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Studies on varying potassium levels on early duration potato varieties

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Abstract
Potato (*Solanum tuberosum* L.) is the third most important food crop in the world after rice and wheat and is the fourth most important food crop in India after rice, wheat and maize. Potato crop prefers well-drained, light, deep, loose soil with high organic matter. A number of macro and micro plant nutrients are required for its growth and development. Potato requires substantial quantity of potassium to produce an optimum yield. However, potassium needs of the crop vary with the agro-climatic region, variety, crop sequence and soil type. Potato requires substantial quantity of potassium to produce an optimum yield. However, potassium needs of the crop vary with the agro-climatic region, variety, crop sequence and soil type. The experiment was laid out in split plot design having twelve treatments combinations in three replicates. Three different varieties (V_1- Kufri Ashoka; V_2–Kufri Pukhraj; V_3 – Kufri Khyati) were randomly allotted in each main plot, while four different levels of potassium (0, 75, 150 and 225 kg ha^{-1}) were randomly allocated in sub plots. It was revealed from the results that the number of tubers per plant increased with the maturity of the crop in both the years of experimentation till harvest. Variety and potassium both played an important role in influencing total tuber yield. The highest tuber yield (22.36 t ha^{-1} and 21.46 t ha^{-1} during 2016-17and 2017-18 respectively) was achieved with the variety Kufri Pukhraj (V_2). It was apparent that 150 kg K_2O ha^{-1}resulted significantly highest tuber yield (55.36%,85.32% over control during 2016-17 & 2017-18 respectively) while the control plots produced the lowest yield of tubers. The response of yield to potassium application showed an increasing trend up to 150 kgK_2O ha^{-1}.It was revealed from the result that the highest Benefit :Cost (B:C) ratio (1.44 & 1.73 during 2016-17 & 2017-18 respectively) was achieved with the variety Kufri Pukhraj under 150 kg K_2O ha^{-1}.

Keywords: Potato, potato varieties, potassium, tuber yield, b: C ratio

Introduction
Potato (*Solanum tuberosum* L.) is the third most important food crop in the world after rice and wheat and is the fourth most important food crop in India after rice, wheat and maize. Global annual potato production during the triennium ending (TE) 2013 was 370 million tonnes resulting in per capita availability of over 50 kg. In India, potato is being cultivated on 2.12 million hectare area with a total annual production of 434.17 lakh MT (Anonymous 2016). The state of West Bengal in India produces 12 million tonnes of potatoes from 0.41 M ha with a productivity of 29.7 t ha^{-1} and ranks second next to UP among all the potato growing states of India (Horticulture Statistics Division, GOI, 2014). Current share of potato to agricultural GDP is 2.86% out of 1.32% cultivable area. On the contrary, the two principal food crops, rice and wheat, contribute 18.25% and 8.22% of agricultural GDP, respectively from 31.19 and 20.56% cultivable area, respectively (FAO, 2014). It indicates that contribution of potato in agricultural GDP from unit area of cultivable land is about 3.7 times higher than rice and 5.4 times higher than wheat. According to estimates published by the International Food Policy Research Institute (IFPRI) and the International Potato Centre (CIP), India is likely to have the highest growth rates in potato production and productivity worldwide (Naik and Thakur, 2007) [5]. These growth rates indicate a total production in India by 2020 of around 43.3 million metric tonnes. The macro nutrients like N, P and K are the most essential that are largely required by potato (Banerjee *et al*. 2016a) [3]. However, K is a limiting factor in soil system as it leaches down from soil system.

