Journal of Experimental Agriculture International

Volume 46, Issue 6, Page 178-192, 2024; Article no.JEAI.115090
ISSN: 2457-0591
(Past name: American Journal of Experimental Agriculture, Past ISSN: 2231-0606)

Studies on the Field Performance of True Potato Seed of Different Entries under Telangana Conditions

Bandela Santhosha [a++*], B. Neeraja Prabhakar [b#], V. Suchitra [c†], S. Mallesh [d‡], B. Naveen Kumar [e^] and B. Prasanna Kumar [f]

[a] Department of Vegetable Science, College of Horticulture, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet district, Telangana, India.
[b] Department of Horticulture, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet District, Telangana, India.
[c] Department of Horticulture, Fruit Research Station, Sangareddy, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet District, Telangana, India.
[d] Department of Vegetable Science, PG Institute of Horticultural Studies, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet District, Telangana, India.
[e] Department of Soil Science and Agricultural Chemistry, Horticultural polytechnic, Ramagirikhilla, Peddapalli, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet District, Telangana, India.
[f] Division of R & D, Sahasra Crop Science Pvt. Ltd., Hyderabad, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JEAI/2024/v46i62469

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/115090

Original Research Article

Received: 06/02/2024
Accepted: 11/04/2024
Published: 30/04/2024

[++] *Ph.D. Scholar;*
[#] *Hon'ble Vice-Chancellor and Senior Professor;*
[†] *Senior Scientist and Head;*
[‡] *Assistant Professor;*
[^] *Vice-Principal;*
**Corresponding author: E-mail: santhoshabandela@gmail.com;*

ABSTRACT

The quality of seedlings obtained from a nursery influence re-establishment in the field and the eventual production of crops. The present investigation was conducted for two consecutive seasons during *rabi*, 2021-22 and *rabi*, 2022-23 at Mulugu, Sri Konda Laxman Telangana State Horticultural University for evaluation of the field performance of true potato seed. The same seedling raised media showed better performance in the main field of experiment, among the treatments, T_1 *i.e* KP-15C3 X D-150 + Cocopeat : Vermicompost : FYM (2:1:1) was recorded the significantly highest growth parameters like plant height (25.15 cm and 47.61 cm), number of compound leaves per plant (15.05 and 28.13), leaf length (8.85 cm and 20.13 cm), leaf width (6.68 cm and 14.23 cm), leaf area (27.94 cm^2 and 51.48 cm^2) and stem diameter (0.60 cm and 0.82 cm) at 30 and 60 DAP respectively. Results related to yield attributing characters like number of micro tubers per plant (11.77), fresh weight of micro tubers per plant (16.21 g), number of small tubers per plant (7.46), fresh weight of small tubers per plant (44.03 g), number of medium tubers per plant (5.89), fresh weight of medium tubers per plant (171.40 g), number of large tubers per plant (2.84), fresh weight of large tubers per plant (115.28 g), total number of tubers per plant (27.95), tuber yield per plant (346.92 g), tuber yield per plot (20.82 kg/ 6 m^2) and tuber yield (34.69 t/ha) was maximum in T_1 treatment. It concluded that successfully tuberlets yield can be produced from seedling raised from TPS method.

Keywords: True potato seed; cocopeat; vermicompost; FYM; growth; yield.

1. INTRODUCTION

Potato (*Solanum tuberosum* L.) is a popular tuber crop that contributes to global food security [1]. Potato is a wholesome food that belongs to the family Solanaceae. It was originated in Peru Bolivia in the Andes (South America) with the fundamental chromosome number (x=12) [2]. The potato was introduced to India by Portuguese traders in the 17th century and its cultivation was spread to North India by the British [3]. For the inhabitants of Peru, the potato has been the bread of life for centuries. It is the fourth most important food crop after wheat, rice and maize in terms of food security, nutrition and avoiding hunger where food is always in short supply to support an ever-increasing population amidst inevitable social and political turmoil [4].

Farmers traditionally propagate potato through seed tubers [5] which are frequently imported from developed seed producing countries and are expensive. These seed tubers are usually bulky, perishable and difficult to transport to remote production sites accounting for more than half the total production cost [6]. Moreover, tubers are often the main carrier of diseases and pests [7] that are attributed to seed degeneration [8] which leads to lower yields and tuber quality considerably. The poor quality seed potato is believed to be one of the major factors contributing to low potato yield [9]. This has been accelerated by the informal seed distribution system prevailing in most developing countries accounting for more than 90 percent of the seed tuber used by small holder farmers [10,11].

True potato seed (TPS) has been suggested as an alternative seed source for potato production, particularly where the use of conventional seed tubers is hampered by large storage losses [12] or infestation with tuber transmitted diseases [13,14] because TPS carries few pathogens especially viruses from season to season [15]. In the conventional method, 3.5 tonnes of bulky tuber seeds are required to plant one hectare of the potato crop, but 100 to 125 g of TPS fulfills the same requirements [16,17,18]. The use of true potato seed (TPS) has many advantages over the use of seed tubers and is attractive for small scale farmers in developing countries [19,20]. It includes the small mass of seed required to sow, transportation and storage of TPS is safe, easy and inexpensive, long-term TPS seed storage, low seed costs and most seed-borne diseases are not transmitted through the true potato seed [21] and reduces production cost [22].

The productivity of potato in Telangana State is higher than the national average potato productivity and also potato growing states which indicate the potential scope for increasing the thrust on potato cultivation in Telangana State. However, the farmers are facing certain problems in the acquisition of seed tubers and non availability of location specific suitable varieties adaptable to local conditions, research is lacking on the location specific technologies suitable for the region. Keeping this in mind the current research work has been formulated with "Studies on the field performance of true potato seed of different entries under Telangana conditions."

