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RESEARCH ARTICLE

EFFECT OF MULCHING AND POTASSIUM APPLICATION METHODS ON GROWTH AND YIELD OF POTATO AT ROLPA, NEPAL

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ABSTRACT

A field experiment was carried out to study the effect of mulching and potassium application method on growth and yield parameters of potato at Rolpa, Nepal from February, 2022 to July, 2022. The experiment was laid out in 2 factorial Randomized Complete Block Design (RCBD) with three replications consisting of 8 treatments. The variety used was Rolpa local. First treatment factor consisted of three mulching materials namely silver on black plastic, black plastic and plant residue including control plot whereas second treatment factor consist of two method of potassium application: split application and basal application of recommended dose. Days to 90% germination, plant height, number of leaves, and canopy diameter exhibited significant variations among the various mulching materials, while the method of potassium application showed no notable impact on these parameters. Notably, plastic mulches played a significant role in the germination rate, with potatoes sprouting 5-6 days earlier than the control group. However, all subsequent observations related to growth and yield parameters demonstrated significantly superior results in the case of silver on black plastic mulch. The silver on black plastic mulches, in particular, displayed a substantial influence, resulting in the highest tuber number, tuber weight, and tuber yield at 23.12, 62.16 gm, and 24.09 t/ha, respectively. Additionally, remarkable tuber characteristics, including circumference, diameter, and length, were recorded with silver on black plastic (14.20 cm, 4.74 cm, and 5.40 cm, respectively). Moreover, variations in tuber weight and total yield were observed among different potassium application methods, with the split application of potash yielding the highest total of 19.66 t/ha. The split application of potassium also produced the highest circumference (13.06 cm) and tuber diameter (4.07 cm), accompanied by a superior benefit-cost ratio of 2.65. Noteworthy was the highest benefit-cost ratio of 2.92 achieved with silver on black plastic mulch. Despite exploring the interaction effect between these two factors for both growth and yield parameters, no significant findings were observed. Consequently, it was concluded that silver on black plastic mulch combined with the split application method of potassium proved to be more effective for promoting growth and tuber yield, exhibiting a promising benefit-cost ratio.

KEYWORDS

Mulching, Potato, Potassium, Silver on Black Plastic, Tuber Weight, Benefit Cost Rat

1. INTRODUCTION

Potato (*Solanum tuberosum* L.) is considered third most important crop worldwide in terms of human consumption after rice and wheat, and more than a billion people worldwide consume potato (CIP, 2022). In Nepal, it is considered among the most important crops of the Hilly region, and holds first position among the non-cereal crop in terms of consumption (Bharati and Joshi, 2020). Nepal's cool climate is well suited for its tuber production and is particularly favored by farmers in high hills areas - roughly 1800 to 3000 masl (Potatopro, 2022). However, it is grown all over the country year round from 70 masl to 4000 masl and its consumption per capita reached 88.1 kg in 2019 in Nepal (Library, 2022; Lama, 2015).

It plays crucial role in hunger deprivation, food security and poverty mitigation. Dry matter per unit time and area is highest in case of potato and holds high national importance in food security (Timsina et al., 2011). Poverty eradication is possible from potato farming as small farmers of hills in Nepal are dependent on potato as a source of income(Gairhe, 2017). The area under potato cultivation in Nepal is 1,88,098 ha, production is 3,131,830 mt and productivity is 16.64 mt/ha (MoALD, 2021). Similarly in Rolpa, potatoes are being produced with production of 23,405 mt potato tuber under area of 1,398 ha with productivity 16.74 mt/ha (MoALD, 2021).

It has highest productivity inside country but lowest in comparison to the world. Weed is one of the major factors in reducing potato yield on and off potato field (Subedi et al., 2019). Weeds are parasites to our main crop for ecological factors and serve as alternate host for several insect pest and diseases and pose greater threat to potato productivity (Mukherjee and Rahaman, 2012). Thus, identifying and understanding most effective stage and method of weed control in field could help to decreases cost of production and increase potato yield (Mondani, 2011). For weed control, temperature regulation and high WUE, mulching could be an effective and most appropriate practice among farmers for GAP and to increase. Mulch acts as a surface layer of soil cover that enhances plant growth and WUE production by regulating the soil evaporation, soil moisture and temperature of the soil. (Li, 2013). Different kinds of mulching material are now in use such as Black polythene, Silver plastic on black/ white on black, white transparent and many more. During spring, polythene

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mulches raises soil temperature and control weed emergence hence cause rapid germination and no alternate host for insect and disease (Orzolek, 1993). It has been found that mulching could increase yield by improving soil structural stability and maintaining soil physical condition (Taylor et al., 2011).

