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Economics of production of potato grown in Kashmir region under different levels and time of potassium application

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Abstract
Present investigation entitled "Response of potato (*Solanum tuberosum* L.)" to varying levels and time of potassium application was carried out at Vegetable Experimental Farm, Division of Vegetable Science during *Kharif* 2011. The economic analysis of potato showed T18 (150 kg per hectare potassium in two splits of ½ basal + ½ top dressing at 40 days after planting) recorded significantly highest net return followed by T21 (150 kg potassium at 40 days after planting).

Keywords: Potato, Potassium, Economics

Introduction
Potato (*Solanum tuberosum* L.) is known for sustaining millions of lives by proving cheap and nutritious food during the times of war andhunger especially for increasing population in developing countries owing to its high production potential per unit area and time, high nutritional value to sustain burgeoning population and ward off malnutrition and hunger. Potato plays a very important role in human diet and this has been realized by FAO and the year 2008 was celebrated as the year of potato with the slogan of the "Hidden Treasure". It ranks fourth in terms of production after maize; rice and wheat and India is the third largest producer of potato in world. Potato has been considered as the king of staple food and it has been recognized as a wholesome food and richest source of energy in most countries of the world. Potato contains significant levels of phenolic compounds and vitamin C as a potent antioxidant (Brown, 2005) [2].

Manurial requirement of the crop is usually high because of its high yield potential per unit area and time. The application of fertilizer and organic manures in a specific manner is thus essential to obtain economic yield. At present the average yield of potato in India is much below the crop potential yield as the farmers are generally using N or N + P unknowingly making these nutrients as shovels to mine the soil potassium. This is neither advisable nor desirable and definitely not in long term interest of farmers who aim to harvest hig her yield year after year. Further, the amounts of potassium used are much smaller than potassium removal, resulting in negative balance even in soils where potassium is applied at traditionally recommended rates. Soil quality is being degraded because of continual removal of potassium along with other nutrients from soil by cropping. The skewed and the excessive use of nitrogen and phosphorus fertilizers might aggravate the situation in different cropping system because of nominal potassium use in the country and continuous use of nitrogen and phosphorus would accelerate drainage of soil native potassium reserves. It will not only impoverish soil potassium but also adversely effect crop yields (Akhtar *et al.*, 2003) [1]. This can be enhanced significantly with balanced fertilization. Potato has a shallow root system compared to other crops. On the other hand, uptake of fertilizer nutrients viz. Nitrogen, Phosphorus, Potassium by potato per unit area and time is quite high due to its fast early growth andtuber bulking (Singh *et al.*, 1996) [7]. A healthy crop of potato removes about 170-230 kg potassium per hectare indicating that potato needs of potassium are much high than that of cereal crops being a shallow rooted crop, the fertilizer use efficiency of potassium ranges between 50-60 per cent. As such potato invariably responds to potassium application in various kinds of soil and agro-climatic conditions in which it is grown. Application of potassium increases plant height, crop vigour and impart resistance against drought, frost and diseases. Potassium increases leaf expansion particularly at early stages of growth, extend leaf area duration by delaying leaf shedding near maturity it increases both the rate and duration of tuber bulking. It activates number of enzymes involved in photosynthesis, carbohydrate metabolism and proteins and assists in the translocation of carbohydrate from leaves to tubers. The analysis revealed that it increases yield by increasing the number a nd yield of large and medium sized tubers which resulted in increase of overall tuber yield as well as the marketable yield. Since no such study has been carried out on this aspect hence present study shall be carried out under Kashmir conditions.