2. MATERIALS AND METHODS

The field experiment was conducted at the PG research farm, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet district, Telangana. The experimental site is located at a latitiude of 17°43'02'' N and a longitude of 78°37'34'' E. The soil was well drained sandy loam having pH 7.85, organic carbon 0.89 % and available N, P_2O_5 and K_2O were 143.26 kg ha^{-1}, 26.00 kg ha^{-1} and 265 kg ha^{-1} respectively. The top 12 best treatments from the nursery experiment of true potato seed (TPS) have been selected based on seedling length and number of true leaves per seedling at transplant stage and it has been used as planting material in field experiment for further yield evaluation. The experiment was laid out in Randomized Block Design (RBD) with two replications. The whole experiment consist of twelve best treatments *i.e*. T_1: {KP-15C3 X D-150 + Cocopeat : Vermicompost : FYM (2:1:1)}, T_2: {PSL/76-6 X D-150 + Cocopeat : Vermicompost : FYM (2:1:1)}, T_3: {PRT-17A X D-150 + Cocopeat : Vermicompost : FYM (2:1:1)}, T_4: {KP-15C3 X D-150 + Cocopeat : FYM (1:1)}, T_5: {PSL/76-6 X D-150 + Cocopeat : FYM (1:1)}, T_6: {PRT-17A X D-150 + Cocopeat : FYM (1:1)}, T_7: {KP-15C3 X D-150 + Cocopeat : Vermicompost (1:1)}, T_8: {PSL/76-6 X D-150 + Cocopeat : Vermicompost (1:1)}, T_9: **{**PRT-17A X D-150 + Cocopeat : Vermicompost (1:1)}, T_{10}: **{**KP-15C3 X D-150 + Cocopeat : Vermiculite : Vermicompost (2:1:1)}, T_{11}: {PSL/76-6 X D-150 + Cocopeat : Vermiculite : Vermicompost (2:1:1)} and T_{12}: **{**PRT-17A X D-150 + Cocopeat : Vermiculite : Vermicompost (2:1:1).

Healthy seedlings were transplanted in the main field at 6.0 m x 1.0 m plots at 60 cm spacing between rows and 20 cm between plants. The field crop received a uniform dose of farmyard manure (30 t ha^{-1}) along with inorganic fertilizers at 120 kg N, 240 kg P_2O_5 and 120 kg K_2O per hectare. Recommended cultural and plant protection measures were followed equally in all the plots when required. The crop was harvested at 90 days after transplanting. Before harvesting, the skin of the tubers was hardened by withholding irrigation for 10 days. After harvest, the tubers were graded according to diameter and weight. Tubers were kept for one week for shade drying to remove field heat and then it was treated in boric acid @ 3 g per litre of water to prevent sprouting. Treated tubers were stored in cold storage at 2-4°C for future use.

The data on different growth parameters like plant height were measured from ground level to the tip of the main shoot with the help of a scale and number of compound leaves per plant was counted at 30, 60 DAT and at harvest. The leaf length, leaf width and leaf area was measured with the help of a leaf area meter and stem diameter was measured with the help of vernier callipers in each tagged five plants from each replication at 30, 60 DAT and at harvest. At the time of harvest, the tuberlets were separated according to their sizes (micro tuber, small tuber, medium tuber and large tuber) with the help of vernier calipers in five randomly selected plants from each replication in each treatment and then their fresh weight of tubers was recorded. The data pertaining to all characters studied were subjected to statistical analysis by using variance techniques as described by Panse and Sukhatme [23]. The treatment differences were tested by the 'F' test of significance based on the null hypothesis. The critical difference was calculated when the difference between the treatments were found significant by the 'F' test at 0.05 level of significance.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

Experimental results revealed that rapid increase in growth parameters was observed up to 60 DAT and recorded maximum growth rate at 60 DAT and after that the growth rate gradually declined due to senescence, while at harvest it was dried.

Plant height is very important to monitor the overall canopy architecture and also govern the orientation of the leaves that further govern the photosynthetic efficiency of a plant to utilize the natural resources. Pooled data of two seasons (Table 1) revealed that significantly maximum plant height (25.15 cm and 47.61 cm) was recorded in T_1 at 30 and 60 DAT respectively, which was on par with T_4 (24.66 cm at 30 DAT and 46.16 cm at 60 DAT) and T_7 (45.62 cm at 60 DAT). Minimum plant height (14.06 cm and 33.72

cm) was registered in T_8 treatment at 30 and 60 DAT respectively. The highest plant height in T_1 at all growth stages which might be due to maximum seedling height, higher seedling vigor index and more number of true leaves per seedling at the transplant stage which resulted in faster recover from transplant shock which led to good establishment in the field [24]. These results were supported by the observation of Chatterjee and Mal [25] in cabbage who found that the seedling received manure like FYM and vermicompost as growth media in the nursery significantly influenced the main crop performance and they concluded that best seedling growth could have enhanced the plant vigor and physiological processes, results in higher metabolic, higher carbohydrate synthesis, faster loading and mobilization of carbohydrates that ultimately enhanced growth parameters in the main field. Bhardwaj [26] reported that good physical and biological conditions in cocopeat, FYM and vermicompost had a positive effect on root development which was helpful in increasing the survival percent of seedlings in the main field after transplanting.

Number of compound leaves per plant is an important character, as it is directly linked with the photosynthetic area available to the plant. The data (Table 1) revealed that among the treatments, T_1 was recorded maximum number of compound leaves per plant (15.05 and 28.13) at 30 and 60 DAT respectively, which was followed by T_4 (13.41) at 30 DAT, while it was on par with T_4 (27.44) at 60 DAT and T_7 (27.15) at 60 DAT. Significantly minimum number of compound leaves per plant (7.84 and 19.62) was observed in T_8 at 30 and 60 DAT respectively. Highest values in T_1 could be attributed with a maximum plant height of this treatment which might provide more area for the production of leaves resulted in the increased photosynthetic area [24]. A similar finding was also obtained by Hazarika et al. [27] in cabbage who reported that the same seedling raised media showed better performance in the main field.

The data from (Table 2) revealed that maximum leaf length (8.85 cm and 20.13 cm) and leaf width (6.68 cm and 14.23 cm) was recorded in T_1 treatment at 30 and 60 DAT respectively, which was on par with T_4 (8.64 cm & 6.50 cm at 30 DAT and 19.95 cm & 14.18 cm at 60 DAT) and T_7 (8.32 cm & 6.47 cm at 30 DAT and 19.86 cm & 14.12 cm at 60 DAT) in leaf length & leaf width respectively. Minimum leaf length (6.28 cm and 15.82 cm) and leaf width (4.08 cm and 11.41 cm) was recorded in T_8 at 30 and 60 DAT respectively. Highest and lowest values of these parameters at all the growth stages might be due to their varietal character, the capacity of root regeneration, their adoptability to different soil and environmental conditions and response to the available nutrients which might influenced the leaf length and width [28]. These results are in close conformity with the findings of Kundu [29], Jamro et al. [30] and Beck [31] in potato.

