The Pharma Innovation Journal 2022; 11(8): 331-340

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(8): 331-340

www.thepharmajournal.com
Received: 08-05-2022
Accepted: 19-07-2022

Devendra Kumar Sahu
Department of Vegetable Science, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Pravin Kumar Sharma
Department of Vegetable Science, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Dhananjay Sharma
Department of Vegetable Science, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Sunil Agrawal
Department of Agronomy, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Laxmi Prasad Bhardwaj
Department of Vegetable Science, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Vandana Yadav
Department of Vegetable Science, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Corresponding Author:
Devendra Kumar Sahu
Department of Vegetable Science, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Studies on effect of cut and whole seed tubers, plant spacing and different varieties on yield attributes of potato (*Solanum tuberosum* L.) under Chhattisgarh plains condition

Devendra Kumar Sahu, Pravin Kumar Sharma, Dhananjay Sharma, Sunil Agrawal, Laxmi Prasad Bhardwaj and Vandana Yadav

Abstract
The present study entitled "Studies on effect of cut and whole seed tubers, plant spacing and different varieties on yield attributes of potato (*Solanum tuberosum* L.) under Chhattisgarh plains condition" was conducted during *rabi* season 2019-20 and 2020-21 under All India Coordinated Research Project on Potato, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) This experiment was designed in Factorial Randomized block design had three replications, sixteen treatment combinations, keeping four varieties *i.e.* V_1: K. Jyoti, V_2: K. Pukhraj, V_3: K. Sindhuri and V_4: K. Neelkanth and four plant spacing *i.e.* S_1: 10 cm cut seed tuber, S_2: 15 cm cut seed tuber, S_3: 20 cm cut seed tuber and S_4: 20 cm whole seed tuber. To identifying the most suitable high yielder potato varieties under cut and whole seed tuber, also to find out the best combination of plant spacing and potato varieties suitable for the grower of these region. Among the varieties the yield attributes were differ significantly higher the treatment V_3 (K. Sindhuri) given the maximum fresh weight of tuber (199.13 g) and dry weight of tuber (25.16 g) at 90 DAP, were found significantly differ among different varieties. The maximum marketable tuber yield (21.59 t ha^{-1}), unmarketable tuber yield (1.99 t ha^{-1}) and total tuber yield (26.01 t ha^{-1}) were recorded under V_3 (K. Sindhuri) at 90 DAP, all the observations were found significant differences among varieties. The harvest index % was found differ non-significantly among varieties although it was recorded higher with the treatment V_3 (K. Sindhuri).

Keywords: Cut and whole seed tubers, potato, quality, specific gravity, starch content, total soluble solid

1. Introduction
Potato (*Solanum tuberosum* L.) having probable a centre of origin in South America, where it occupies the largest area. It is an annual herbaceous plant grown in every country in the world. It is called as "King of vegetables". It has fourth position among the food crops after wheat, rice and maize. Potato has been disseminated throughout the world. India is the third-largest producer of potato in the world after China and Russia. In the world, 368.24 million tonnes of potato is being produced in area of 17.57 million hectares with 16.64 tonnes per hectare productivity (Anonymous, 2019) [1-3]. In India, it is cultivated in about the 21.42 lakh hectares area with a production of 513.27 lakh MT and average productivity of 23.68 tonnes per hectare (Anonymous, 2019) [1-3]. In Chhattisgarh, it is mainly cultivated in Sarguja, Raigarh, Jashpur, Balrampur, Bilaspur and Baster as rabi crop and in Mainpat and Samripat hills of Sarguja district as kharif crop. However, it can be grown in all the agro-climatic zones of Chhattisgarh under irrigated conditions. It is presently being grown in an area of 43541 hectares with annual production of 598315 tonnes and productivity 15.02 tonnes per hectare (Anonymous, 2019) [1-3].

Potato is a highly nutritious, easily digestible, wholesome food containing carbohydrates, proteins, minerals, vitamins, high quality dietary fiber with high yielding capability to produce more food per unit area and time than any important vegetable crops which not only helps in food self-sufficiency but provides a good alternative means to earn foreign exchange. A potato tuber contains 70-80 per cent water and 20-25 per cent dry matter consisting edible protein (2.8 g), total sugar (0.6 g), starch (16.3 g), crude fiber (0.5 g), fat (0.14 g), carbohydrate (22.6 g), vitamin C (25 mg), mineral (0.9 g), calcium (7.7 mg), iron 2 (0.75 mg), ash (1-1.5%), amylose (22-25%) and glycoalkaloids (< 1 mg) per 100 g fresh weight as an antinutritional factor (Bist and Sharma,1997) [4].

Cutting whole potato tubers and use the pieces for seed (seed-pieces) is a common practice. This is a key reason for cutting to produce seed-pieces to recommended planting size. However, another key reason is to overcome apical dominance exerted by the apical eye or sprout. In brief, the apical eye or sprout (at the "bud end") suppresses the sprouting of eyes more basal (toward the "stem end"). For more on apical dominance in seed tubers, see panel "Tuber Aging" A major problem with cutting, however, is that it opens a severe and large wound through the skin allowing some key pathogens to get into the seed-piece. Because of this concern, seed-pieces must be allowed to heal (suberize) and seed treatments containing fungicides are applied. The situation is further aggravated in the cultivars, which have a tendency to produce large size tubers. One way of reducing cost of seed input in such cultivars is to use cut seed pieces and maintain higher planting density per unit area than of whole seed tubers.

2. Methodology

The experiment was carried out in Factorial RBD with three replication having sixteen treatment combinations with four varieties assigned to four potato spacing. Each treatment combination was randomly replicated thrice. The treatment details are given below. Experimental site was located at Research cum Demonstrational Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, (C.G.) having with adequate facilities for irrigation and drainage are available.

Seed tubers were cut vertically in such a way that each piece had at least 2-3 eyes (40–50 g by weight). The cut pieces were immediately dip treated with 0.2% dithane M-45 @ 2.5 g ltr-^{1} for 10-20 minutes and shade dried. The cut seed pieces were directly planted after drying. Seeds tubers were planted in furrows made at four different spacing as per the experimental design. The spacing was S_1 (60×10cm planting of cut seed tuber), S_2 60× 15cm planting of cut seed tuber), S_3 (60×20cm planting of cut seed tuber) and S_4 (60 ×20 cm planting of whole tuber (recommended spacing)). The treated seed tubers with 2-3 eyes were placed in the furrows as per the spacing. Thereafter, the seed tubers were covered with soil and light irrigation was given.