Because of the higher loss and low rate of replenishment of K in the soil, widespread deficiencies have been reported in many of the intensively cultivated areas (Adhikary *et al*., 2006) [1] and the crop responds very well to the application of K fertilisers (Regmi *et al.*, 2002) [6]. Potassium (K) is very important for potato plant. It regulates growth as well as vigour of the plant and also improves the quality of tubers and general health of plant that ultimately hastens yield. It essentially takes part in the synthesis of sugars and starch, and translocation of carbohydrates. It also plays an important role in maintaining growth and vigour of the plants (Singh *et al*., 1996 and Banerjee *et al.*, 2016b) [7, 2]. Application of potassium (K) increases plant height and imparts resistance against drought, frost and diseases. Potassium also protects potato from various physiological disorders and pathogenic infections. It has major role in improving early growth and increasing the vigour of the haulm and it also increases the size of upper leaves without impairing their longevity (Fernando, 1958) [4]. It is involved in the activation of a number of enzymes, metabolic activities and translocation of photosynthates to the tubers, thus increasing the size and yield of tubers. According to Essah (2015), the tuber bulking and marketable tuber yield are influenced with source and time of K application. The harvest index and benefit: cost ratio (B: C ratio) also increases with the increasing levels of K (Singh and Lal, 2012) [8].

Materials and Methods

A field experiment was conducted at the farm of Uttar Banga Krishi vishwavidyalaya at Pundibari, Cooch Behar, West Bengal for two consecutive seasons of 2016-17 and 2017-18. The farm is situated at $26^0$19'87"N latitude and $89^0$23'55" E longitude at an elevation of 43 meters above mean sea level. The soil was sandy loam, slightly acidic in reaction (pH 5.72), high organic carbon (0.93%) and low in available nitrogen (175.82 kg ha^{-1}), phosphorus (17.32 kg ha^{-1}) and potassium (103.08 kg ha^{-1}). During crop growth period the total amount of rainfall from December-March, 2016-17 was 67.7 mm and during the second season i.e. December-March, 2017-18 it was 105 mm. The experiment was laid out in split plot design and consisted of three number of varieties *viz*., (V_1), Kufri Pukhraj (V_2) and Kufri Khyati (V_3) in main plot and four different levels of potassium (0, 75, 150 and 225 kg ha^{-1})in sub plot replicated three times. FYM was applied @ 15 tonnes ha^{-1} and incorporated thoroughly into the soil before the last ploughing. The fertilizer doses of 125 kg $Nha^{-1}$and 100 kg $P_2O_5ha^{-1}$were given uniformly and the different doses of potassium like 0, 75, 150, & 225 kg K_2Oha^{-1}were given in four sub-plots. Out of these, ½ dose of nitrogen and full dose P_2O_5 and 1/3rddose of K_2O were given as basal at the time of planting of tubers. The rest ½ doses of nitrogen and 1/3rdpotassium was given as first top dressing at 21DAP and the third split of potassium was given as second top dressing at 42 DAP. Potato was sown manually using a seed rate of 25 q ha^{-1}andthe row to row spacing was 50cm and plant to plant (intra-row) spacing was 15cm. The soil texture was determined by International Pipette method, soil pH by Systronics pH meter, Organic carbon by Walkley and Black method, available N was determined by Alkaline permanganate method, available phosphorus was determined by Bray and Kurtz's method and available potassium was determined by Flame photometer method. The observations recorded were yield, yield components and days taken to phonological stage.

Result and Discussion

a) Growth and growth components

Effect of varieties and different levels of potassium on number of stems

There was significant difference in number of stems among varieties at 40, 60 and 80 DAP as shown in table no. 1. The maximum number of stems were observed in Kufri Ashoka at 20, 40, 60 and 80 DAP (1.29, 4.07, 4.95 and 3.76 respectively during 2016-17 and 2.33, 4.03, 4.83 & 3.37 respectively during 2017-18) and minimum number of stems were observed in Kufri Khyati in 20, 40, 60 and 80 DAP (1.26, 2.99, 3.05 and 2.90 respectively during 2016-17 and 1.41, 2.91, 3.38 & 2.68 respectively during 2017-18). As shown in Table no. 2, there was significant difference in the number of stems among the various potassium levels except 20 DAP in both the years and 40 DAP in 2016-17. At 60 DAP maximum number of stems were observed in 150 kg K_2O ha^{-1} (4.13 and 4.27 during 2016-17 and 2017-18 respectively) and minimum number of stems were observed in 0 kg K_2O ha^{-1} (3.54 and 3.60 during 2016-17 and 2017-18 respectively).There was no significant difference in the interaction effects at all stages except at 60 DAP. Similar results had been observed by Singh and Lal, 2012 [8].