Leaf area is required for the capture of solar radiation to optimize final tuber yield and dry matter content [32]. Data from (Table 3) the highest leaf area was recorded in T_1 (27.94 cm^2 and 51.48 cm^2) at 30 and 60 DAT respectively, which was on par with T_4 (27.53 cm^2 at 30 DAT and 51.31 cm^2 at 60 DAT), T_7 (27.45 cm^2 at 30 DAT and 51.24 cm^2 at 60 DAT) and T_9 (26.64 cm^2 at 30 DAT and 48.13 cm^2 at 60 DAT). Minimum leaf area (21.51 cm^2 and 40.45 cm^2) was recorded in T_8 at 30 and 60 DAT respectively. Highest values in T_1 treatment at all the growth stages might be attributed to the same treatment registered the best figures in terms of leaf length and leaf width. Atiyeh et al. [33] suggested that FYM and vermicompost contained good microbial activity and the ability to produce growth regulated materials resulting in an increased leaf surface.

Stem diameter is one of the most important parameters for the transportation of water, nutrients and other internal fluids from the roots to the leaves and the flow of photosynthates from source to sink [34]. The data from (Table 3) maximum stem diameter (0.60 cm and 0.82 cm) was recorded in T_1 at 30 and 60 DAT respectively, which was on par with T_4 (0.59 cm at 30 DAT and 0.80 cm at 60 DAT) and T_7 (0.57 cm at 30 DAT and 0.79 at 60 DAT). The minimum stem diameter (0.25 cm and 0.46 cm) was observed in T_8 at 30 and 60 DAT respectively. The maximum values in T_1 might be positively correlated with plant height, as plant height was increased automatically the stem diameter was also increased [35] and it also might be positively correlated with number of compound leaves [36]. A similar finding was also obtained by Hazarika et al. [27] in cabbage who reported that the same seedling raised media showed better performance like plant height, leaf area and stem diameter in the main field. These results are also in agreement with the findings of Gholamnejad et al. [37], Nasirabad et al. [38] in sweet pepper and Vivek and Duraisamy [35] in tomato.

Table 1. Studies on the field performance of best treatments from the nursery experiment on plant height (cm) and number of compound leaves per plant of TPS method

Treatments	Plant height (cm)							Number of compound leaves per plant						
	30 DAT			60 DAT			At harvest	30 DAT			60 DAT			At harvest
	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled		2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	
T_1	26.22	24.07	25.15	50.50	44.73	47.61	Dried	15.60	14.50	15.05	29.35	26.90	28.13	Dried
T_2	22.54	20.53	21.54	47.00	38.30	42.65	Dried	13.20	11.75	12.48	28.05	22.25	25.15	Dried
T_3	20.56	19.05	19.81	44.07	36.50	40.29	Dried	10.05	9.40	9.73	25.65	20.78	23.22	Dried
T_4	25.62	23.70	24.66	50.29	42.04	46.16	Dried	14.00	12.82	13.41	29.08	25.80	27.44	Dried
T_5	22.49	20.45	21.47	46.87	37.75	42.31	Dried	11.20	10.61	10.90	27.76	21.97	24.87	Dried
T_6	22.41	20.40	21.40	44.28	37.56	40.92	Dried	10.50	9.90	10.20	25.78	21.40	23.59	Dried
T_7	23.91	22.30	23.10	49.58	41.67	45.62	Dried	13.90	12.70	13.30	28.60	25.70	27.15	Dried
T_8	15.09	13.03	14.06	37.75	29.68	33.72	Dried	8.56	7.12	7.84	23.00	16.25	19.62	Dried
T_9	22.77	21.15	21.96	47.21	39.00	43.11	Dried	13.70	12.50	13.10	28.30	24.00	26.15	Dried
T_{10}	17.22	15.07	16.15	39.00	30.56	34.78	Dried	9.02	7.73	8.38	23.20	17.39	20.30	Dried
T_{11}	19.86	18.06	18.96	42.50	34.58	38.54	Dried	9.60	8.50	9.05	25.36	19.38	22.37	Dried
T_{12}	17.53	16.12	16.82	41.50	31.18	36.34	Dried	9.40	8.03	8.72	25.17	18.12	21.65	Dried
CD (P=0.05) Treatments	3.03	2.73	1.92	4.97	4.29	3.09	-	1.33	1.50	0.94	2.94	2.39	1.78	-
CD (P=0.05)Years			0.78			1.26				0.39			0.73	
SEm ± Treatments	0.97	0.88	0.66	1.60	1.38	1.05	-	0.43	0.48	0.32	0.94	0.77	0.61	-
SEm ± Years			0.27			0.43				0.13			0.25	
CV	6.44	6.37	6.42	5.02	5.27	5.15	-	5.24	6.51	5.85	5.01	5.01	5.04	-

Table 2. Studies on the field performance of best treatments from the nursery experiment on leaf length (cm) and leaf width (cm) of TPS method

Treatments	Leaf length (cm)							Leaf width (cm)						
	30 DAT			60 DAT			At harvest	30 DAT			60 DAT			At harvest
	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled		2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	
T_1	9.22	8.48	8.85	20.75	19.50	20.13	Dried	6.88	6.49	6.68	14.51	13.95	14.23	Dried
T_2	7.83	7.61	7.72	18.35	17.25	17.80	Dried	5.99	5.66	5.82	13.13	12.75	12.94	Dried
T_3	7.45	7.18	7.31	17.50	16.25	16.88	Dried	5.70	5.22	5.46	11.99	11.62	11.80	Dried
T_4	8.97	8.32	8.64	20.50	19.39	19.95	Dried	6.71	6.29	6.50	14.47	13.89	14.18	Dried
T_5	7.77	7.54	7.65	18.33	17.00	17.67	Dried	5.90	5.60	5.75	13.11	12.73	12.92	Dried
T_6	7.62	7.35	7.48	17.77	16.90	17.33	Dried	5.81	5.35	5.58	12.05	11.66	11.86	Dried
T_7	8.45	8.19	8.32	20.47	19.25	19.86	Dried	6.69	6.25	6.47	14.40	13.85	14.12	Dried
T_8	6.51	6.05	6.28	16.90	14.74	15.82	Dried	4.29	3.87	4.08	11.69	11.12	11.41	Dried
T_9	7.96	7.88	7.92	18.60	17.42	18.01	Dried	6.00	5.71	5.86	13.18	12.85	13.02	Dried
T_{10}	6.90	6.92	6.91	17.00	15.09	16.05	Dried	4.33	4.00	4.17	11.82	11.34	11.58	Dried
T_{11}	7.22	6.89	7.05	17.42	16.00	16.71	Dried	5.67	5.19	5.43	11.93	11.56	11.75	Dried
T_{12}	7.06	6.72	6.89	17.25	15.45	16.35	Dried	5.56	5.10	5.33	11.89	11.52	11.71	Dried
CD (P=0.05) for Treatments	1.04	1.08	0.71	2.49	2.29	1.60	-	1.07	1.02	0.69	1.42	1.63	1.02	-
CD (P=0.05) for Years			0.29			0.65				0.28			0.42	
SEm ± for Treatments	0.33	0.35	0.24	0.80	0.74	0.54	-	0.34	0.33	0.24	0.46	0.53	0.35	-
SEm ± for Years			0.10			0.22				0.10			0.14	
CV	6.09	6.63	6.35	6.16	6.11	6.14	-	8.36	8.56	8.46	5.03	5.99	5.51	-

