World Academy of Science, Engineering and Technology
International Journal of Agricultural and Biosystems Engineering
Vol:6, No:7, 2012

# Effect of Transplant Preparation Method on Yield and Agronomic Traits of True Potato Seed (TPS) Progenies in Sahneh Region

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***Abstract*—**To study the effect of suitable methods for propagation of True Potato Seed (TPS) progenies, transplant and selection of the best progenies, a factorial experiment base on a randomized complete block design was carried out in the research field of Sahneh region, Kermanshah, Iran during 2009-2010. Five selective progenies from CIP (International Potato Center) including CIP.994013, CIP.994002, CIP.994014, CIP.888006, and CIP.994001 and two transplant preparation methods (Paper pot preparation for mechanical cultivation and preparation in transplant trays for manual cultivation) were studied in three replications. Results showed that different progenies had no significant effect on plant height (cm) and tuber yield (t $ha^{-1}$), whereas had a significant effect on number of tubers per unit area ($m^2$). There was significant difference between transplant preparation methods for plant height and tuber yield. The interaction effect of progenies and transplant preparation method was not significant for these traits. CIP.888006 progeny and paper pot preparation method produced the highest tuber yields. Also CIP.994002 and CIP.994014 progenies considered as the best progenies under paper pot preparation method due to high yields.

***Keywords*—**Potato, *Solanum tuberosum*, TPS progenies, Transplant preparation method



## I. Introduction

POTATO (*Solanum tuberosum*) is a highly productive and nutritious crop and the fourth world crop after wheat, corn, and rice. Potato was grown in more than 100 countries under temperate, subtropical, and tropical conditions. It is essentially a cool weather crop and temperature is the main limiting factor on its production. Optimum yields are obtained where mean daily temperatures are in the 18 to 20°C range [1]. Iran is number 12 of the world's potato producers and the third biggest in Asia, after China and India. Since 1961, production has increased more than 15 times over. In 2007, the country's farmers achieved an all time record harvest of 5.24 million tonnes, with per hectare yields averaging 25 tonnes. The potato is one of Iran's leading agricultural exports, with shipments in 2005 totalling around 166 000 tonnes. Potatoes are grown mostly under irrigation around the southern shore of the Caspian Sea, in the Zagros Mountains, and on the southern lowlands, alternated with wheat, vegetables, sugar beets and fallow in three or four year rotations [2].

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Potato can be multiplied both vegetatively (i.e., from seed tubers or plant tissue culture techniques) and sexually from True Potato Seed (TPS) [3]. Using botanical or TPS is one of the safest methods in potato production to prevent pathogen infection, decrease production cost and guarantee high yields especially when they were obtained in controlled condition and by desired parents. Malagamba *et al*. (2006) reported that on average 4 parental plants needed for production of required TPS for 1 ha, while 4000 plants needed for the same area when seed tuber uses [4]. Gebrmarin *et al*. (2006) reported that higher tuber yields obtain by TPS rather than seed tubers [5]. As direct-seeding in main field due to more susceptibility of plant early growth stages to environmental conditions such as temperature, soil water, and even to existing pathogens and pests may have a negative effect on crop and reduce desirable yields, usually progenies raised from TPSs under greenhouse or nursery conditions used in potato production. In addition, transplanting method increase the length of growing season by earlier planting in greenhouse when direct seeding may impossible due to not appropriate environmental condition outside the greenhouse and this prolongation of growing season have a positive effect on tuber yield. In Iran, raising progenies on transplant trays or greenhouse benches and transplanting them to main field manually is the most common method for this purpose which is time consuming and bearing lots of costs including labor cost. These problems could be modify by shifting transplant preparation method in which seedlings could be transplanted by special machineries along with choosing the most appropriate progeny for a special region. Malagamba (2006) reported seedling establishment in main field mainly related to progenies reaction to environmental conditions and their ability to modify the transplanting stress [6].

Little is known in this field and previous studies mainly assessed the progenies differences. Therefore this study conducted with the objective to assess the profitability of paper pot preparation method for raising potato seedlings in order to mechanized the transplanting process in addition to determine the most suitable progeny in Sahneh region of Iran. It is noticeable that this is the first time such a study was done in Iran.

## II. Materials and Methods

### A. Experimental site and design

The experiment was carried out at the experimental farm located in Sahneh, Kermanshah, Iran (48°30′E, 34°47′N; 1312 m a.s.l) during the 2009-2010 crop year. Sahneh located in Zagros zone and receives mean annual rainfall of 269.2 mm.

Mean annual temperature in this region is 10.7 °C with the maximum and minimum temperatures of 34.2 and -8°C (according to a 20 year period data).

The used experimental design was a factorial arrangement in the form of randomized complete block design with three replications. Treatments were five selective progenies from CIP (International Potato Center) including $P_1$: CIP.994013 (HPS LT8/13), $P_2$: CIP.994002 (HPS Atzimba/67), $P_3$: CIP.994014 (HPS LT8/67), $P_4$: CIP.888006 (HPS 7/67), and $P_5$: CIP.994001 (HPS Atzimba/13) and two transplants preparation methods including $M_1$: preparation in transplant trays for hand cultivation and $M_2$: paper pot preparation for mechanical cultivation. Each experimental plot extended in an 1 m× 1.95 m area and consisted of 3 rows, 60 cm apart. Soil characteristics were determined before experiment for suggesting appropriate fertilizer doses. Seeds were planted on 4 May 2010 in paper pots (2 cm× 2 cm× 15 cm) and transplant trays (40 cm× 70 cm) in greenhouse with plant density of 5 cm× 10 cm. The seedlings were transplanted on 29 May 2010 to the main field.

