

## Growth, Productivity and Profitability of Different Cultivars of Potato (*Solanum tuberosum* L.) with and without Straw-Mulch in Dadeldhura, Nepal

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### Abstract

Farmers use different potato cultivars and cultivation methods, but there is a lack of information on the most suitable cultivars and techniques for optimal yields under local conditions in far western mid-hill agro-ecology of Nepal. To assess the impact of cultivars and straw mulching on the growth, yield performance and economics of potato, a field experiment was conducted during the spring, 2023 at Dotighatal, Amargadhi Municipality-03, Dadeldhura, Nepal. The experiment was laid out in two factorial Randomized Complete Block Design (RCBD) with 4 replications. Three potato cultivars (Cardinal, Desiree and Bajhang Local) were evaluated under straw-mulch and no-mulch conditions, wherein the data entry and analysis were done in MS-Excel and R-Studio, respectively. Bajhang Local exhibited the highest plant height (cm), average number of leaves and branches hill<sup>-1</sup>. But, the highest number of stems hill<sup>-1</sup> was observed in Cardinal followed by Bajhang Local. The highest tuber yield was obtained in Cardinal (52.1 t/ha) followed by Desiree (48.0 t/ha) due to the highest weight of tubers hill<sup>-1</sup> (1.36 kg) and number of large sized tuber (35-55 mm). Similarly, straw-mulch resulted higher yield (50.31 t/ha) than no-mulch (42.4 t/ha). However, interaction of two factor showed non-significant in both growth parameter and overall yield. This study concluded that potato cultivar Cardinal with straw-mulch was most suitable for improving the productivity, profitability and soil health of potato in the far-western mid hill agro-ecology of Nepal.

**Keywords:** Mulching effect, Potato cultivars, Profitability, Straw mulch, Tuber yield

### Introduction:

Potato (*Solanum tuberosum* L.) belongs to the Solanaceae family is cultivated in all geographical regions of Nepal. In the mountains and high hills, it is mainly regarded as a staple food crop, but in the mid-hills and Terai, it is cultivated as a major vegetable crop. In Nepal, the area covered by potatoes is 211,505 ha, and production is 3,521,794 mt with hardly 15.0 t/ha yield (MoALD, 2023/24a). Moreover, potato contributes about 6.55 % of Agriculture's Gross Domestic Product (MoALD, 2023/24b) in Nepal. Due to the short vegetative cycle

and high cash-value crop, it plays a vital role in food security and alleviating poverty (Bista et al., 2013). Beals( 2019) reported that potato is rich in nutrition as it is rich in vitamins (C, B, B<sub>3</sub>, B<sub>6</sub>, K, folate, pantothenic acid), protein, and minerals (K, Mn, Mg, Fe, Cu, P).

In Nepal, the lower yield of potatoes can be attributed to the unavailability of desired cultivars and insufficient quantity of quality seeds at affordable prices, as well as the low adoption rate of advanced cultivation technologies, despite applying other production inputs optimally (Shrestha et al., 2020a). Due to variations in agro-

ecologies such as soil type, moisture and temperature regimes, fertility condition, and rainfall patterns, it is not possible for any existing cultivar to be universally suitable for production across all environments and for all purposes (Fantaw et al., 2019a). In higher altitude of mid-hill and mountain regions, potato cultivation is common in spring due to its suitable climatic norms (Amgain et al., 2024).

Among the several improved cultivation practices, conservation agriculture practices based on the principal of minimum tillage, organic residue recycling and crop diversification is major chaos in increasing the resource use efficiency in field crops (Lamsal et al., 2022, Amgain et al. 2022). Mulching is one which have some important advantages regarding soil conservation and productivity. Mulching is known as an important soil cover which helps to improve the soil condition, stability of soil temperature, reduce water evaporation, inhibit weed emergence, protect from pest and fungal diseases, and acts as a tool for the control of nitrogen losses (Amgain et al., 2019; Dvořák et al., 2012). Mulching can serve as an effective alternative to irrigation, helping to lower cultivation costs. In a mulched field, the incoming solar radiation of solar energy is decreased, which favors tuberization and helps to produce good quality of seed because of moderation of temperature and moisture conservation in soil (Kar and Kumar, 2007a, Amgain et al., 2020). Organic mulching further helps to increase available nutrient in soil, increase the phosphorus concentration, and is the best way for controlling weed (Sinkevičienė et al., 2009). Straw mulching is one of the biodegradable, locally available, and cost-effective mulching methods that might be useful for the virus control in seed tuber (Döring et al., 2005) and reduces the virus transmission from aphids (Waheed et al., 2023). Organic mulching has greater value than inorganic mulching, which increases the infiltration and water retention. Likewise, the rate of straw mulching decreases the rate of evaporation by 35% (Iqbal et al., 2020).