Similarly, potatoes are highly voracious crops which demands around 20 ton per ha FYM, 100 kg N, 100 kg P and 60 kg K per ha (MoALD, Agriculture Diary, 2078). Potato is voracious feeder and needs high amount of potassium than other fertilizer (FarmProgress, 2022). Potassium has highest concentration in potato plant and it has many roles like enzyme regulation, starch synthesis, leaf expansion and stomatal movement (Naumann, 2020). Since Nepalese farmers have low affordability and availability of Potassium, they only depend upon FYM for nutrition supply to their planted crop. Especially in Rolpa district, there is lack of macronutrients and farmers are unaware of using fertilizer for high production. Due to continuous farming and low replenishment of Potassium, widespread deficiencies of potassium have been reported in many cultivated field (Adhikary and Karki, 2006). Deficiency of potassium during tuberization drastically reduced the potato production because potassium plays important role in sugar synthesis and sugar transportation from source to sink.

The use of rice straw mulching and potassium has been reported to produce large size tubers than mulching alone (Pulok et al., 2016). According to potatoes produced under mulching and potassium treatment combinations not only showed greater yields but also better performance in storage conditions (Pulok et al., 2014). Various studies have been conducted to understand the independent effects of N, P and K fertilizers and mulching on growth and yield of potato in different places of Nepal. However, study hasn't been conducted to assess the perfect combinations of mulching and potassium application methods in Nepal. Hence, determining the appropriate potassium dosage for cultivating potatoes under various mulching treatments is a critical factor in enhancing potato yield in Nepal.

2. Materials and Methods

2.1 Description of Experimental Site

Rolpa district (Mid hill) lies in Lumbini province of Nepal and famous for production of potato (local). Active potato production area in Rolpa is 1350 ha producing 22248 mt with productivity 16.48 mt/ha (GON, 2021). From February to July, a field experimental trial was conducted in Rolpa municipality-4, Liwang (1896 masl, 28.3000° N latitude and 82.6333° E longitude).

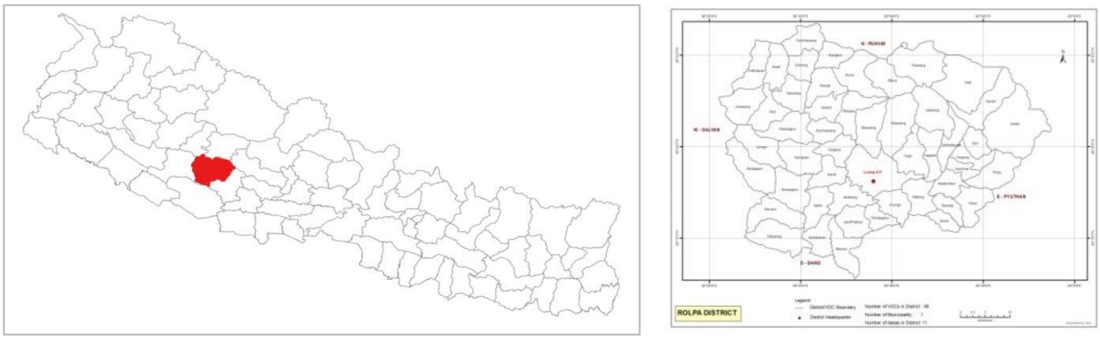

Figure 1: Location of Research Site i.e., Liwang, Rolpa

2.2 Weather Condition During Course of Experiment

Maximum and Minimum Temperatures, Precipitation and Relative humidity (RH) were recorded from NASA power during course of experiment in 15 days of interval and is presented below.