Research Methods

The present investigation entitled "Response of potato (*Solanum tuberosum* L.) variety Kufri Jyoti to varying levels and time of potassium application was carried out at Vegetable Experimental Farm of Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar campus during *Kharif*, 2011. The experiment was laid in a Randomized block design with three replications at the spacing of 60 x 20 cm. Three levels of potassium i.e., 50, 100 and 150 kg per hectare and seven different time of application: full basal; ¾ basal + ¼ top dressing at 60 days after planting; no basal + ½ top dressing at 40 days after planting + ½ top dressing at 60 days after planting; full top dressing at 40 days after planting were tried in the experiment. The cost of cultivation of potato was calculated which includes both variable and fixed cost. Total variable cost includes both variable and added cost. (Table -1)

Research Finding and Discussion

As per Table 1 and 2 it was observed that as all other operations except levels and time of potassium application were common under all the treatments. Persual data revealed that treatment T18 with 150 kg potassium applied in two splits of ½ basal and ½ top dressing at 40 days after planting proved to be most remunerative, yielding a net profit of Rs 251585.60 per hectare over an overall expenditure of Rs 110322.36 i.e., return of Rs 2.28 per rupee invested. Similar finding has been reported by Prakash and Singh (1976) [6], Karam *et al.*, (2011) [4] and Daniel *et al.*, (2016) [3].

Highest net return are with T18 with 150 kg potassium applied in two splits of ½ basal and ½ top dressing at 40 days after planting due to higher yield in this treatment. This may be attributed to the fact that availability of potassium at 40 days after planting played an important role in transport of assimilates and nutrients and improved the water use efficiency by controlling stomatal opening and closing. Potassium is also involved in activation of enzymes which are fundamental to metabolic processes. Thus, the food manufactured with the process of photosynthesis is transported from the source to the sink of their use or storage promptly i.e., tubers (Mengel, 1997) [5] which has resulted in increasing the yield.

Table 1: Cost of Cultivation of economics of production of Potato (Cost involved on variable and fixed factors)

A) Preparation/sowing, management(10 labours@ Rs 120 per labour)	1200.00
B) Preparatory Tillage(Three ploughing@3031per hectare)	9093.00
C) Clod breaking/Levelling(20 labours@ Rs 120 per labour)	2400.00
D) Preparation of beds/channels (35labours@ Rs 120 per labour)	4200.00
E) Sowing/covering of tubers(35labours@ Rs 120 per labour)	4200.00
F) Irrigation(4 irrigation-12 labours@ Rs 120 per labour)	1440.00
G) Weeding(3 hand weeding -10 labours@ Rs 120 per labour	1200.00
H) Earthing(20 labours@ Rs 120 per labour)	2400.00
I) After care operations(10 labours@ Rs 120 per labour)	1200.00
J) Harvesting(40 labours@ Rs 120 per labour) K) Grading (13 labours@ Rs 120 per labour)	4800.00 1560.00
L) Total labour component involved in total cost of cultivation	34893.00
M) Cost of seed @Rs 20 per kg for 24 quintal per hectare	48000.00
N) Variable cost (labour + cost of seed::34893+48000)	82893.00
O) Land rent @Rs 9000 per kanal	18000.00
P) Land tax	80.00
Q) Deprecation on implements	800.00
R) Total (Interest@ 6.5% on fixed factor)	1227.20
S) Total fixed cost(18880+1227.20)	20107.20

Table 2: Treatment wise added cost in cultivation of potato (Kufri jyoti)

Treatment		Cost involved in urea+DAP (Rs)	Cost involved in MOP(Rs)	Number of labours for spreading@120/labour	Amount involved (Rs)	Total added cost(Rs/ha)
T_1	50 kg K_2O (full basal)	4094	988	2	240	5322
T_2	50 kg K_2O (¾ basal + ¼ TD at 40 DAP)	4094	988	2	240	5322
T_3	50 kg K_2O (¾ basal + ¼ TD at 60 DAP)	4094	988	2	240	5322
T_4	50 kg K_2O (½ basal + ½ TD at 40 DAP)	4094	988	2	240	5322
T_5	50 kg K_2O (½ basal + ½ TD at 60DAP)	4094	988	2	240	5322
T_6	50 kg K_2O (no basal + ½ TD at 40 DAP + ½ at 60 DAP)	4094	988	3	360	5442
T_7	50 kg K_2O (full at 40 DAP)	4094	988	2	240	5322
T_8	100 kg K_2O (full basal)	4094	1977	2	240	6311
T_9	100 kg K_2O (¾ basal + ¼ TD at 40 DAP)	4094	1977	2	240	6311
T_{10}	100 kg K_2O (¾ basal + ¼ TD at 60 DAP)	4094	1977	2	240	6311
T_{11}	100 kg K_2O (½ basal + ½ TD at 40 DAP)	4094	1977	2	240	6311
T_{12}	100 kg K_2O (½ basal + ½ TD at 60 DAP)	4094	1977	2	240	6311
T_{13}	100 kg K_2O (no basal + ½ TD at 40 DAP + ½ at 60 DAP)	4094	1977	3	360	6431
T_{14}	100 kg K_2O (full at 40 DAP)	4094	1977	2	240	6311

