Full Length Research Article

Research Journal of Agricultural Sciences
Volume 15; Issue 01 (Jan–Feb 2024); pp 289–295

ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

Effect of Planting Depth on Different Genotypes of Potato (*Solanum tuberosum* L.)

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Received: 24 Aug 2023; Revised accepted: 04 Feb 2024; Published online: 27 Feb 2024

Abstract

A field experiment was conducted during winter season 2021-2022 at the Experimental Farm, Kharora, Department of Agriculture, Mata Gujri College, Fatehgarh Sahib, Punjab, India from October 2021 to February 2022. The present study was conducted to determine the optimum level of planting depth and genotypes for better growth and yield of potato. The experiment consisted of two factors: Factor A: Genotypes (03), G_1: Kufri Jyoti G_2: Lady Rubusta and G_3: Kufri Pushkar and Factor B: Planting depth (4 levels), D_1: 5cm; D_2: 10cm; D_3: 15cm and D_4: 20cm. The experiment was laid out in Factorial Randomized Block Design (FRBD) with three replications. In growth parameters, maximum plant height (26.70), number of stems plant^{-1} (7.85), shoot length (23.33cm), number of secondary branches plant^{-1} (11.17) and number of leaves plant^{-1} (50.73). Among yield parameters viz. numbers of tubers plant^{-1} (6.22), tuber weight (57.25g), tuber diameter (38.67cm), tuber yield (27.40 t ha^{-1}), marketable yield (24.66 t ha^{-1}), biological yield (30.40 t ha^{-1}) and economic parameters viz. gross return (Rs. ha^{-1} 294000), net return (Rs. ha^{-1} 206887) was obtained by Kufri Pushkar at 15 cm planting depth. Results demonstrated that treatment combination G_3D_3 (Kufri Pushkar at 15 cm planting depth) found to be best in most growth and yield characteristics in potato.

***Key words*:** *Solanum tuberosum* L., Planting depth, Genotypes, Tuber yield, Harvest index, Economics

The potato (*Solanum tuberosum* L.), an annual herbaceous plant with the chromosomal number (2n=4×=48), is a tuber crop that includes all the necessary nutrients for good health. Since their introduction outside the Andes region in the fourth century, potatoes have played a significant role in the global food supply. Following maize, wheat, and rice, it is the fourth-largest food crop in the world. From the United States to Southern Chile, there are various wild potato species. Initially, it was thought that the potato had been separately domesticated in several different places, but later genetic research of the numerous cultivars and wild species revealed a common origin for potatoes in the region of modern-day Southern Peru and extreme North Western Bolivia [1]. Potatoes were first grown in Peru between 8,000 and 5,000 BC [2].

The potato has roughly 80% water, 2% protein, and 18% starch on average. Given that it contains starch, sugar, crude fiber, proteins, amino acids, vitamin C, and important minerals, it has good nutritional value (P, Ca, Mg, K, S and Cl). This crop offers tremendous potential for addressing the nation's ever-growing population's issues with emptiness and malnutrition [3]. Consuming fiber-rich foods like potatoes and other fruits and vegetables is linked to a lower risk of colorectal cancer. In order to maintain a healthy digestive system, constipation is avoided and regularity is encouraged by the fiber in potatoes. Vitamin B6 is abundantly found in potatoes. This is important for the metabolism of energy because it converts proteins and carbs into glucose and amino acids. The body can use these smaller chemicals for energy more readily. According to research, vitamin C may help shorten the length and intensity of a cold. It is consumed by more than a billion people practically every day. In emerging nations, potatoes are a necessity for the life of hundreds of millions of people [1].

