

Field performance evaluation of two potato (*Solanum tuberosum* L.) cultivars propagated *In Vitro*

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Abstract

A comparison study of field performances between two potato cultivars namely Emma and Burren propagated *In Vitro*. Results revealed that significant differences were found in most of traits. In general, at first planting date Burren produced maximum average weight of minitubers reached (12.17 g) as compared to (7.55 g) for Emma cultivar. Moreover, earlier planting date (P1) had higher plant height, Shoots fresh, dry weight and number of leaves. plant⁻¹ which reached 25.99 cm, 6.55 g, 0.50 g and 22.16 respectively. In case of yield traits, no significant differences were found between Burren and Emma in related to the number of minitubers while highest weight and tuber diameter were found in Burren as compared to Emma.

Keywords: Minituber, *In Vitro*, True Seed, Field Performance, Plantlet

Introduction

Potato *Solanum tuberosum* L belongs to Solanaceae family which contain other important economic crops such as tomato, eggplant and pepper. According to FAO (2012), Asia concedes the most producer then Europe, south, North and Central of America. In regard to its nutritive value, potato is an important source of carbohydrate, potassium, also potato enrich with vitamin C, niacin and vitamin B6 (Zakaria *et al*, 2009). Usually, the potato propagated by tubers as vegetative propagules, in this way there is a risk of disease infection with viruses or other invading pathogens as well. Moreover, imported seeds tubers are too cost in addition to the imported date which is often mismatch with regular planting time.

To overcome these problems, tissue culture technique is an alternative fast technology which solves many problems. Among many advantages for using *In Vitro* techniques is the mass productions of microtubers (Al-Safadi *et al.*, 2000) and obtaining virus free seed potato (Hoque 2010.; Rocha *et al*, 2015.; Wang and Hu, 1982.; Islam and Chowdhury, 1998; Khan *et al* 2003), production of microtubers is the easy to produce, no costly since the whole processes achieved in restricted area no greenhouse (Rolot, 2012) and can produced at any time of the year (Liljan *et al*, 2012.; Saha *et al*, 2013). In addition, microtubers reduce the time to produce seed tubers and number of field generations required to produce higher quality seed tubers (Prematilake and

Mendis, 1999). Also microtubers are easy to transport, and easily stored for longtime (Hoque 2010). Minitubers the (basic seed) produced from microtubers after transplanting which in turn enters seed production chain to produce certified seeds (Liljan *et al*, 2012). In general, minitubers produced either from the plantlets or from microtubers (Saha *et al*, 2013). A production of minitubers via plantlets is a simple cheap way and described as a conventional minitubers production system (Dimante and Gaile, 2014) and also using *In Vitro* plantlets to produce minitubers speeded up seed production program.

The purpose of this study was to compare yield performance of two potato cultivars. In this regards, the work have done in two ways, *In Vitro* production of plantlets in closed containers under growth room conditions, and *Ex Vitro* transferring propagules (rooting plantlets) into the green house to produce minitubers.

Materials and Methods

The study was conducted at The Ministry of Science and Technology/ Directorate of Agricultural Research /Genetic engineering labrotary/ Baghdad, Iraq. Two experiments were conducted *In Vitro* and *Ex Vitro*.

In Vitro Culture initiation and shoots multiplication experiment

Meristems (0.1-0.3 mm) were isolated from two potato cultivars namely Emma and Burren and sterilized under aseptic conditions according to Bhuiyan (2013), then

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cultured on initiation media which prepared based on MS salts (Murashige and Skoog, 1962) fortified with other component shown in table 1 with a notice that all media were autoclaving at 121 °C for 20 minutes before using. Shoots multiplication were performed on media which described in (table 1). Five shoots (1 cm) height were cultured in each glass container. Cultures were maintained at 25±1 °C with (16:8 h) light / dark.

Ex Vitro Minutubers production and field performance experiment

After four weeks of multiplication, the propagules (rooted plantlets) were washed in tap water to remove the agar and transplanting in polyethylene bags filled with a mixture of sand: peatmoss with 1:1 ratio. The plantlets were covered with transparent plastics bags and planted in three dates: P1 represent (first planting date) at 8 of January, P2 (second planting date) at 22 January, and P3 (third planting date) at 5 February. Harvested yield at 14 May 2017 for all planting date. The experiment was designed in completely randomized (C.R.D) with three replicates. Plant height (cm), fresh and dry weight for vegetative system, and yield such as the number, average weight and minutubers diameter were recorded, and data analyzed using GenStat software program, means were compared at 0.05% of probability level.

Table 1: Constituents of media for initiation, multiplication and microtuberization of two potato cultivars *In Vitro*

Media component	Initiation media mg.l ⁻¹	Multiplication media mg.l ⁻¹
MS Salts	MS Full strength	MS Full strength
Inositol	100	100
Glycine	2	2
Pyridoxine- HCl	0.5	0.5
Nicotinic acid	0.5	0.5
Thiamine- HCl	0.5	0.5
IAA	0.1	-
GA3	0.5	-
Sucrose	2000.0	3000.0
Agar	7000	7000

Results and Discussion

The means of morphological characteristics measured in the plastic house are shown in (Table 2 and 3). Among all morphological traits a significant difference was found in plant height (25.21 cm) for Burren cultivar. While no significant differences were found between both cultivars in related to shoots fresh, dry weight and the number of

leaves. plant⁻¹ as well. Concerning to planting date, data in Table 3 clarified that earlier planting date P1 had higher plant height, Shoots fresh, dry weight and number of leaves. plant⁻¹ which reached 25.99 cm, 6.55 g, 0.50 g and 22.16 respectively.