Table 3. Studies on the field performance of best treatments from the nursery experiment on leaf area (cm²) and stem diameter (cm) of TPS method

Treatments	Leaf area (cm²)							Stem diameter (cm)						
	30 DAT			60 DAT			At harvest	30 DAT			60 DAT			At harvest
	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled		2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	
T_1	28.38	27.50	27.94	53.30	49.66	51.48	Dried	0.66	0.54	0.60	0.85	0.79	0.82	Dried
T_2	26.63	24.82	25.73	48.14	47.19	47.66	Dried	0.48	0.38	0.43	0.75	0.68	0.72	Dried
T_3	23.19	22.62	22.90	45.25	43.25	44.25	Dried	0.38	0.29	0.33	0.66	0.59	0.63	Dried
T_4	28.30	26.75	27.53	53.28	49.34	51.31	Dried	0.65	0.53	0.59	0.83	0.77	0.80	Dried
T_5	26.52	24.61	25.56	48.00	46.25	47.13	Dried	0.47	0.36	0.41	0.74	0.66	0.70	Dried
T_6	23.25	23.00	23.12	45.31	44.43	44.87	Dried	0.39	0.30	0.34	0.68	0.60	0.64	Dried
T_7	28.27	26.63	27.45	53.23	49.25	51.24	Dried	0.62	0.52	0.57	0.81	0.76	0.79	Dried
T_8	22.03	20.98	21.51	41.13	39.76	40.45	Dried	0.28	0.21	0.25	0.49	0.42	0.46	Dried
T_9	26.75	26.52	26.64	48.25	48.00	48.13	Dried	0.50	0.41	0.46	0.77	0.68	0.73	Dried
T_{10}	22.15	21.45	21.80	41.98	40.42	41.20	Dried	0.30	0.25	0.28	0.54	0.48	0.51	Dried
T_{11}	23.14	22.09	22.62	44.91	42.68	43.80	Dried	0.36	0.29	0.33	0.64	0.55	0.60	Dried
T_{12}	23.06	22.00	22.53	44.36	41.88	43.12	Dried	0.33	0.27	0.30	0.61	0.53	0.57	Dried
CD (P=0.05) for Treatments	2.84	2.69	1.84	5.30	4.99	3.43	-	0.09	0.08	0.06	0.12	0.12	0.07	-
CD (P=0.05) for Years			0.75			1.40				0.02			0.03	
SEm ± for Treatments	0.91	0.87	0.63	1.70	1.60	1.17	-	0.03	0.02	0.02	0.04	0.03	0.03	-
SEm ± for Years			0.26			0.48				0.01			0.01	
CV	5.13	5.08	5.11	5.09	5.02	5.06	-	9.49	9.76	9.65	7.56	7.80	7.68	-

T_1: KP-15C3 X D-150 + Cocopeat : Vermicompost :FYM (2:1:1)
T_2: PSL/76-6 X D-150 + Cocopeat + Vermicompost: FYM (2:1:1)
T_3: PRT-17A X D-150 + Cocopeat : Vermicompost :FYM (2:1:1)
T_4: KP-15C3 X D-150 + Cocopeat : FYM (1:1)
T_5: PSL/76-6 X D-150 + Cocopeat : FYM (1:1)
T_6: PRT-17A X D-150 + Cocopeat : FYM (1:1)
T_7: KP-15C3 X D-150 + Cocopeat : Vermicompost (1:1)
T_8: PSL/76-6 X D-150 + Cocopeat : Vermicompost (1:1)
T_9: PRT-17A X D-150 + Cocopeat : Vermicompost (1:1)
T_{10}: KP-15C3 X D-150 + Cocopeat :Vermiculite :Vermicompost (2:1:1)
T_{11}: PSL/76-6 X D-150 + Cocopeat : Vermiculite : Vermicompost (2:1:1)
***T_{12}:** PRT-17A X D-150 + Cocopeat : Vermiculite:Vermicompost (2:1:1)*

Table 4. Studies on the field performance of best treatments from the nursery experiment on number of micro, small, medium and large tubers per plant of TPS method

Treatments	Number of micro tubers per plant			Number of small tubers per plant			Number of medium tubers per plant			Number of large tubers per plant		
	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled
T_1	11.72	11.81	11.77	7.45	7.47	7.46	6.39	5.39	5.89	3.43	2.25	2.84
T_2	10.01	10.15	10.08	6.58	6.61	6.59	4.51	3.88	4.19	2.25	1.45	1.85
T_3	9.82	10.00	9.91	6.55	6.59	6.57	4.12	3.61	3.86	2.08	1.08	1.58
T_4	11.19	11.33	11.26	6.84	7.02	6.93	5.58	4.50	5.04	3.39	2.19	2.79
T_5	10.02	10.22	10.12	6.38	6.39	6.38	4.32	3.82	4.07	2.17	1.28	1.72
T_6	9.61	10.01	9.81	6.26	6.24	6.25	4.22	3.71	3.96	2.10	1.11	1.60
T_7	11.02	11.31	11.17	6.80	7.01	6.90	5.21	4.15	4.68	3.33	2.13	2.73
T_8	8.89	9.37	9.13	4.95	5.10	5.02	3.25	2.23	2.74	1.88	0.70	1.29
T_9	10.32	10.54	10.43	6.59	6.72	6.65	5.06	4.03	4.54	2.29	1.75	2.02
T_{10}	8.94	9.46	9.20	5.05	5.63	5.34	3.42	2.40	2.91	1.93	0.82	2.07
T_{11}	9.63	10.01	9.82	6.11	6.19	6.15	3.92	3.39	3.65	2.03	1.01	1.37
T_{12}	9.20	9.93	9.56	6.02	6.15	6.08	3.81	3.28	3.54	1.98	0.98	1.52
CD (P=0.05) for Treatments	1.57	1.29	0.95	1.12	1.11	0.74	1.21	1.00	0.74	1.00	0.56	0.54
CD (P=0.05) for Years			NS			NS			0.30			0.22
SEm ± for Treatments	0.50	0.41	0.33	0.36	0.36	0.25	0.39	0.32	0.25	0.32	0.18	0.18
SEm ± for Years			0.13			0.10			0.10			0.08
CV	7.10	5.64	6.39	8.08	7.83	7.96	12.24	12.31	12.33	18.99	18.25	19.45

