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Research Article

EFFECT OF PACLOBUTRAZOLE AND CULTURE VESSELES ON MICROTUBER PRODUCTION IN POTATO (*Solanum tuberosum* L.)

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Abstract- Using the micro-propagated potato shoots, originating from meristem culture was used to produce microtuber. Effect of different vessels and paclobutrazole were studied and results revealed that the size of culture vessels play important role for the microtuber production and among them 150 Erlenmeyer conical flask is most suitable. The varietal performance of Kufri Chipsona-1 found to better response in terms of obtaining maximum weight. The paclobutrazole effect on microtuberisation weight and size were non-significant, however the weight of microtuber were higher (0.110 gm) in the paclobutrazole treated treatment and corresponding size were reduced (0.487 cm) in paclobutrazole treatment. At the very same time its effect on number of microtuber were significant and it was maximum (4.7) in case of M_2 treatment where paclobutrazole were absent and less/ reduced, number (3.4) in the paclobutrazole treatment.

Keywords- Culture vessels, *Solanum tuberosum* L., Micro-propagation, Microtuber and Paclobutrazole

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Introduction

Potato (*Solanum tuberosum* L.) is one of the most important crop in India. Potato provides food and nutrition security in the world; considering the nutritive value and potential for cultivating, FAO has rightly identified potato as" Food for Future" [1]. Potato cultivation is an important source of income, recruitment and non-grain food. Potato crop infected adversely by number of viruses, diseases and pest. The cost of seed potato alone about 40 to 60% of the total production cost [2]. Tissue culture techniques gave high quality disease free planting material with short time during the whole year. *In-vitro* propagation methods using sprouts and nodal cuttings are more reliable for maintains genetic integrity of the multiplied clones [3].

In-vitro microtuber can be induced under different culture conditions; because of their small size and weight microtuber has tremendous advantages in terms of storage, transportation and production practices. They have similar morphological and biochemical characteristics compared to field produced tubers. Therefore, mass production of potato microtuber is likely to revolutionize the world potato production [4].

The present investigation was carried out with a objective to find out techniques for optimization of microtuberisation and evaluate the effect of growth regulators in different culture vessels with three different popular cultivar *viz.*, Kufri Badshah (KB), Kufri Pukhraj (KP) and Kufri Chipsona-I (KC) known among farmers and use in processing industry in middle Gujarat.

Material and Methods

Establishment of axenic cultures on to Murashige and Skoog's [5] medium with incorporation of 10.0 mgl^{-1} GA_3 and 2% sucrose for initiation of axenic culture.

The axenic cultures were used for obtaining microtuber. Evaluation of the paclobutrazole effect on microtuberisation was made in sequence where in first step explants were kept in propagation media in which vitamins were excluded (M_1 & M_2) about one week where in M_1; 0.1 mg l^{-1} paclobutrazole were present in addition to 0.005 mg l^{-1} NAA while in M_2; paclobutrazole was absent and 2.0 mg l^{-1} calcium pantothanate is incorporated. In second step/stage microtuberisation media containing 5 mg l^{-1} BA and 250 mg l^{-1} CCC were provide in MS liquid form and kept in static condition under dark with higher concentration (8%) of sucrose.

Result and Discussion

Effect of paclobutrazole on shoot growth and tuberisation

Effect of different vessels and paclobutrazole effect on shoot growth was recorded. The good results for the tuberisation were observed in M_2 treatment. Microtuberisation effect in three varieties in the absence of paclobutrazole shows the shoot growth [Fig-1]. While in presence of paclobutrazole the overall shoot growth was reduced. The paclobutrazole effect shows the dwarfisms in plant growth [Fig-2].

The cultures/ inocula first kept in propagation media M_1 and M_2 for one week [Fig-3]. M_1 contains paclobutrazole, which shows the poor shoot growth and in M_2 which has no paclobutrazole reported better, elongated shoot growth [Fig-4] after 21 days.

Different culture vessels reported significant effect on microtuber induction. The bottles had poor microtuberisation while 150 ml flask shows the best results [Fig-4].

Weight of microtuber

The [Table-1] (average weight of microtuber) shows that no significant difference for the average weight of microtuberisation in case of media. Variety and culture vessels were found to be significant.

Fig-1 Absences of Paclobutrazole (M_2) in three varieties (KB, KC and KP)

Fig-2 Presence of Paclobutrazole (M_1) in three varieties (KB, KC and KP)

Fig-3 Culture in M_1 and M_2 media

Fig-4 Effect of culture vessels in absences of Paclobutrazole

The Kufri Chipsona-1 variety produced higher average weight and least in Kufri Badshah (0.099 gm). Average weight of microtuber was non-significant in the media used but their effect was significant in the different variety and different culture vessels used. [Table-1]. The Kufri Chipsona-1 reported significantly the highest (0.119 gm) average mean weight followed by Kufri Pukhraj (0.106 gm) and Kufri Badshah (0.099 gm). Among the different culture vessels used the treatment having 150 ml flask gave the highest (0.148 gm) average mean weight of microtuber followed by 250 ml flask (0.114 gm) and the lowest in jar i.e. (0.062 gm).The interaction effect showed in [Table-2] 2indicates that M_1 media which contains paclobutrazole in 150 ml flask obtained highest average mean weight (0.190 gm) in Kufri Chipsona-1 variety while lowest average mean weight (0.015 gm) in the same situation (i.e. M_1 media) in bottles/jar in Kufri Pukhraj variety too.