Table 1: Effect of different varieties on number of stem plant per plant, plant height (cm), LAI and dry matter accumulation in shoot (g m^{-2}) at 60 DAP

Treatments	No of stem plant per plant		Plant height (cm)		LAI		Dry matter accumulation in shoot (g m^{-2})	
Varieties	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016 -17	2017-18
V_1 (Kufri Ashoka)	4.95	4.83	37.97	37.91	2.64	2.93	130.86	114.89
V_2 (Kufri Pukhraj)	2.98	3.02	32.39	30.53	3.39	3.36	116.81	116.25
V_3 (Kufri Khyati)	3.05	3.38	38.09	36.10	2.71	2.98	113.54	112.50
S. Em. (±)	0.06	0.08	0.62	1.12	0.09	0.03	1.93	1.32
CD (0.05)	0.24	0.30	2.45	4.41	0.34	0.10	7.58	5.17

Effect of varieties and different levels of potassium on plant height (cm)

There was significant difference among the varietal performance at 40, 60 and 80 DAP during 2016-17 and at all the growth stages during 2017-18. The maximum plant height was observed in Kufri Ashoka at 80 DAP (41.09 and 43.02 cm during 2016-17 and 2017-18 respectively) and minimum was observed in case of Kufri Pukhraj (34.50 and 36.05 cm during 2016-17 and 2017-18 respectively). There was significant difference observed in the plant height with different potassium levels in all the stages of observation during both the years (Table no.2). The maximum height was observed at 40, 60 and 80 DAP (29.49, 39.83 and 43.59 cm respectively) under 150 kg K_2O ha^{-1} during 2016-17 and during 2017-18 the maximum height was observed at 40 DAP (25.27 cm) under 225 kg K_2O ha^{-1} and at 60 and 80 DAP (36.76 and 46.19 cm respectively) under 150 kg K_2O ha^{-1}.The minimum height at 40, 60 and 80 DAP (26.67, 29.42 and 34.95 cm respectively during 2016-17) and (23.16, 31.16 and 34.14 cm respectively during 2017-18) was observed in control.

Table 2: Effect of different levels of potassium on number of stem plant per plant, plant height (cm), LAI and dry matter accumulation in shoot (g m^{-2}) at 60 DAP

Treatments	No of stem plant per plant		Plant height (cm)		LAI		Dry matter accumulation in shoot (g m^{-2})	
Potassium	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
K_0	3.54	3.60	29.42	31.16	2.43	2.37	105.55	88.29
K_{75}	3.42	3.73	36.71	34.73	2.95	2.91	117.52	110.61
K_{150}	4.13	4.27	39.83	36.76	3.22	3.68	132.27	138.36
K_{225}	3.54	3.36	38.63	36.72	3.05	3.38	126.26	120.93
S. Em. (±)	0.08	0.13	0.71	0.64	0.10	0.11	0.97	2.04
CD (0.05)	0.23	0.39	2.11	1.91	0.30	0.32	2.89	6.06

There was significant difference in the interaction effects at 20 and 60 DAP and non-significant at 40 and 80 DAP during 2016-17. During 2017-18 it was found significant at all stages of observation except 40 DAP. Maximum height was observed at 60 DAP (43.50 and 40.68 cm during 2016-17 2017-18 respectively) and at 80 DAP (44.95 and 49.94 cm during 2016-17 2017-18 respectively) for Kufri Ashoka under 150 kg K_2O ha^{-1} and minimum height was observed in control. Similar results had been observed by Singh and Lal, 2012 [8].