Note: microtubers (1-9 mm), small tubers (10-19 mm), medium tubers (20-39 mm) and large tubers (> 40 mm)

Table 5. Studies on the field performance of best treatments from the nursery experiment on fresh weight of micro, small, medium and large tubers per plant of TPS method

Treatments	Fresh weight of micro tubers per plant (g)			Fresh weight of small tubers per plant (g)			Fresh weight of medium tubers per plant (g)			Fresh weight of large tubers per plant (g)		
	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled
T_1	16.07	16.34	16.21	43.83	44.24	44.03	182.80	160.00	171.40	121.06	109.50	115.28
T_2	12.63	12.96	12.79	32.50	32.89	32.69	142.00	129.79	135.90	94.46	78.21	86.33
T_3	12.78	13.00	12.89	30.01	30.25	30.13	116.44	97.28	106.86	76.36	57.30	66.83
T_4	15.97	16.23	16.10	41.10	41.44	41.27	179.61	156.81	168.21	118.00	98.16	108.08
T_5	13.05	13.63	13.34	29.45	29.82	29.63	130.00	127.75	128.88	93.00	69.00	81.00
T_6	12.43	12.87	12.65	28.10	28.35	28.22	118.45	105.45	111.95	77.44	58.10	67.77
T_7	15.29	15.48	15.38	38.45	38.91	38.68	170.87	148.87	159.87	115.00	96.09	105.55
T_8	10.91	11.39	11.15	25.67	26.38	26.03	98.98	77.50	88.24	61.00	39.56	50.28
T_9	15.21	15.41	15.31	32.85	33.16	33.00	158.50	138.12	148.31	102.40	82.56	92.48
T_{10}	11.81	12.11	11.96	25.89	26.39	26.14	100.50	80.07	90.28	64.84	45.46	55.15
T_{11}	12.36	12.45	12.40	26.61	27.18	26.89	110.87	88.28	99.57	71.00	52.13	61.57
T_{12}	12.04	12.39	12.21	26.06	26.44	26.25	109.45	82.87	96.16	69.00	48.50	58.75
CD (P=0.05) for Treatments	1.55	1.61	1.05	3.82	4.09	2.64	16.33	18.30	11.56	9.86	9.18	6.35
CD (P=0.05) for Years			NS			NS			4.72			2.59
SEm ± for Treatments	0.50	0.52	0.36	1.23	1.31	0.90	5.25	5.88	3.94	3.17	2.95	2.16
SEm ± for Years			0.15			0.37			1.61			0.88
CV	5.27	5.35	5.31	5.47	5.78	5.63	5.50	7.16	6.28	5.06	6.00	5.47

T_1: KP-15C3 X D-150 + Cocopeat : Vermicompost :FYM (2:1:1)
T_2: PSL/76-6 X D-150 + Cocopeat + Vermicompost: FYM (2:1:1)
T_3: PRT-17A X D-150 + Cocopeat : Vermicompost :FYM (2:1:1)
T_4: KP-15C3 X D-150 + Cocopeat : FYM (1:1)
T_5: PSL/76-6 X D-150 + Cocopeat : FYM (1:1)
T_6: PRT-17A X D-150 + Cocopeat : FYM (1:1)
T_7: KP-15C3 X D-150 + Cocopeat : Vermicompost (1:1)
T_8: PSL/76-6 X D-150 + Cocopeat : Vermicompost (1:1)
T_9: PRT-17A X D-150 + Cocopeat : Vermicompost (1:1)
T_{10}: KP-15C3 X D-150 + Cocopeat :Vermiculite :Vermicompost (2:1:1)
T_{11}: PSL/76-6 X D-150 + Cocopeat : Vermiculite : Vermicompost (2:1:1)
T_{12}: PRT-17A X D-150 + Cocopeat : Vermiculite:Vermicompost (2:1:1)

