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Performance of TPS Lines under Raised and Brick Bed Nursery Methods for Tuberlet Production in North Central India

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ABSTRACT

An experiment was conducted at ICAR-Central Potato Research Station, Gwalior during 2013-14, 2014-15 and 2016-17 with two TPS lines D-150 (Open pollinated) and 92-PT-27 (cross pollinated) and planted in two types of nursery beds *viz.* brick bed method and normal nursery method in 1.0 m length and 1.0 m breadth (area of 1sq.m). Overall vigour (1-5 scale) was higher in normal method (4.6) over brick bed method (3.6) of planting. Uniformity (1-5 scale) of tubers was at par in both the TPS lines and nursery raising methods. Mean number of tubers (000/m^2) was higher in brick bed method (2.94) than normal method (1.50). Open pollinated family D-150 (2.53) recorded higher number (000/m^2) of tubers over cross pollinated family 92-PT-27 (1.89). Weight of tubers (Kg)/m^2 was higher in normal method (4.58) than brick bed method (3.84). Among TPS lines tubers yield (Kg/m^2) was higher in open pollinated family D-150 (5.11) over cross pollinated family 92-PT-27 (3.30). Hence among the TPS lines D-150 performed better in both the method of planting than 92-PT-27. For production of higher number of tuber using brick bed method was found to be better as far as of nursery raising is concerned. Brick-bed method can be effective for the areas like North-Central India where proper irrigational facilities are the constraints for potato production.

1. Introduction

The cost of cultivation is very high in potato as cost share of seed is about 40-50% of total production cost of potato and is associated with such a quick degeneration by viruses and soil borne diseases. True Potato Seed (TPS) is a captivating technological alternative that offers farmers an option to overcome the above-mentioned weakness of clonally propagated tuber as a source of planting material and also for where quality tuber seed cannot be produced under the prevailing agro-climate condition. TPS is a cost-effective propagating material and could be used by the farmers for generating healthy planting material in desired quantities under Tripura conditions (Tripura and Ghosh 2017and Nath *et al.,* 2017). Besides, being a hybrid, TPS expresses vigour for different yield components resulting in increase in yield with quality tuber (Sen *et al.,* 2010). TPS has been used for commercial seed production in China, Sri Lanka, Rwanda, Egypt, Philippine, India and Bangladesh (Mulatu *et al.,* 2005, Guenthner 2006 and Gildemacher 2006). In India, TPS technology is highly suitable for the states of Karnataka, Maharashtra, Madhya Pradesh, Orissa, North-eastern hill states (first priority) where yields are extremely low (<10 t/ha) due to poor quality seed and higher biotic and abiotic stresses during crop period (Thakur *et al.*, 2008). TPS planting materials can be used for ware potato production as well as seed tuber production depending upon the agro ecological situation and availability of irrigation facilities (Deb *et al.*, 2013).

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In the conventional system 3.5 tons seeds of bulky tubers are needed to plant one hectare of potato crop as compared only 100 to 125 grams of TPS fulfils the same requirements (Takur *et al.,* 2008, Nizamuddin *et al.,* 2010 Mihaela *et al.,* 2012 and Deb *et al.,* 2013). TPS does not carry major viruses and nematodes. It is less susceptible to major potato diseases like late blight (*Phytophthora infestans*) and it requires less fungicide as compared to crop grown from clonally multiplied varieties (Bhattarai and Gautam 2014). With rare but important exceptions (*e.g.* potato spindle tuber viroid), TPS is indeed free of virtually all diseases including systemically transmitted viruses (Mandi *et al.,* 2017). Hybrid 92-PT-27 showed relatively better performance as compared to TPS C-3 both at the research farm and farmers' fields for all the identified attributes *viz* seedling germination (%), transplants mortality (%) and incidence of late blight in seedling crop under North Eastern conditions of India (Dubey *et al.,* 2010).

Use of seedling tubers is most common method than direct sowing of TPS in the field for production of seed or ware tubers and raising seedlings from TPS in a greenhouse or seedbed and transplanting them later into the field for seed or ware tubers production in the same season (Almekinders *et al.,* 1996; Simmonds 1997 and Shambhu Kumar 2013). Use of seedling tubers avoids the problems associated with direct sowing (*i.e.* slow seedling growth, physiological stress resulting in early tuberization and hence low yields), and transplanting seedlings (*i.e.* transplanting shock) (Almekinders *et al.,* 2009). Raising potato crop from seedling transplanting may be done only in areas where temperatures are mild, irrigation is assured and crop season is of longer duration so as to accommodate a period of nearly one month in the season for raising seedlings in the nursery beds. However, seedling tubers from TPS may be used in all the areas where potato is produced through conventional system using seed tubers (Gupta *et al.,* 2004). The use of seedling tubers or later- generation tubers from TPS varieties is agronomically similar to the use of tubers from conventional cultivars in terms of seed rate, initial crop development, number of tubers per stem *etc.* (Almekinders *et al.,* 1996). Also, the yield potential of seedling tubers and later generations of selected TPS varieties competes well with that of clonal cultivars (Love *et al.,* 1994; Benz *et al.,* 1995 and CIP 1995). In India TPS technology normally utilized in NE states and in eastern states like Bihar and West Bengal and recent introduction of M/S Bejo Sheetal Pvt Ltd, Jalna for TPS and seedling tuber production in Maharashtra (Takur *et al.,* 2008). Normal nursery bed method is standard method of production of seedling tubers in TPS while it can also be produced by Brick-bed method. Performance of tuberlet production under TPS technology in North –Central plains is unknown. Hence considering above points, a trial was undertaken to study the performance of TPS lines under normal nursery and brick bed method.

