Journal of Nepal Agricultural Research Council
Vol. 9: 69-78., December 2023
ISSN: 2392-4535 (Print), 2392-4543 (Online)
DOI: https://doi.org/10.3126/jnarc.v9i1.61588

Growth and Yield Traits of Potato Genotypes Grown under Different Cultivation Practices in Dailekh, Nepal

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Received: August 28, 2023 Revised: August 02, 2023, Accepted: Sept. 12, 2023, Published : May 9, 2023.

The authors declare that there is no conflict of interest.

ABSTRACT

Variable rainfall and recurrent drought in spring season limit the potato production at Dailekh. To address this problem, a two-year (2019-2020) field experiment was conducted at HRS, Dailekh to investigate 12 potato genotypes (T-304347.6, T-393371.58, T-304350.1, T-304351.109, T-302498.7, T-304405.47, T-303381.3, T-396311.1, T-397029.1, T-304368.46, Desiree and Cardinal) along with different growing practices (Partial Irrigation (PI), rain-fed and straw mulch) for their growth, and yield traits. The experiment was laid out in split-plot design, where three different growing practices were allotted as main plot and 12 potato genotypes were placed as sub-plot treatment, and it was replicated three times. The combined analysis revealed that growing practices significantly affected the ground cover, plant height, stem number, marketable tuber number and weight, and yield. Potato genotypes showed the significant effect on all the plant and yield traits. Straw mulch produced 28.7% and 21.6% higher marketable tuber yield than PI and rain-fed potato, respectively. Genotypes T-304351.109 and T-397029.1 imparted 22.9% and 17.4% higher marketable tuber yield than Desiree, check variety, respectively. Therefore, growing of high yielding genotypes T-304351.109 and T-397029.1 along with straw mulch can be the best option to increase the potato productivity at rain-fed condition of Dailekh.

Keywords: Drought, genotypes, partial irrigation, straw mulching, yield

सारांश

बर्षामा हुने फेरबदल र बसन्त ऋतुमा बारम्बार हुने सुख्खाले दैलेखमा आलुको उत्पादनमा असर गर्छ । यो समस्यालाई सम्बोधन गर्न बागवानी अनुसन्धान केन्द्र, दैलेखमा १२ वटा आलुका जिनोटाइपहरु (टि-३०४३४७.६, टि-३९३३७१.५८, टि-३०४३५०.१, टि-३०४३५१.१०९, टि-३०२४९८.७, टि-३०४४०५.४७, टि-३०३३८१.३, टि-३९६३११.१, टि-३९७०२९.१, टि-३०४३६८.४६, डेजिरे र कार्डिनल) विभिन्न खेती गरिने तरिकाहरु (आंशिक सिंचाइ, आकासे खेती र परालको छापो) सहितमा तिनीहरुको बृद्धि तथा उत्पादन विशेषताहरुको अध्ययन गर्न दुई वर्षे (२०१९ र २०२०) परिक्षण संचालन गरिएको थियो । तीन विभिन्न खेती गर्ने तरिकाहरु मुख्य प्लटमा र १२ वटा आलुका जिनोटाइपहरु उप-प्लटमा राखी स्प्लिट प्लटमा परीक्षण रेखाङ्कन गरिएको थियो र यो तीन पटक दोहोर्याइएको थियो । खेती गर्ने तरिकाहरुले ग्राउण्ड कभर, बोटको उचाइ, प्रतिविरुवा डांठको संख्या, प्रतिप्लट बजारयोग्य दानाको संख्या, प्रतिप्लट बजारयोग्य दानाको तौल र प्रतिहेक्टर बजारयोग्य दानाको उत्पादकत्वमा महत्वपूर्ण असर पारेको कुरा दुई बर्षको संयुक्त विश्लेषणबाट देखियो । आलुका जिनोटाइपहरुले सबै वानस्पतिक र उत्पादन विशेषताहरुमा महत्वपूर्ण असर गरेको देखायो । परालको छापोले आंशिक सिंचाइ र आकासे खेती भन्दा क्रमशः २८.७ प्रतिशत र २१.६ प्रतिशत बढी बजारयोग्य दानाको उत्पादकत्व दियो । टि-३०४३५१.१०९ र टि-३९७०२९.१ जिनोटाइपहरुले डेजिरे चेक जात भन्दा क्रमशः २२.९ प्रतिशत र १७.४ प्रतिशत बढी बजारयोग्य दानाको उत्पादकत्व दिए । तसर्थ उत्पादन बढी दिने टि-३०४३५१.१०९ र टि-३९७०२९.१ जिनोटाइपहरुलाई परालको छापो सहित खेती गर्दा आलुको उत्पादकत्व बढाउन दैलेखको जस्तो आकाशे खेतीको अवस्थामा राम्रो उपाय हुन सक्छ ।