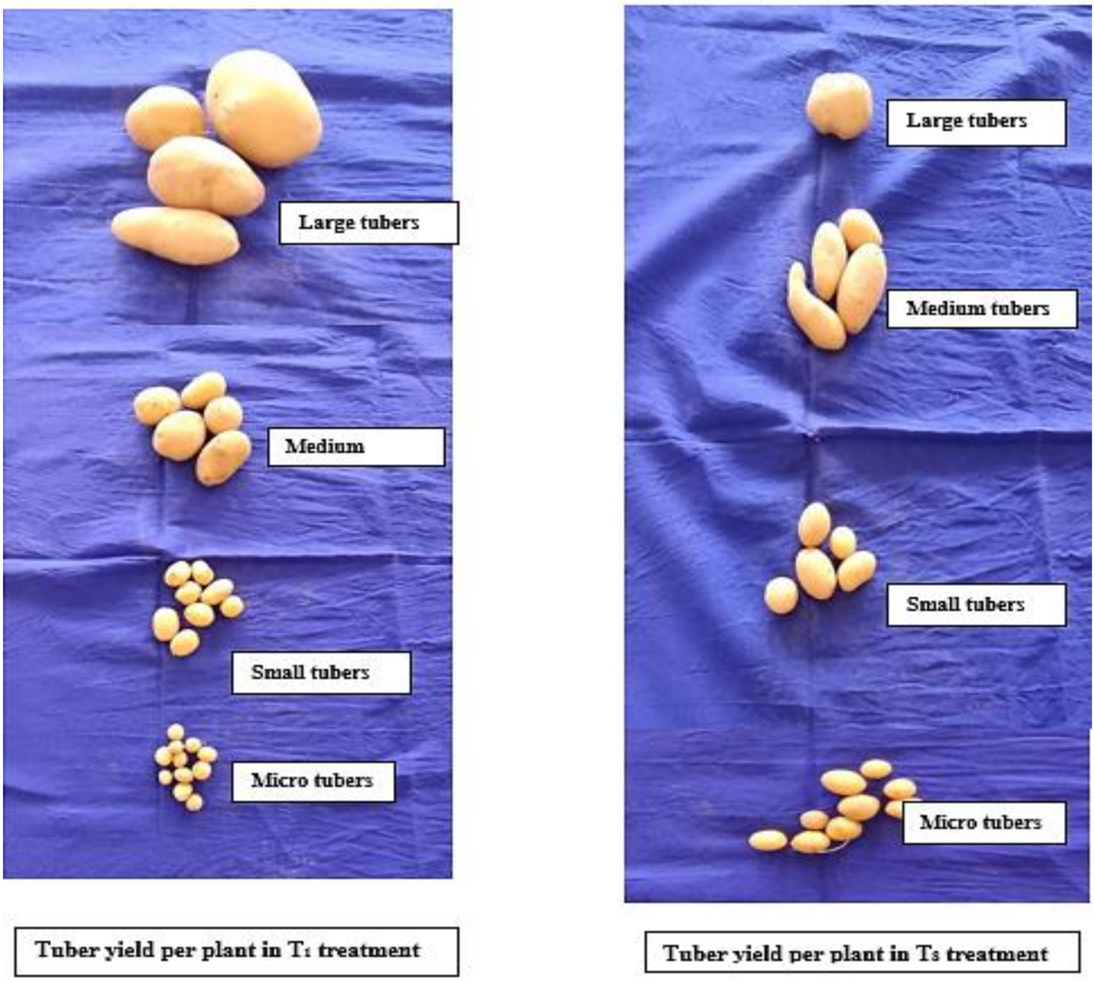

Fig. 1. Comparison of tuber yield per plant in highest (T_1) and lowest (T_8) treatment

3.2 Yield Parameters

The results from (Table 4) showed that T_1 was recorded a significantly maximum number of tubers per plant *viz*., micro tubers (11.77), small tubers (7.46), medium tubers (5.89) and large tubers (2.84), which was on par with T_4 (11.26, 6.93 and 2.79) and T_7 (11.17, 6.90 and 2.73) in micro tubers, small tubers and large tubers respectively, while it was followed by T_4 (5.04) in medium tubers. The minimum number of tubers per plant *viz*., micro tubers (9.13), small tubers (5.02), medium tubers (2.74) and large tubers (1.29) was recorded in T_8.

The data from (Table 4) treatment T_1 has recorded a significantly maximum number of tubers per plant like micro tubers, small tubers, medium tubers and large tubers might be attributed to good root regeneration, thus resulting in more vigorous plant morphological growth like plant height, number of compound leaves per plant and leaf area with more effective physiological processes such as photosynthesis, With effective photosynthesis, more carbohydrates could have been produced and has promoted more initiation of stolons per hill and bulking as well as environmental factors that caused differences in the size of tubers [39]. Pavek and Thornton [32] reported that the number of tubers per plant might be influenced by weather conditions as well as morphological characters. Gebremedhin et al. [40] who concluded that the number of tubers among the cultivars could be genetic. The same trend was found by Nizamuddin et al. [17], Moeini et al. [41], Bilate and Mulualem [42] and Jamro et al. [30] in potato.

Table 6. Studies on the field performance of best treatments from the nursery experiment on total number of tubers, tuber yield per plant, plot and hectare of TPS method

Treatments	Total number of tubers per plant			Tuber yield (g/plant)			Tuber yield per plot (kg/6 m^2)			Tuber yield (t/ha)		
	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled	2021-22 (*Rabi*)	2022-23 (*Rabi*)	Pooled
T_1	28.98	26.92	27.95	363.76	330.08	346.92	21.83	19.81	20.82	36.38	33.01	34.69
T_2	23.34	22.09	22.71	281.58	253.85	267.71	16.90	15.23	16.06	28.16	25.38	26.77
T_3	22.57	21.27	21.92	235.58	197.82	216.70	14.14	11.87	13.00	23.56	19.79	21.67
T_4	26.99	25.03	26.01	354.67	312.62	333.65	21.28	18.76	20.02	35.47	31.27	33.37
T_5	22.88	21.70	22.29	265.50	240.19	252.85	15.93	14.42	15.17	26.55	24.03	25.29
T_6	22.18	21.06	21.62	236.41	204.76	220.59	14.19	12.29	13.24	23.64	20.48	22.06
T_7	26.36	24.60	25.48	339.60	299.35	319.47	20.38	17.97	19.17	33.96	29.95	31.95
T_8	18.96	17.39	18.17	196.56	154.83	175.69	11.80	9.29	10.54	19.66	15.49	17.57
T_9	24.25	23.04	23.65	308.95	269.24	289.09	18.54	16.15	17.34	30.89	26.92	28.90
T_{10}	19.33	18.31	18.82	203.03	164.02	183.53	12.18	9.85	11.01	20.30	16.41	18.35
T_{11}	21.67	20.60	21.13	220.83	180.03	200.43	13.25	10.80	12.03	22.09	18.00	20.04
T_{12}	20.99	20.34	20.67	216.54	170.20	193.37	12.99	10.22	11.60	21.65	17.03	19.34
CD (P=0.05) for Treatments	3.10	2.13	1.77	22.30	20.19	14.17	1.33	1.22	0.85	2.22	2.03	1.42
CD (P=0.05) for Years			0.72			5.79			0.35			0.58
SEm ± for Treatments	1.00	0.68	0.60	7.16	6.49	4.83	0.43	0.39	0.29	0.72	0.65	0.48
SEm ± for Years			0.25			1.97			0.12			0.20
CV	6.07	4.43	5.36	3.77	3.96	3.87	3.76	3.98	3.87	3.76	3.98	3.87

T_1: KP-15C3 X D-150 + Cocopeat : Vermicompost :FYM (2:1:1)
T_2: PSL/76-6 X D-150 + Cocopeat + Vermicompost: FYM (2:1:1)
T_3: PRT-17A X D-150 + Cocopeat : Vermicompost :FYM (2:1:1)
T_4: KP-15C3 X D-150 + Cocopeat : FYM (1:1)
T_5: PSL/76-6 X D-150 + Cocopeat : FYM (1:1)
T_6: PRT-17A X D-150 + Cocopeat : FYM (1:1)
T_7: KP-15C3 X D-150 + Cocopeat : Vermicompost (1:1)
T_8: PSL/76-6 X D-150 + Cocopeat : Vermicompost (1:1)
T_9: PRT-17A X D-150 + Cocopeat : Vermicompost (1:1)
T_{10}: KP-15C3 X D-150 + Cocopeat :Vermiculite :Vermicompost (2:1:1)
T_{11}: PSL/76-6 X D-150 + Cocopeat : Vermiculite : Vermicompost (2:1:1)
***T_{12}:** PRT-17A X D-150 + Cocopeat : Vermiculite:Vermicompost (2:1:1)*