Size of microtuber

The culture vessels used in the experiment were found to be significant for the average size of microtuber while other factors like varietal difference, media and their all interaction were found to be non-significant [Table-1]. The maximum average size (0.573 cm) was reported in 150 ml flask and lowest average size of microtuber (0.459 cm) in bottles.

Number of microtuber

The number of microtubers in all the characters like variety, media, culture vessels and their interaction were found to be significant [Table-1]. Kufri Chipsona-1 has maximum number (4.9) followed by Kufri Pukhraj and least number (3.0) of microtuber in Kufri Badshah was reported. Media M_2 which does not contain paclobutrazole has maximum 4.7 numbers of microtuber [Table-1]. Culture vessels 150 ml flask found to be having maximum (5.9) number of microtuber and bottles/ jars contain least minimum (2.1) number of microtuber [Table-1]. The interactions between varieties and media, variety and culture vessels & media and culture vessels reported significantly higher. The M_2 media found to be significantly higher in both varieties Kufri Pukhraj and Kufri Chipsona-1. Kufri Chipsona-1 and Kufri Pukhraj found to be maximum number of microtuber and reported at par. The 150 ml culture vessels are significantly maximum number of microtubers obtained in V_2 Kufri Chipsona-1 (7.9). The interaction between variety and culture vessels (V x C)found significantly maximum number (7.8) in Kufri Chipsona-1 followed by Kufri Pukhraj (6.333) reported, while the least number of microtuber found in jars only in the same Kufri Chipsona-1 variety [Table-3]. The interaction between media and culture vessels resulted [Table-3] maximum number (6.4) in M_2C_1 while minimum number in M_1C_3. The interaction between (V x M x C) variety, media and culture vessels results reported maximum number of microtuber in $V_2M_1C_1$ which was at par with $V_3M_2C_1$. While minimum number of microtuber was detected in $V_1M_1C_3$ and $V_2M_1C_3$.

Table-1 *Different vessels and paclobutrazole effect on microtuberisation*

	Average weight of microtuber (gm)	Average size of microtuber (cm)	Number of microtuber Nos.
V_1 Kufri Badshah	0.099	0.492	3.0
V_2 Kufri Chipsona-1	0.119	0.524	4.9
V_3 Kufri Pukhraj	0.106	0.503	4.2
S.Em. ±	0.00213	0.0207	0.184
C.D.	0.006	NS	0.5
M_1	0.110	0.487	3.4
M_2	0.106	0.526	4.7
S.Em. ±	0.00174	0.0169	0.150
C.D.	NS	NS	0.4
C_1 150 ml flask	0.148	0.573	5.9
C_2 250 ml flask	0.114	0.487	4.2
C_3 500 ml Jar	0.062	0.459	2.1
S.Em. ±	0.00213	0.0207	0.184
C.D.	0.006	0.059	0.5
Interaction			
V x M S.Em. ±	0.00302	0.0292	0.260
C.D.	0.009	NS	0.748
V x C S.Em. ±	0.00370	0.0358	0.3191
C.D.	0.011	NS	0.916
M x C S.Em. ±	0.003026	0.02929	0.2605
C.D.	0.006	NS	0.529
VxMxC S.Em. ±	0.05244	0.05074	0.4513
C.D.	0.015	NS	1.296
C.V. %	8.47	17.36	19.2

Table-2 *Interaction table for the average weight of microtuber (gm)*

Treatment	Variety			Mean (M) gm
	V_1 Kufri Badshah	V_2 Kufri Chipsona-1	V_3 Kufri Pukhraj	
M_1	0.089	0.122	0.119	0.110
M_2	0.109	0.116	0.093	0.106
Mean (V)	0.099	0.119	0.106	
S.Em. ±		0.00302		
C.D.		0.009		
C_1 150 ml flask	0.137	0.162	0.146	0.148
C_2 250 ml flask	0.101	0.112	0.129	0.114
C_3 500 ml Jar	0.059	0.083	0.043	0.062
Mean (V)	0.099	0.119	0.106	
S.Em. ±		0.00370		
C.D.		0.011		
M_1C_1	0.125	0.190	0.176	
M_1C_2	0.106	0.105	0.166	
M_1C_3	0.033	0.070	0.015	
M_2C_1	0.145	0.133	0.116	
M_2C_2	0.097	0.119	0.092	
M_2C_3	0.082	0.096	0.071	
S.Em. ±		0.00524		
C.D.		0.015		
C.V. %		8.41		