INTRODUCTION

Potato (*Solanum tuberosum* L.) is an economically important staple crop in Nepal. Potato is the fourth most important food crops after rice, wheat and maize in Nepal, but it ranks the first in total productivity (NPRP 2021). It is a major food crop in mountain region (NAFSCIP 2010). Potato is regarded as a high potential crop to ensure food and nutritional security in hills, and mountains (Luitel et al 2020). Average potato productivity (16.7 t/ha) in Karnali Province is higher than that of national productivity (16.6 t/ha) (MoALD 2021). There is still more potential to increase potato productivity by using quality seed tuber of improved potato varieties and appropriate crop management practices.

The altitude of Dailekh district ranges from 544 m asl (Tallo Dungeshwor) to 4,168 m asl (Mahabu hill) which is created the diverse climate across the district. Potato planting time varies depending on the altitude and climate of particular location. In general, it can be harvested twice a year at the altitude from 1,000 m asl to 1,500 m asl. Spring is the main season of potato cultivation in Dailekh and it suffers from drought during tuberization period (NPRP 2012). This region is characterized by uneven patterns of rainfall and recurrent droughts. Water deficit is a critical factor for diminishing the crop yield (Jaleel et al 2007). Potato is a shallow rooted crop and considered as drought sensitive crop. Drought stress affects the growth of shoots, roots and tubers (Lahlou et al 2003). Partial irrigation or supplemental irrigation generally refers to rain-fed crop receiving irrigation during the sensitive growth stages. This can be one of the approaches to save water and increase potato production at rain-fed areas. Partial root drying is also an approach for potato irrigation and it is possible to save water for irrigation, and increase tuber quality (Brocic et al 2009). Deficit irrigation at tuber bulking stage for two weeks is also suitable method to increase potato yield (Karam et al 2014).

Myriad benefits of mulching in different crops particularly at rain-fed areas have been published previously by many researchers (Yang et al 2003, Dhakal et al 2011, Genger et al 2016, Adhikary et al 2016). Straw mulching is also biodegradable and environmentally friendly approach (Zhao et al 2019). Locally available rice straw mulching can be the best practice to improve soil water retention and to increase potato production. Besides, potato genotypes may respond differently to different growing practices. Therefore, this study was conducted to identify the suitable combination of growing practices and high yielding potato genotypes to maximize potato productivity at rain-fed condition of Dailekh.

MATERIALS AND METHODS

Experimental Site

This experiment was conducted from 2019 to 2020 at HRS, Dailekh (28° 13□ 6.18□ N, 83° 58□ 27.72□ E, altitude; 1,255 m) of Karnali Province, Nepal. The experimental site is characterized by sub-tropical climate, where the annual rainfall at Dailekh district was 160 mm and 170 mm in 2019 and 2020, respectively (HRS 2020). The average monthly temperature (maximum and minimum) was increased consistently during the cropping season in 2019 and 2020 but inconsistent patterns of precipitation were observed during the crop growing period (**Figure 1**). The soil at the experimental site was clay loam with slightly acidic type.