The bottom of seed tubers has a significant impact on yield. The tubers should be planted in a homogeneous culture with consistent spacing between the rows and uniform planting depth to speed up the germination of potato sprouts in suitable soil. Proper planting depth for root penetration and efficient soil drainage should also be taken into consideration [4]. The emergence, seedling establishment, survival, and each stage of growth can be aided by proper planting depth if favorable environmental conditions are fulfilled. The most common factor that will result in achieving maximum product performance is proper planting depth. Proper planting depth is the number provided to each region and the growing number of qualities to be decided because the soil is different in each location and other types of a species also respond differently [5]. The soil temperature and humidity surrounding the tubers grown on the land, planting depth, and agricultural practices all have a considerable impact in this regard [6]. If planting is done and the surface gland production out of the soil and the sun will destroy, tubers developed in depth sometimes because the plant to have only a single stem and much lower density per unit area if planting is carried out, the surface gland production will be destroyed by the sun and the soil. Potato planting depth can vary depending on a number of variables, such as seed quality, soil moisture, and temperature [7].

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Citation: Kaur R, Singh SK, Singh B, Singh G, Raturi HC. 2024. Effect of planting depth on different genotypes of potato (*Solanum tuberosum* L.). *Res. Jr. Agril. Sci.* 15(1): 289-295.

MATERIALS AND METHODS

The present experiment was carried in the Experimental Farm, Department of Agriculture, Mata Gujri College, Fatehgarh Sahib, Punjab, India situated between 30° 41' 51.93" N latitudes and 76° 24'36.1" E longitudes and at a mean height of 279 meter above sea level from October 2018 to February 2019. The experimental soil was sandy loam having pH 7.3, EC 0.64 dS m^{-1}, 295.40 kg ha^{-1} available nitrogen, 22.43 kg ha^{-1} available phosphorus and 162.38 kg ha^{-1} available potassium. The experiment was laid out in factorial randomized block design (FRBD) with three replications. The experiment consisted of two factors such as Factor A: Genotypes, G_1: Kufri Jyoti G_2: Lady Rubusta and G_3: Kufri Pushkar and Factor B: Planting depth (4 levels), D^1: 5cm; D_2: 10cm; D_3: 15cm and D_4: 20cm. There were 12 treatment combinations such as G_1D_1 – Kufri Jyoti at 5 cm, G_1D_2 – Kufri Jyoti at 10 cm, G_1D_3 – Kufri Jyoti at 15 cm, G_1D_4 – Kufri Jyoti at 20 cm, G_2D_1 – Lady Rubusta at 5 cm, G_2D_2 – Lady Rubusta at 10 cm, G_2D_3 – Lady Rubusta at 15 cm, G_2D_4 – Lady Rubusta at 20 cm, G_3D_1 – Kufri Pushkar at 5 cm, G_3D_2 – Kufri Pushkar at 10 cm, G_3D_3 – Kufri Pushkar at 15 cm and G_3D_4 – Kufri Pushkar at 20 cm. The tuber of potato genotypes were planting on well-prepared field on October 22nd, 2021. The experimental Farm was ploughed followed by clod breaking, hoeing and leveling. The field was divided into three blocks and each block was divided into 12 plots. There were 36-unit plots and the size of each unit plot was 2.40m × 2.40m = 5.76m^2. All appropriate cultural practices including weeding, watering, hoeing and insect-pest control were timely performed. Urea was used as source of nitrogen fertilizer. Observations on different growth and yield attributing characters were recorded from seven randomly selected plants from each replication to find out the significance difference of potato genotypes and planting depth on growth and yield contributing characters of potato. Observations were recorded on randomly selected plants with different characters i.e. days to germination (cm), plant height (cm), number of stems $plant^{-1}$, shoot length (cm), number of secondary $plant^{-1}$, number of leaves $plant^{-1}$, number of tubers, tuber diameter (cm), tuber weight (g), marketable yield (t ha^{-1}), unmarketable yield (t ha^{-1}), biological yield (t ha^{-1}) and economics of treatments. The experimental data for various observations were analyzed by fisher's method of analysis of variance (ANOVA) as per outlined by [8]. The data were analyzed and are presented at the 5% level of significance.