2.3 Details of Experiment

Experiment was conducted in open field condition to assess the adaptability of potato Rolpa Local Variety with mulching and potassium application method. The intention of using local variety was to promote local potato of Rolpa.

2.4 Experimental Design

Two factorial RCBD was designed for the experiment which includes 3 replication and 8 treatments. Each replication consists of 8 plot and each plot was 2.25 m × 1 m with well-spaced 45 cm × 20 cm between R-R and P-P respectively. Two experimental plots were 25 cm spaced to each other.

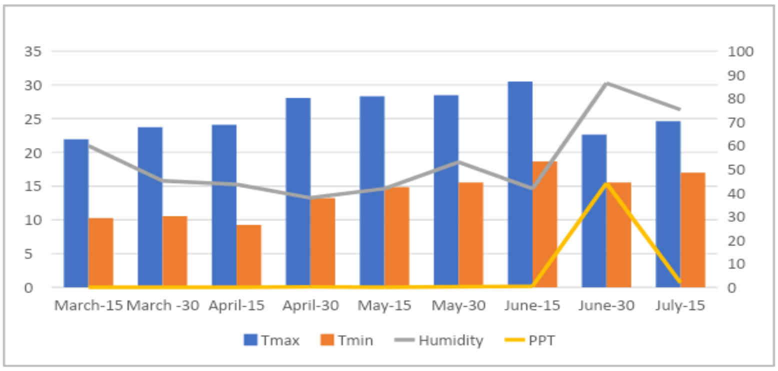

Figure 2: Weather condition during the course of experiment i.e., from March to July 2022

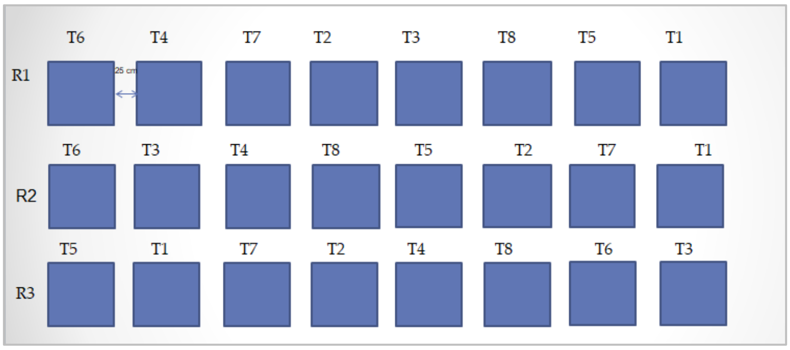

Figure 3: Layout of Experimental Field

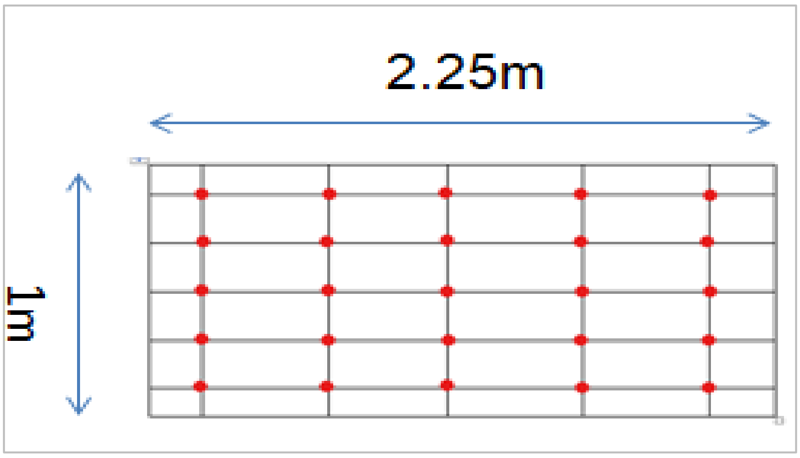

Figure 4: Individual Plot of Experimental Field

Every plot was designed to have 5 rows of plants having 5 plants in each row where first and fifth row were taken as border row and center 3 row were considered as net plot. Random 5 plants were selected as sample plants from net plot to collect biometrical and phenological data whereas, 4 random plants from middle row were taken as sample for yield and harvesting data.