Effect of varieties and different levels of potassium on dry matter accumulation in leaves (g m^{-2})

Among the varieties there was significant differences in dry matter accumulation in leaves at 20, 40 and 60 DAP during 2016-17 but there was no significant differences in dry matter accumulation in leaves at all the stages of observation during 2017-18 (Table 1). Maximum dry matter accumulation was observed in Kufri Pukhraj (108.31g m^{-2}) and minimum was observed in Kufri Khyati (95.89 g m^{-2}) at 60 DAP. There was significant difference in all the stages of observation among the various potassium levels (Table 2). At 20, 40, 60 and 80 DAP maximum dry matter accumulation in leaves was recorded under 150 kg K_2O ha^{-1} (8.40, 49.72, 111.24 and 73.37g m^{-2}respectively during 2016-17& 8.60, 50.23, 110.80 and 60.61 g m^{-2} respectively during 2017-18). Minimum dry matter accumulation in leaves was found in control. There was no significant difference among varieties and potassium levels in dry matter accumulation in leaves at all stages of observation except 60 DAP. The maximum dry matter accumulation was observed in Kufri Pukhraj along with 150 kg K_2O ha^{-1} (115.63 and 125.06 g m^{-2} during 2016-17 and 2017-18 respectively). However it is interesting to note that the interaction effect between potassium and variety was significant at 20, 40, 60 and 80 DAP.

Effect of varieties and different levels of potassium on dry matter accumulation in stem (g m^{-2})

Among the varieties there was significant difference in dry matter accumulation in stem at 40, 60 and 80 DAP during 2016-17 and at 20 & 60 DAP during 2017-18 (Table 1). Maximum dry matter accumulation in stem was observed in Kufri Pukhraj (22.91 and 21.36 g m^{-2} during 2016-17 and 2017-18 respectively) and minimum was observed in Kufri Ashoka (14.09 and 17.93 g m^{-2} during 2016-17 and 2017-18 respectively) at 60 DAP. There was significant difference in all the stages of observation among the various potassium levels (Table 2). At 40, 60 and 80 DAP maximum dry matter accumulation in stem was recorded under 150 kg K_2O ha^{-1} (14.35, 21.40. and 20.12 g m^{-2} respectively during 2016-17 & 16.47, 27.12 and 19.47 g m^{-2} respectively during 2017-18). Minimum dry matter accumulation in stem was found in control plots. There was significant difference among varieties and potassium levels in dry matter accumulation in stem at all stages of observation except 40 DAP during 2016-17 and durking 2017-18, it was found significant at 20 and 60 DAP & non-significant at 40 and 80 DAP. The maximum dry matter accumulation was observed in Kufri Pukhraj along with 225 kg K_2O ha^{-1} (26.22 g m^{-2} during 2016-17) and 150 kg K_2O ha^{-1} (29.20 g m^{-2}) during 2017-18.

Effect of varieties and different levels of potassium on dry matter accumulation in shoot (g m^{-2})

Among the varieties there was significant difference in dry matter accumulation in shoot at all the stages of observation during 2016-17 and 2017-18 (Table 1). Maximum dry matter accumulation in shoot was observed in Kufri Pukhraj (116.81 and 116.25 g m^{-2} during 2016-17 and 2017-18 respectively) at 60 DAP and minimum was observed in Kufri Khyati (113.54 and 112.50 g m^{-2} during 2016-17 and 2017-18 respectively) at 60 DAP. There was significant difference in all the stages of observation among the various potassium levels (Table 2). At 20, 40, 60 and 80 DAP maximum dry matter accumulation in shoots was recorded under 150 kg K_2O ha^{-1} (10.56, 64.04, 132.27 and 92.19 g m^{-2} respectively during 2016-17 & 11.41, 66.60, 138.36 and 86.48 g m^{-2} respectively during 2017-18). Minimum dry matter accumulation in shoot was found in control. There was significant difference among varieties and potassium levels in dry matter accumulation in shoot at all stages of observation. The maximum dry matter accumulation was observed in Kufri Ashoka along with 150 kg K_2O ha^{-1} (141.27 g m^{-2} during 2016-17) and during 2017-18 Kufri Pukhraj along with 150 kg K_2O ha^{-1} recorded maximum dry matter accumulation (151.71 g m^{-2}). The interaction effect between V_1K_{150} and V_2K_{150} were statistically at par.