RESULTS AND DISCUSSION

Days to germination

Days to germination shows significantly variation by various treatments present in (Table 1). The data revealed that minimum days for germination (12.25) was obtained with G_3 (Kufri Pushkar) and the maximum was obtained by G_1 (Kufri Jyoti) with the value of 17.00. In different planting depth, minimum days to germination (13.67) was recorded with D_3 (15 cm) which was statically at par with D_2 (10 cm) with the value of 14.22. However, the maximum days to germination (15.67) was recorded in the D_1 (5cm). Minimum days taken to germination (11.33) was recorded in G_3D_3- Kufri Pushkar at 15 cm which was statistically at par with G_3D_2- Kufri Pushkar at 10 cm and maximum days taken for germination (18.00) by G_1D_1- Kufri Jyoti at 5 cm. Deep planting can maximize the days taken to germination because potato sprouts had to come across long distance of the ground to germinate [9-11].

Table 1 Effect of planting depth on days to germination, plant height (cm) and number of stems $plant^{-1}$, shoot length (cm) and number of secondary branches $plant^{-1}$ on different genotypes of potato

Treatment combination	Days to germination	Plant height (cm)	Numbers of stems $plant^{-1}$	Shoot length (cm)	Number of secondary branches $plant^{-1}$
		Genotypes (G)			
G_1: Kufri Jyoti	17.00	21.74	3.68	17.99	8.51
G_2: Lady Rubusta	14.67	23.29	4.62	19.42	9.72
G_3: Kufri Pushkar	12.25	25.75	6.61	21.27	10.83
SEm (±)	0.18	0.15	0.25	0.20	0.10
$CD_{0.05}$	0.54	0.43	0.72	0.58	0.29
		Planting depth (D)			
D_1: 5 cm	15.67	22.90	4.29	18.92	9.18
D_2: 10 cm	14.22	23.75	5.25	19.44	9.78
D_3: 15 cm	13.67	24.22	5.76	20.70	10.17
D_4: 20 cm	15.00	23.52	4.59	19.18	9.62
SEm (±)	0.21	0.17	0.28	0.23	0.11
$CD_{0.05}$	0.62	0.49	0.83	0.67	0.34
		Interaction (G*D)			
G_1D_1: Kufri Jyoti at 5 cm	18.00	21.43	3.42	17.42	7.87
G_1D_2: Kufri Jyoti at 10 cm	16.67	21.84	3.60	18.20	8.57
G_1D_3: Kufri Jyoti at 15 cm	16.00	22.06	4.25	18.49	9.23
G_1D_4: Kufri Jyoti at 20 cm	17.33	21.65	3.45	17.85	8.37
G_2D_1: Lady Rubusta at 5 cm	15.67	22.69	4.27	18.81	9.40
G_2D_2: Lady Rubusta at 10 cm	14.00	23.43	4.74	19.48	9.80
G_2D_3: Lady Rubusta at 15 cm	13.67	23.89	5.18	20.27	10.10
G_2D_4: Lady Rubusta at 20 cm	15.33	23.17	4.30	19.13	9.57
G_3D_1: Kufri Pushkar at 5 cm	13.33	24.57	5.18	20.51	10.27
G_3D_2: Kufri Pushkar at 10 cm	12.00	26.00	7.39	22.17	10.97
G_3D_3: Kufri Pushkar at 15 cm	11.33	26.70	7.85	23.33	11.17
G_3D_4: Kufri Pushkar at 20 cm	12.33	25.73	6.01	20.57	10.93
SEm (±)	0.37	0.29	0.49	0.40	0.20
$CD_{0.05}$	1.08	0.85	1.45	1.17	0.58

*G = Genotypes; *D = Planting depth

Plant height (cm)

Plant height shows significantly variation by different treatments present in (Table 1). The data revealed that maximum plant height (25.75 cm) was obtained with G_3 (Kufri Pushkar) and the minimum was obtained by G_1 (Kufri Jyoti) with the value of 21.74 cm.In different planting depth, maximum plant height (24.22 cm) was recorded with D_3 (15 cm) which was statically at par with D_2 (10 cm) with the value of 23.75 cm. However, the minimum plant height (22.90 cm) was recorded in the D_1 (5 cm). Maximum plant height (26.77 cm) was obtained by G_3D_3 – Kufri Pushkar at 15 cm which was statistically at par with G_3D_2 – Kufri Pushkar at 10 cm and minimum plant height (21.47 cm) by G_1D_1 – Kufri Jyoti at 5 cm. This may be due to the fact of limited compaction, moisture conditions are typically better, which reduce the risk of dehydration and promote better plant height [12-14].