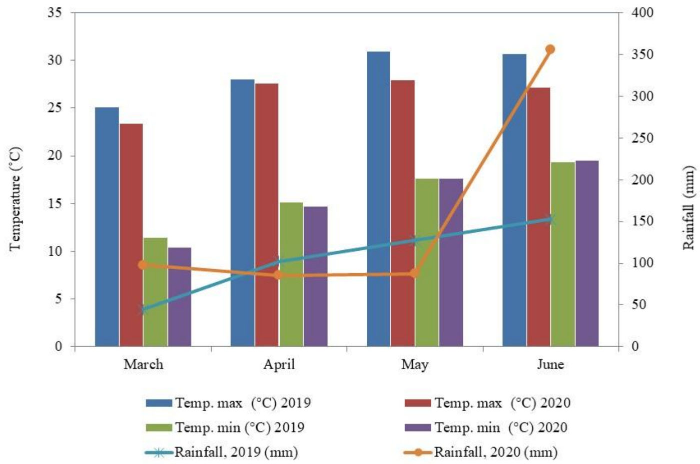

Figure 1. Monthly weather status of potato growing season (March-June) in 2019 and 2020

Plant Materials and Treatment Design

Techno-tubers of 12 genotypes (T-304347.6, T-393371.58, T-304350.1, T-304351.109, T-302498.7, T-304405.47, T-303381.3, T-396311.1, T-396311.1, T-397029.1, T-304368.46, Desiree and Cardinal) were received from National Potato Research Program (NPRP), Khumaltar during 2019 and 2020. Out of 12 potato genotypes, 'Desiree' and 'Cardinal' were popular early varieties, red-skinned and oval-shaped tuber and widely grown in Dailekh district (Personal observation), which were used as checks in the experiments. The experiments were laid out in split-plot design where three growing practices (PI, rain-fed and straw mulch) were allotted as main plot and potato genotypes were placed as sub-plot, and it was replicated three times. Medium size (30-50 g) well sprouted tubers were planted on flat by hand in rows 60 cm apart and with 25 cm between plants within the rows. Potato tubers were planted in two rows and each row had eight tubers, and the tubers were planted in March 1 and March 3 of the years 2019 and 2020, respectively. Blocks were separated by 1 m and 50 cm between the plots within the block and plot size was maintained at 2.4 m^2. Chemical fertilizers were used at the rate of 100:100:60 $NP_2O_5K_2O$ kg/ha along with farm yard manure (FYM) 20 t/ha. Urea (46% N), diammonum phosphate (DAP) (18% N, 46% P_2O_5) and muriate of potash (MoP) (60% K_2O) were used as source of Nitrogen, Phosphorus, and Potassium, respectively. The entire amount of Phosphorus, Potassium and half amount of nitrogen was applied at the time of planting, and the remaining half of the nitrogen was applied 45 days after planting. Soil moisture content was determined using TRIME-PICo64/32 device at 10 cm depth in upper soil layer. When volumetric soil moisture content (%) drop below 4%, irrigation was given partially (4-8% or 50% of full irrigation). PI (50% of full irrigation) was given manually to potato crop at three times (after planting, 35 days after plant emergence (DAPE) and 50 DAPE between two rows in furrow method. Rainfall was the major source for rain-fed potato and locally available rice straw was used as mulching (approx. 80 mm thickness) throughout the crop growing season. Intercultural operations earthing-up and weeding were carried out as recommended (AITC 2019).

Data Recording and Analysis

Observations on ground cover, plant height, stem number/plant, non-marketable tuber number and weight, marketable tuber number and weight, non-marketable, and marketable tuber yield were recorded from each plot. For the ground cover, each plot was assessed for the percentage of ground cover by foliage converted to a 1-9 scale using following key; 1 = No emergence; 2 = Less than 20% ground cover, 3 = 29-35% ground cover, 4 = 36-50% ground cover, 5 = 51-65% ground cover; 6 = 66-75% ground cover; 7 = 76-90% ground cover; 8 = 91-99% ground cover, and 9 = 100% ground cover (Khatri and Luitel 2014). Plant height (cm) was measured on five plants from the soil surface to the top most growth point of the main shoot apex when 50% of the plants produce flowers, and averaged. The stem number/plant was recorded the stems that emerged independently above the soil as single stems at 50% flowering. All the plants were harvested in last week of June. Tubers were graded after harvesting; tubers less than 25.0 g, diseased infected, rotten and insect infested were categorized as non-marketable. Tubers size with greater than 25.0 g, and more than 50.0 g were categorized into marketable tuber. The marketable tuber yield was calculated using marketable tuber weight/plant multiplied by planting density divided by area in hectare basis (De Haan et al 2014.). The data were analyzed using GenStat Release 10.3 DE Software.