2.5 Treatment Details

Two factors were used to prepare treatment for each plot

Table 1: Treatment Combination

SN	Treatment (T)	Treatment Combination
1	Treatment (T1)	Control with 100% basal application
2	Treatment (T2)	Control with 50% at basal + 50% as side dressing at 45 DAP
3	Treatment (T3)	Plant Residue with 100% basal application
4	Treatment (T4)	Plant Residue with 50% basal + 50% as side dressing at 45 DAP
5	Treatment (T5)	Black Plastic with 100% basal application
6	Treatment (T6)	Black Plastic with 50% basal + 50% as side dressing at 45 DAP
7	Treatment (T7)	Silver coated on black plastic mulch with 100% basal application
8	Treatment (T8)	Silver coated on black plastic mulch with 50% basal + 50% as side dressing at 45 DAP

Factor 1: Mulching
M_0: No Mulching
M_1: Plant Residue
M_2: Black Plastic
M_3: Silver on black Plastic

Factor 2: Potassium Application Method

P_1= 100% at basal application of recommended dose

P_2= 50% at basal and 50% as side dressing at 45 days of recommended dose

2.6 Cultural Practices

2.6.1 Field Preparation and Plant Population

Primary tillage was done using mini tiller and made free of weed and other residues. Secondary tillage was done by mini tiller and harrower to make soil fine, well drained and well aerated. After that 24 plots were made manually where each replication consists of 8 plots. Whole experimental plots consists of 600 plants of potato comprising 24 plots and each plot having 25 plants.

2.6.2 Fertilizer Application

The Urea, DAP (Di-ammonium Phosphate) and MOP (Muriate of Potash) were used as source of NPK at the recommended dose i.e., 140:220:100 NPK kg/ha. Half dose (24.375 gm) of Nitrogen and full dose (48.75 gm) of Phosphorous were applied as basal dose whereas remaining half dose of nitrogen was top dressed at 45 DAP. While potassium (22.5 gm/plot) was applied as per the treatment variable.

2.6.3 Seed Rate and Sowing

Healthy sprouted (1-2 cm) tubers of local variety were planted ensuring one tuber per hill with the help of potato planter on raised bed. Planting of tuber was done on 29th of February, 2022.

2.6.4 Irrigation

Requirement of water for crops was fully maintained during the experiment based on soil condition, seasons rainfall and crop requirement.

2.6.5 Earthing Up And Weeding

No weeding and earthing up was done as experiment was done in raised bed with mulching.

2.6.6 Control Practices

No significant damage was seen throughout experiment so no need to use control measurements. Although few infestations of *Agrotis* species (Cutworms) were seen and they were handpicked from soil surface just below the stem and destroyed manually.

2.6.7 Harvesting

Maturity indices of potato were yellowing of vine, tuber set (when pressure is applied, tuber skin does not peel from the flesh) and desired tuber size. Harvesting was done in June, 2022 from 4 plants selected as sample from net plot and harvested with the help of hoe manually.

2.7 Observation of Data Recorded in Potato

For phenological traits, data were collected from 5 sample plants which comprised of Plant height, Plant canopy diameter, Number of leaves and days to 90% germination. Similarly, for yield attributing character, total tuber number/ hill, tuber diameter, tuber circumference, tuber length, tuber weight and total tuber yield were recorded from 4 sample plants.

2.8 Statistical Analysis

The recorded data were presented in MS Excel and analyzed by using R-studio. All the recorded data then subjected to analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT) for mean separation. And significance differences among the means were studied using least significance difference (LSD) at 5% level of significance (Kwanchai A. Gomez, 1984).

2.9 Economic Analysis

Total cost of cultivation for different inputs (seed tuber, fertilizer, mulching material, labor and other materials) were calculated on the basis of local charges and gross returns (NRs/ha) was calculated on the basis of local market price. Net return was calculated by deducting total cost from gross return and expressed in NRs/ha. Benefit: Cost ratio (B: C) was calculated by following formula.

Benefit-Cost Ratio (B:C) = Gross Returns/Total cost of Cultivation

Benefit cost ratio (B:C) = $\frac{Gross\ Returns}{Total\ Cost\ of\ Production}$

3. Results and Discussion

Various observations were made during the experiment on growth parameters and yield attributes. The obtained results are described below in the table as well as figure wherever suitable.