Numbers of stems plant^{-1}

The data revealed that among different planting depth and different genotypes showed significant variation at numbers of stems plant^{-1} present in (Table 1). The data revealed that maximum number of stems plant^{-1} (6.61) was obtained with G_3 (Kufri Pushkar) and the minimum was obtained by G_1 (Kufri Jyoti) with the value of 3.68. In different planting depth, maximum number of stems plant^{-1} (5.76) was recorded with D_3 (15 cm) which was statically at par with D_2 (10cm) with the value of 5.25. However, the minimum number of stems plant^{-1} recorded (4.29) was recorded in the D_1 (5cm). Maximum number of stems plant^{-1}(7.85) was obtained by G_3D_3 – Kufri Pushkar at 15 cm which was statistically at par with G_3D_2 – Kufri Pushkar at 10 cm and minimum number of stems plant^{-1} (3.42) by G_1D_1 – Kufri Jyoti at 5 cm. The maximum number of stems due to the favourable environment conditions such as temperature, moisture and soil air [15-16].

Shoot length (cm)

Shoot length (cm) shows significantly variation by different treatments present in (Table 1). The data revealed that maximum shoot length (21.27cm) was obtained with G_3 (Kufri Pushkar) and the minimum was obtained by G_1 (Kufri Jyoti) with the value of 17.99cm. In different planting depth, maximum shoot length (20.70cm) was recorded with D_3 (15 cm) which was statically at par with D_2 (10cm) with the value of 19.44. However, the minimum shoot length recorded (18.92) was recorded in the D_1 (5cm). Maximum shoot length (23.33 cm) was obtained by G_3D_3 – Kufri Pushkar at 15 cm which was statistically at par with G_3D_2 – Kufri Pushkar at 10 cm and minimum shoot length (17.42 cm) by G_1D_1 – Kufri Jyoti at 5 cm. According to Kumar *et al.* [13] similar length at 10 cm and 15 cm depth of planting but the shoot length were significantly reduced when the tubers were planted at 20 cm depth. It is found that with the increase in planting depth, the length of shoot decreased [12].

Number of secondary branches plant^{-1}

The results were revealed that among different planting depth and different genotypes showed significant variation at number of secondary branches plant^{-1} present in (Table 1). The data revealed that maximum number of secondary branches plant^{-1} (10.83) was obtained with G_3 (Kufri Pushkar) and the minimum was obtained by G_1 (Kufri Jyoti) with the value of 8.51. In different planting depth, maximum number of secondary branches plant^{-1} (10.17) was recorded with D_3 (15 cm) which was statically at par with D_2 (10cm) with the value of 9.78. However, the minimum number of secondary branches plant^{-1} recorded (9.18) was recorded in the D_1 (5cm). Maximum number of secondary branches plant^{-1} (11.73) was obtained by G_3D_3 – Kufri Pushkar at 15 cm which was statistically at par with G_3D_2 – Kufri Pushkar at 10 cm and minimum number of secondary branches plant^{-1} (7.87) by G_1D_1 – Kufri Jyoti at 5 cm. At a deeper planting depth, the decrease in number of branches shows a negative effect on plant development. The peak number of branches recorded at 15 cm could be ascribed to the depth being the optimum for plant development [16-18].

Number of leaves plant^{-1}

The results revealed that among different planting depth and different genotypes showed significant variation at number of leaves plant^{-1} present in (Table 2). The data revealed that maximum number of leaves plant^{-1} (49.88) was obtained with G_3 (Kufri Pushkar) and the minimum was obtained by G_1 (Kufri Jyoti) with the value of 44.38. In different Planting Depth, maximum number of leaves plant^{-1} (48.37) was recorded with D_3 (15 cm) which was statically at par with D_2 (10cm) with the value of 47.54. However, the minimum number of leaves plant^{-1} recorded (45.92) was recorded in the D_1 (5cm). Maximum number of leaves plant^{-1} (50.73) was obtained by G_3D_3 – Kufri Pushkar at 15 cm which was statistically at par with G_3D_2 – Kufri Pushkar at 10 cm and minimum number of leaves plant^{-1} (42.83) by G_1D_1 – Kufri Jyoti at 5 cm. This may be due to an upper surface of soil there is more stress which ultimately suppresses cell expansion and cell growth due to low turgor pressure [18].