Dadeldhura, considering the far-western mid-hill is one of the progressing districts in terms of potato cultivation, where the potato super zone of prime-ministerial modernization project is launching from last 6-8 years (Devkota, 2021). The spring cultivation of potato with suitable cultivars and conservation agriculture practices are the new research arena in this super-zone. Therefore, the present research with diverse potato cultivars and conservation agriculture means was carried out to evaluate the growth, productivity, profitability and soil health of the potato field in mid-hill agro-ecology during the spring.

## Materials and Methods:

### Experimental Site

The experiment was conducted at Dhotighatal-3 of

Amargadhi Municipality, Dadeldhura (28°59' - 29°26' N, 80°12' - 80°47' E and 333-2639 masl.) in Sudurpaschim Province under humid sub-tropical region.

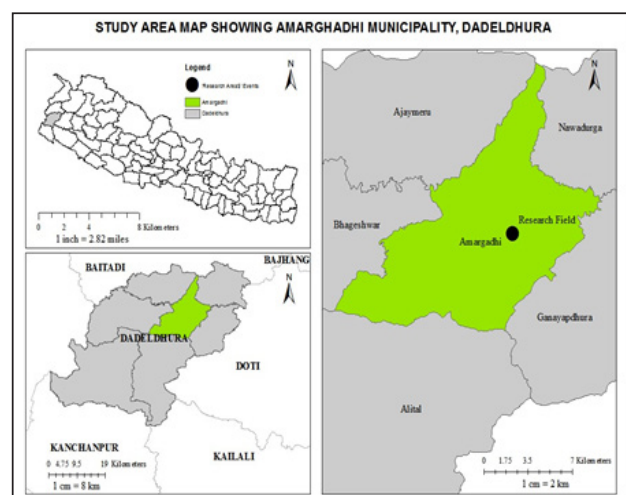


Figure 1: Map of research site

### Physio-chemical characteristics of the experimental soil

To study the physio-chemical characteristics of soil, the soil was collected from a depth of 0-20 cm and analyzed from the Soil and Fertilizer Testing Laboratory, Sundarpur, Kanchanpur. The test revealed that the soil was sandy loam in texture with slightly acidic (pH 5.2) reaction, medium in total nitrogen content (0.18%), high in soil available phosphorous (94.98kg/ha) and potassium (404.4 kg/ha). The organic matter was found to be medium (3.53%).

### Climatic Condition

NASA Power Weather Repository (<https://power.larc.nasa.gov/data-access-viewer/>) was used to study the meteorological data of the study site from Feb-June, 2023. The analysis revealed an average maximum temperature of 21.97°C, fluctuating between 18.17°C to 26.13°C, along with an average minimum temperature of 10.23°C, ranging from 5.4°C to 17.4°C. Additionally, the area experienced an average rainfall of 259.5 mm, totaling 1297.5 mm during the experimental period. These collective findings affirm the region's suitability for potato cultivation (Fig. 2).

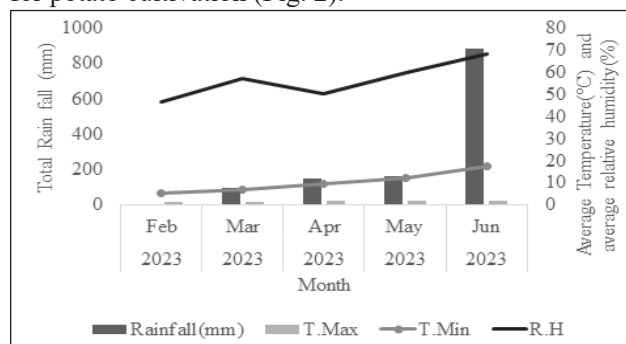


Figure 2: Meteorological data of the Dhotighatal, Dadeldhura during the spring of 2023

### Cultivar Details

In this research, the treatment consists of three cultivars of potato including two registered cultivars viz. Cardinal and Desiree, and a local cultivar Bajhang Local as a cross check.

### Experimental Design and Treatment Details

The experiment was conducted in two factorial Randomized Complete Block Design (RCBD) with six treatments and four replications. The first factor was cultivars (Cardinal, Desiree and Bajhang Local), and the second factor was mulching practices (Paddy straw mulch @ 5.0 t/ha, and no mulch). The size of each plot was 3.75 m<sup>2</sup> (2.5 m x 1.5 m) with the space between each plot and replication with 0.5m.