Nitrogen was applied in form of urea as per the treatments and phosphorous was applied @100 kg/ha in form of Single Super Phosphate (SSP) respectively, whereas, potassium is applied @ 120 kg/ha in the form of Murate of Potash (MOP). The recommended dose of fertilizer *i.e.*,150: 100:100 kg NPK ha-^{1} was applied.

3. Result

3.1 Influence of Variety

The data pertaining Influence of Variety on fresh weight of tuber (g), dry weight of tuber (g), marketable tuber yield (t ha-^{1}), unmarketable tuber yield (tha^{-1}), total tuber yield (t ha^{-1}) and harvest index (%) data were recorded and presented in Table 1, 2, 3, 4, 5 and 6 and depicted in Fig 1, 2, 3, 4, 5 and 6

The data indicated significantly differ among different varieties during the first year, second year and in pooled mean. The maximum fresh weight of tuber (g) during the first year, V_4 (K. Neelkanth) of (202.42 g), second year and pooled mean, were recorded under V_3 (K. Sindhuri) of (202.26 g and 199.13 g, respectively), followed by V_1 (K. Jyoti) was recorded (198.75 g) during first year, and Variety V_2 (K. Pukhraj) (200.16 g and 198.62 g) for second year and pooled mean. Whereas, it was minimum under V_3 (K. Sindhuri) of (196.00 g) during first year and second year, were recorded under V_4 (K. Neelkanth) (193.93 g) and pooled mean data, were recorded under V_1 (K. Jyoti) (197.65 g respectively). The Variety V_3 (K. Sindhuri) was recorded for maximum dry weight of tuber in first year (25.20 g), in second year (25.13 g) and in pooled mean (25.16 g). Followed by V_2 (K. Pukhraj) recorded under first year (24.92g), during second year (24.70 g) and in pooled mean (24.81g). Whereas, it was minimum in first year (23.20 g), in second year (23.80 g) and in pooled mean (23.50 g), under V_4 (K. Neelkanth). The maximum marketable tuber yield (t ha^{-1}) during the first year, second year and pooled mean, were recorded under V_3 (K. Sindhuri) of 21.56, 21.63 and 21.59 t ha^{-1}, respectively, followed by V_2 (K. Pukhraj) of 20.86, 21.06 and 21.59 t ha^{-1}, respectively. The minimum marketable tuber yield (t ha^{-1}) was recorded under V_4 (K. Neelkanth) of 20.09, 20.03 and 20.06 t ha^{-1}, respectively. The Variety V_3 (K. Sindhuri) was recorded for maximum unmarketable tuber yield (t ha^{-1}) was recorded in first year (1.97 t ha^{-1}), in second year (2.01 t ha^{-1}) as well as pooled mean (1.99 t ha^{-1}). Followed by V_2 (K. Pukhraj) recorded under first year (1.85), during second year (1.81 t ha-^{1}) as well as pooled mean (1.83 t ha^{-1}). Where, it was minimum in first year (1.65 t ha^{-1}), in second year (1.62 t ha^{-1}) and in pooled mean (1.64 t ha^{-1}), under V_4 (K. Neelkanth). The Variety V_3 (K. Sindhuri) was recorded for maximum total tuber yield (t ha^{-1}) during the first year, second year and pooled mean 25.71, 26.32 and 26.01 t ha^{-1}, respectively. Followed by V_2 (K. Pukhraj) of 23.09, 22.66 and 22.87 t ha^{-1}, respectively. However, it was minimum (20.25, 20.31 and 20.28 t ha^{-1}, respectively), recorded under V_4 (K. Neelkanth). The maximum harvest index (%) was recorded under V_3 (K. Sindhuri) in first year (57.62%), Second year (57.38%) and in pooled mean (57.50%). Followed by V_2 (K. Pukhraj) was recorded in first year (56.62%), second year (57.28%) and in pooled mean (56.95%). Where, it was minimum under Variety V_4 (K. Neelkanth) in first year (56.10%), second year (56.28%) and pooled mean (56.19%,) respectively.

3.2 Influence of spacing

The data pertaining Influence of Variety on fresh weight of tuber (g), dry weight of tuber (g), marketable tuber yield (t ha-^{1}), unmarketable tuber yield (tha^{-1}), total tuber yield (t ha^{-1}) and harvest index (%) data were recorded and presented in Table 1, 2, 3, 4, 5 and 6 and depicted in Fig 1, 2, 3, 4, 5 and 6

The results have shown that significantly differ among different plant spacing during the first year, second year, and pooled mean. It showed that maximum fresh weight of tuber (g) during the first year S_1 (10 cm cut seed tuber) 214.67 g, second year S_4 (20 cm Whole seed tuber) (215.06 g) and, pooled mean were recorded under S_3 (20 cm cut seed tuber) (202.05 g, respectively), which were found *at par* with S_2 (15 cm cut seed tuber) (207.17 g) during first year and S_3 (20 cm cut seed tuber) (205.36 g) during second year and S_2 (15 cm cut seed tuber) of (201.45 g) in pooled mean. Where, it was minimum under S_4 (20 cm Whole seed tuber) of (173.67 g) during first year and S_1 (10 cm cut seed tuber) of (176.76 g) during second year and in pooled mean S_4 (20 cm Whole seed tuber) of (194.36 g,) respectively. The maximum dry weight of tuber (g) was recorded under S_4 (20 cm whole seed tuber) in first year, second year and pooled mean (26.90 g, 27.27 g and 27.08 g, respectively), which were found *at par* with S_3 (20 cm cut seed tuber) of (25.25 g, 25.00 g and 25.13 g