Number of tubers plant^{-1}

The results were revealed that number of tubers plant^{-1} showed significantly variation among different planting depth and different genotypes showed in (Table 2). The data revealed that maximum number of tubers plant^{-1} (5.66) was obtained with G_3 (Kufri Pushkar) and the minimum was obtained by G_1 (Kufri Jyoti) with the value of 4.29. In different planting depth, maximum number of tubers plant^{-1} (5.35) was recorded with D_3 (15 cm) which was statically at par with D_2 (10cm) with the value of 5.02. However, the minimum number of tubers plant^{-1} recorded (4.62) was recorded in the D_1 (5cm). Maximum number of tubers plant^{-1} (6.22) was obtained by G_3D_3 – Kufri Pushkar at 15 cm which was statistically at par with G_3D_2 – Kufri Pushkar at 10 cm and minimum number of tubers plant^{-1} (3.92) by G_1D_1 – Kufri Jyoti at 5 cm. Planting depth at 15 cm depth produces higher number of aerial stems per plant and maximum number of leaves that enhanced the photosynthetic area which ultimately help to increases the number of tubers [16], [18].

Tuber weight (g)

Tuber weight (g) shows significantly variation by different treatments present in (Table 2). The data revealed that maximum tuber weight (52.83 g) was obtained with G_3 (Kufri Pushkar) and the minimum was obtained by G_1 (Kufri Jyoti) with the value of 38.98 g. In different planting depth, maximum tuber weight (47.85) was recorded with D_3 (15 cm) which was statistically at par with D_2 (10cm) with the value of 46.96 g. However, the minimum tuber weight recorded (39.99 g) was recorded in the D_1 (5cm). Maximum tuber weight (57.25g) was obtained by G_3D_3 – Kufri Pushkar at 15 cm which was statistically at par with G_3D_2 – Kufri Pushkar at 10 cm and minimum tuber weight (30.97g) by G_1D_1 – Kufri Jyoti at 5 cm. There was significantly maximum number of aerial stem and leaves per plant at 15 cm planting depth that enhanced the photosynthetic area of plant and spontaneously resulted in maximum tuber weight of potato [9], [16], [19].

Table 2 Effect of planting depth on number of leaves plant^{-1}, tuber weight (g), tuber diameter (cm) and unmarketable yield (t ha^{-1}) on different genotypes of potato

Treatment combination	Number of leaves plant^{-1}	Number of tubers plant^{-1}	Tuber weight (g)	Tuber diameter (cm)	Unmarketable yield (t ha^{-1})
		Genotypes (G)			
G_1: Kufri Jyoti	44.38	4.29	38.98	33.73	2.46
G_2: Lady Rubusta	47.25	4.89	43.00	35.38	2.07
G_3: Kufri Pushkar	49.88	5.66	52.83	37.27	1.89
SEm (±)	0.46	0.10	0.40	0.38	0.04
$CD_{0.05}$	1.35	0.30	1.18	1.11	0.11
		Planting depth (D)			
D_1: 5 cm	45.92	4.62	39.99	34.59	2.31
D_2: 10 cm	47.54	5.02	46.96	35.69	2.09
D_3: 15 cm	48.37	5.35	47.85	36.46	2.11
D_4: 20 cm	46.84	4.81	44.96	35.10	2.06
SEm (±)	0.53	0.12	0.46	0.44	0.04
$CD_{0.05}$	1.56	0.35	1.36	1.28	0.12
		Interaction (G*D)			
G_1D_1: Kufri Jyoti at 5 cm	42.83	3.92	30.97	32.93	2.74
G_1D_2: Kufri Jyoti at 10 cm	44.77	4.44	41.60	34.44	2.42
G_1D_3: Kufri Jyoti at 15 cm	46.53	4.57	41.82	34.60	2.49
G_1D_4: Kufri Jyoti at 20 cm	43.40	4.23	41.55	32.97	2.21
G_2D_1: Lady Rubusta at 5 cm	46.63	4.61	42.19	34.61	2.17
G_2D_2: Lady Rubusta at 10 cm	47.47	5.04	42.84	35.43	2.03
G_2D_3: Lady Rubusta at 15 cm	47.83	5.26	44.47	36.11	2.08
G_2D_4: Lady Rubusta at 20 cm	47.07	4.66	42.50	35.37	2.01
G_3D_1: Kufri Pushkar at 5 cm	48.30	5.34	46.81	36.23	2.01
G_3D_2: Kufri Pushkar at 10 cm	50.40	5.61	56.43	37.20	1.84
G_3D_3: Kufri Pushkar at 15 cm	50.73	6.22	57.25	38.67	1.77
G_3D_4: Kufri Pushkar at 20 cm	50.07	5.53	50.82	36.97	1.96
SEm (±)	0.92	0.21	0.80	0.75	0.07
$CD_{0.05}$	2.69	0.61	2.35	2.21	0.21