### Cultural Practices

Finely graded medium sized seed tubers (about 25-45 g tuber<sup>-1</sup>) were sown into the depth of 4-5 cm within the ridges at the rate of 6 tubers per row with a plant-to-plant distance of 25 cm. Seed tubers were dipped for 3-4 minutes by Bavistin Powder (2g liter<sup>-1</sup>) one day earlier of sowing, and left in a shady place for drying. Recommended dose of fertilizers applied was at the rate of 100:100:60 N, P, K Kg/ha with 30 t/ha of Farm Yard Manure (FYM). Paddy straw mulch @ 5.0 t/ha was scattered over the mulch plots after a week of planting. All the above-mentioned fertilizer was incorporated into the soil before sowing and 50% of N was applied after one month of sowing at the time of first intercultural operation. The field was irrigated twice using the furrow method at 50 and 75 days after sowing (DAS). Weeding was done at 50 DAS and at 80 DAS in the field.

Mancozeb (2.5g/l) was applied at 50 DAS and 80 DAS of potato as a preventive measure for controlling early and late blight. Cypermethrin was applied at 65 DAS and 80 DAS @3ml/l of water to control infestation of insects, especially thrips and ants. Potatoes were harvested after 10-15 days of cutting the haulm. The potatoes were harvested after 110 days of planting.

### Observation recorded

#### Soil temperature

The soil temperature was observed using a 4-in-1 soil survey instrument. This instrument is hand-held device which measure four key factors like soil temperature, moisture, pH and light intensity. It was taken in every month after planting to harvesting.

#### Growth parameters

Plant height was determined by scale and used to measure the height of the plants from its ground level and averaged on 50, 65 and 80 days after sowing (DAS). The number of leaves hill<sup>-1</sup> was recorded at 50, 65 and 80 DAS. The different cultivars of potato have a different quantity of sprouts or number of eyes on the tuber, which directly influences the main stem number (Asnake et al., 2023). Therefore, the number of stems hill<sup>-1</sup> was taken from the five plants and the mean values was recorded at 50, 65 and 80 DAS. The number of branches hill<sup>-1</sup> was recorded from the tagged five plants. Data was taken at 50, 65 and 80 DAS.

#### Yield parameters

Tubers from the sample plants after harvest were graded by weight as small (<25 mm), medium (25-35 mm) and

**Table 1:** Effect of cultivars and mulch materials on plant height (cm) and average number of branches hill<sup>-1</sup> in potato during 2023 at Dotighatal, Dadeldhura

Treatments	Plant height (cm)			Average number of branches hill <sup>-1</sup>		
	50 DAS	65 DAS	80 DAS	50 DAS	65 DAS	80 DAS
Cultivars						
Cardinal	30.30	35.82	46.65 <sup>b</sup>	1.80 <sup>c</sup>	2.37 <sup>c</sup>	2.92 <sup>c</sup>
Bajhang Local	28.05	40.55	56.62 <sup>a</sup>	5.70 <sup>a</sup>	7.52 <sup>a</sup>	8.10 <sup>a</sup>
Desiree	28.22	35.62	41.82 <sup>b</sup>	3.75 <sup>b</sup>	4.40 <sup>b</sup>	4.62 <sup>b</sup>
LSD	3.18	4.96	8.56	0.96	1.29	1.30
F-test	Ns	Ns	**	***	***	***
Mulch condition						
Straw-mulch	32.76 <sup>a</sup>	42.53 <sup>a</sup>	51.88 <sup>a</sup>	4.18 <sup>a</sup>	5.36 <sup>a</sup>	5.75 <sup>a</sup>
No-mulch	24.95 <sup>b</sup>	32.13 <sup>b</sup>	44.85 <sup>b</sup>	3.31 <sup>b</sup>	4.16 <sup>b</sup>	4.68 <sup>b</sup>
F-test	***	***	*	*	*	*
LSD (0.05)	2.59	4.0	6.99	0.78	1.05	1.06
CV%	10.34	12.47	16.61	24.19	25.45	23.39
Grand mean	28.85	37.33	48.36	3.75	4.76	5.216

**Note:** LSD: Least significant difference, CV: Coefficient of variation, NS: non-significant, \*\*\*: Significant at 0.1% probability level, \*\*: Significant at 1% probability level, \*: Significant at 5% probability level, values with the same letters in the columns are not significantly different at 5%.

