

Original Research Article

**EFFECT OF POTASH ON GROWTH, YIELD, QUALITY AND ECONOMICS OF
POTATO (*Solanum tuberosum* L.)**

ABSTRACT

The present investigation was carried out at Research farm of Abhilashi University, Chail Chowk, Mandi during *Rabi* season 2022 to evaluate the effect of potash on growth and yield of potato. The experiment was laid down in randomized block design consisting eight treatments in which one is control and others are combination of potash with three replications. There was significant effect found under various potash treatments in terms of plant height, number of haulms and haulm diameter at various crop growth stages and fresh and dry weight of plants, marketable yield and harvest index and specific gravity and dry matter content of tubers. The maximum marketable tuber yield was obtained with the split application (basal + foliar spray) of potash. The findings revealed that the growth and yield parameters were significantly influenced by different split potash levels.

Keywords: Haulm diameter, Potash, Growth, Yield, Economics.

Comment [R1]: Add few keywords

INTRODUCTION

Potato (*Solanum tuberosum* L.) is a fourth major food crop after rice, wheat and maize. It is most widely grown vegetable crop in India as well as Himachal Pradesh. In Himachal Pradesh, it is a major off season vegetable crop. India ranks fourth in area (2226 ha.) and third in production (56176 million tonnes) in India with an average yield of 183.3 q/ ha. In Himachal Pradesh, area under potato is about 15.00 thousand hectare with a production of 196.30 metric tonnes /ha (Anonymous 2022). The potato is a versatile vegetable that can be used as a fresh vegetable, a raw ingredient in culinary items or other food ingredients, a source of starch and alcohol, and animal feed. From the nutritional point of view, potato is the best source of energy and vitamins. It contains high amount of carbohydrate (19.4%) in the form of starch, protein (2%) and fat. Potato plants prefer deep, loose, light, well-drained soil with lots of organic content.

A number of macro and micro plant nutrients are essential for the growth and development of potato. The macro nutrients like N, P and K are most required by potato (Banerjee et al. 2016). Potassium is one of the macronutrients that is major for potato plant growth. It controls vigor of plant, development and quality of the tubers, which regulates the health and productivity of plant. It also helps in translocation of carbohydrates as well as the synthesis of sugars and starch. Application of potassium (K) increases plant height and resistant to diseases, drought, and frost. Application of K_2SO_4 is more beneficial to potato than KCl in terms of yield and quality of tubers. The harvest index and benefit: cost ratio also increases with the increasing levels of potassium (Singh and Lal 2012).

High dry matter content improves the quality of potatoes (Wibowo et al., 2014). Higher the specific gravity the higher will be the quantity of dry matter and greater will be the yield. The potatoes having high specific gravity are mainly used for the preparation of chips and French fries where as low specific gravity potatoes are used for canning. Therefore, the present work was done with the objective to study the effect of potash on growth, yield and quality of potato crop.