*G = Genotypes; *D = Planting depth

Tuber diameter (cm)

The results were revealed that among different planting depth and different genotypes showed significant variation at tuber diameter in potato present in (Table 2). The data revealed that maximum tuber diameter (37.27) was obtained with G_3 (Kufri Pushkar) and the minimum was obtained by G_1 (Kufri Jyoti) with the value of 33.73. In different planting depth, maximum tuber diameter (36.46) was recorded with D_3 (15 cm) which was statistically at par with D_2 (10cm) with the value of 35.69. However, the minimum tuber diameter recorded (34.59) was recorded in the D_1 (5cm). Maximum tuber diameter (38.67cm) was obtained by G_3D_3 – Kufri Pushkar at 15 cm which was statistically at par with G_3D_2 – Kufri Pushkar at 10 cm and minimum tuber diameter (32.93cm) by G_1D_1 – Kufri Jyoti at 5 cm. There was significantly maximum number of aerial stem and leaves per plant at 15 cm planting depth that enhanced the photosynthetic area of plant and spontaneously resulted in maximum tuber weight of potato and diameter of tuber [9], [16], [19].

Unmarketable yield (t ha^{-1})

Among different planting depth and different genotypes result showed significant variation under unmarketable yield present in (Table 2). The data revealed that minimum unmarketable yield (1.89 t) was obtained with G_3 (Kufri Pushkar) and the maximum was obtained by G_1 (Kufri Jyoti) with the value of 2.46 t. In different planting depth, minimum unmarketable yield (2.06 t) was recorded with D_4 (20cm) which was followed by D_2 (10 cm) with the value of 2.09 t. However, the maximum unmarketable recorded (2.31 t) was recorded in the D_1 (5cm). Minimum unmarketable yield (1.77t) was obtained by G_3D_3 – Kufri Pushkar at 15 cm which was statistically at par with G_3D_2– Kufri Pushkar at 10 cm and maximum unmarketable yield (2.74t) by G_1D_1 – Kufri Jyoti at 5 cm. The small sized and greening tubers were high in tuber planting depth of 5 cm and this; in turn increase in unmarketable produce [20-21].

Marketable yield (t ha^{-1})

Among different planting depth and different genotypes result showed significant variation under marketable yield present in (Table 3). The data revealed that maximum marketable yield (22.18t) was obtained with G_3 (Kufri Pushkar) and the minimum was obtained by G_1 (Kufri Jyoti) with the value of 17.04 t. In different Planting Depth, maximum marketable yield (20.76 t) was recorded with D_3 (15 cm) which was followed by D_2 (10cm) with the value of 19.60 t. However, the lowest marketable yield (17.95 t) was recorded in the D_1 (5cm). Maximum marketable yield (24.66t) was obtained by G_3D_3 – Kufri Pushkar at 15 cm which was statistically at par with G_3D_2 – Kufri Pushkar at 10 cm and minimum marketable yield (15.90t) by G_1D_1 – Kufri Jyoti at 5 cm. This may due to planting depth of 15 cm produced maximum number of stems, number of leaves per plant, increase in number of medium and large size tuber per plant, which contributes to increase in marketable yield [22].