**Table 2:** Effect of cultivars and mulch materials on average number of leaves hill<sup>-1</sup> and average number of stems hill<sup>-1</sup> during 2023 at Dotighatal, Dadeldhura

Treatments	Average number of leaves hill <sup>-1</sup>			Average number of stems hill <sup>-1</sup>		
	50 DAS	65 DAS	80 DAS	50DAS	65 DAS	80 DAS
<b>Cultivars</b>						
Cardinal	46.27 <sup>a</sup>	51.52 <sup>a</sup>	60.47 <sup>b</sup>	5.70 <sup>a</sup>	6.77 <sup>a</sup>	7.27 <sup>a</sup>
Bajhang Local	51.32 <sup>a</sup>	72.42 <sup>a</sup>	88.22 <sup>a</sup>	5.77 <sup>a</sup>	6.57 <sup>a</sup>	7.17 <sup>a</sup>
Desiree	35.95 <sup>b</sup>	45.62 <sup>b</sup>	52.42 <sup>b</sup>	3.07 <sup>b</sup>	3.67 <sup>b</sup>	4.52 <sup>b</sup>
LSD	8.37	8.42	13.35	0.41	0.70	1.42
F-test	**	***	***	***	***	**
<b>Mulch condition</b>						
Straw-mulch	47.03 <sup>a</sup>	60.23 <sup>a</sup>	67.51	4.93	5.90	6.53
No-mulch	42.00 <sup>b</sup>	52.81 <sup>b</sup>	66.56	4.76	5.45	6.53
F-test	*	*	NS	NS	NS	NS
LSD (0.05)	6.83	6.87	10.90	0.33	0.57	1.16
CV%	17.65	13.98	18.69	7.96	11.69	21.10
Grand mean	44.51	56.52	67.04	4.85	5.67	6.32

**Note:** LSD: Least significant difference, CV: Coefficient of variation, NS: non-significant, \*\*\*: Significant at 0.1% probability level, \*\*: Significant at 1% probability level, \*: Significant at 5% probability level, values with the same letters in the columns are not significantly different at 5%.

large (35-55 mm). The number of the tubers after grading were noted. For estimation of number of tubers hill<sup>-1</sup>, the total number of tubers harvested from hills was divided by the number of plants harvested. The total number of tubers harvested from hills was weighted and expressed as potato tubers hill<sup>-1</sup>. Total tuber yield was recorded by multiplying the net plot yield with the hectare area.

### Statistical Analysis

The data taken directly on various growth and yield parameters and the data on economic analysis based on the cost and price of inputs and outputs at the local market as taken estimated were entered in MS Excel and then the arranged data were analyzed using the R Studio software. ANOVA table was prepared, and mean treatments were compared by least significant difference (LSD) at 5% level of significance (Gomez & Gomez, 1984).

## Results and Discussion:

### Effect of cultivar and mulches on growth parameters of potato

The plant height was found non-significant at 50 DAS, but found significant at 65 and 80 DAS. The highest plant height at 80 DAS was observed in Bajhang Local (56.62 cm), whereas the lowest plant height was observed in Desiree followed by Cardinal (Table 1). Different cultivars possess differences in plant height due to the quality of the plant materials and plant genetics (Eaton et al., 2017a). Similarly, the data comparison between straw mulch and non-mulch showed significantly higher height for straw mulch at 50 DAS, 65 DAS and 80 DAS.

Under mulched conditions, the increased plant height might be due to improved weed management, better moisture conservation and favorable micro-climate (Chaudhary et al., 2022).

In case of cultivars, the maximum number of branches were observed in Bajhang local which was 5.70, 7.52 and 8.20 at 50, 65 and 80 DAS, respectively. Cardinal cultivar of potato significantly possessed less branches in all three observations. The increase number of branches is due to the increased rate of photosynthesis and change in internal auxin levels that affect apical dominance, which increases the number of branches (Agrawal et al., 2016). Similarly, straw mulch showed a significantly higher number of branches (5.75) at 80 DAS.

Cultivars and mulching significantly affect the number of leaves hill<sup>-1</sup>. The average leaf number hill<sup>-1</sup> was observed the highest in Bajhang Local (88.22) on 80 DAS followed by Cardinal (60.47) and Desiree (52.42) and was also significant on 50 DAS and 65 DAS. Straw mulching showed a significant result on 50 DAS and 65 DAS, but did not show significant difference on 80 DAS. However, the value of mulch condition has higher number of branches than no-mulch on 80 DAS. Mulched plot has significantly higher nutrient uptake capacity and helps in proper vegetative growth of plant than non-mulched plots (Bhatta et al., 2020).