3.1 Morphological Parameters

3.1.1 Germination

From observation, in Black plastic mulches, 90% germination was observed in 16.83 days which was statistically at par silver on black plastic (17.66 days) but was significantly earlier than in control plot (22.66 days) and plant residue mulch (21.33 days). Quicker germination in mulching than control plot was observed due to increase in temperature and moisture around the crop root zone (Bharati and Joshi, 2020; Al-Zohiri, 2013). This result is also correlated with finding of (Aryal, 2023).

Days to 90% germination was not influenced by Potassium levels. In general fertilizer has no influence on germination (Adhikari, 2009).

Table 2: Days to 90% Germination of Potato as Influenced by Types of Mulches And Potassium Application Methods at Liwang, Rolpa, 2022

Treatment	Germination (Days)
Mulching	
Silver on black plastic	17.66^{a}
Black plastic	16.83^{a}
Plant residue	21.33^{b}
Control	22.66^{b}
SEM (±)	0.12
LSD	1.56***
CV (%)	6.42
Potassium Application Methods	
Split	20.00^{a}
Basal	19.25^{a}
SEM (±)	0.18
LSD	1.10^{ns}
CV (%)	6.42
Grand Mean	19.62

Note: LSD: least significant differences, SEM (±): Standard error of mean, CV: Coefficient of variation, means with different letters in columns are significantly different at P <0.05 level by DMRT. *Significant at P <0.05 and ** significant at P<0.01 level. ***significant at P<0.001. ns: non-significant

3.1.2 Number of Leaves

From analyzed data, at each observation, it is found that the highest number of leaves was found in silver on black plastic mulches and lowest in control plot. It shows that mulching has significant effect on leaf number of plants. Higher number of leaves per plant is seen in plastic mulches than no mulch condition (Bharati and Joshi, 2020). Similarly, number of leaves per plant is highest in silver on black plastic mulches and lowest in control condition (Chaudhary, 2022). This result is also correlated with the findings of where highest number of leaves is found in silver on black plastic mulches (Aryal, 2023).

Under all observations, Difference between basal and split application was not significant. Only the higher dose of potassium at basal application has significant effect on leaf number but split application has no significant difference (Kumar and Pandey, 2007). These findings are correlated with the findings of (Grewal, 1980).

3.1.3 Plant Height

On evaluation of data at different DAP, highest plant height was observed in both plastic mulches as compared to the plant residue and control. At each observation, the plant height observed in silver on black plastic mulches (31.74, 50.81, 62.98 and 84.48 cm, respectively) was significantly higher and plant height found in control plot (23.77, 40.93, 54.29 and 68.64 cm, respectively) was significantly lower. This shows that mulching and plant height exhibit positive

correlation. At all observation, Silver on black plastic mulches exhibit significantly higher plant height than control plant growth is favored by mulching condition creating better micro-climate condition and efficient water management resulted from mulching favors plant growth (Chaudhary et al., 2004; Chaudhary, 2022; Bhardwaj, 2013). Plastic mulches give highest yield of potato in potato cultivation (Ahmed and Mahmud, 2017).

3.1.4 Plant Canopy

Results of statistical analysis showed that at each observation, widest plant canopy was found in silver on black plastic mulch and lowest in control plot. From here it is clear that mulching and plant canopy is positively correlated. Maximum vegetative growth and maximum foliage coverage is observed in plastic mulches condition than control plot which results in high photosynthetic rate (Bharati and Joshi, 2020; Ruiz-Machuca, 2014). Black and silver plastic mulches are efficient in Increasi ng area of leaf than control treatment (Jenni, 1996). These findings are also correlated with findings of (Chaudhary, 2022).

3.1.5 Tuber Characteristics

Circumference and Diameter of potato tuber was highest in silver on black plastic (14.20 cm and 4/74 cm) which is statistically at par with black plastic (13.16cm and 4.25 cm) and followed by plant residue (12.54 cm and 3.87 cm). The lowest circumference and diameter was found in control plot (11.45 cm and 3.68 cm). The length of potato tuber was highest in silver on black plastic (5.40 cm) which was significantly at par with black plastic (5.05 cm) and plant residue (12.54 cm). The lowest length of potato tuber was found in control plot (4.38 cm). Mean effect of mulching is equal to one irrigation (5 cm) in the matter of potato yield advantage i.e. water use efficiency (WUE) increased and moisture conserved, thus result in increment of tuber size (Chandra et al., 2002).