### *B. Measurement of traits*

At harvest stage, sampling was done, after eliminating margin effect. Plant height, number of tubers per unit area ($m^2$) and tuber yield were measured.

### *C. Statistics*

Analyses were performed using the MSTATC software. A factorial analysis of variance (ANOVA) was performed for all parameters. In addition the Duncan's Multiple Range Test (DMRT) ($P = 0.05$) was used to conduct mean comparison of treatments.

## III. Results And Discussion

### *A. Plant Height*

Statistically plant height was not affected by progeny and progeny× Transplant preparation method (Table I) and no significant difference was observed in different levels of progeny and progeny× transplant preparation method for it, although the highest plants obtained in $P_5$ and $P_5M_1$ on average 64.83 cm and 67.55 cm, respectively (Table II). In contrast, transplant preparation method had a significant effect on this trait (Table I) as plants raised from transplants of first method was higher than the plants raised from second one on average 60.56 cm (Table II). $P_1$ and $P_3$ produced higher plants when planted using second transplant preparation method. Under first preparation method $P_5$ and under second preparation method $P_1$ produced the highest plants on average 67.55 and 66.94 cm, respectively (Table II).

### *B. Number of Tubers per $m^2$*

Progeny had a significant effect on the number of tubers per unit area ($m^2$) at $P = 0.05$ (Table I). $P_2$ on average 153.6 and $P_1$ on average 97.37 produced the highest and lowest number of tubers, respectively (Table II). Transplant preparation method and the interaction effect of treatment had not a significant effect on this trait (Table I), although the highest number of tubers obtained in $M_2$ and $P_2M_2$ on average 131.62 and 176.9, respectively. $P_2$ and $P_5$ produced higher number of tubers per unit area when planted using paper pot transplant preparation method. Under first preparation method $P_4$ and under second preparation method $P_2$ produced the highest number of tubers on average 154.2 and 176.9, respectively (Table II).

### *C. Tuber yield*

Tuber yield was not affected by progeny and progeny× Transplant preparation method (Table I) as all treatments placed in the same statistical group, although the highest tuber yield obtained in $P_4$ and $P_4M_1$ on average 36.91 and 39 t $ha^{-1}$, respectively (Table II). In contrast, transplant preparation method had a significant effect on this trait at $P = 0.01$ (Table I) as plants raised from transplants of second method produced higher yields in comparison to plants raised from first one on average 34.0692t $ha^{-1}$. $P_1$ and $P_3$ produced higher tuber yield per unit area when planed using paper pot transplant preparation method and $P_5$ produced nearly the same amount of tuber yield in both methods. Under first preparation method $P_4$ and under second preparation method $P_3$ produced the highest tuber yield on average 39 and 36.61 t $ha^{-1}$, respectively (Table II).

TABLE I
Analysis of Variance for Assessed Traits

| S.O.V. | D.F. | Plant height | Number of tubers | Tuber yield |
|---|---|---|---|---|
| Replication | 2 | | | |
| Progeny | 4 | ns | * | ns |
| Transplant preparation method | 1 | * | ns | ** |
| Progeny× Transplant preparation methods | 4 | ns | ns | ns |
| Error | 18 | | | |
| Total | 29 | - | - | - |
| CV (%) | - | 18.08 | 20.54 | 23.51 |

*, ** significant at 5 and 1%, respectively, ns: not significant

TABLE II
Simple and Interaction Effects of Treatments on Assessed Traits

| Treatment | Mean | | |
|---|---|---|---|
| | Plant height (cm) | Number of tubers | Tuber yield (t $ha^{-1}$) |
| Progeny (M) | | | |
| $P_1$ | 63.25 a | 97.37 b | 33.700 a |
| $P_2$ | 59.11 a | 153.6 a | 30.870 a |
| $P_3$ | 60.94 a | 125.4 ab | 33.870 a |
| $P_4$ | 53.12 a | 149.5 a | 36.910 a |
| $P_5$ | 64.83 a | 128.6 ab | 34.480 a |
| Transplant preparation method (M) | | | |
| $M_1$ | 60.56 a | 130.21 a | 33.86475 b |
| $M_2$ | 59.94 b | 131.62 a | 34.0692 a |

Progeny× Transplant preparation methods

| | | | |
|---|---|---|---|
| $P_1 \times M_1$ | 59.55 a | 114.3 bc | 31.860 a |
| $P_1 \times M_2$ | 66.94 a | 80.44 c | 35.550 a |
| $P_2 \times M_1$ | 59.55 a | 130.4 abc | 32.640 a |
| $P_2 \times M_2$ | 58.66 a | 176.9 a | 29.100 a |
| $P_3 \times M_1$ | 59.44 a | 128.4 abc | 31.130 a |
| $P_3 \times M_2$ | 62.44 a | 122.4 bc | 36.610 a |
| $P_4 \times M_1$ | 56.68 a | 154.2 ab | 39.000 a |
| $P_4 \times M_2$ | 49.55 a | 144.9 ab | 34.820 a |
| $P_5 \times M_1$ | 67.55 a | 123.8 bc | 34.690 a |
| $P_5 \times M_2$ | 62.11 a | 133.5 ab | 34.260 a |

Any two means sharing a common letter do not differ significantly from each other at 5% probability

## IV. Conclusion

According to our results mechanical cultivation of potato via paper pot preparation could decrease cost of potato production in fields of Iran and CIP.994002 and CIP.994014 due to high yields under Sahne condition when planted using paper pot transplant preparation method considered as the most suitable progenies. Although the difference among progenies is not prominent from tuber yield point of view, but due to importance of this crop in Iran even low differences in tuber yields are important economically.

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