The number of stems was significantly higher for cultivar Cardinal. Similarly, the number of stems and branches per plant is high in mulched condition which lead to the greater number of tubers in tuber initiation (Uddin et al., 2017a). The mulched condition did not show significant



**Table 3:** Interaction effect of cultivars and mulch materials on different growth Parameter in 2023 at Dotighatal, Dadeldhura

Treatments	Plant height (cm)	Average number of branches hill <sup>-1</sup>	Average number of leaves hill <sup>-1</sup>	Average number of Stem hill <sup>-1</sup>
Cardinal * Straw mulch	48.80 <sup>abc</sup>	3.55 <sup>bc</sup>	56.90 <sup>b</sup>	7.40 <sup>a</sup>
Cardinal * No mulch	44.50 <sup>bc</sup>	2.30 <sup>c</sup>	64.05 <sup>b</sup>	6.95 <sup>a</sup>
Bajhang Local *Straw Mulch	60.90 <sup>a</sup>	8.90 <sup>a</sup>	91.90 <sup>a</sup>	7.35 <sup>a</sup>
Bajhang Local * No mulch	52.35 <sup>ab</sup>	7.30 <sup>a</sup>	84.55 <sup>a</sup>	7 <sup>a</sup>
Desiree * Straw mulch	45.95 <sup>bc</sup>	4.80 <sup>b</sup>	53.75 <sup>b</sup>	4.85 <sup>b</sup>
Desiree * No mulch	37.70 <sup>c</sup>	4.45 <sup>b</sup>	51.10 <sup>b</sup>	4.20 <sup>b</sup>
CV (%)	16.61	23.39	18.69	21.10
LSD	2.13	1.83	18.88	2.01
F-Test	Ns	Ns	Ns	Ns

**Table 4:** Effect of cultivars and mulch materials on number and weight of potato tubers hill<sup>-1</sup> and total yield (t/ha) of potato during 2023 at Dotighatal, Dadeldhura

Treatments	Number of tubers hill <sup>-1</sup>	Weight of tubers hill <sup>-1</sup> (kg)	Total tuber yield (t/ha)
Cultivars			
Cardinal	13.82 <sup>b</sup>	1.36	52.1 <sup>a</sup>
Bajhang Local	26.52 <sup>a</sup>	0.91	42.4 <sup>b</sup>
Desiree	10.95 <sup>b</sup>	1.14	48.0 <sup>ab</sup>
LSD	3.87	0.07	0.63
F-test	***	NS	*
Mulch condition			
Straw-mulch	17.61	1.41 <sup>a</sup>	50.31 <sup>a</sup>
No-mulch	16.58	0.86 <sup>b</sup>	42.9 <sup>b</sup>
LSD (0.05)	3.16	0.39	0.51
F-test	NS	**	**
CV%	21.24	39.404	12.49
Grand mean	17.1	1.13	4.299

**Note:** LSD: Least significant difference, CV: Coefficient of variation, NS: non-significant, \*\*\*: Significant at 0.1% probability level, \*\*: Significant at 1% probability level, \*: Significant at 5% probability level, values with the same letters in the columns are not significantly different at 5%.

result in any observation, but had a higher number of stems on 50 DAS, 65 DAS and 80 DAS than no-mulch.

Interaction effect of date of cultivars and mulch materials was found non-significant on growth parameters at 80DAS. The highest plant height (60.90 cm) was found in Bajhang Local planted with straw mulch which was at par with Bajhang Local planted with no-mulch. The average number of branches hill<sup>-1</sup> (8.90) and average number of leaves hill<sup>-1</sup> (91.90) was observed in Bajhang local with straw. However, Cardinal with straw was found highest number of steams hill<sup>-1</sup> (7.40) (Table 3).

#### ***Effect of cultivars and mulch in yield and yield parameters of potato***

Among the cultivars, number of tubers hill<sup>-1</sup> was found to be highly significant. Fantaw et al. (2019b) revealed

that different potato cultivars displayed varying results in relation to the number of tubers per plot. The highest number of tubers hill<sup>-1</sup> was observed in Bajhang Local (26.52) followed by Cardinal (13.82) and both were at par with Desiree (10.95). Similarly, straw mulch has produced higher value of number of tubers hill<sup>-1</sup> (17.61) than no-mulch (16.58).

Cultivars had non-significant on the weight of tubers hill<sup>-1</sup>, whereas the effect was significant in straw mulch and no-mulch. Cardinal (1.36Kg) showed a higher weight of tubers hill<sup>-1</sup> followed by Desiree. Straw mulch increased the potato tuber weight (1.41 g) by 0.86 g plant<sup>-1</sup> under no-mulch.