Effect of varieties and different levels of potassium on leaf area index (LAI)

There was significant difference in LAI at 20 and 60 DAP among the varieties during both the years. However, there was no significant differences in LAI at 40 and 80 DAP among the varieties (Table 1). At 60 DAP maximum LAI was observed in case of Kufri Pukhraj (3.39 and 3.36 during 2016-17 and 2017-18 respectively) and minimum was observed in Kufri Ashoka (2.64 and 2.93 during 2016-17 and 2017-18 respectively).There was significant difference in different potassium levels at20, 60 and 80 DAP during both the years but at 40 DAP, during 2016-17 it was significant and during 2017-18 it was non-significant (Table 2). At 60 DAP maximum LAI was observed under 150 kg K_2O ha^{-1}(3.22 and 3.68 during 2016-17 and 2017-18 respectively) and minimum LAI was observed in control. (2.43 And 2.37 during 2016-17 and 2017-18 respectively). Again at 20, 60 and 80 DAP the LAI in different interaction levels was non-significant during 2016-17, but at 40 DAP, LAI was significant. During 2017-18 LAI in different interaction levels was non-significant at 40 and 80 DAP and was significant at 20 and 60 DAP. Due to crop's initial slow growth at 20 DAP and due to senescence of leaves at 80 DAP the LAI observed was less and had become non-significant. But due to vigorous growth of the crop linearly in 40 and 60 DAP LAI increased linearly up to 60 DAP showing highest LAI in between 40 and 60 DAP. Similar results were found by Fernando (1958) [4]. The increase of LAI at 60 DAP indicated full shooting of expanded leaves, which increased the capacity factor for carbon assimilation. Potassium increased the leaf area index (Watson and Wilson 1974) by higher level of potassium application.

Effect of varieties and different levels of potassium on dry weight of tubers (in percent)

There was significant difference in dry weight of tubers at 40, 60 and 80 DAP among the varieties during both the years except at 60 DAP during 2017-18 (Table 1). At 80 DAP maximum dry weight of tubers was observed in case of Kufri Khyati (17.97 and 18.30 during 2016-17 and 2017-18 respectively) and minimum was observed in Kufri Pukhraj (15.22 and 15.57 during 2016-17 and 2017-18 respectively). There was significant difference in different potassium levels at 40 and 60 DAP during both the years but at 80 DAP, during both the years it was non-significant (Table 2).At 60 DAP maximum dry weight of tubers was observed under 150 kg K_2O ha^{-1}(16.07 and 16.50 during 2016-17 and 2017-18 respectively) and minimum dry weight of tubers was observed in control (14.94 and 15.34 during 2016-17 and 2017-18 respectively). Again at 40, 60 and 80 DAP, the dry weight of tubers in different interaction levels was non-significant during both the years, except at 40 DAP dry weight of tubers which was significant during 2016-17. It was interesting to note that the interaction between potassium and variety were found significant in both the years of experimentation at all stages of observation.

b) Yield and Yield Components

Effect of varieties and different levels of potassium on number of tubers per plant.

There was significant difference among varieties at 40, 60 and 80 DAP during both the years except at 40 DAP during 2016-17 (Table 3). Maximum number of tuber per plant was obtained in Kufri Ashoka at 80 DAP (6.55 and 5.08 during 2016-17 and 2017-18, respectively) and minimum tuber number was recorded at 20 DAP in Kufri Khyati (3.59) during 2016-17 and in Kufri Pukhraj (2.43) during 2017-18.There was significant difference in the number of tubers per plant among different potassium levels at 40, 60 and 80 DAP during both the years except at 40 DAP during 2016-17 (Table 3). Maximum number of tuber per plant was recorded under potassium level 150 kg ha^{-1} at 80 DAP (6.98 and 5.77 during 2016-17 and 2017-18, respectively) and minimum was recorded in control during 2017-18 (2.57) and under potassium level 75 kg ha^{-1}during 2016-17 (3.65). The interaction between varieties and potassium levels was found non-significant at 60 DAP during both the years and at40 and 60 DAP during 2016-17. During 2017-18 it was found significant at 40 and 80 DAP. Among the varieties and potassium level, Kufri Ashoka along with 150 kg K_2O ha^{-1} recorded highest number of tuber per plant at 80 DAP.