respectively,) and S_2 (15 cm cut seed tuber) of (24.02 g, 23.58 g and 23.80 g, respectively). However, it was minimum under S_1 (10 cm cut seed tuber) of (21.49, 22.22 and 21.85, respectively). The maximum marketable tuber yield (t ha^{-1}) during the first year, second year and in pooled mean, were recorded under S_4 (20 cm whole seed tuber) of (23.21, 24.16 and 23.69 t ha^{-1}, respectively), which were found *at par* with S_3 (20 cm cut seed tuber) of (21.02, 20.50 and 20.76 t ha^{-1}, respectively) and S_2 (15 cm cut seed tuber) at (19.55, 19.44 and 19.49 t ha^{-1}, respectively). However, it was minimum under S_1 (10 cm cut seed tuber) of (18.98, 18.97 and 18.98 t ha^{-1}, respectively). The maximum unmarketable tuber yield (t ha^{-1}) was recorded (2.35, 2.50 and 2.43 t ha^{-1}) during first year, second year as well as pooled mean under S_4 (20 cm whole seed tuber) which were found *at par* with S_3 (20 cm cut seed tuber) of (2.12, 2.10 and 2.11 t ha^{-1}, respectively) and S_2 (15 cm cut seed tuber) at (1.74, 1.56 and 1.65 t ha^{-1}, respectively). The minimum was recorded during first year, second year as well as pooled mean (0.93, 0.96 and 0.95, t ha^{-1}) under V_4 (Kufri Pukhraj). It showed that maximum total tuber yield (t ha^{-1}) was recorded under S_4 (20 cm whole seed tuber) first year, second year and in pooled mean (23.07, 23.02 and 23.04 t ha^{-1}, respectively), which were found *at par* with S_1 (10 cm cut seed tuber) of (22.84, 22.69 and 22.76 t ha^{-1},) and S_2 (15 cm cut seed tuber) of (22.43, 22.47 and 22.45 t ha^{-1}, respectively). Whereas, it was minimum under S_3 (20 cm cut seed tuber) during the first year, second year and pooled mean (21.99, 22.02 and 22.00 t ha^{-1}, respectively). The spacing S_4 (20 cm whole seed tuber) were recorded for maximum harvest index (%) during the first year, second year and in pooled mean (58.41%, 58.66% and 58.53%, respectively), which were found *at par* with S_3 (20 cm cut seed tuber) of (57.57%, 57.44% and 57.50%, respectively) and S_2 (15 cm cut seed tuber) at (56.84%, 56.56% and 56.70%, respectively). However, it was minimum under S_1 (10 cm cut seed tuber) of (53.87%, 54.74% and 54.30%, respectively).

3.3 Interaction effect with variety x spacing

The data pertaining Interaction (Variety x Spacing) on fresh weight of tuber (g), dry weight of tuber (g), marketable tuber yield (t ha^{-1}), unmarketable tuber yield (tha^{-1}), total tuber yield (t ha^{-1}) and harvest index (%) data were recorded and presented in Table 1, 2, 3, 4, 5 and 6 and depicted in Fig 1, 2, 3, 4, 5 and 6

The results showed that significantly difference for interactions of different varieties and plant spacing. The interactions V_4S_1 (K. Neelkanth and 10 cm cut seed tuber) were recorded for maximum fresh weight (216.67 g), second year V_3S_4 (K. Sindhuri and 20 cm Whole seed tuber) at (217.00 g) and pooled mean, was recorded under treatment V_1S_2 (K. Jyoti and 15 cm cut seed tuber) of (202.33 g), followed by treatment V_1S_1 (K. Jyoti and 10 cm cut seed tuber) of (215.33 g) during first year, and V_2S_4 (K. Pukhraj and 20 cm Whole seed tuber) of (216.67 g) during second year, V_3S_2 (K. Sindhuri and 15 cm cut seed tuber) of (202.28 g) for pooled mean, However, it was minimum in first year V_3S_4 (K. Sindhuri and 20 cm Whole seed tuber) of (170.00 g), second year V_4S_1 (K. Neelkanth and 10 cm cut seed tuber) of (213.35 g), and pooled mean was recorded V_1S_4 (K. Jyoti and 20 cm Whole seed tuber) of (191.62 g,) respectively. It showed that higher fresh weight of tuber (g) might be because of better absorption of nutrient due to higher plant spacing which ultimately facilitate more accumulation of dry matter in the tubers and provided better yield similar results were also reported by Zaag (1990) that wider plant spacing, produced higher fresh weight of tuber plant^{-1}.

The data found significantly differ for interaction of different varieties and plant spacing the interaction V_3S_4 (K. Sindhuri and 20 cm whole seed tuber) was recorded for maximum dry weight of tuber (g) during the first year, second year and pooled mean 27.90 g, 28.00 g and 27.95 g, respectively. Followed by V_3S_3 (K. Sindhuri and 20 cm cut seed tuber) of 25.75 g, 25.67 g and 25.71g, respectively. Where, it was minimum under V_4S_1 (K. Neelkanth and 10 cm cut seed tuber) of 19.60 g, 21.70 g and 20.65 g, respectively. The data revealed that the interaction of different varieties and plant spacing was differ significantly in first year, second year, and in pooled mean. The maximum marketable tuber yield (t ha^{-1}) during the first year, second year and in pooled mean, was recorded under V_3S_4 (K. Sindhuri and 20 cm whole seed tuber) of (25.33, 26.00 and 25.67 t ha^{-1}, respectively), followed by V_3S_3 (K. Sindhuri and 20 cm cut seed tuber) (21.83, 21.50 and 21.67 t ha^{-1}, respectively). However, it was minimum under V_4S_1 (K. Neelkanth and 10 cm cut seed tuber) of (18.60, 18.67 and 18.63 t ha^{-1}, respectively).

The maximum marketable tuber yield (t ha^{-1}) during the first year, second year and in pooled mean was recorded under V_3S_4 (K. Sindhuri and 20 cm whole seed tuber). The increase in marketable tuber yield might be due to optimum plant spacing under these treatments which provides congenial conditions for better growth and development of the tuber. At the wider intra row spacing due the presence of minimum competition, plants absorbed sufficient natural resources and intercepted more light. It also increased their photosynthetic efficiency for higher photo assimilate production and ultimately resulted in increased more marketable tuber yield. Similar findings revealed that for producing potato the inter-row spacing of 60 cm and intra-row spacing of 20 cm was found to be best. Jatav *et al.* (2017) [9]. The findings are also supported by some earlier workers such as Mishra *et al.* (2021) [12] field studies were conducted with Variety (Kufri Jyoti, Kufri Surya and Kufri Ashoka they found that the highest marketable tuber yield was observed in Kufri Ashoka both with whole seed and cut seed.

The data revealed non-significantly differ in the interaction of different varieties and plant spacing. The maximum unmarketable tuber yield (t ha) during the first year, second year and in pooled mean, were recorded under V_3S_4 (K. Sindhuri and 20 cm whole seed tuber) of (2.57, 3.00 and 2.79 t ha^{-1}, respectively), Where it was lowest under V_4S_1 (K. Neelkanth and 10 cm cut seed tuber) of (0.87, 0.88 and 0.88 t ha^{-1}, respectively).