Potato cultivars and mulch both showed the significant result in the total yield of potato tuber. In cultivars, the highest yield was observed in Cardinal. Shrestha et al.

**Table 5:** Interaction effect of cultivars and mulch materials on yield attributes and yield of potato in 2023 at Dotighatal, Dadeldhura

Treatments	Number of tubers hill <sup>-1</sup>	Weight of tubers hill <sup>-1</sup> (kg)	Total tuber yield (t/ha)
Cardinal * Straw mulch	14.90 <sup>b</sup>	1.77 <sup>a</sup>	57.91 <sup>a</sup>
Cardinal * No mulch	12.75 <sup>b</sup>	0.94 <sup>b</sup>	46.39 <sup>bc</sup>
Bajhang Local * Straw mulch	27.75 <sup>a</sup>	1.10 <sup>ab</sup>	46.60 <sup>bc</sup>
Bajhang Local * No Mulch	25.30 <sup>a</sup>	0.73 <sup>b</sup>	38.20 <sup>c</sup>
Desiree * Straw mulch	10.20 <sup>b</sup>	1.36 <sup>ab</sup>	51.78 <sup>ab</sup>
Desiree * No mulch	11.70 <sup>b</sup>	0.91 <sup>b</sup>	44.39 <sup>bc</sup>
CV(%)	21.24	39.40	12.49
LSD	5.47	0.67	0.89
F Test	NS	NS	NS

**Table 6:** Effect of cultivars and mulch materials on different grading size of tuber during 2023 at Dotighatal, Dadeldhura

Treatments	Number of Tubers		
	Small sized tubers (<25mm)	Medium sized tubers (25-35mm)	Large sized tubers (35-55mm)
Cultivars			
Cardinal	3.20 <sup>b</sup>	5.42 <sup>b</sup>	5.42 <sup>a</sup>
Bajhang Local	15.00 <sup>a</sup>	9.32 <sup>a</sup>	2.150 <sup>b</sup>
Desiree	2.25 <sup>b</sup>	3.30 <sup>c</sup>	5.25 <sup>a</sup>
LSD	2.96	1.52	1.44
F-test	***	***	***
Mulch condition			
Straw-mulch	6.83	6.53	4.55
No-mulch	5.80	5.50	4.00
LSD (0.05)	2.41	1.24	1.17
F-test	NS	NS	NS
CV%	40.74	23.82	31.70
Grand mean	6.81	6.01	4.27

**Note:** LSD: Least significant difference, CV: Coefficient of variation, NS: non-significant, \*\*\*: Significant at 0.1% probability level, \*\*: Significant at 1% probability level, \*: Significant at 5% probability level, values with the same letters in the columns are not significantly different at 5%.

**Table 7:** Interaction effect of cultivars and mulch materials of potato on grading of tuber in 2023 at Dotighatal, Dadeldhura, Nepal

Treatments	Number of tubers		
	Small sized tubers (<25mm)	Medium sized tubers (25-35mm)	Large sized tubers (35-55mm)
Cardinal * Straw mulch	3.70 <sup>b</sup>	5.50 <sup>c</sup>	6.25 <sup>a</sup>
Cardinal * No mulch	2.70 <sup>b</sup>	5.35 <sup>cd</sup>	4.60 <sup>a</sup>
Bajhang Local * Straw mulch	14.45 <sup>a</sup>	10.90 <sup>a</sup>	2.45 <sup>b</sup>
Bajhang Local * No Mulch	15.55 <sup>a</sup>	7.75 <sup>b</sup>	1.85 <sup>b</sup>
Desiree * Straw mulch	2.27 <sup>b</sup>	3.20 <sup>d</sup>	5.55 <sup>a</sup>
Desiree * No mulch	2.25 <sup>b</sup>	3.40 <sup>cd</sup>	4.95 <sup>a</sup>
CV (%)	40.74	23.82	31.70
LSD	4.18	2.16	2.04
F Test	NS	NS	NS

**Table 8:** Effect of cultivars and mulch materials on surface soil temperature of potato field during 2023 at Dotighatal, Dadeldhura

Treatments	First month of planting (°C)	Second month of planting (°C)	Third month of planting (°C)
Cultivars			
Cardinal	16.62	20.12	23.62
Bajhang Local	16.37	19.50	23.00
Desiree	17.00	19.12	24.12
LSD	1.04	1.38	1.41
F-test	NS	NS	NS
Mulch condition			
Straw-mulch	15.75 <sup>b</sup>	18.33 <sup>b</sup>	22.91 <sup>b</sup>
No-mulch	17.58 <sup>a</sup>	20.83 <sup>a</sup>	24.25 <sup>a</sup>
LSD (0.05)	0.85	1.12	1.15
F-test	***	***	*
CV%	5.86	6.61	5.61
Grand mean	16.66	19.58	23.58

**Note:** LSD: Least significant difference, CV: Coefficient of variation, Ns: non-significant, \*\*\*: Significant at 0.1% probability level, \*\*: Significant at 1% probability level, \*: Significant at 5% probability level, values with the same letters in the columns are not significantly different at 5%.