Table-3 *Interaction table for the average number of microtubers*

Treatment V x M	Variety		
	V_1 Kufri Badshah	V_2 Kufri Chipsona-1	V_3 Kufri Pukhraj
M_1	2.1	4. 9	3.1
M_2	3.9	5.0	5.3
S.Em. ±		0.260	
C.D.		0.8	
V x C	V_1	V_2	V_3
C_1 150 ml flask	3.7	7.8	6.3
C_2 250 ml flask	2.5	5.3	4.5
C_3 500 ml Jar	2.8	1.5	1.9
S.Em. ±		0.319	
C.D.		0.9	
M x C	M_1	M_2	
C_1 150 ml flask	5.4	6.4	
C_2 250 ml flask	2.9	5.4	
C_3 500 ml Jar	1.8	2.3	
S.Em. ±		0.261	
C.D.		0.6	
C.V. %		19.2	
M_1C_1	2.7	8.7	5.0
M_1C_2	2.3	4.7	2.7
M_1C_3	1.3	1.3	1.7
M_2C_1	4.7	7.0	7.7
M_2C_2	3.7	6.3	6.3
M_2C_3	3.3	1.7	2.0
S.Em. ±		0.451	
C.D.		1.3	
C.V. %		19.2	

The results of this work indicates the paclobutrazole effect on microtuberisation weight and size were non-significant, however the weight of microtuber were higher (0.110 gm) in the paclobutrazole treated treatment and corresponding size were reduced (0.487 cm) in paclobutrazole treatment [Table-1]. At the very same time its effect on number of microtuber were significant and it was maximum (4.7) in case of M_2 treatment where paclobutrazole were absent and less/ reduced, number (3.4) in the paclobutrazole treatment. These were supported by Davis *et* al. (1988) [6] where they reported that paclobutrazole is a triazole compound, which inhibit extension growth in a wide range of species and its growth retarding properties are largely attributed to its interference with gibberellin biosynthesis. Simko [7] suggest that paclobutrazole could be used in *In-vitro* routine tuberisation especially when formation of microtuber is necessary; furthermore, they indicated that both paclobutrazole and cytokinin should be incorporated to the medium are effective that was done in this experiment. The observed reduction could be attributed to a decline in number in response to GA biosynthesis. The involvement of gibberellins in regulating number through stolon initiation was reported by Kumar and Wareing[8]. Frommer and Sonnewald [9] reported that the competition among tuber initiates reduce the final tuber number. In agreement with our results, Balamani and Poovaiah [10] and Simko [11] reported an increase tuber weight in response to paclobutrazole treatment.

Furthermore, it was concluded that the size of culture vessels play important role for the microtuber production. Our results of this experiment were significantly better in 150 ml Erlenmeyer conical flask; in which average weight, size and number of microtuber produced were maximum, while minimum in case of 500 ml/ Jar (air sealed closed with parafilm). This may be due to the presence of space available and may be some gaseous effect.

The culture conditions provide in this experiment through the culture vessels and the induction treatment of paclobutrazole also significantly affect on varietal performance and the Kufri Chiposona-1 found to be better response in terms of obtaining maximum weight, size and number of microtuber in presence of paclobutrazole in the 150 ml Erlenmeyer conical flask.

Conclusion

Paclobutrazole effect on weight of microtuber and their size were no significant when the propagation media were evaluated while the variety and culture vessels were found to be significant. The Kufri Chipsona-1 variety produced higher average weight. The size of culture vessels play important role for the microtuber production. In this study 150 ml Erlenmeyer conical flask reported significantly better results in which weight, size and number microtuber produced were maximum compared to 250 ml Erlenmeyer conical flask and 500 ml/jar capacity.

Abbreviations

FAO-Food and Agriculture Organization, GA_3-Gibberellic acid, BA- 6-Benzylaminopurine, benzyl adenine, CCC-Chlorocholine Chloride, MS-Murashige and Skoog, V- variety, M-media, C-culture vessels, gm-gram, mg-milligram, ml-milliliters, cm- centimeter

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References

[1] Bhatnagar A., Singh S.P. and Singh B.P (2014) *Indian Horticulture*, 5-6,12-14

[2] Venkatasalam E.P., Sood R., Pandey K.K., Thakur V., Sharma A.K. and Singh B.P. (2013) *African Journal of Agricultural Research*, 8(49), 6375-6382

[3] Liljana K.G., Mitrev S., Fidanka T. and Mite I. (2012) *Electr. J. Biol.*, 8(30), 45-49

[4] Kanwal A.A. and Shoaib K. (2006) *International Journal of Agriculture and* Biology, 8(3), 337-340

[5] Murashige T. and Skoog F.(1962) *Physiol. Plant*, 15, 473-497

[6] Davis T.D., Saukhla N. and Upadyaya A. (1988) *Hort. Rev*., 10, 63–105.

[7] Simko I. (1993) *Plant Growth Regulation*, 12, 23-27.

[8] Kumar D. and Wareing P.F. (1972) *New Phytologist*, 71, 639-648.

[9] Frommer W.B. and Sonnewald U. (1995) *J. of Experimental Botany*, 46 (287), 587-607.

[10] Balamani V. and Poovaiah B.W. (1985) *Am. Potato J.*, 62, 363–369.

[11] Simko I. (1994) *J Plant Growth Regul.*, 13, 73-77