The data revealed that interaction of different varieties and plant spacing was differ significantly. The interaction V_3S_4 (K. Sindhuri and 20 cm whole seed tuber) was recorded maximum total tuber yield in first year (26.38 t ha^{-1}), in second year (27.00 t ha^{-1}) as well as in pooled mean (26.69 t ha^{-1}). Followed by V_3S_1 (K. Sindhuri and 10 cm cut seed tuber) recorded under first year (26.37 t ha^{-1}), during second year (26.39 t ha^{-1}) as well as in pooled mean (26.38 t ha^{-1}). Whereas, it was minimum in first year (20.17 t ha^{-1}), in second year (20.20 t ha^{-1}) and pooled in mean (20.18 t ha^{-1}), under V_4S_3 (K. Neelkanth and 20 cm cut seed tuber). In the present experiment, the total yield was significantly influenced by different varieties and plant spacing. It is

evident from the results that the total tuber yield t ha^{-1}, increased significantly with the increase in plant spacing, and the best result was attained with (K. Sindhuri and 20 cm whole seed tuber). This could be due to the $plant^{-1}$ more land area availability. Widely spaced plant had less competition for nutrient uptake, water, light and air which helped the plant to produce more dry matter photosynthesis and resulting, increasing in yield. The finding of present study is in accordance with those of Patel *et al.* (2003) investigated the effects of inter-row spacings (40, 50 and 60 cm) and intra-row spacings (10, 15 and 20 cm) on the performance of potato cv. Kufri Badshah. Produced highest total tuber yield at a spacing 60x20 cm. which was followed by plant spacing 60x15 cm. Similar results were also reported by Brar *et al.* (2018) [6] and Kushwah *et al.* (2001) [11]

The data interaction of different varieties and plant spacing found non-significantly were differ. The interaction V_3S_4 (K. Sindhuri and 20 cm whole seed tuber) was observed for numerically higher harvest index (%) in first year, second year and in pooled mean (58.92%, 59.00% and 58.96%, respectively). However, it was minimum (53.20%, 53.50% and 53.35%, respectively), under V_1S_1 (K. Jyoti and 10 cm cut seed tuber.

The maximum harvest index (%) was recorded with (K. Sindhuri and 20 cm whole seed tuber). It might be due to the fact that in potato plants, the value of Harvest index depends on by total biological yield and economical yield and as Sindhuri and 20 cm whole seed tuber) the treatment produce higher yield for both the observations therefore it also have been recorded for higher harvest index Similar, result also reported by Belanger *et al.* (2001) [5].

Table 1: Fresh weight of tuber (g) of potato as influenced by varieties and plant spacing

Treatments	Fresh weight of tuber (g)		
	2019-20	2020-21	Mean
A. Variety			
V_1= K. Jyoti	198.75	196.56	197.65
V_2= K. Pukhraj	197.08	200.16	198.62
V_3= K. Sindhuri	196.00	202.26	199.13
V_4= K. Neelkanth	202.42	193.93	198.17
SEm±	12.08	8.84	10.46
CD (P=0.05)	34.90	25.53	30.22
B. Spacing			
S_1= 10 cm cut seed tuber	214.67	176.76	195.71
S_2= 15 cm cut seed tuber	207.17	195.73	201.45
S_3= 20 cm cut seed tuber	198.75	205.36	202.05
S_4= 20 cm whole seed tuber	173.67	215.06	194.36
SEm±	12.08	8.84	10.46
CD (P=0.05)	34.90	25.53	30.22
Interaction (A x B)			
V_1S_1	215.33	173.69	194.51
V_1S_2	209.67	195.00	202.33
V_1S_3	200.00	204.30	202.15
V_1S_4	170.00	213.23	191.62
V_2S_1	213.33	181.30	197.32
V_2S_2	205.00	197.35	201.18
V_2S_3	196.67	205.33	201.00
V_2S_4	173.33	216.67	195.00
V_3S_1	213.33	181.50	197.42
V_3S_2	204.00	200.56	202.28
V_3S_3	196.67	209.96	203.31
V_3S_4	170.00	217.00	193.50
V_4S_1	216.67	170.53	193.60
V_4S_2	210.00	190.00	200.00
V_4S_3	201.67	201.84	201.75
V_4S_4	181.33	213.35	197.34
SEm±	24.16	17.68	20.92
CD (P=0.05)	69.80	51.07	60.44

Table 2: Dry weight of tuber (g) of potato as influenced by varieties and plant spacing

Treatments	Dry weight of tuber (g)		
	2019-20	2020-21	Mean
A. Variety			
V_1= K. Jyoti	24.34	24.44	24.39
V_2= K. Pukhraj	24.92	24.70	24.81
V_3= K. Sindhuri	25.20	25.13	25.16
V_4= K. Neelkanth	23.20	23.80	23.50
SEm±	1.27	1.10	1.19
CD (P=0.05)	3.66	3.18	3.42
B. Spacing			
S_1= 10 cm cut seed tuber	21.49	22.22	21.85
S_2= 15 cm cut seed tuber	24.02	23.58	23.80
S_3= 20 cm cut seed tuber	25.25	25.00	25.13
S_4= 20 cm whole seed tuber	26.90	27.27	27.08
SEm±	1.27	1.10	1.19
CD (P=0.05)	3.66	3.18	3.42
Interaction (A x B)			
V_1S_1	21.70	22.25	21.98
V_1S_2	23.67	23.33	23.50
V_1S_3	24.83	24.75	24.79
V_1S_4	27.17	27.42	27.29
V_2S_1	22.25	22.42	22.33
V_2S_2	24.33	23.67	24.00
V_2S_3	25.67	24.83	25.25
V_2S_4	27.42	27.90	27.66
V_3S_1	22.42	22.50	22.46
V_3S_2	24.75	24.33	24.54
V_3S_3	25.75	25.67	25.71
V_3S_4	27.90	28.00	27.95
V_4S_1	19.60	21.70	20.65
V_4S_2	23.33	23.00	23.17
V_4S_3	24.75	24.75	24.75
V_4S_4	25.12	25.75	25.43
SEm±	2.54	2.20	2.37
CD (P=0.05)	7.33	6.35	6.84