T_{15}	150 kg K_2O (full basal)	4094	1977	2	240	6311
T_{16}	150 kg K_2O (¾ basal + ¼ TD at 40 DAP)	4094	2965	2	240	7299
T_{17}	150 kg K_2O (¾ basal + ¼ TD at 60 DAP)	4094	2977	2	240	7311
T_{18}	150 kg K_2O (½ basal + ½ TD at 40 DAP)	4094	2989	2	240	7323
T_{19}	150 kg K_2O (½ basal + ½ TD at 60DAP)	4094	3001	2	240	7335
T_{20}	150 kg K_2O (no basal + ½ TD at 40 DAP + ½ at 60 DAP)	4094	3012	3	360	7466
T_{21}	150 kg K_2O (full at 40 DAP)	4094	3024	2	240	7358

Table 3: Treatment wise comparative economics of cost of cultivation of potato

Treatment		Fixed cost (Rs/ha)	Variable cost (Rs/ha)	Added cost(Rs/ha)	Total Variable cost(Rs/ha)	Total cost of cultivation(Rs/ha)
T_1	50 kg K_2O (full basal)	20107	82893	5322	88215	108321.58
T_2	50 kg K_2O (¾ basal + ¼ TD at 40 DAP)	20107	82893	5322	88215	108321.58
T_3	50 kg K_2O (¾ basal + ¼ TD at 60 DAP)	20107	82893	5322	88215	108321.58
T_4	50 kg K_2O (½ basal + ½ TD at 40 DAP)	20107	82893	5322	88215	108321.58
T_5	50 kg K_2O (½ basal + ½ TD at 60DAP)	20107	82893	5322	88215	108321.58
T_6	50 kg K_2O (no basal + ½ TD at 40 DAP + ½ at 60 DAP)	20107	82893	5442	88335	108441.58
T_7	50 kg K_2O (full at 40 DAP)	20107	82893	5322	88215	108321.58
T_8	100 kg K_2O (full basal)	20107	82893	6311	89204	109310.23
T_9	100 kg K_2O (¾ basal + ¼ TD at 40 DAP)	20107	82893	6311	89204	109310.23
T_{10}	100 kg K_2O (¾ basal + ¼ TD at 60 DAP)	20107	82893	6311	89204	109310.23
T_{11}	100 kg K_2O (½ basal + ½ TD at 40 DAP)	20107	82893	6311	89204	109310.23
T_{12}	100 kg K_2O (½ basal + ½ TD at 60 DAP)	20107	82893	6311	89204	109310.23
T_{13}	100 kg K_2O (no basal + ½ TD at 40 DAP + ½ at 60 DAP)	20107	82893	6431	89324	109430.23
T_{14}	100 kg K_2O (full at 40 DAP)	20107	82893	6311	89204	109310.23
T_{15}	150 kg K_2O (full basal)	20107	82893	6311	89204	109310.23
T_{16}	150 kg K_2O (¾ basal + ¼ TD at 40 DAP)	20107	82893	7299	90192	110298.64
T_{17}	150 kg K_2O (¾ basal + ¼ TD at 60 DAP)	20107	82893	7311	90204	110310.50
T_{18}	150 kg K_2O (½ basal + ½ TD at 40 DAP)	20107	82893	7323	90216	110322.36
T_{19}	150 kg K_2O (½ basal + ½ TD at 60DAP)	20107	82893	7335	90228	110334.22
T_{20}	150 kg K_2O (no basal + ½ TD at 40 DAP + ½ at 60 DAP)	20107	82893	7466	90359	110466.08
T_{21}	150 kg K_2O (full at 40 DAP)	20107	82893	7358	90251	110357.94