RESULTS

Plant Characters

Growing practices significantly influenced the ground cover, plant height and stem number/plant (**Table 1**). The combined mean over the years showed that straw mulching produced the highest ground cover (71.0%). Similarly, the tallest plants (51.8 cm) were measured in straw mulch and the lowest plant height (44.8 cm) was measured in partial irrigation potato. The number of stem produced the highest (5.0/plant) in rain-fed treatment. However, the stem number/plant produced in partial irrigation was statistically similar to straw mulch treatment. Genotypes had a highly significant effect on all the studied plant traits. Genotype T-304368.46 produced the highest ground cover (81.0 %), followed by genotype T-302498.7 (76.0%), but the lowest ground cover (44.0%) was measured in Cardinal. Genotype T-303381.3 showed the tallest plants (55.2 cm), followed by the genotypes T-304405.47 (54.5 cm) and T-304351.109 (54.1 cm), but the lowest plant height (38.9 cm) was measured in Cardinal. The highest number of stem (5.0/plant) was counted in genotypes T-304351.109, T-304405.47, T-304368.46 and Desiree, but the least number (3.0) was recorded in T-304347.6. The interaction between growing practices and genotypes in all the plant traits were non-significant (**Table** 1).

Table 1. **Plant characters of potato genotypes as influenced by genotypes and growing practices, 2019 and 2020**

Growing Practices (GP)	Ground cover (%)		Mean	Plant height (cm)		Mean	Stem/plant (no.)		Mean
	2019	2020		2019	2020		2019	2020	
Partial irrigation	72.0	56.0	64.0	42.8	46.8	44.8	4.0	5.0	4.0
Rain-fed	70.0	59.0	65.0	46.9	50.2	48.5	4.0	5.0	5.0
Straw mulch	77.0	66.0	71.0	50.9	52.7	51.8	4.0	4.0	4.0
F-Test			**			**			*
LSD (0.05)			4.531			1.882			0.336
Genotypes (G)									
T-304347.6	74.0	60.0	67.0	51.5	54.8	53.2	3.0	3.0	3.0
T-393371.58	68.0	51.0	60.0	48.3	49.0	48.7	4.0	4.0	4.0
T-304350.1	66.0	46.0	56.0	38.3	40.9	39.6	3.0	4.0	4.0
T-304351.109	84.0	66.0	75.0	53.4	54.8	54.1	4.0	5.0	5.0
T-302498.7	83.0	68.0	76.0	42.5	47.3	44.9	4.0	5.0	4.0
T-304405.47	65.0	70.0	68.0	58.3	50.7	54.5	4.0	5.0	5.0
T-303381.3	70.0	55.0	63.0	58.0	52.3	55.2	4.0	5.0	4.0
T-396311.1	88.0	55.0	72.0	44.4	46.8	45.6	4.0	4.0	4.0
T-397029.1	83.0	66.0	74.0	46.7	49.3	48.0	4.0	5.0	4.0
T-304368.46	92.0	71.0	81.0	50.8	47.8	49.3	4.0	6.0	5.0
Desiree (Check)	59.0	67.0	63.0	39.7	57.1	48.4	4.0	7.0	5.0
Cardinal (Check)	40.0	48.0	44.0	30.5	47.3	38.9	4.0	4.0	4.0
Mean	72.71	60.2	66.46	46.88	49.88	48.38	3.83	4.66	4.25
F-Test			**			**			**
LSD (0.05)			9.061			3.76			0.673
GP × G			NS			*			NS
LSD (0.05)			15.69			6.51			1.16
CV (%)			12.8			9.6			19.4

*[ns] non-significant; * and ** significant at 5% and 1%, respectively*

Number and Weight of Non-marketable Tubers

Growing practices had non-significant effect on non-marketable tuber number and weight (**Table 2**). But the genotypes significantly influenced on non-marketable tuber number and weight. The highest number of non-marketable tuber (94.0/plot) and weight (0.9 kg/plot) were harvested from T-304368.46, but the lowest number of non-marketable tubers (21.0/plot) were obtained from T-393371.58 and T-304350.1. Whereas, T-304347.6, T-304350.1, and T-303381.3 produced the lowest non-marketable tuber weight (0.2 kg/plot). The interaction effect of growing practices and genotypes was non-significant in non-marketable tuber number and weight (**Table** 2).