(2020b) reported that for obtaining high yield, genetic variability is considered as an important factor. Literature has reported that there are differences in yield due to variation in growth traits influenced by genetic, nutrient usage and climatic adaptability (Zeru et al., 2016) which has also been marked in this study.

The straw mulch treatment gave higher yield (50.31 t/ha) compared to no-mulched condition (42.9 t/ha). Mulching provides significantly higher yields of potato tuber than no-mulch due to the moderated temperature and congenial moisture for early stolon development. Utilization of mulching resulted in improved seedling emergence rates, higher stem, branch formation per plant which in turn contributed to an increased number of tubers from the initial growth phase of the potato crop. Additionally,

the longer tuber initiation period under straw mulch plot could have supported the growth of large tubers (Uddin et al., 2017b). Owing to many advantages, mulching helps to enhance soil water infiltration, maintain soil moisture, and increase water use efficiency (Wang et al., 2005).

Interaction effect of cultivars and mulch materials of potato did not significantly affect number and weight of tubers, tuber hill<sup>-1</sup>, and total tuber per hill. The non-significantly higher values of weight tuber hill<sup>-1</sup> (kg) and total tuber yield (t/ha) was noticed between the Cardinal planted with straw and Bajhang Local with straw mulch (Table 5).

Potato was graded into three size categories; small (less than 25 mm), medium (25-35 mm) and large (35-55mm)

**Table 9:** Interaction effect of cultivars and mulch materials on surface soil temperature of potato field in 2023 at Dotighatal, Dadeldhura

Treatments	First month of planting (°C)	Second month of planting (°C)	Third month of planting (°C)
Cardinal * Straw mulch	15.75 <sup>c</sup>	19.00 <sup>bc</sup>	22.50 <sup>c</sup>
Cardinal * No mulch	17.50 <sup>ab</sup>	21.25 <sup>a</sup>	24.75 <sup>ab</sup>
Bajhang Local * Straw mulch	15.25 <sup>c</sup>	17.75 <sup>c</sup>	23.12 <sup>bc</sup>
Bajhang Local * No Mulch	17.47 <sup>ab</sup>	21.23 <sup>a</sup>	23.00 <sup>bc</sup>
Desiree * Straw mulch	16.25 <sup>bc</sup>	18.25 <sup>bc</sup>	23.35 <sup>abc</sup>
Desiree * No mulch	17.75 <sup>a</sup>	20.00 <sup>ab</sup>	25.00 <sup>a</sup>
CV(%)	5.86	6.61	5.61
LSD	1.47	1.95	1.99

**Table 10:** Effect of cultivars and mulch materials on economics of potato grown during 2023 at Dotighatal, Dadeldhura

Treatments	Total cost of Cultivation (NPR.000/ha)	Gross return (NPR.000/ha)	Net return (NPR.000/ha)	B:C ratio
Cultivars				
Cardinal	534438	1564643 <sup>a</sup>	996802.0 <sup>a</sup>	1.74 <sup>a</sup>
Bajhang Local	534438	1272165 <sup>b</sup>	704324.5 <sup>b</sup>	1.23 <sup>b</sup>
Desiree	534438	1442680 <sup>ab</sup>	874839.2 <sup>ab</sup>	1.53 <sup>ab</sup>
LSD		189944.7	189944.7	0.345
F-test		*	*	*
Mulch condition				
Straw-mulch	601243 <sup>a</sup>	1563076 <sup>a</sup>	63014.015 <sup>a</sup>	1.59
No-mulch	534438 <sup>b</sup>	1289916 <sup>b</sup>	755478 <sup>b</sup>	1.41
LSD (0.05)		130236.3	155089.2	0.28
F Test		*	*	Ns
CV%		12.49	20.75	21.544
Grand mean	567840.5	1426496	858655.2	1.50