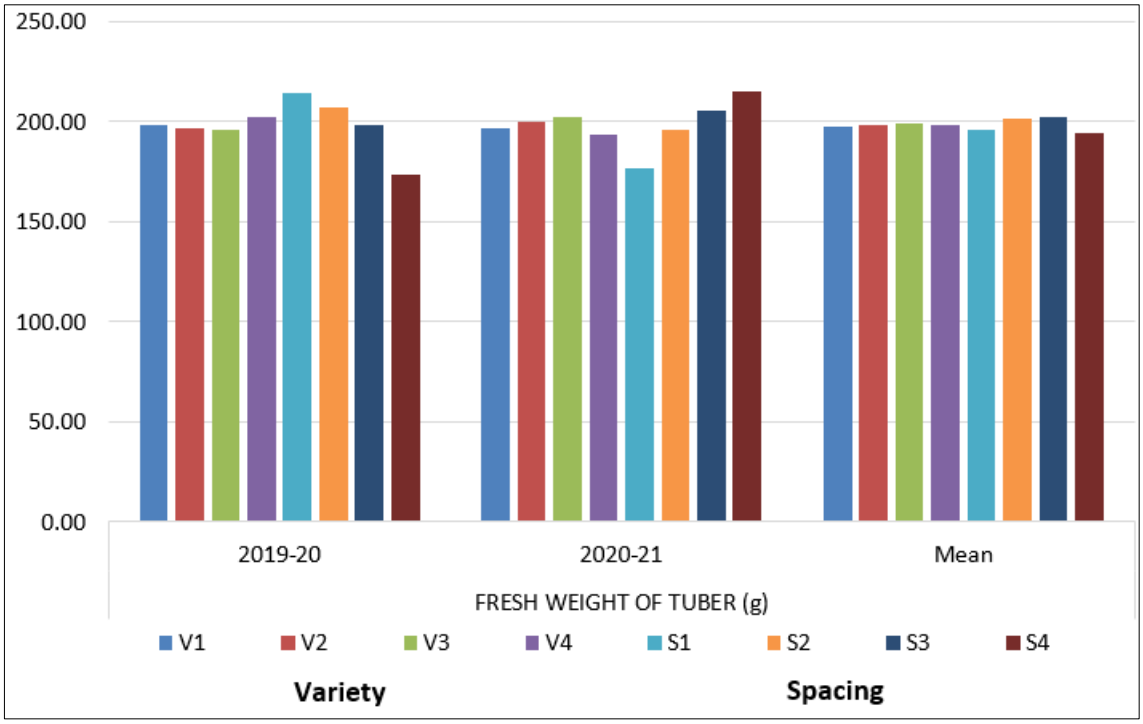

Fig 1: Fresh weight of tuber (g) of potato as influenced by varieties and plant spacing

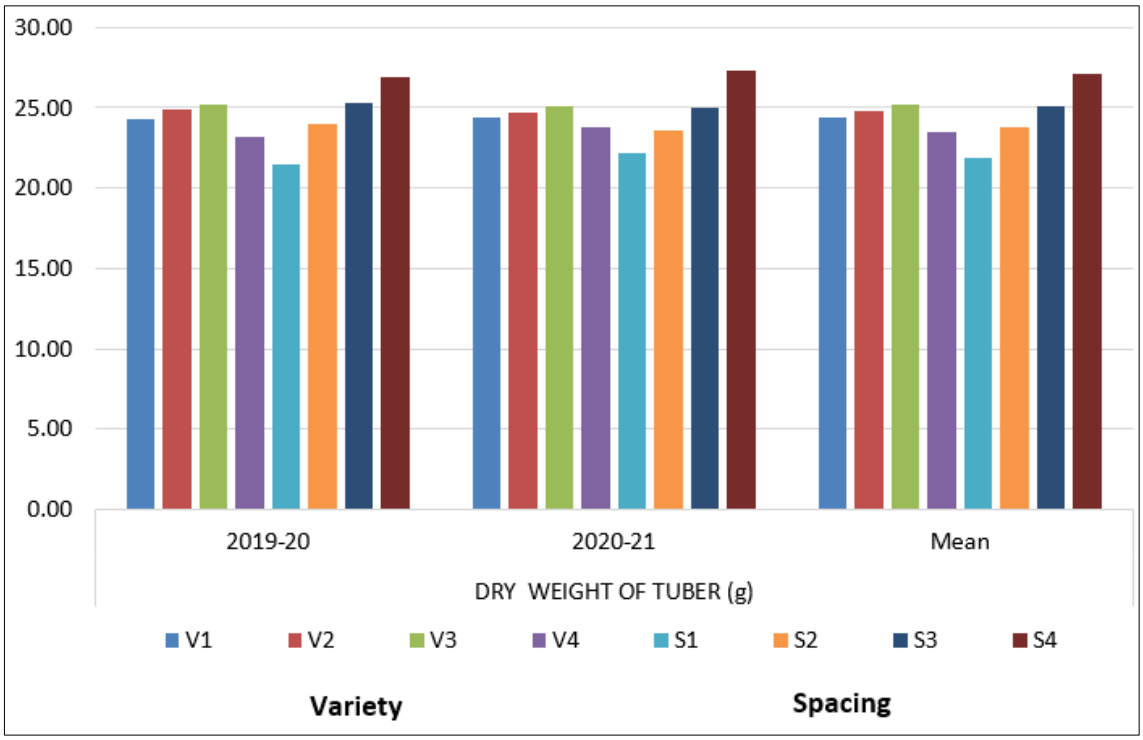

Fig 2: Dry weight of tuber (g) of potato as influenced by varieties and plant spacing

Table 3: Marketable tuber yield (t ha^{-1}) of potato as influenced by varieties and plant spacing