The results from (Table 5) showed that T1 was recorded a significantly maximum fresh weight of tubers per plant viz., micro tubers (16.21 g), small tubers (44.03 g), medium tubers (171.40 g) and large tubers (115.28 g), which was on par with T4 (16.10 g, 41.27 g, 168.21 g and 108.08 g) in all above tubers respectively, T7 (15.38 g in micro tubers and 159.87 g in medium tubers) and T9 (15.31 g) in microtubers. The minimum fresh weight of tubers per plant viz., micro tubers (11.15 g), small tubers (26.03 g), medium tubers (88.24 g) and large tubers (50.28 g) was recorded in T8. The variation in weight of tubers might be due to heredity and adaptability or establishment effect of other growth attributes like plant height, leaf number which might influenced differently on different varieties. Tekalign [43] reported that yield differences among varieties were attributed to the inherent yield potential of varieties and growing environment as well as the interaction of varieties x environment in potato. It also might be due to better growth of the above ground parts which led to more photosynthetic formation and their translocation in the sink (tuber) resulted in higher yield [44]. This result is in agreement with the finding of Muthuraj et al. [45], Asmamawu [46], Elfinesh [47], Patel et al. [48], Cioloca et al. [20], Gebreselassie et al. [49], Jamro et al. [30] and Beck [31] in potato.

The data from (Table 6) revealed that a significantly maximum number of total tubers per plant (27.95), tuber yield per plant (346.92 g), tuber yield per plot (20.82 kg) and tuber yield (34.69 t/ha) was recorded in T_1, which was followed by T_4 (26.01) in total number of tubers per plant, while it was on par with T_4 (333.65 g, 20.02 kg and 33.37 t/ha) in tuber yield per plant, tuber yield per plot and tuber yield per hectare. The minimum number of total tubers per plant (18.17), tuber yield per plant (175.69 g), tuber yield per plot (10.54 kg) and tuber yield (17.57 t/ha) was recorded in T_8. The highest number of tuber per plant and their fresh weight in T_1 treatment could be attributed to the maximum number of micro tubers, small tubers, medium tubers and large tubers per plant and their fresh weight of this treatment. The highest tuber yield per plot could be attributed to the maximum tuber yield per plant of this treatment as compared to other treatments. This result is in agreement with the finding of Badr et al. [50] who stated that tuber number and tuber weight per plant jointly increased tuber yield per plot. This finding was in close conformity with the results of Beck [31] in potato.

Lower tuber yield in T_8 treatment might be due to slow growth and development it might possible that tuber initiation was reduced and this finally resulted into poor tuber yield [51].

4. CONCLUSION

The result of the field experiment of true potato seed revealed that KP-15C3 X D-150 + Cocopeat: Vermicompost: FYM (2:1:1) was recorded significantly highest values for growth parameters in terms of plant height, number of compound leaves per plant, leaf area and stem diameter with highest tuberlet yield. It can conclude that successfully tuberlets yield can be produced from seedling raised from TPS.

ACKNOWLEDGEMENTS

The authors sincerely acknowledge the ICAR-CPRI, Regional Station, Patna, Bihar for provision of seed material used for the experiment.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Karam F, Rouphac Y, Lahoud R, Breidi J, Coll G. Influence of genotypes and potassium application rates on yield and potassium use efficiency of potato. Journal of Agronomy. 2009;8(1):27- 32.
2. Hawkes JG. The Potato: Evolution, biodiversity and genetic resources. Belhaven press, London; 1990.
3. Nath P, Srivastava VK, Dutta OP, Swamy KRM. Vegetable crops improvement and production. Jwalamukhi job press, Karnataka, India. 2008;398.
4. Dev A, Kumar S, Kumar D, Patel VK, Kumar A, Sahu RK, Singh P. The effect of integrated nutrient management (INM) and Zn fertilization on yield of potato. International Journal of Current Microbiology and Applied Sciences, ISSN: 2319-7706 Volume Number 4; 2020.
5. Struik PC, Lommen WJM. Production, storage and use of micro and minitubers. Proceedings 11th Triennial Conference of the European Association for Potato Research, Edinburgh, UK. 1990;122- 133.
6. Mahmood. Comparison of hydroponic culture and culture in a peat/sand mixture

and the influence of nutrient solution and plant density on potato yields. Potato Research. 2005;40:431-438.
7. Simmonds NW. A Review of Potato Propagation by Means of Seeds as Distinct from Clonal Propagation by Tubers. Potato Research. 1997;40(2).
8. Gildemacher P, Demo P, Kinyae P, Nyongesa M, Mundia P. Selecting the best plants to improve seed potato. LEISA. 2007;23:10-11.
9. Fuglie KO. Priorities for potato research in developing countries: Results of a survey. American Journal of Potato Research. 2007;84:353- 365.
10. Hidalgo O, Manrique K, Velasco C, Devaux A, Andrade JL. Diagnostic of seed potato systems in Bolivia, Ecuador and Peru focusing on native varieties. In: 15th International Symposium of the International Society for Tropical Root Crops (ISTRC), Lima, Peru. 2009;2-7.
11. Lungaho C, Nyongesa MW, Mbiyu NM, Ngang DN, Kipkoech P, Pwaipwai J, Karinga. Potato (*Solanum tuberosum* L.) minituber production using aeroponics: Another arrow in the quiver? Paper presented at the 12th KARI Scientific Conference, KARI Headquarters, Kenya. 2010;8-12.
12. Hoang VT, Liem PX, Dan VB, Dam ND, Linh NX, Viet NV, Tung P, Zaag PV. True potato seed research and development in Vietnam. American Potato Journal. 1988; 65:295-30.
13. Bofu S, Yu QD, Zaag VP. True potato seed in China, past, present and future. Potato Journal. 1987;64:321–327.
14. Fernandez BB, Tumapon AS, Duna LV, Balanay NM, Kloos JP, Zaag PV. On-farm evaluation of true potato seed in the Philippines. American Potato Journal. 1988;65:457-461.
15. Burrows ME, Zitter TA. Virus problems of potatoes, vegetable MD Online. USDA-ARS and department of plant pathology, Cornell University, Ithaca; 2005.
16. Thakur KC, Kumar S, Pande PC. True potato seed for potato production. In: Twenty steps towards hidden treasure. Ed. SK. Pandey SK. Chakrabarti. CPRI, Shimla. 2008;162-173.
17. Nizamuddin QM, Mirza B, Shakirullah AM, Ahmad S, Din M, Hussain I, Baig D. Yield performance of true potato seeds (TPS) hybrids under climatic conditions of Northern areas. Sarhad Journal of Agriculture. 2010;26(2):241-244.
18. Mihaela C, Baciu A, Nistor A, Popa M. Production of seedling tubers from true potato seed (TPS) in protected area. Journal of Horticulture, Forestry and Biotechnology. 2012;16(4):136-141.
19. Almekinders CJM, Chujoy E, Thiele G. The use of true potato seed as pro-poor technology. The efforts of an international agricultural research institute to innovating potato production. Potato Research. 2009; 52:275–293.
20. Cioloca M, Baciu A, Nistor A, Popa M. Production of seedling tubers from true potato seed (TPS) in protected area. Journal of Horticulture, Forestry and Biotechnology. 2012;16(4):136-141.
21. Rowell AB, Ewing EE, Plaisted RL. General combining ability of neotuberosum for potato production from true seed. American Potato Journal. 1986;63:141-153.
22. Accatino P, Malagamba JP. Potato production from TPS, A Bulletin of International Potato Centre Lima, Peru. 1982;20.
23. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. ICAR publication, New Delhi. 2000;360.
24. Govind S, Chandra R. Standardization of suitable potting media for raising seedlings of khashi mandarin. Indian Journal Horticulture. 1993;50(3):224-227.
25. Chatterjee R, Mal D. Influence of nursery technique and growing media on seedling growth and field performance of cabbage (*Brassica oleracea* var. capitata L). Journal Environmental Agricultural Science. 2016; 9:15-20.
26. Bhardwaj RL. Effect of growing media on seed germination and seedling growth of papaya Cv. Red lady. Indian Journal Agricultural Research. 2013;47(2):163-168.
27. Hazarika M, Saikia J, Phookan DB, Kumar P, Gujar D. Effect of different growing media on seedling quality and field performance of cabbage (*Brassica oleracea var. capitata L*.). The Pharma Innovation Journal. 2022;11(1):1493-1497.
28. Singh TP, Singh KB. Association of grain yield and its components in segregating populations of green gram. Indian Journal Genetics. 1973;33:112-117.
29. Kundu SK. Exploitation of true potato seed technology for commercial potato production in West Bengal. PhD thesis submitted to the Bidhan Chandra Krishi