Likewise, Circumference and diameter of potato tuber was significantly higher in split application i.e. 13.06 cm and 4.07 cm respectively as compared to the basal application (12.61 cm and 3.88 cm respectively). The Length of potato tuber in split application (4.99 cm) was higher than control (4.94 cm) but no significant difference was seen. K enhances high assimilation (in leaves) and high sugar accumulation (in tuber) thus increasing tuber size. So split application promises K availability throughout the growing season (Sharma and Sud, 2001). Optimum K nutrition ensures 2/3rd of the photosynthates, in one day, passed into the tubers after intensive growth of tubers set in (Haeder et al., 1973).

Table 3: Number of leaves of potato as influenced by types of mulches and Potassium application methods at Liwang, Rolpa, 2022

Treatment	Leaves Number			
	30 DAP	45 DAP	60 DAP	75 DAP
Mulching				
Silver on black plastic	23.41^{a}	35.66^{a}	54.16^{a}	88.45^{a}
Black Plastic	21.41^{b}	32.37^{b}	46.46^{b}	75.75^{b}
Plant Residue	19.25^{c}	29.20^{c}	41.58^{c}	69.83^{c}
Control	16.75^{d}	24.37^{d}	34.37^{d}	51.91^{d}
SEM (±)	0.33	0.25	0.45	0.69
LSD	1.90***	3.10***	5.52***	8.46***
CV (%)	7.63	8.23	10.11	9.56
Potassium application methods				
Split	20.39^{a}	31.10^{a}	46.08^{a}	71.50^{a}
Basal	20.02^{a}	29.70^{a}	42.21^{a}	71.47^{a}
SEM (±)	0.46	0.36	0.64	0.98
LSD	1.35^{ns}	2.19^{ns}	3.90^{ns}	5.98^{ns}
CV (%)	7.63	8.23	10.11	9.56
Grand Mean	20.20	30.40	44.14	71.48

Note: LSD: least significant differences, SEM (±): Standard error of mean, CV: Coefficient of variation, means with different letters in columns are significantly different at P <0.05 level by DMRT. *Significant at P <0.05 and ** significant at P<0.01 level. ***significant at P<0.001. ns: non-significant.

Table 4: Plant Height of potato as influenced by types of mulches and Potassium application methods at Liwang, Rolpa, 2022

Treatment		Plant Height (in cm)		
	30 DAP	45 DAP	60 DAP	75 DAP
Mulching				
Silver on black Plastic	31.74a	50.81a	62.98a	84.48a
Black Plastic	26.50a	45.25a	59.75b	77.40b
Plant Residue	25.10bc	42.43c	58.98b	74.53b
Control	23.77c	40.93c	54.29c	68.64c
SEM (±)	0.12	0.14	0.21	0.25
LSD	1.46***	1.69	2.45***	3.06***
CV (%)	4.41	3.05	3.35	3.24
Potassium application methods				
Split	27.04a	45.39a	60.15a	77.36a-
Basal	26.51a	44.32a	57.84b	75.17b
SEM (±)	1.17	0.19	0.31	0.35
LSD	1.03ns	1.20ns	1.87*	2.16*
CV	4.41	3.05	3.35	3.24
Grand Mean	26.78	44.85	59.00	76.26

Note: LSD: least significant differences, SEM (±): Standard error of mean, CV: Coefficient of variation, means with different letters in columns are significantly different at P <0.05 level by DMRT. *Significant at P <0.05 and ** significant at P<0.01 level. ***significant at P<0.001. ns: non-significant.