Treatments	Marketable tuber yield (t ha^{-1})		
	2019-20	2020-21	Mean
A. Variety			
V_1= K. Jyoti	20.25	20.35	20.30
V_2= K. Pukhraj	20.86	21.06	20.96
V_3= K. Sindhuri	21.56	21.63	21.59
V_4= K. Neelkanth	20.09	20.03	20.06
SEm±	1.34	1.28	1.31
CD (P=0.05)	3.89	3.71	3.80
B. Spacing			
S_1= 10 cm cut seed tuber	18.98	18.97	18.98
S_2= 15 cm cut seed tuber	19.55	19.44	19.49
S_3= 20 cm cut seed tuber	21.02	20.50	20.76
S_4= 20 cm whole seed tuber	23.21	24.16	23.69
SEm±	1.34	1.28	1.31
CD (P=0.05)	3.89	3.71	3.80
Interaction (A x B)			
V_1S_1	18.67	18.90	18.78
V_1S_2	19.42	19.33	19.38
V_1S_3	20.50	20.25	20.38
V_1S_4	22.40	22.92	22.66
V_2S_1	19.33	19.00	19.17
V_2S_2	19.70	19.42	19.56
V_2S_3	21.50	20.50	21.00
V_2S_4	22.92	25.33	24.13
V_3S_1	19.33	19.30	19.32
V_3S_2	19.73	19.70	19.72
V_3S_3	21.83	21.50	21.67
V_3S_4	25.33	26.00	25.67
V_4S_1	18.60	18.67	18.63
V_4S_2	19.33	19.31	19.32
V_4S_3	20.25	19.73	19.99
V_4S_4	22.18	22.40	22.29
SEm±	2.69	2.57	2.63
CD (P=0.05)	8.06	7.79	7.84

Table 4: Unmarketable tuber yield (t ha^{-1}) of potato as influenced by varieties and plant spacing

Treatments	Unmarketable tuber yield (t ha^{-1})		
	2019-20	2020-21	Mean
A. Variety			
V_1= K. Jyoti	1.67	1.68	1.67
V_2= K. Pukhraj	1.85	1.81	1.83
V_3= K. Sindhuri	1.97	2.01	1.99
V_4= K. Neelkanth	1.65	1.62	1.64
SEm±	0.13	0.13	0.13
CD (P=0.05)	0.38	0.39	0.39
B. Spacing			
S_1= 10 cm cut seed tuber	0.93	0.96	0.95
S_2= 15 cm cut seed tuber	1.74	1.56	1.65
S_3= 20 cm cut seed tuber	2.12	2.10	2.11
S_4= 20 cm whole seed tuber	2.35	2.50	2.43
SEm±	0.13	0.13	0.13
CD (P=0.05)	0.38	0.39	0.39
Interaction (A x B)			
V_1S_1	0.87	0.92	0.90
V_1S_2	1.52	1.48	1.50
V_1S_3	2.08	2.07	2.08
V_1S_4	2.19	2.25	2.22
V_2S_1	0.92	1.05	0.99
V_2S_2	1.88	1.52	1.70
V_2S_3	2.17	2.08	2.13
V_2S_4	2.44	2.57	2.51
V_3S_1	1.05	1.00	1.03
V_3S_2	2.06	1.88	1.97
V_3S_3	2.17	2.18	2.17
V_3S_4	2.57	3.00	2.79
V_4S_1	0.87	0.88	0.88
V_4S_2	1.48	1.35	1.41
V_4S_3	2.07	2.06	2.07
V_4S_4	2.19	2.20	2.20
SEm±	0.26	0.27	0.27
CD (P=0.05)	NS	NS	NS

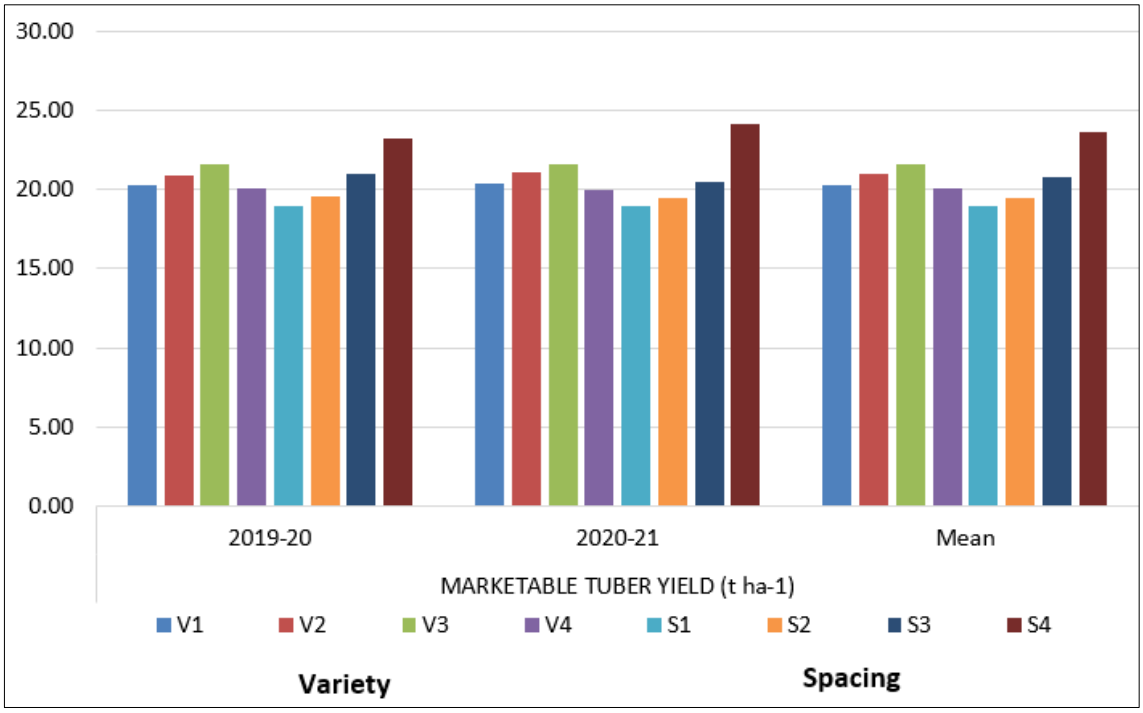

Fig 3: Marketable tuber yield (t ha^{-1}) of potato as influenced by varieties and plant spacing