Table 2. **Number and weight of non-marketable tubers as influenced by growing practices and genotypes, 2019 and 2020**

Growing Practices (GP)	Non-marketable tuber/plot (no.)		Mean	Non-marketable tuber weight/plot (kg)		Mean
	2019	2020		2019	2020	
Partial irrigation	44.0	27.0	35.0	0.5	0.3	0.3
Rain-fed	52.0	24.0	38.0	0.6	0.2	0.4
Straw mulch	53.0	26.0	39.0	0.5	0.3	0.4
F-Test			NS			NS
LSD (0.05)			6.76			0.095
Genotypes (G)						
T-304347.6	28.0	17.0	22.0	0.3	0.2	0.2
T-393371.58	25.0	17.0	21.0	0.3	0.2	0.3
T-304350.1	23.0	18.0	21.0	0.2	0.2	0.2
T-304351.109	45.0	28.0	37.0	0.5	0.3	0.4
T-302498.7	66.0	21.0	44.0	0.8	0.2	0.5
T-304405.47	60.0	32.0	46.0	0.6	0.3	0.4
T-303381.3	34.0	21.0	28.0	0.3	0.1	0.2
T-396311.1	32.0	17.0	24.0	0.4	0.2	0.3
T-397029.1	51.0	32.0	42.0	0.5	0.3	0.4
T-304368.46	137.0	51.0	94.0	1.3	0.5	0.9
Desiree (Check)	34.0	23.0	28.0	0.5	0.3	0.4
Cardinal (Check)	60.0	30.0	45.0	0.7	0.3	0.5
Mean	49.5	25.5	37.5	0.54	0.27	0.411
F-Test			**			**
LSD (0.05)			13.51			0.190
GP × G			NS			NS
LSD (0.05)			24.07			0.32
CV (%)			24.0			34.5

*[ns] non-significant; * and ** significant at 5% and 1%, respectively*

Number and Weight of Marketable Tubers

Growing practices revealed highly significant differences in marketable tuber number and weight (**Table** 3). The combined mean over the years showed the greatest number of marketable tubers (103.0/plot) in straw mulch treatment. But the lowest number of marketable tubers (84.0/plot) was recorded in rain-fed treatment which was statistically similar to the number produced in partial irrigation treatment. Genotypes significantly influenced on marketable tuber number and weight. Similarly, T-304368.46 produced the highest (130.0/plot) number of marketable tubers, followed by T-304351.109 (119.0/plot), T-302498.7 (111.0/plot) and T-397029.1 (111.0/plot). In contrast, T-396311.1 produced the lowest number of marketable tuber (64.0/plot). Straw mulch produced the higher marketable tuber weight (5.8 kg/plot) than that of rain-fed condition (4.4 kg/plot). The highest marketable tuber weight was produced in T-304351.109 (6.9 kg/plot) and T-397029.1 (6.4 kg/plot), but Cardinal produced the lowest marketable weight (2.9 kg/plot). The interaction effect of growing practices and genotypes for marketable tuber number and weight was non-significant (**Table** 3).

Table 3. Marketable tuber numbers and weight as influenced by growing practices and genotypes, 2019 and 2020

Growing Practices (GP)	Marketable tuber /plot (no.)		Mean	Marketable tuber wt./plot (kg)		Mean
	2019	2020		2020	2019	
Partial irrigation	105.0	65.0	85.0	5.5	3.0	4.3
Rain-fed	92.0	76.0	84.0	5.2	3.6	4.4
Straw mulch	121.0	84.0	103.0	6.8	4.7	5.8
F-Test			**			**
LSD (0.05)			7.40			0.406
Genotypes (G)						
T-304347.6	85.0	61.0	73.0	6.8	3.8	5.3
T-393371.58	91.0	49.0	70.0	6.1	2.2	4.2
T-304350.1	95.0	52.0	74.0	5.4	2.4	3.9
T-304351.109	140.0	97.0	119.0	8.4	5.4	6.9
T-302498.7	126.0	97.0	111.0	4.9	4.4	4.6
T-304405.47	76.0	82.0	79.0	4.3	4.7	4.5
T-303381.3	111.0	68.0	89.0	5.4	2.8	4.1
T-396311.1	93.0	35.0	64.0	5.4	2.1	3.8
T-397029.1	132.0	90.0	111.0	8.2	4.8	6.4
T-304368.46	156.0	104.0	130.0	7.0	4.1	5.5
Desiree (Check)	87.0	93.0	90.0	5.1	5.4	5.3
Cardinal (Check)	81.0	73.0	77.0	3.1	2.8	2.9
Mean	106.0	75.0	90.5	5.84	3.76	4.805
F-Test			**			**
LSD (0.05)			16.79			0.812
GP × G			NS			NS
LSD (0.05)			1.37			1.40
CV (%)			22.8			20.8