Comment [R2]: Add few more paragraphs of introduction

MATERIALS AND METHODS

The field experiment was conducted during winter season 2022 at research farm of Abhilashi University, Chail Chowk, Mandi (H.P.). The experimental farm is situated at 31°33', 32°N and 77°00', 53°E longitudes having an altitude of 1,411 meters above mean sea level. The soil of the experimental plot is acidic having pH 5.13 having available nitrogen (173 kg N/ha), available phosphorus (44kg P/ha) and available potassium (269 kg K/ha). The experiment was laid out in randomized block design with three replications and eight treatments viz., T₁(Control without potash application), T₂(75% of recommended dose of Potash as basal application and 25% of RDF as top dress at 30 Days After Planting), T₃(50% of recommended dose of Potash as basal application and half dose of potash as top dress at 30 DAP), T₄(75% recommended dose of Potash as basal application and one spray of potassium sulphate @ 2% at 30 DAP), T₅ (50% recommended dose of Potash as basal application and one spray of potassium sulphate @ 2% at 30 DAP), T₆(125% potash as basal), T₇(Half dose of T₆ as basal application and half dose of T₆ as top dress at 30 DAP) and T₈(Full dose of T₆ as basal application and one spray of potassium sulphate @ 2% at 30 DAP). The recommended dose of fertilizers was 160 kg N/ha, 100 P₂O₅/ha and 120 kg K₂O/ha. Half dose of nitrogen and full dose of phosphorus was applied at the time of planting and remaining half dose of nitrogen was applied at the time of earthing up. The potash was applied as per the treatments. The source of nitrogen, phosphorus and potassium were applied in the form of Urea, SSP (Single Super Phosphate) and MOP (Muriate of Potash) and potassium sulphate respectively. The field and plots were prepared with net plot size 3× 2.5 m². The well sprouted tubers of Kufri Jyothi variety were planted at 60× 20 cm. The crop was dehaulmed after 70 days after planting and after 12 days of dehaulming harvesting of tubers was done. Other agronomic practices were adopted as per recommendations. The observations for plant height, number of haulms and haulm diameter were recorded at 30, 45, 60 days after planting and at dehaulming stage while fresh and dry weight of plants were recorded at dehaulming stage. The yield attributing characters were observed at the time of harvest. Dry matter content of tubers was determined by drying tubers in oven at 70°C till constant weight. Yield parameters of tuber were recorded at harvest. Dry matter content of tubers was determined by drying tubers in oven at 70°C till constant weight (Thriveni et al., 2015). The harvest index per hectare (El-Naim et al. 2012) was calculated by

$$\text{Harvest index (\%)} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

Where,

Economic yield= Total tuber yield (t/ha) and

Biological yield= Total tuber yield + total bio-mass yield (t/ha)

Specific gravity was determined using the method described by Dinesh et al. (2005):

$$\text{Specific gravity of tubers} = \frac{\text{Weight of tuber (g)}}{\text{Volume of tuber (cm}^3\text{)}}$$

B: C ratio is calculated by the formula described by Singh and Lal (2012)

$$\text{B: C ratio} = \frac{\text{Gross income (₹/ha)}}{\text{Total expenditure (₹/ha)}}$$

RESULTS AND DISCUSSION

Growth parameters

1. Emergence

Emergence is a developmental stage, when first leaves of plant emerge from the soil. After two weeks of planting, the plants started emerging out from several tubers in each plot. Within a month, the emergence was almost complete. Emergence count was done at 30 days after planting (DAP) Emergence percent is determined after 30 days after planting. From data, the emergence percent of potato was not influenced by various potash treatments. The maximum emergence percent (97.47) was recorded in treatment T₁ (Control without potash application). Singh and Lal (2012) also reported that the emergence of potato was not influenced by the potash treatments.

2. Plant Height

The plant height was significantly affected at all stages of crop growth. The plots having split doses of potash (basal + top-dress + spray) gives higher plant height. The maximum plant height at 30 (29.70 cm), 45 (40.42 cm), 60 (40.15 cm) days after planting and at dehaulming stage (42.57 cm) was recorded in the treatment T₅ (50% recommended dose of Potash as basal application and one spray of potassium sulphate @ 2% at 30 DAP). It is indicated that split application (basal + spray) gives higher plant height than control. Gunadi (2009) also reported that the split application of potash (basal + foliar spray) gives higher plant height.

3. Number of haulms per hill

The number of haulms per hill was not affected by different treatments. The maximum number of haulms at 30 (4.37), 45 (4.59), 60 (5.82) days after planting and at dehaulming stage (5.29) was recorded in the treatment T₆ (125% potash as basal). The application of potash did not have any impact on number of haulms. Al-Moshileh and Errebi (2004) also reported that the number of haulms per hill was not affected by the various potash applications.

4. Haulm girth (mm)

The haulm girth was significantly affected at all stages of crop growth. The maximum haulm girth at 30 (7.17mm), 45 (7.50mm), 60 (7.90mm) days after planting and at dehaulming stage (8.30mm) were recorded in the treatment T₈ (100% of T₆ as basal + one spray of potassium sulphate @ 2% at 30 DAP). The haulm girth is increased with the split application (basal + spray) than the control. Yingang (2003) also reported that haulm girth was significantly increased with the increasing rates of potassium fertilizer.