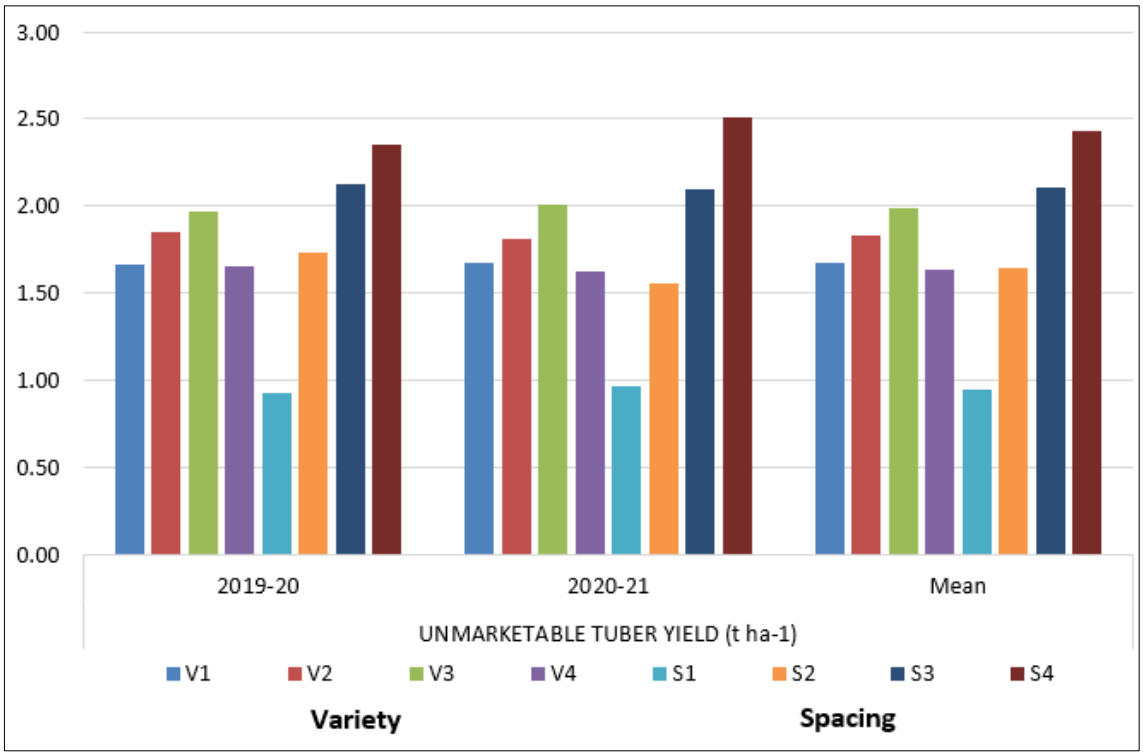

Fig 4: Unmarketable tuber yield (t ha^{-1}) of potato as influenced by varieties and plant spacing

Table 5: Total tuber yield (t ha^{-1}) of potato as influenced by varieties and plant spacing

Treatments	Total tuber yield (t ha-1)		
	2019-20	2020-21	Mean
A. Variety			
V_1= K. Jyoti	21.27	20.92	21.10
V_2= K. Pukhraj	23.09	22.66	22.87
V_3= K. Sindhuri	25.71	26.32	26.01
V_4= K. Neelkanth	20.25	20.31	20.28
SEm±	1.33	1.31	1.32
CD (P=0.05)	3.85	3.78	3.82
B. Spacing			
S_1= 10 cm cut seed tuber	22.84	22.69	22.76
S_2= 15 cm cut seed tuber	22.43	22.47	22.45
S_3= 20 cm cut seed tuber	21.99	22.02	22.00
S_4= 20 cm whole seed tuber	23.07	23.02	23.04
SEm±	1.33	1.31	1.32
CD (P=0.05)	3.85	3.78	3.82
Interaction (A x B)			
V_1S_1	21.61	20.97	21.29
V_1S_2	20.97	20.61	20.79
V_1S_3	20.61	20.50	20.55
V_1S_4	21.89	21.61	21.75
V_2S_1	23.06	23.06	23.06
V_2S_2	23.06	22.60	22.83
V_2S_3	22.60	21.89	22.25
V_2S_4	23.65	23.07	23.36
V_3S_1	26.37	26.39	26.38
V_3S_2	25.50	26.38	25.94
V_3S_3	24.57	25.50	25.03
V_3S_4	26.38	27.00	26.69
V_4S_1	20.31	20.33	20.32
V_4S_2	20.18	20.31	20.24
V_4S_3	20.17	20.20	20.18
V_4S_4	20.33	20.40	20.37
SEm±	2.66	2.62	2.64
CD (P=0.05)	8.01	7.87	7.93

Table 6: Harvest index (%) of potato as influenced by varieties and plant spacing

Treatments	Harvest index (%)		
	2019-20	2020-21	Mean
A. Variety			
V_1= K. Jyoti	56.35	56.47	56.41
V_2= K. Pukhraj	56.62	57.28	56.95
V_3= K. Sindhuri	57.62	57.38	57.50
V_4= K. Neelkanth	56.10	56.28	56.19
SEm±	1.13	1.07	1.10
CD (P=0.05)	NS	NS	NS
B. Spacing			
S_1= 10 cm cut seed tuber	53.87	54.74	54.30
S_2= 15 cm cut seed tuber	56.84	56.56	56.70
S_3= 20 cm cut seed tuber	57.57	57.44	57.50
S_4= 20 cm whole seed tuber	58.41	58.66	58.53
SEm±	1.13	1.07	1.10
CD (P=0.05)	NS	NS	NS
Interaction (A x B)			
V_1S_1	53.20	53.50	53.35
V_1S_2	56.50	56.47	56.48
V_1S_3	57.43	57.43	57.43
V_1S_4	58.25	58.47	58.36
V_2S_1	53.50	56.27	54.88
V_2S_2	57.00	56.50	56.75
V_2S_3	57.50	57.43	57.47
V_2S_4	58.47	58.92	58.69
V_3S_1	56.27	56.00	56.13
V_3S_2	57.40	57.00	57.20
V_3S_3	57.90	57.50	57.70
V_3S_4	58.92	59.00	58.96
V_4S_1	52.50	53.20	52.85
V_4S_2	56.47	56.27	56.37
V_4S_3	57.43	57.40	57.42
V_4S_4	58.00	58.25	58.13
SEm±	2.27	2.14	2.21
CD (P=0.05)	NS	NS	NS

