequent growth of the plantlets. There was no significant difference among the varieties in respect of *in vivo* establishment, but significant differences were observed on plant height, growth rate and vigour. Combined effects of various substrate and interaction between substrates and varieties were significant in respect of plant establishment, height, growth and vigour.

Key words: plant establishment, potato plantlets, potting substrates.

Introduction

Potato (*Solanum tuberosum* L.) belongs to the family Solanaceae is one of the leading vegetables of Bangladseh. The average per hectare yield of potato in Bangladesh is 10.95 tons (Anonymous, 1998), whereas, the average yield per hectare in the world and in Asia is 15.18 and 14.72 tons, respectively (Anonymous, 1995). Such a low yield of this crop in Bangladesh is mainly because of the use of degenerated low quality seeds and lack of improved production practices. Rabbani (1996) stated that seed potato production system using micropropagation technique has been practicing in Bangladesh to produce the good quality and virus free seed.

The success of micropropagation technique depends on successful establishment of *in vitro* generated plantlets under field conditions. Several factors are involved in successful establishment of plantlets under field conditions. Among these, use of proper substrate is very important, if the roots do not establish properly in the substrate, it cannot sustain, as a result, the plants become desiccated and die before establishment mainly due to excess transpiration (Posplislova *et al.*, 1988).

Transfer of *in vitro* plantlets to the *in vivo* environment is an important stage in tissue culture and if the plantlets are not handed carefully, significant loss of propagated material might occur. According to Sutter and Langhans (1979; 1980), high relative humidity and low irradiance results in there being less leaf epicutcular wax than on plants raised in growth chambers or green houses. They also found that stomata of leaves produced *in vitro* may also be atypical and incapable of complete closure under conditions of low relative humidity. Tissue cultured plants therefore, lose water rapidly when exposed to external conditions. On the otherhand, mixotrophic nutrition (sucrose containing nutrient media) prohibits the formation of a stimulus needed for being fully capable of feeding themselves (Marin and Gella, 1987). Such situation only occurs after several days *in vivo.* Hence after transplanting, they can not be established in any rooting media.

Different materials such as soil, peat, perlite, vermiculite etc. are used as substrate for establishment of *in vitro* generated potato plantlets. Under Bangladesh condition, very little information is available regarding the influence of different substrate on establishment of *in vitro* generated plantlets in the field. Therefore, the present study was undertaken to investigate the effects of different substrates on establishment and subsequent growth of *in vitro* generated plantlets of three potato varieties.

Materials and Methods

The experiment was conducted at the Department of Horticulture, Bangladesh Agricultural University, Mymensingh, Bangladesh. Treatments were given using pots where different substrates were taken as rooting media. Plantlets derived from single node culture of three potato varieties used as plant material. The *in vitro* generated plantlets of about 25-30 days old with well-developed and gently washed out with tap water to remove the medium attached to roots. The plantlets were kept on glass plates and the plates were moistened with water for hardening and to prevent desiccation. Plantlets were then individually transplanted in pots containing different substrates. The pots along with the plantlets were covered with transparent polythene bags for three days to prevent desiccation of the plantlets. The experiment was conducted in completely randomized design

*Corresponding author: Tel.: 880-41-721791 Ext. 211; Fax.: 880-41-731244; e-mail: sakuk@bttb.net.bd
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with five replications. The treatments were as follows:
T_1 = Sandy loam soil, T_2 = 50% sandy loam soil + 50% cowdung and T_3 = 50% sandy loam soil + 50% leaf mould.

Data were recorded on per cent plant establishment, increased height (cm), growth rate (mm/d) and vigor (scale 1-10) of the plantlets. Vigor of the plantlets was measured by eye estimation. The data for above parameters were analyzed and evaluated by F-test. The significant of differences were evaluated by Least Significance Difference (LSD) test according to Gomez and Gomez (1984).

Results and Discussion

The highest percentage of plant establishment was recorded in Cardinal (75.67%), though the varieties under study did not show any significant difference in this regard (Table 1). From the study, it was found that the maintenance of high humidity was an essential factor for *in vivo* establishment of the *in vitro* generated plantlets. Khanom (1984) and Hu and Wang (1983) noticed the similar results. Maximum number of plantlets (88.00%) was established in the substrate containing sandy-loam soil and cowdung, was statistically insignificant with the substrate containing sandy-loam soil and leaf mould (Table 2).

Both the combinations of cowdung or leaf mould with sandy-loam soil gave better results because of their characteristic looseness. The combined effect of different varieties and substrates on *in vivo* establishment of potato plantlets has been found statistically insignificant, but maximum number of established plantlets was obtained when they were planted in the substrate containing sandy-loam soil and cowdung and lower number of plantlets established when they were planted on sandy loam soil (Table 3).