Table 5: Plant Canopy of potato as influenced by types of mulches and Potassium application methods at Liwang, Rolpa, 2022

Treatment		Plant Canopy (in cm)		
	30 DAP	45 DAP	60 DAP	75 DAP
Mulching				
Silver on black Plastic	19.91a	27.91a	27.79a	29.87a
Black Plastic	18.31ab	26.31ab	26.54a	29.35a
Plant Residue	16.81bc	24.81bc	25.81ab	29.12ab
Control	15.04c	23.04c	24.00b	27.81b
SEM (±)	0.21	0.21	0.18	0.11
LSD	2.66**	2.66**	2.20*	1.36*
CV (%)	12.27	8.42	6.83	3.79
Potassium application methods				
Split	17.52a	25.52a	26.66a	29.50a
Basal	17.52a	25.52a	25.41a	28.58a
SEM (±)	0.31	0.31	0.25	0.15
LSD	1.88ns	1.88ns	1.55ns	0.96ns
CV (%)	12.27	8.42	6.83	3.79
Grand Mean	17.52	25.52	26.04	29.04

Note: LSD: least significant differences, SEM (±): Standard error of mean, CV: Coefficient of variation, means with different letters in columns are significantly different at P <0.05 level by DMRT. *Significant at P <0.05 and ** significant at P<0.01 level. ***significant at P<0.001. ns: non-significant.

Table 6: Tuber Characteristics of Potato as Influenced by Types of Mulches And Potassium Application Methods at Liwang, Rolpa, 2022

Treatment		Tuber Characteristics (in cm)	
	Circumference	Length	Diameter
Mulching			
Silver on black Plastic	14.20a	5.40a	4.74a
Black Plastic	13.16b	5.05a	4.25b
Plant Residue	12.54c	5.04a	3.87c
Control	11.45c	4.38b	3.68c
SEM (±)	0.05	0.03	0.013
LSD	0.62***	0.41**	0.20***
CV (%)	3.90	6.75	3.08
Potassium application methods			
Split	13.06a	4.99a	4.07a
Basal	12.61b	4.94a	3.88b
SEM (±)	0.07	0.04	0.017
LSD	0.43*	0.29	0.10**
CV (%)	3.90	6.75	3.08
Grand Mean	12.84	4.97	3.97

Note: LSD: least significant differences, SEM (±): Standard error of mean, CV: Coefficient of variation, means with different letters in columns are significantly different at P <0.05 level by DMRT. *Significant at P <0.05 and ** significant at P<0.01 level. ***significant at P<0.001. ns: non-significant.

3.1.6 Yield Attributing Characters

The examination of the interaction effect between mulching and potassium on yield per plant yielded non-significant results (Table 8); consequently, we proceeded to analyze the main effects. Plot with mulching has significant influence on tuber numbers, tuber weight and total yield than no mulch condition. Highest tuber number, tuber weight and total yield were reported in silver in black plastic (23.12, 62.16 gm and 24.09 ton/ha) and lowest in control plot (14.16, 31.20 gm and 13.27 ton/ha). High tuber number and high tuber yield is observed in mulching plot than no mulch (Bhatta, 2020; Ahmed and Mahmud, 2017; Hochmuth, 2018). Low weed population, optimum soil moisture and temperature enhances crop growth and lengthening tuber bulking period results in high number of tuber and weight of tuber (Ahmed and Mahmud, 2017). Average tuber weight and total yield was found to be highest in plastic mulches than no mulch condition (Bhatta, 2020; Bharati and Joshi, 2020). This result was also in accordance with (Chaudhary, 2022).

Likewise, Tuber number in split application of potassium (19.75) was higher than basal application (18.89) but there was no significant difference between them. This could be due to potassium role only in photosynthesis in leaves and sugar translocation to tuber but not in new tuber initiation. Since split application of given recommended dose of potassium increase the availability of potassium fertilizer throughout growth period so there is a smaller number of small sized tuber and more medium sized tuber (Dhakal et al., 2011;Sud, 1994). Also, K availability while potato production increased the number of marketable tubers (Zelele et al., 2016).

Tuber weight and total yield in split application (48.48 gm & 19.66 ton/ha) were reported significantly higher than basal application (43.21 gm & 17.56 ton/ha). This could be due to direct positive relationship between potassium and tuber size as potassium plays important role in photosynthesis, enzyme activities and sugar translocation from leaves to tuber (Karki, 2006). Potassium availability during tuber bulking period is highly significant for increasing tuber weight by accumulation of sugar (Zelele et al., 2016). Split application results in higher yield increasing potassium availability throughout crop growth period increases tuber yield and split application of potassium is beneficial than basal application (Kolar and Grewal, 1994; Karki, 2006; Abd El Latif et al., 2011).