Viswavidyalaya in Agriculture (Genetics and Plant Breeding); 1998.

30. Jamro MMR, Shah AN, Laghari GM, Chandio AS, Depa MS. Evaluation of suitable substrate for seedling tuber production by true potato seed through nursery raising. Journal of Basic and Applied Sciences. 2016;12:170-175.
31. Beck N. Performance of true potato seed population (*Solanum tuberosum* L.) for north hills region of Chhattisgarh. M.sc thesis. Submitted to the Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.); 2021.
32. Pavek MJ, Thornton RE. Planting depth influences potato plant morphology and economic value. American Journal Potato Research. 2009;86:56−67.
33. Atiyeh RM, Edwards CA, Subler S, Metzger JD. Pig manure vermicompost as a component of a horticultural bedding plant medium: Effects on physicochemical properties and plant growth. Bioresource Technology. 2001;1:78(1):11-20.
34. Wien HC. The physiology of vegetable crops. CAB. International, New York, USA. 1997;662.
35. Vivek P, Duraisamy VM. Study of growth parameters and germination on tomato seedlings with different growth media. International Journal Agriculture Science Research. 2017;7(3):461-470.
36. Borah AS, Nath A, Ray AK, Bhat R, Maheswarappa HP, Subramanian P, Krishnakumar V. Evolution of potting mixture for raising are canut seedling in polybags. Journal Plantation Crops. 2008; 36(2):137-139.
37. Gholamnejad S, Aroujee H, Nemati SH. Effect of different ratios of cocopeat and vermicompost as a cultural media on seed emergence and some qualitative and quantitative charecterstics of sweet pepper (*Capsicum annuum* L.) transplants. Journal of Horticultural Science. 2012;25: 369-375.
38. Nasirabad SG, Hussain A, Hossein S. The effect of ratio of cocopeat and vermicompost on sweet pepper seedling emergence and some quantitative and qualitative charecterstics. Journal of Horticultural Science. 2012;25:369-375.
39. Patel PB, Patel NH, Patel RN. Correlation and path analysis of some economic characters in potato. Journal Indian Potato Association. 2002;29(3-4):163-164.
40. Gebremedhin W, Endale G, Kiflu B. National potato research program report. Ethiopian agricultural research organization, Holetta Agricultural Research Cente. 2013;125.
41. Moeini MJ, Armin M, Asgharipour MR, Yazdi SK. Effects of different plant growth regulators and potting mixes on micropropagation and mini-tuberization of potato plantlets. Advance in Environment Biology. 2011;5(4):631-638.
42. Bilate B, Mulualem T. Performance evaluation of released and farmers potato (*Solanum tuberosum* L.) varieties in eastern Ethiopia. Sky Journal of Agricultural Research. 2016;5(2):034–041.
43. Tekalign T. Phenotypic stability for tuber yield in elite potato (*Solanum tuberosum* L) genotypes in Eastern Ethiopia. Tropical Agriculture. 2003;80(2):110-113.
44. Diengdoh LC, Rai R, Srivastava AK, Bag TK. Optimizing crop geometry for potato mini-tuber multiplication in net-house. International Journal of Agriculture, Environment and Biotechnology. 2012;5: 113-115.
45. Muthuraj R, Ravichandran G, Krishna KS, Singh S. Effect of planting date on seed size tuber yield of potato in Nilgiris. Potato Journal. 2005;32:3-4:239.
46. Asmamawu Y. Post harvest quality of potato (*Solanum tuberosum* L.) cultivars as influenced by growing environment and storage period. An M.Sc. Thesis presented to the school of graduate studies of Haramaya university, Ethiopia. 2007;41-44.
47. Elfinesh F. Processing quality of improved potato (*Solanum tuberosum L.)* varieties as influenced by growing environment, genotype and blanching. MSc. Thesis submitted to school of plant sciences, Haramaya University, Ethiopia; 2008.
48. Patel CK, Patel PT, Chaudhari SM. Effect of physiological age and seed size on seed production of potato in North Gujarat. Potato Journal. 2008;35:85-87.
49. Gebreselassie H, Mohamed W, Shimelis B. Evaluation of potato (*Solanum tuberosum* L.) varieties for yield and yield components in Eastern Ethiopia. Journal of Biology, Agriculture and Health Care. 2016;6:5:146-154.
50. Badr MA, El-Tohamy WA, Zaghloul AM. Yield and water use efficiency of potato grown under different irrigation and nitrogen levels in an arid region.

Agricultural Water Management. 2012;110: 9-15.

51. Burton WG. Factors limiting potato yields in tropical areas and the technology available for raising yields, Rep. planning conf. optimizing potato productivity in developing countries, (ed W.J. Hooker). International Potato Center, Lima, Peru. 1978;45-67.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/115090