Table 4: Effect of different levels and time of potassium application on Relative economics of potato

Treatment		Cost of cultivation (treatment cost/ha)	Production (q/ha)	Gross Returns	Net Profit (Rs/ha)	Return /rupee invested
T_1	50 kg K_2O (full basal)	108321.58	210.6	252720	144398.4	1.33
T_2	50 kg K_2O (¾ basal + ¼ TD at 40 DAP)	108321.58	164.3	197160	88838.42	0.82
T_3	50 kg K_2O (¾ basal + ¼ TD at 60 DAP)	108321.58	162.8	195360	87038.42	0.80
T_4	50 kg K_2O (½ basal + ½ TD at 40 DAP)	108321.58	192.8	231360	123038.4	1.14
T_5	50 kg K_2O (½ basal + ½ TD at 60DAP)	108321.58	165.8	198960	90638.42	0.84
T_6	50 kg K_2O (no basal + ½ TD at 40 DAP + ½ at 60 DAP)	108441.58	162.8	195360	86918.42	0.80
T_7	50 kg K_2O (full at 40 DAP)	108321.58	165.84	199008	90686.42	0.84
T_8	100 kg K_2O (full basal)	109310.23	211.35	253620	144309.8	1.32
T_9	100 kg K_2O (¾ basal + ¼ TD at 40 DAP)	109310.23	209.03	250836	141525.8	1.29
T_{10}	100 kg K_2O (¾ basal + ¼ TD at 60 DAP)	109310.23	192.83	231396	122085.8	1.12
T_{11}	100 kg K_2O (½ basal + ½ TD at 40 DAP)	109310.23	210.57	252684	143373.8	1.31
T_{12}	100 kg K_2O (½ basal + ½ TD at 60 DAP)	109310.23	209.03	250836	141525.8	1.29
T_{13}	100 kg K_2O (no basal + ½ TD at 40 DAP + ½ at 60 DAP)	109310.23	209.03	250836	141525.8	1.29
T_{14}	100 kg K_2O (full at 40 DAP)	109430.23	209.03	250836	141405.8	1.29
T_{15}	150 kg K_2O (full basal)	109310.23	256.08	307296	197985.8	1.81
T_{16}	150 kg K_2O (¾ basal + ¼ TD at 40 DAP)	110298.64	260.71	312852	202553.4	1.84
T_{17}	150 kg K_2O (¾ basal + ¼ TD at 60 DAP)	110310.50	258.4	310080	199769.5	1.81
T_{18}	150 kg K_2O (½ basal + ½ TD at 40 DAP)	110322.36	301.59	361908	251585.6	2.28
T_{19}	150 kg K_2O (½ basal + ½ TD at 60DAP)	110334.22	277.68	333216	222881.8	2.02
T_{20}	150 kg K_2O (no basal + ½ TD at 40 DAP + ½ at 60 DAP)	110466.08	256.08	307296	196829.9	1.78
T_{21}	150 kg K_2O (full at 40 DAP)	110357.94	281.54	337848	227490.1	2.06

Conclusion

The above studies show that use of fertilizers is recognized as one of the quickest ways of increasing the production of crops. The extra returns obtainable depends on many other factors like climate, soil type, integrated insect pest management, cultural management practices and other factors. Under unfavorable weather conditions and poor crop husbandry, use of fertilizers may give only marginal returns. Therefore for a farmer it is essential to know optimum manipulation of different production factors to harvest higher economic returns. As per the study, the following conclusions can be drawn:

- The treatment combination of 150 kg potassium applied half basal and half top dressing at 40 days after planting was economically feasible giving a cost-benefit ratio of 2.28 and a net profit of 251585.60 Rs/ha

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