Table 7:Tuber number, tuber weight and total yield (ton/ha) of potato as influenced by type of mulches and Potassium application methods at Liwang, Rolpa, 2022

Treatment		Yield Parameters	
	Tuber Number	Tuber Weight (gm)	Total Yield (ton/ha)
Mulching			
Silver on black Plastic	23.12[a]	62.16[a]	24.09[a]
Black Plastic	21.54[b]	48.08[b]	20.11[b]
Plant Residue	18.45[c]	41.94[b]	16.98[c]
Control	14.16[d]	31.20[c]	13.27[d]
SEM (±)	0.17	0.56	0.20
LSD	2.07***	6.91***	2.47***
CV (%)	8.67	12.17	10.74
Potassium application methods			
Split	19.75[a]	48.48[a]	19.66[a]
Basal	18.89[a]	43.21[b]	17.56[b]
SEM (±)	0.24	0.80	0.28
LSD	1.46	4.88*	1.75*
CV (%)	8.67	12.17	10.74
Grand Mean	19.32	45.85	18.61

Note: LSD: least significant differences, SEM (±): Standard error of mean, CV: Coefficient of variation, means with different letters in columns are significantly different at P <0.05 level by DMRT. *Significant at P <0.05 and ** significant at P<0.01 level. ***significant at P<0.001. ns: non-significant.

3.2 Benefit-Cost Ratio (Economies of Potato)

The results indicated that the highest net returns were observed in plots with silver on black plastic mulches (Rs. 793333.33/ha), followed by black plastic (Rs. 648148.148/ha) and plant residue (Rs. 466666.66/ha), while the control plot recorded the lowest net returns (Rs. 312962.96/ha). Similarly, a higher net return was noted in plots employing the split application method of potassium (Rs. 612059.25/ha) compared to basal application (Rs. 447718.51/ha). The highest benefit-to-cost ratio was found in plots with silver on black plastic (2.92), followed by black plastic (2.52) and plant residue (2.22), with the lowest ratio in the control plot (1.90). Likewise, a higher benefit-to-cost ratio was observed in plots with split application of potassium (2.65) compared to basal application (2.04). These findings align with the results reported by B. Chaudhary in 2022.

Table 8: Gross Returns, Net Returns and Benefit-Cost Ratio of potato plant as influenced by types of mulches and Potassium application methods at Liwang, Rolpa, 2022

Treatment	Total Cost (Nrs/ha)	Gross Returns (Nrs/ha)	Net Returns (Nrs/ha)	B:C Ratio
Mulching				
Silver on black plastic	Rs. 413333.3	Rs. 1206666.67	Rs. 793333.33	2.92
Black Plastic	Rs. 425925.92	Rs. 1074074.07	Rs. 648148.148	2.52
Plant Residue	Rs. 381481.48	Rs. 848148.14	Rs. 466666.66	2.22
Control	Rs. 350370.37	Rs. 663333.33	Rs. 312962.96	1.9
Potassium Application Methods				
Split	Rs. 370940.74	Rs. 983000	Rs. 612059.25	2.65
Basal	Rs. 430281.481	Rs. 878000	Rs. 447718.51	2.04

4. Conclusion

In conclusion, vegetative growth as well as the yield of potatoes was accelerated effectively by mulching. Moreover, the tuber yield was higher in case of split application of potassium as compared to basal application of potato. The combined impact of mulching and the method of potassium application on growth and yield parameters were determined to be statistically insignificant. Despite this lack of statistical significance, there was a tendency toward a positive effect when these two factors were utilized in conjunction. Hence, it is concluded that silver on black plastic mulch and split application of potassium proved to be effective, and increased the tuber yield with a promising Benefit: Cost (B: C) ratio, contributing to profitability.

Conflicts of Interest

The signing authors of this research work declare that they have no potential conflict of personal or economic interest with other people or organizations that could unduly influence this manuscript.

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