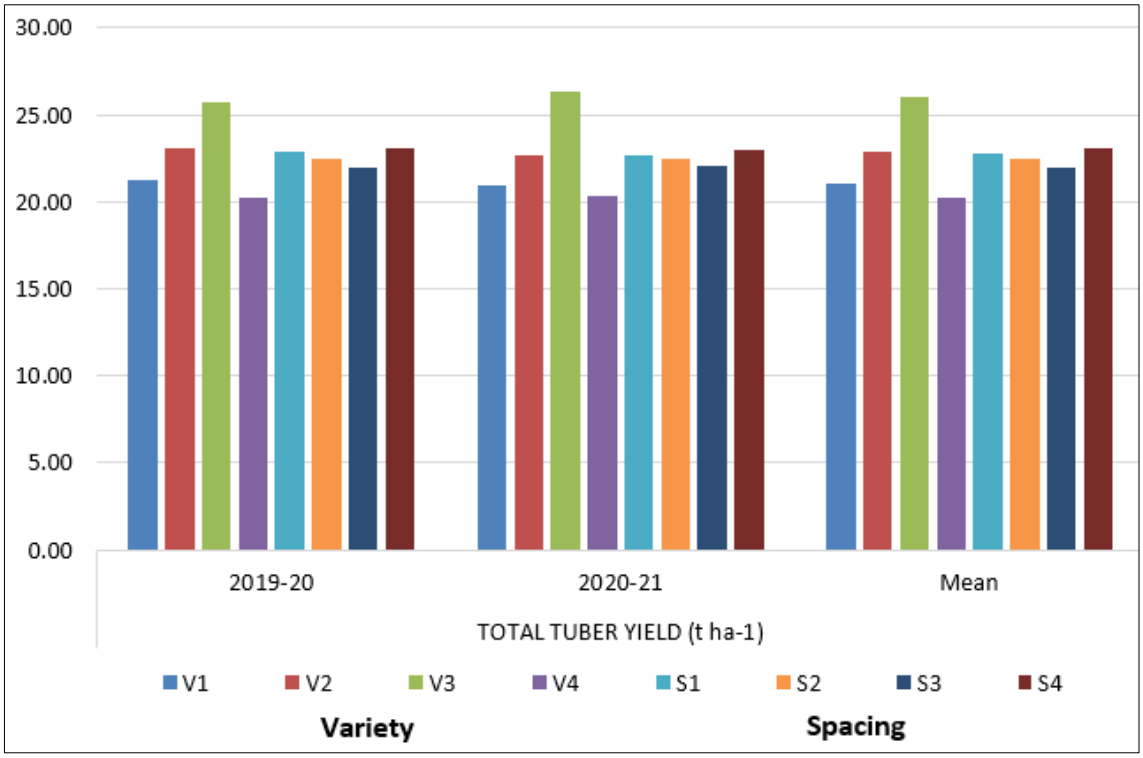

Fig 5: Total tuber yield (t ha^{-1}) of potato as influenced by varieties and plant spacing

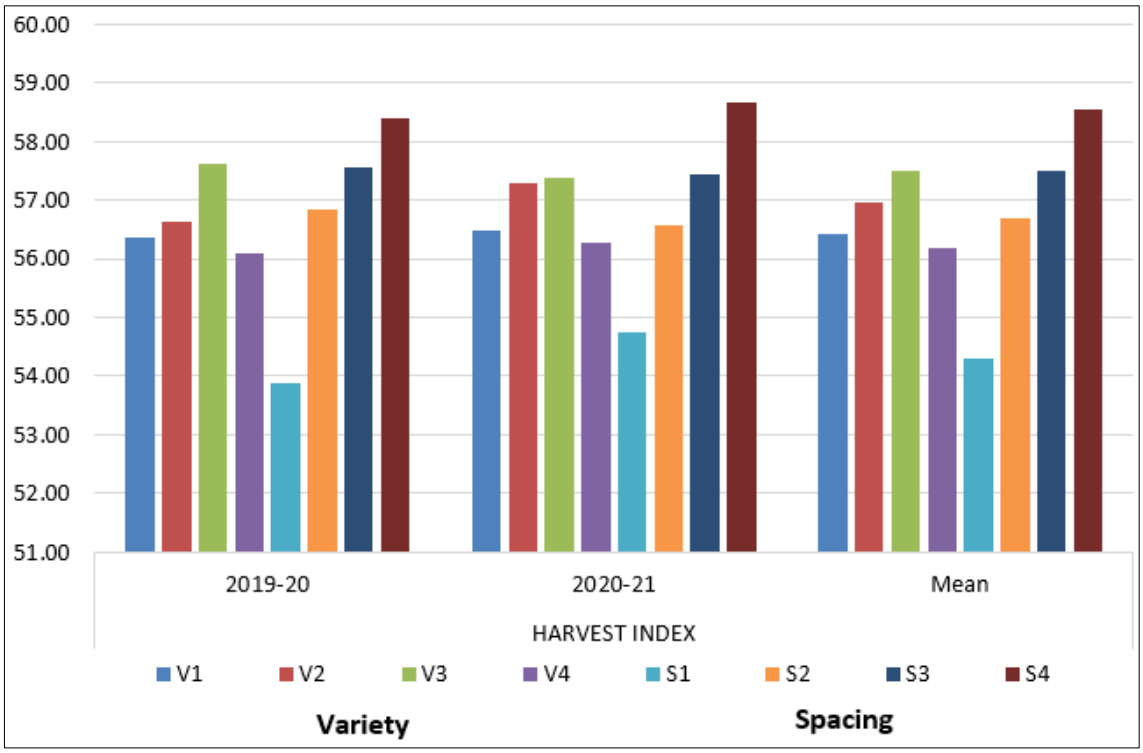

Fig 6: Harvest index (%) of potato as influenced by varieties and plant spacing

4. Conclusion

The yield attributes were recorded V_4S_1 (K. Neelkanth and 10 cm cut seed tuber) for maximum fresh weight (216.67 g), second year V_3S_4 (K. Sindhuri and 20 cm Whole seed tuber) at (217.00 g) and pooled mean. Maximum dry weight of tuber (g) during the first year, second year and pooled mean 27.90 g, 28.00 g and 27.95 g, respectively. Followed by V_3S_3 (K. Sindhuri and 20 cm cut seed tuber) of 25.75 g, 25.67 g and 25.71g, respectively. The maximum unmarketable tuber yield (t ha) during the first year, second year and in pooled mean, were recorded under V_3S_4 (K. Sindhuri and 20 cm whole seed tuber) of (2.57, 3.00 and 2.79 t ha^{-1}, respectively), V_3S_4 (K. Sindhuri and 20 cm whole seed tuber) was recorded maximum total tuber yield in first year (26.38 t ha^{-1}), in second year (27.00 t ha^{-1}) as well as in pooled mean (26.69 t ha^{-1}).

There for it may be concluded that treatment V_3S_4 (K. Sindhuri and 20 cm whole seed tuber) may be prefer for higher yield of potato.

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