According to table 4 no significant differences were found between both potato cultivars Burren and Emma in related to the number of minitubers while Burren minituber was superior to give highest weight and diameter reached 10.08 g, 25.66 mm respectively compared to 7.20 g and 20.88 mm in Emma. Similar results were found in table 5 no significant differences among the three planting date in related to the number of minitubers. plant⁻¹, while first planting date affected positively on minitubers weight and diameter 9.86 g and 26.16 mm respectively. In case of interaction between potato cultivars and planting date, the results in table 6 showed that first planting date (P1) significantly affected on plant height (27.66 cm) in Burren which differ from other interactions except second planting date for the same cultivar. Moreover, non significant differences were found between Burren and Emma in related to Shoots fresh and dry weight traits. While Burren was superior to give high number 24 of leaves. plant⁻¹ at first planting date. For yield components, interaction between potato cultivars and planting date in table 7 revealed that despite no significant differences were found between potato cultivars and planting date regarding to number of minitubers. plant⁻¹, yet the first planting date affected significantly on average weight of minitubers and diameter traits for Burren 12.17 g, 31.00 mm respectively.

Plantlets produced *In Vitro* considered as the base of potato seed programs. Several authors outline the production of minitubers from *In Vitro* derived potato plantlets in greenhouse conditions (Lommen and Struik, 1992; Struik, 2007; Dimante and Gaile, 2014). (Hossain *et al.* 2017) made field evaluation between microtubers and minitubers produced from plantlets. In our results tubers yielded within the range of (2.66 -3.66) per plant which agree with Struik(2007) who summarized on the number of minitubers in a rang of (2-5) per plant and disagree with Ahlowalia (1994) who found minimum average of minitubers (0.26-3.07) and also disagree with (Correa *et al.* 2008) who reported maximum average (7-8.31) of minitubers per plants.

In conclusion, despite that productions of minitubers from microtubers have been reported by many authors, still little information is available about production of minitubers from plantlets and their field performance. In our results a positive correlation between first planting date and minitubers yield was found and its may be due to the long growth period till harvesting time which gave the plants adequate time to growth compare to the second and third planting date since all tubers were harvested at the same date. The advantage of by using *In Vitro* plantlets

Table2: Morphological characteristic of vegetative system for two potato cultivars

Cultivars	Plant height(cm)	Shoots fresh weight (g)	Shoots dry weight (g)	Number of leaves. plant ⁻¹
Burren	25.21	5.40	0.43	19.99
Emma	23.22	5.45	0.42	19.88
LSD 0.05	1.712	0.529	0.051	1.304

Table 3: Effect of planting date on some morphological characteristic for two potato cultivars

planting date	Plant height(cm)	Shoots fresh weight (g)	Shoots dry weight (g)	Number of leaves. plant ⁻¹
P1	25.99	6.55	0.50	22.16
P2	24.99	5.16	0.42	19.66
P3	21.66	4.57	0.37	17.99
LSD 0.05	2.097	0.648	0.062	1.597

Table 4: Yield characteristic of two potato cultivars Burren and Emma

Cultivars	Number of minitubers. plant ⁻¹	Average of minituber weight g	Minituber diameter (mm)
Burren	3.21	10.08	25.66
Emma	3.11	7.20	20.88
LSD 0.05	0.641	1.205	1.795

Table 5: Effect of planting date on Yield characteristic of two potato cultivars

Planting date	Number of minitubers. plant ⁻¹	Average of minituber weight (g)	Minituber diameter (mm)
P1	3.33	9.86	26.16
P2	3.33	8.21	23.66
P3	2.83	7.85	19.99
LSD 0.05	0.784	1.476	2.199

Table 6: Interaction effect of potato cultivars and planting date on morphological characteristics

plant height (cm)			
	P1	P2	P3
Burren	27.66	25.66	22.33
Emma	24.33	24.33	21.0
LSD (0.05)		2.965	
Shoots fresh weight (g)			
Burren	6.80	4.94	4.46
Emma	6.31	5.38	4.68
LSD(0.05)		0.916	
Shoots dry weight (g)			

Burren	0.53	0.42	0.36
Emma	0.47	0.42	0.39
LSD(0.05)		0.088	
Number of leaves.plant ⁻¹			
Burren	24	17.66	18.33
Emma	20.33	21.66	17.66
LSD(0.05)		2.258	

Table 7: Interaction effect of potato cultivars and planting date on yield components

Number of minitubers. plant ⁻¹			
	P1	P2	P3
Burren	3.66	3.33	2.66
Emma	3.00	3.33	3.00
LSD (0.05)		N.S	
Average weight of minitubers (g)			
Burren	12.17	9.38	8.70
Emma	7.55	7.04	7.01
LSD(0.05)		2.088	
Minitubers diameter(mm)			
Burren	31.00	25.33	20.66
Emma	21.33	22.00	19.33
LSD(0.05)		3.110	

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