Yield of tuber (t ha^{-1})

Among different planting depth and different genotypes result showed significant variation present in (Table 3). The data revealed that maximum tuber yield (24.67 t) was obtained with G_3 (Kufri Pushkar) and the minimum was obtained by G_1 (Kufri Jyoti) with the value of 18.95 t. In different planting depth, maximum tuber yield (23.06t) was recorded with D_3 (15

cm) which was followed by D_2 (10cm) with the value of 21.87 t. However, the minimum tuber yield recorded (19.95) was recorded in the D_1 (5cm). Maximum tuber yield (27.40t) was obtained by G_3D_3 – Kufri Pushkar at 15 cm which was statistically at par with G_3D_2 – Kufri Pushkar at 10 cm and minimum tuber yield (17.67t) by G_1D_1 – Kufri Jyoti at 5 cm. There was significantly maximum number of aerial stem and leaves per plant at 15 cm planting depth that enhanced the photosynthetic area of plant and spontaneously resulted in maximum tuber yield [16], [19].

Table 3 Effect of planting depth on marketable yield (t ha^{-1}), tuber yield (t ha^{-1}), biological yield (t ha^{-1}) and harvest index (%) on different genotypes of potato

Treatment combination	Marketable yield (t ha^{-1})	Tuber yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
Genotypes (G)				
G_1: Kufri Jyoti	17.04	18.95	21.93	77.83
G_2: Lady Rubusta	18.65	20.73	23.72	84.17
G_3: Kufri Pushkar	22.18	24.67	27.64	86.17
SEm (±)	0.33	0.36	0.36	0.56
$CD_{0.05}$	0.96	1.07	1.07	1.63
Planting depth (D)				
D_1: 5 cm	17.95	19.95	22.95	80.56
D_2: 10 cm	19.60	21.87	24.77	83.11
D_3: 15 cm	20.76	23.06	26.06	84.89
D_4: 20 cm	18.84	20.93	23.93	82.33
SEm (±)	0.38	0.42	0.42	0.64
$CD_{0.05}$	1.11	1.23	1.23	1.89
Interaction (G*D)				
G_1D_1: Kufri Jyoti at 5 cm	15.90	17.67	20.67	73.00
G_1D_2: Kufri Jyoti at 10 cm	17.65	19.70	22.61	78.33
G_1D_3: Kufri Jyoti at 15 cm	18.08	20.09	23.09	82.33
G_1D_4: Kufri Jyoti at 20 cm	16.52	18.35	21.35	77.67
G_2D_1: Lady Rubusta at 5 cm	18.11	20.12	23.12	83.67
G_2D_2: Lady Rubusta at 10 cm	18.70	20.83	23.77	84.33
G_2D_3: Lady Rubusta at 15 cm	19.53	21.70	24.70	84.67
G_2D_4: Lady Rubusta at 20 cm	18.26	20.28	23.28	84.00
G_3D_1: Kufri Pushkar at 5 cm	19.85	22.05	25.05	85.00
G_3D_2: Kufri Pushkar at 10 cm	22.45	25.53	27.94	86.67
G_3D_3: Kufri Pushkar at 15 cm	24.66	27.40	30.40	87.67
G_3D_4: Kufri Pushkar at 20 cm	21.75	24.17	27.17	85.33
SEm (±)	0.66	0.73	0.73	1.11
$CD_{0.05}$	1.92	2.14	2.14	3.27

*G = Genotypes; *D = Planting depth

Biological yield (t ha^{-1})

Among different planting depth and different genotypes result showed significant variation under biological yield present in (Table 3). The data revealed that maximum biological yield (14.60kg) was obtained with G_3 (Kufri Pushkar) and the minimum was obtained by G_1 (Kufri Jyoti) with the value of 11.28kg. In different planting depth, maximum biological yield (13.75kg) was recorded with D_3 (15 cm) which was followed by D_2 (10cm) with the value of 12.99kg. However, the minimum biological yield recorded (11.92) was recorded in the D_1 (5cm). Maximum biological yield (30.40t) was obtained by G_3D_3 – Kufri Pushkar at 15 cm which was statistically at par with G_3D_2 – Kufri Pushkar at 10 cm and minimum biological yield (20.67t) by G_1D_1 – Kufri Jyoti at 5 cm. This may be due to the appropriate planting depth that contributes towards to increase in number of stems, leaves per plant, increase in tuber yield that ultimate attribute to increase in biological yield [9], [19], [22].