Table 1. Response of different varieties on *in vivo* establishment of potato plantlets

Variety	*Per cent establishment*	*Increased height (cm)*	*Growth rate (mm/d)*	*Vigour (scale 1-10)*
Lalpakhri	72.00	2.55	1.28	6.54
Cardinal	75.67	2.13	1.07	7.04
BARI TPS-1	73.33	2.43	1.22	7.20
LSD at 5%	NS	0.07	0.13	0.55

NS = Non significant

Table 2. Response of different substrates on establishment of potato plantlets

Potting mixtures	*Per cent establishment*	*Increase in height (cm)*	*Growth rate (mm/d)*	*Vigour (scale 1-10)*
T_1	57.00	2.06	1.04	6.61
T_2	88.00	2.72	1.37	7.50
T_3	75.67	2.33	1.16	6.68
LSD at 5%	10.56	0.07	0.13	0.55

T_1 = Sandy loam soil, T_2 = 50% sandy loam soil + 50% cowdung, T_3 = 50% sandy loam soil + 50% leaf mould

Increased plant height was significantly higher (2.55 cm) in plantlets of Lalpakri and it was lower (2.13 cm) in Cardinal. The moderately increased plant height (2.43 cm) was observed in BARI TPS-I (Table 1). Such results might be due to the difference in varietal characteristics.

The substrate containing sandy-loam soil and cowdung gave significantly increased plant height (2.72 cm) (Table 2). The interaction between substrates and varieties on the increased plant height was also statistically significant (Table 3). The increased plant height was maximum (2.9 cm) for Lalpakri and BARI TPS-1 when the plantlets were planted in the substrates containing sandy-loam soil and cowdung. From the present investigation, though it was found that the establishment of plantlets was independent of variety but the height of the plantlets depends on variety, substrate and interaction between variety and substrate.

The response of different varieties regarding growth rate of the plantlets was statistically significant. The maximum growth rate (1.28 mm/d) was found in the plantlets of Lalpakri which was followed by BARI TPS-I (1.22 mm/d) and Cardinal (1.07 mm/d) respectively (Table 1). The highest growth rate (1.37 mm/d) was observed when the plantlets were grown on the mixture of sandy loam soil and cowdung (Table 2). Hossain (1987) also found similar results. Interaction between varieties and substrates was found significant in respect of growth rate (Table 3). The highest growth rate (1.46 mm/d) was found in BARI TPS-I potted on the substrate composed of sandy-loam soil and cowdung. Growth rate was lowest (0.94 mm/d) in Cardinal potted on sandy loam soil.

Vigour of the BARI TPS-I and Cardinal was statistically insignificant. Plantlets of Lalpakri were comparatively

less vigorous (Table 1). Among the potting substrates, the sandy loam soil and sandy loam soil with leaf mould showed similar effect on the vigour of the plantlets. The maximum vigour (score-7.50) was found in the plantlets grown on the substrate of sandy loam soil and cowdung (Table 2). Interaction among different varieties and substrates on the vigour of the plantlets was significant. However, the plantlets of Cardinal were more vigorous (Score-7.95) when potted on the substrate of sandy loam soil and cowdung (Table 3).

Table 3. Interaction between varieties and substrates on *in vivo* establishment of potato plantlets

Treatments	*Per cent establishment*	*Increase in height (cm)*	*Growth rate (mm/d)*	*Vigour (scale 1-10)*
Lalpakri				
T_1	52.00	2.30	1.16	6.75
T_2	92.00	2.90	1.45	7.86
T_3	72.00	2.46	1.23	6.52
Cardinal				
T_1	63.00	1.88	0.94	6.72
T_2	85.00	2.35	1.19	7.95
T_3	79.00	2.15	1.08	6.93
BARI TPS-1				
T_1	56.00	1.99	1.00	6.35
T_2	88.00	2.92	1.46	6.69
T_3	76.00	2.36	1.18	6.58
LSD at 5%	NS	0.13	0.22	NS

T_1 = Sandy loam soil, T_2 = 50% sandy loam soil + 50% cowdung, T_3 = 50% sandy loam soil + 50% leaf mould, NS = Non significant

Conclusion

For successful establishment of microplants, the use of 50% sandy loam soil and 50% cowdung may be considered as the best potting mixture. However, further studies are suggested to investigate the effect of different substrates on *in vivo* establishment of potato varieties before recommending the practice for use at commercial level under Bangladesh condition.

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