Effect of varieties and different levels of potassium on fresh weight of tuber (g m^{-2})

There was significant difference among the varieties in respect of fresh weight of tuber per plant at 40, 60, 80 DAP and at harvest during both the years (Table 3). The highest fresh weight of tuber per plant was observed in Kufri Pukhraj (3639.76 and 3458.52 g m^{-2}during 2016-17 and 2017-18, respectively) at harvest and lowest fresh weight of tuber per plant was observed in Kufri Ashoka at 40 DAP (248.34 and 280.26 g m^{-2} during 2016-17 and 2017-18, respectively).There was significant difference in the fresh weight of tubers among the different potassium levels at all the stages of observation during both the years. Highest tuber fresh weight per plant was observed in potassium level of 150 kgha^{-1} (3956.79 g m^{-2} during 2016-17) at harvest and 3914.58 g m^{-2} during 2017-18 at 80 DAP. There was significant difference between varieties and different levels of potassium at 40 and 60 DAP during both the years and at 80 DAP during 2016-17 and non-significant at 80 DAP during 2017-18 and at harvest. With increase in potassium levels, the weight of tuber per plant increased up to an optimum potassium level after that the weight of tuber per plant decreased. This might be because of the same trend followed by the dry matter accumulation.

Effect of varieties and different levels of potassium on yield (t ha^{-1}).

There was significant difference in yield among the varieties during both the years (Table 3). Maximum yield was observed in Kufri Pukhraj (22.36t $ha^{-1}$and 21.46 during 2016-17 and 2017-18, respectively) and minimum was observed in Kufri Ashoka (18.28 and 19.21 t ha^{-1} during 2016-17 and 21017-18, respectively). There was significant difference in yield among potassium levels during both the years (Table 3). Maximum yield had been obtained under 150 kg K_2O ha^{-1}(23.92 and 23.74 t ha^{-1} during 2016-17 and 21017-18, respectively) and minimum yield was obtained under control (14.58 and 14.32 t ha^{-1} during 2016-17 and 2017-18, respectively).There was significant difference between varieties and different levels of potassium during both the years. Maximum yield was obtained from Kufri Pukhraj under 150 kg K_2O (27.67 and 26.52 t ha^{-1} during 2016-17 and 2017-18, respectively) and minimum was obtained in Kufri Ashoka under control (11.27 and 13.87 t ha^{-1}during 2016-17 and 2017-18, respectively). Increasing levels of application of potassium fertilizer plays vital role in increasing the yield of potato. Similar results were found by several researchers (EL-Gamal, 1985 and Humadi, 1986). Such increase in yield of potato tubers is either due to the formation of large size tubers or increasing of number of tubers per plant or both.

Table 3: Effect of varieties and different levels of potassium on number of tubers per plant, fresh weight of tubers (g m^{-2}) and yield (t ha^{-1})

Treatments	**No of tubers per plant**		**Fresh weight of tubers (g m^{-2})**		**Yield (t ha^{-1})**	
Varieties	**2016-17**	**2017-18**	**2016-17**	**2017-18**	**2016-17**	**2017-18**
V_1 (Kufri Ashoka	6.33	3.98	1593.27	1494.29	18.28	19.21
V_2 (Kufri Pukhraj)	5.05	3.45	2111.81	1824.21	22.36	21.46
V_3 (Kufri Khyati)	4.43	4.38	1911.19	1735.23	18.50	19.21
S. Em. (±)	0.20	0.17	84.65	21.16	0.92	0.51

CD (0.05)	0.80	0.68	332.29	83.08	3.62	2.02
Potassium						
K_0	4.63	3.33	1488.07	1138.38	14.58	14.32
K_{75}	5.60	3.70	1780.89	1457.86	20.33	20.35
K_{150}	5.43	4.80	2304.31	2245.22	23.92	23.74
K_{225}	5.40	3.90	1915.08	1896.86	20.02	21.42
S. Em. (±)	0.24	0.13	40.27	53.29	0.66	0.25
CD (0.05)	0.71	0.37	119.66	158.32	1.96	0.73