*[ns] non-significant; * and ** significant at 5% and 1%, respectively*

Non-marketable and Marketable Tuber Yield

Non-marketable and marketable tuber yield were significantly influenced by growing practices (**Table 4**). The combined analysis showed the highest non-marketable tuber yield (2.5 t/ha) in straw mulch and the lowest yield (2.1 t/ha) in partially irrigated potato. Similarly, straw mulch contributed to the highest marketable tuber yield (24.0 t/ha) and the lowest (17.1 t/ha) was harvested from partially irrigated treatment, but it showed the statistically similar to rain-fed treatment. Genotypes had a highly significant difference in non-marketable and marketable tuber yield. The non-marketable tuber yield produced the highest (3.9 t/ha) in T-304351.109 and the lowest (0.8 t/ha) was in T-304350.1. Marketable tuber yield varied from 12.3 t/ha (Cardinal) to 28.8 t/ha (T-304351.109). The interaction between growing practices and genotypes showed non-significant effect for non-marketable and marketable tuber yield (**Table** 4).

Table 4. Non-marketable and marketable tuber yield as influenced by growing practices and genotypes, 2019 and 2020

Growing Practices (GP)	Non-marketable tuber yield (t/ha)		Mean	Marketable tuber yield (t/ha)		Mean
	2019	2020		2019	2020	
Partial irrigation	1.9	1.1	2.1	22.8	12.7	17.1
Rain-fed	2.6	0.9	2.3	21.5	14.9	18.8
Straw mulch	2.3	1.4	2.5	28.7	19.4	24.0
F-Test			*			**
LSD (0.05)			0.112			1.69
Genotypes (G)						
T-304347.6	1.1	0.8	0.9	28.5	15.7	22.1
T-393371.58	1.6	0.8	1.1	25.4	9.3	17.4
T-304350.1	0.9	0.7	0.8	22.7	10.2	16.4
T-304351.109	1.9	1.3	1.6	35.1	22.7	28.8
T-302498.7	3.7	0.8	2.3	20.5	18.5	19.5
T-304405.47	2.4	1.3	1.8	18.1	19.6	18.8
T-303381.3	1.3	0.7	1.0	22.3	11.5	16.8
T-396311.1	1.8	0.8	1.3	22.4	8.4	15.6
T-397029.1	2.1	1.4	1.8	34.1	19.8	26.9
T-304368.46	5.5	2.4	3.9	29.2	17.2	23.2
Desiree (Check)	2.1	1.2	1.6	21.6	22.7	22.2
Cardinal (Check)	3.0	1.3	2.1	12.7	11.9	12.3
Mean	2.28	1.15	1.71	24.37	15.67	20.02
F-Test			**			**
LSD (0.05)			0.371			3.38
GP × G			NS			NS
LSD (0.05)			1.37			5.86
CV (%)			34.5			21.5