2. Materials and Methods

The experiment was conducted under AICRP (Potato) at ICAR-Central Potato Research Station, Gwalior during 2013-14, 2014-15and 2016-17. Two types of TPS lines D-150 (Open pollinated) and 92-PT-27 (cross pollinated) were used for the planting in two types of nursery beds *viz* Brick bed method and normal nursery method in 1.0 m length and 1.0 m breadth (area of 1sq.m) fig 1 and 2. Beds were separated by 1.0 m wide pathway. For good germination TPS were treated with dormancy breaking chemicals (immersing) in the solution of 1500 ppm Gibberlic Acid for 24 hours before sowing (Takur *et al.,* 2008). Sowing of TPS in potato crop season was when minimum daily temperature starts touching 20ºC ± 2ºC in third week of November every year. Normal nursery bed preparation and seedling raising were followed as per suggested methodology in Extension Bulletin no.30 (E) of CPRI, Shimla (Gaur 1996). While in Brick bed method beds (1.0 m X 1.0 m) were prepared on wide polythene sheets by new bricks of similar sizes.

The sides of polythene sheets were raised to enable ponding water around the brick beds. On top of the brick bed layer a thin layer (2") of weed free fine soil and FYM mixture in the ratio of 1:1 was spread out. Rest of the processes were followed as per normal nursery bed method except water sprinkling irrigation because the water ponded around the brick beds allows them to move to the top of the bed through capillary action. Irrigation was repeated as per requirement to the crop. Pre-weeded fine soil + FYM mixture broadcasted/top dressed frequently *i.e.* almost twice at weekly intervals after seedling emergence to allow the development of dense thick roots of the seedlings. Haulms were removed at 90 days after sowing. Data were recorded with respect to various biological attributes consisting seedling survival (%), seedling vigour (1-5 scale), tuber yield (Kg/M^2), tuber uniformity (1-5 scale) at the time of harvesting. Simple statistics of average range and percentage were employed to draw meaningful conclusion

Figure 1. Normal nursery method

Figure 2. Brick bed method of nursery raising

3. Results and Discussion

Finding revealed that overall vigour (1-5 scale) was higher in Normal method (4.6) over Brick bed method (3.6) of planting (Figure 1 and Table 1). Mean vigour in D-150 (4.2) was slightly higher than 92-PT-27 (4.0) as superiority of vigour in D-150 was recorded in both the method of planting than 92-PT-27 (Table 1). Uniformity (1-5 scale) of tubers was at par in Normal method (4.4) and Brick bed method (4.3). Uniformity (1-5 scale) in 92-PT-27 (4.5) was slightly higher than D-150 (4.3) (Table 2). Tuber uniformity and seedling vigour were found higher in cross pollinated family 92PT-27 than open pollinated family D-150 under both the methods (Shambhu Kumar 2014). Mean number of tubers (000/m^2) was higher in brick bed method (2.94) than Normal method (1.50). Similar trend has been reported by Shambhu Kumar (2014) where brick bed method (3.65) recorded higher tuber number (000/m^2) than normal nursery method (3.79) under patna conditions of eastern India and production of tuberlets in brick-bed method was cheaper, easier and most acceptable to the farmers. Open pollinated family D-150 (2.53) recorded higher number (000/m^2) of tubers over cross pollinated family 92-PT-27 (1.89) (Table 1). Under Patna conditions of eastern India number of tubers (000/M^2) were at par in both the TPS lines *viz.* D-150 (3.51) and 92-PT-27 (3.63) (Shambhu Kumar 2014). Weight of tubers (Kg)/M^2 was higher in normal method (4.58) than brick bed method (3.84). But reverse trend was reported by Shambhu Kumar (2014) wherein brick bed method (2.44) recorded higher tuber yield (Kg/M^2) over normal nursery method (1.94). Among TPS lines tubers yield (Kg/m^2) was higher in open pollinated family D-150 (5.11) over cross pollinated family 92-PT-27 (3.30) (Table 1). Performance of D-150 was far better than 92-PT-27 for tuber number and yield/m^2 under both the methods of nursery raising (Table 1). Open pollinated families even yielded higher than hybrids have also been reported by Golmirzare *et al.* 1994. This suggests that some of the families like D-150 might be able to "resist" the inbreeding effect thus offering the possibility of using them for potato production or in a TPS breeding programme (Gopal 2003) because production of open pollinated true seed is inexpensive and costs only a fraction of that of hybrid seeds (Golmirzare *et al.,* 1994, 1998). Our results support this, though some open pollinated families can be better than the best hybrid families. From the above result, brick-bed method

Table 1. Vigour (1-5 scale) and performance of TPS lines for tuber yield parameters in normal and brick bed nursery raising methods

	Vigour (1-5 scale)			**Tuber uniformity (1-5 scale)**			**No of tubers (000)/M^2**			**Wt of tubers (Kg)/M^2**		
Culture/ Method of planting	Brick bed method	Normal method	Av	Brick bed method	Normal method	Av	Brick bed method	Normal method	Av	Brick bed method	Normal method	Av
D-150	3.7	4.7	4.2	4.0	4.3	4.2	3.58	1.49	2.53	4.90	5.32	5.11
92-PT-27	3.5	4.5	4.0	4.5	4.5	4.5	2.29	1.50	1.89	2.78	3.83	3.30
Mean	3.6	4.6	4.1	4.3	4.4	4.3	2.94	1.50	2.21	3.84	4.58	4.20

might be effective for the areas like North-Central India where proper irrigational facilities are the constraints for potato production and quality seed can be made available at cheaper rate. Hence among the TPS lines D-150 performed better in both the method of planting than 92-PT-27. For production of higher number of tuber using brick bed method was found to be better as far as of nursery raising is concerned.

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