Table 4: Economics of potato crop as influenced by variety and different levels of potassium

Treatment	Yield (t/ha)		Market Price (Rs/t)		Cost of cultivation (Rs)	Gross return (Rs)		Net return (Rs)		B:C Ratio	
	2016-17	2017-18	2016-17	2017-18		2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
V_1K_0	11.27	13.87	8000	10000	148853	90166.67	138702.78	-58686.33	-10150.22	0.61	0.93
V_1K_{75}	19.29	19.18	8000	10000	150978	154331.11	191772.22	3353.11	40794.22	1.02	1.27
V_1K_{150}	22.29	22.67	8000	10000	153103	178282.22	226716.67	25179.22	73613.67	1.16	1.48
V_1K_{225}	20.99	21.13	8000	10000	155228	167924.44	211325.00	12696.44	56097.00	1.08	1.36
V_2K_0	17.82	14.31	8000	10000	148853	142522.22	143088.89	-6330.78	-5764.11	0.96	0.96
V_2K_{75}	23.47	22.71	8000	10000	150978	187760.00	227072.22	36782.00	76094.22	1.24	1.50
V_2K_{150}	27.65	26.52	8000	10000	153103	221217.78	265213.89	68114.78	112110.89	1.44	1.73
V_2K_{225}	24.47	22.29	8000	10000	155228	195764.44	222938.89	40536.44	67710.89	1.26	1.44
V_3K_0	14.67	14.79	8000	10000	148853	117395.56	147905.56	-31457.44	-947.44	0.79	0.99
V_3K_{75}	18.24	19.18	8000	10000	150978	145886.67	191825.00	-5091.33	40847.00	0.97	1.27
V_3K_{150}	21.82	22.02	8000	10000	153103	174591.11	220172.22	21488.11	67069.22	1.14	1.44
V_3K_{225}	19.29	20.86	8000	10000	155228	154348.89	208550.00	-879.11	53322.00	0.99	1.34

Economics of cultivation of potato

The economics of potato crop as influenced by variety and potassium levels were calculated and mean values were tabulated (Table 4). The price of potato was considered as per market price of rupees 8 kg^{-1} and 10 kg^{-1} at the time of harvest during 2016-17 and 2017-18 respectively. The economics of potato as influenced by variety Kufri Pukhraj with 150 kg K_2O ha^{-1} gave the highest gross income (Rs. 2,21,217.78 and 2,65,213.89 during 2016-17 and 2017-18 respectively), net return (Rs. 68,114.78 and 1,12,110.89 during 2016-17 and 2017-18 respectively) and benefit cost ratio (1.44 and 1.73 during 2016-17 and 2017-18 respectively). It might be taken into consideration that the farmers of *Terai* zone were growing the early duration variety like Kufri Pukhraj and they should be advised to cultivate potato under late planted condition with a higher dose of potassium preferably 150 kg K_2O ha^{-1}.

Conclusion

The treatment 150 Kg K_2O ha^{-1} (K_{150}) recorded highest values in most of the yield attributes. The economics of potato as influenced by variety Kufri Pukhraj with 150 kg K_2O ha^{-1} gave the highest gross income (Rs. 2,21,217.78 and 2,65,213.89 during 2016-17 and 2017-18 respectively), net return (Rs. 68,114.78 and 1,12,110.89 during 2016-17 and 2017-18 respectively) and benefit cost ratio (1.44 and 1.73 during 2016-17 and 2017-18 respectively).

From the results, it was observed that the nutrients in the right dose played an important role in the variation of final tuber yields. The highest tuber yield was obtained from the treatment 150 Kg K_2O ha^{-1} (K_{150}). The increase in final yield of tubers corresponded to the higher Leaf Area Index, higher dry matter accumulation in shoot, higher weight of tubers perplant.

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