Table 4 Effect of different planting depth on cost of cultivation (Rs. ha^{-1}), gross return (Rs. ha^{-1}), net return (Rs. ha^{-1}) and benefit: cost ratio on different genotypes of potato

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	Benefit: Cost ratio
G_1D_1: Kufri Jyoti at 5 cm	96113	194000	97887	1.02
G_1D_2: Kufri Jyoti at 10 cm	96113	203000	106887	1.11
G_1D_3: Kufri Jyoti at 15 cm	96113	212400	116287	1.21
G_1D_4: Kufri Jyoti at 20 cm	96113	201000	104887	1.09
G_2D_1: Lady Rubusta at 5 cm	90113	214000	123887	1.37
G_2D_2: Lady Rubusta at 10 cm	90113	217000	126887	1.41
G_2D_3: Lady Rubusta at 15 cm	90113	240000	149887	1.66
G_2D_4: Lady Rubusta at 20 cm	90113	214000	123887	1.37
G_3D_1: Kufri Pushkar at 5 cm	87113	242000	154887	1.78
G_3D_2: Kufri Pushkar at 10 cm	87113	289000	201887	2.32
G_3D_3: Kufri Pushkar at 15 cm	87113	294000	206887	2.37
G_3D_4: Kufri Pushkar at 20 cm	87113	254400	167287	1.92

*G = Genotypes, *D = Planting depth

Harvest index (%)

Among different planting depth and different genotypes result showed significant variation under harvest index present in (Table 3). The data revealed that maximum harvest index (86.17%) was obtained with G_3 (Kufri Pushkar) and the minimum was obtained by G_1 (Kufri Jyoti) with the value of 77.83%. In different planting depth, maximum harvest index (84.89%) was recorded with D_3 (15 cm) which was followed by D_2 (10cm) with the value of 83.11%. However, the minimum harvest index recorded (80.56%) was recorded in the D_1 (5cm). Maximum harvest index (87.67%) was obtained by G_3D_3 – Kufri Pushkar at 15 cm which was statistically at par with G_3D_2 – Kufri Pushkar at 10 cm and minimum harvest index (73.00%) by G_1D_1 – Kufri Jyoti at 5 cm. The reason behind increase in harvest index percentage is by increase in biological yield and tuber yield [9], [19], [22].

Economics

Economics of the treatments was worked out under different levels of planting depth to potato genotypes presented in (Table 4). Examination of the data revealed that maximum net return (Rs. 2,06,887) and highest gross return (Rs. 2,94,000) were obtained in Kufri Pushkar at 15 cm depth. Whereas, minimum gross return (Rs. 1,94,000) and net return (Rs. 97887) were obtained in Kufri Jyoti at 5 cm depth. On the same lines, maximum benefit: cost ratio (2.37) was calculated in Kufri Pushkar at 15 cm depth and minimum (1.02) was recorded in Kufri Jyoti at 5 cm depth [23-24].

CONCLUSION

Based on the results experimentation it seems quite logical to conclude that genotype G_3. Kufri Pushkar observed maximum growth and yield. Among planting depth at 15 cm were recorded the best regarding the growth and yield of potato. In case of interaction, maximum growth and yield parameters were recorded in G_3D_3 (Kufri Pushkar + 15 cm). Hence, it is apparent that genotypes and levels of plating depth had significant positive effect on most of growth, yield and yield attributing characteristics along with economics of potato.

Acknowledgement

We are highly thankful to Mata Gujri College, Fatehgarh Sahib for providing the fields and labs facilities for conducting research.

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