**Note:** LSD: Least significant difference, CV: Coefficient of variation, Ns: non-significant, \*\*\*: Significant at 0.1% probability level, \*\*: Significant at 1% probability level, \*: Significant at 5% probability level, values with the same letters in the columns are not significantly different at 5%.

which was influenced both by cultivars and mulching (Table 6). The highest number of small tuber size (<25 mm) was observed on Bajhang Local (15.00) followed by Desiree (2.25) whereas, straw mulch showed non-significant result with no-mulch, but have higher value. Similarly, the number of medium sized tuber (25-35 mm) was observed on Bajhang Local (9.32) followed by Cardinal (5.42). In the case of large sized tuber (35-55 mm), cultivars showed significant result. Large sized tuber (35-55 mm) was observed on Cardinal (5.42) followed by Desiree (5.25). Mulching showed non-significant result. This result is in corroborates with the findings of Eaton et al. (2017b), wherein the different potato cultivars showed the different type of grades because of their different adaptability capacity as per the local climate, different gene or are grown from better tubers. But, non-significantly higher values of large sized of tuber was found in cardinal with straw mulch (Table 7).

### Soil temperature

The mean soil temperature was observed to increase from 16.6 °C at first month of planting (March) to 23.58 °C at third month of planting (May). Soil temperature at 15 cm depth was not influenced by cultivar. However, mulch condition decreased the soil temperature from 24.25 °C to 22.91°C compared to non-mulch conditions. This result is in accordance with the finding of Kar and Kumar (2007) wherein, soil temperature in the surface layer of mulched plots were about 4-6 °C lower than that of non-mulched plots.

### Economic Analysis

Economic analysis of data (Table 10) revealed that potato cultivar Cardinal provided the significantly higher gross return (NPR1564643 /ha), net return (NPR 996802.0 / ha), and B:C ratio (1.74) than the other two cultivars. Similarly, higher B:C ratio was observed for straw-mulch fields (2.69) and lower for no-mulch fields (2.60).

### Soil chemical properties

The results revealed that straw-mulched plots exhibited higher soil chemical properties compared to no-mulch treatments across all tested varieties. The soil organic matter content in mulched plots was relatively higher, with values of 4.70% for Cardinal, 4.57% for Bajhang Local, and 4.32% for Desiree, compared to 4.51%, 4.51%, and 4.22%, respectively, in the no-mulch conditions. Similarly, total soil nitrogen was observed to be highest under mulched conditions, with values of 0.24% for Cardinal and 0.22% for Desiree, compared to 0.23% and 0.21%. Available phosphorus content was also markedly higher in mulched plots. In this study, straw mulching enriches soil by supplying nutrients to plants, boosting inorganic nitrogen, and increasing microbial content as reported by Du et al., 2022.

### Conclusion:

The study results indicate that potato cultivar Cardinal produced significantly the highest tuber yield and B: C ratio than the Desiree and Bajhang Local cultivars. Numerous stems on each plant, heavier individual potatoes within hills, and significantly more number of



**Table 11:** Chemical properties of soil after potato harvest of experimental site at Dadeldhura, 2023

Treatments	Soil pH	Organic matter (%)	Total Nitrogen (%)	Soil Available Phosphorous (kg/ha)	Soil Available Potash (kg/ha)
Cardinal * Straw mulch	6.1	4.70	0.24	100.90	712.54
Cardinal * No mulch	6	4.51	0.23	88.31	426.84
Bajhang Local * Straw mulch	6.2	4.57	0.23	118.54	569.69
Bajhang Local * No mulch	6.1	4.51	0.23	77.60	493.49
Desiree * Straw mulch	6.4	4.32	0.22	71.93	561.7
Desiree * No mulch	6.2	4.22	0.21	47.37	379.22

commercially viable tubers measuring 35-55 mm in size were higher in Cardinal with straw mulching. Despite being different, the local variant Bajhang Local exhibited notably higher growth parameters viz. plant height, leaf count on hills, and number of branches among plants but could not exhibit the higher yields as other improved cultivars. In general, using locally available vegetative mulch in potatoes could be economically viable if appropriate residues and human resources are readily available. In conclusion, potato cultivars Cardinal and Desiree out-yielded more in Dadeldhura's climate while using paddy straw mulch significantly improved the physicochemical properties of soil, potato tuber yields and economic returns in long-run for its sustainability.

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### Declaration of conflict of interest and ethical approval:

The first and second authors together planned and designed the experiment. The first author performed the experiment and analysis while the second author supervised throughout the experiment, help in result interpretation and manuscript development. The third author contributed to facilitating and supervising the experiment as a local supervisor.

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