5. Fresh and dry weight of plants (g)

The significant increase in fresh and dry weight of plants at dehaulming stage. The maximum fresh weight (212.45 g) and dry weight (34.84 g) at dehaulming stage was recorded in the treatment T₈ (100% of T₆ as basal + one spray of potassium sulphate @ 2% at 30 DAP). The results indicated that the fresh and dry weight of plants were increases with increasing levels of potash. Adhikary and Karki (2006) also reported that maximum plant weight is reported in the treatment treated with 100 kg/ha potassium. Gunadi (2009) reported that higher dry weight of plants is recorded in split doses of potash (basal+ foliar spray).

Table 1 Effect of potash on Emergence %, plant height (cm) and Number of haulms

Treatment	Emergence %	Plant height (cm)				Number of haulms			
		30 DAP	45 DAP	60 DAP	At dehaulming	30 DAP	45 DAP	60 DAP	At dehaulming
T ₁	97.47	12.43	26.47	30.04	33.76	2.90	3.35	4.88	4.93
T ₂	97.18	14.36	33.42	35.71	40.20	3.55	4.06	5.09	5.21
T ₃	91.97	13.36	32.98	35.21	39.94	3.59	4.07	5.12	5.27
T ₄	92.77	12.48	31.08	34.87	39.80	4.06	4.28	5.17	5.30
T ₅	97.21	29.70	40.42	40.15	42.57	4.00	4.11	5.15	5.27
T ₆	93.09	17.33	33.52	36.65	40.91	4.37	4.59	5.82	5.59
T ₇	92.48	29.20	34.88	36.98	41.84	4.06	4.11	5.15	5.29
T ₈	91.47	21.19	33.98	36.67	41.18	3.17	4.01	5.07	5.15
SE(±)	1.45	2.68	1.88	1.82	1.7	0.23	0.20	0.13	0.09
CD _{0.05}	4.46	0.87	0.61	0.59	0.55	0.71	0.63	0.42	0.28

Table 2 Effect of potash on haulm girth (mm), fresh weight and dry weight of plants (g)

Treatment	Haulm girth (mm)				Fresh weight (g)	Dry weight (g)
	30 DAP	45 DAP	60 DAP	At dehauling		
T ₁	5.50	6.00	6.30	6.43	163.73	22.89
T ₂	6.09	6.50	6.90	7.40	182.22	30.51
T ₃	6.37	6.76	7.16	7.57	183.57	30.86
T ₄	6.59	6.90	7.30	7.70	189.30	31.02
T ₅	6.90	7.30	7.70	7.90	212.06	33.70
T ₆	6.23	6.63	7.02	7.43	182.37	30.69
T ₇	5.90	6.30	6.70	7.10	207.41	32.97
T ₈	7.17	7.50	7.90	8.30	212.45	34.84
SE(±)	0.10	0.07	0.13	0.14	5.54	1.71
CD _{0.05}	0.33	0.23	0.4	0.43	16.97	5.23

Yield parameters

1. Total number of tuber per plant and per plot

The total number of tubers was significantly affected with various potash treatments. The maximum number of tubers per plant (11.02 g) and per plot (575.46 g) was observed in the treatment T₈ (100% of T₆ as basal + one spray of potassium sulphate @ 2% at 30 DAP) whereas minimum number of tubers were recorded in treatment T₁ (Control without potash application). Moinuddin et al. (2004) reported that increase in number of tubers is due to increase in the rates of potassium fertilizer.

2. Total tuber yield per plant and per plot

The tuber yield was significantly affected with the various potash treatments. The maximum tuber yield per plant (820.67 g) and per plot (78.27 kg) were recorded in the treatment T₈ (100% of T₆ as basal + one spray of potassium sulphate @ 2% at 30 DAP) where as minimum was recorded in Control treatment. Khan et al. (2004) reported that increase in the tuber yield is due to the enhancement of foliar application of potassium.

3. Marketable tuber yield (t/ha)

The marketable tuber yield was affected with the various potash treatments. The maximum marketable tuber yield (31.49 t/ha) was obtained in the treatment T₈ (100% of T₆ as basal + one spray of potassium sulphate @ 2% at 30 DAP) where as minimum marketable tuber yield was obtained in T₁ (Control without potash application). Gunadi (2009) also reported that split application of potash (basal + foliar spray) had significantly higher marketable tuber yield.

4. Harvest index (%)

The harvest index was significantly affected with the various treatments. The maximum harvest index (59.29 %) in the treatment T₃ (50% RDF as basal + 50% RDF as top dress at 30 DAP) whereas lowest value was observed in treatment T₁ (Control without potash application). Singh and Lal (2012) also reported that increase in harvest index with increase in the potassium rates.

Table 3 Effect of potash on yield parameters of potato

Treatment	Tubers/plant	Tubers/plot	Tuber yield (g/plant)	Tuber yield (kg/plot)	Marketable Yield (t/ha)	Harvest index (%)
T ₁	8.25	476.20	320.09	51.86	17.23	50.42
T ₂	9.22	486.40	500.07	61.94	29.40	51.10
T ₃	10.16	513.62	700.73	69.62	20.83	59.29
T ₄	10.41	528.60	760.47	66.69	30.20	58.45
T ₅	10.70	571.44	800.78	72.43	31.29	53.15
T ₆	8.80	494.68	600.00	64.00	22.95	56.12

T ₇	10.32	543.16	761.00	66.94	30.74	55.14
T ₈	11.02	575.46	820.67	78.27	31.49	53.02
SE(±)	0.49	6.36	12.18	1.71	0.38	0.94
CD _{0.05}	1.05	19.47	37.30	5.25	1.18	2.90

Quality parameters

The quality parameters like dry matter content of tubers (%) and specific gravity (g/cm³) were significantly affected with the various potassium rates of different treatments. The maximum dry matter content of tubers (17.79 %) and specific gravity (1.08 g/cm³) were recorded in the treatment T₈ (100% of T₆ as basal + one spray of potassium sulphate @ 2% at 30 DAP) than the control or basal only. Khan et al. (2010) also reported that potassium sulphate also increases the dry matter content of tubers.

Table 4 Effect of potash on quality parameters of potato

Treatment	Dry matter content of tubers (%)	Specific gravity (g/cm ³)
T ₁	14.08	1.01
T ₂	15.10	1.02
T ₃	15.50	1.03
T ₄	16.10	1.03
T ₅	16.60	1.07
T ₆	16.20	1.05
T ₇	16.43	1.06
T ₈	17.79	1.08
SE(±)	0.24	0.03
CD _{0.05}	0.73	0.03

Economics of the treatment

The growth and yield performance was reflected by the gross income and net profit. The maximum gross return (448005 Rs/ha) and net profit (344376.84 Rs/ha) with benefit: cost ratio(1:3.32) were recorded in the treatment T₈ (100% of T₆ as basal + one spray of potassium sulphate @ 2% at 30 DAP). It is revealed that highest net return and B: C ratio was obtained in the treatment having split application (basal + spray) of potash application.

Table 5 Effect of potash on economics of the treatments

Treatment	Total cost (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B: C ratio
T ₁	101625.48	309090	207464.52	1: 3.04
T ₂	103079.88	436005	332925.12	1: 4.22
T ₃	103079.88	363630	260550.12	1: 3.52
T ₄	105266.28	418185	312918.72	1: 3.97
T ₅	104902.68	327270	222367.32	1: 3.11
T ₆	103443.48	318180	214736.52	1: 3.07
T ₇	103443.48	409095	305651.52	1: 3.95
T ₈	105629.88	448005	342375.12	1: 4.24
T ₁	101625.48	309090	207464.52	1: 3.04
T ₂	103079.88	436005	332925.12	1: 4.22

On the basis of present investigation, it can be concluded that the split application of potash (basal + foliar spray) is more beneficial to the growth and yield of potato crop than the no control or basal application only. It improves availability of nutrients in terms with higher yield.

Comment [R3]: Discussion and conclusion part missing

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