*ns non-significant; *, and ** significant at 5% and 1%, respectively.*

DISCUSSIONS

Growing practices significantly influenced on plant traits like ground cover, plant height and stem number/plant. In this study, straw mulch produced more foliage cover than PI and rain-fed potato. Straw mulching helps to conserve soil moisture, reduce soil temperature and suppress weed and that might have contributed to produce more ground foliage. Many researchers (Kar and Singh 2004, Kar and Kumar 2007, Chang et al 2019) have been reported the roles of straw mulch to conserve soil moisture and reduce soil temperature. In a study by Bhatta et al (2020), they have reported the lower soil temperature in white and silver plastic mulch than black plastic mulch in potato. Timilsina et al (2022) have reported the significant differences in yield attributing traits in plastic mulching treatment. In this study, we measured the highest plant height in straw mulch treatment. Chang et al (2019) have also reported that application of straw mulching promotes plant growth in potato. We observed more number of stem/plant in rain-fed potato than other treatments. Meanwhile, the stem number per plant in 2019 was found non-significant among growing practices and this might be due to consistent rainfall in this particular year. In general, soil temperature increases in rain-fed or bare potato that promoted more branches in potato and similar results have been published by Slater et al (1968). Canopy cover and plant height were affected by PI and rain-fed treatment and this might be due to drought stress during vegetative stage. Foliage cover and plant height found to be more sensitive to drought stress and this result agrees to the findings of Luitel et al (2015). Genotypes exhibited highly significant differences in plant characters and this might be due to genetic make-up of cultivar. Potato genotypes differ in their tuber maturity period and it can be early, mid, and late maturing types. Potato genotypes are also classified as leaf and stem types based on shoot morphology. Hence, the differences in plant traits are genotype-dependent (Schittenhelm et al 2006).

Our study found the highest marketable tuber number per plot in straw mulch treatment. Compared to PI and rain-fed potato, this study showed that marketable tuber number per plot in straw-mulch increased by 17.4 % and 18.4 %, respectively. But most of the tubers under PI and rain-fed plot were observed as malformed and defected tubers. In general, water deficit condition markedly influences the tuber expansion and produces the defected tubers (Wagg et al 2021). Schafleitner et al (2007) have observed the malformed tubers in water deficit condition. Luitel et al (2015) have reported that marketable tuber number reduction due to drought stress varied from 64% to 85%, but this study found less reduction of marketable tuber number per plot due to uneven distribution of rainfall during growing season. Potato plants at PI and rain-fed condition exposed to high temperature and water deficit during tuber initiation and development stage, and this might have attributed to less marketable tuber number/plot. Genotypes revealed highly significant differences in non-marketable tuber number/plant, non-marketable weight and marketable tuber number/plot, and this might be due to genetic traits. Furthermore, cultivation environments also affected the performance of genotypes. We found that straw mulch increased more marketable tuber yield by 28.7% and 21.6% than PI and rain-fed potato, respectively. But in a study by Kral et al (2019), they reported that marketable tuber yield increased by 21.2% in straw mulch treatment in comparison to non-mulch which is consistent to our results. But Karam et al (2014) mentioned that deficit irrigation at tuber maturity stage reduced tuber yield by 42% compared to well-irrigated treatment. Chang et al (2019) have reported that the tuber yield was increased by 10.5-34.2% in straw mulch. Straw mulch decreased the soil temperature and increased moisture which favored to increase marketable tuber yield and similar results were stated by Chang et al (2019). Canopy cover, marketable tuber number and yield were higher in 2019 compared to the year 2020. Low precipitation in 2020 during April-May (**Figure** 1) which was critical for tuber initiation and development that reduced the tuber number and yield. But straw mulch contributed to the highest canopy cover, marketable tuber and yield indicating that straw mulch can be the best option to conserve soil moisture in water deficit areas. Shrestha et al (2020) have also mentioned the highest yield in straw mulch potato in comparison to non-mulch.

Genotypic differences with regard to marketable tuber yield was highly significant. Genotypes T-304351.109 and T-397029.1 gave 57.6% and 54.2% higher marketable tuber yield than Cardinal. Desiree and Cardinal were early maturing varieties, but in this study, Cardinal did not perform well for the plant and yield traits. Compared to Cardinal, Desiree produced more canopy cover, plant height, marketable tuber number and yield. In addition to the genotypes T-304351.109, T-397029.1, and T-304369.46, Desiree can also perform better in rain-fed condition. Furthermore, variation tuber yield is also governed by genetic traits (Struik and Wiersema, 1999). In a study by Upadhyay et al (2021), they have found that T-304351.109 is a promising genotype for good storability at mid-hill region.

CONCLUSION

In this study, we investigated the performance of potato genotypes under different growing practices at rain-fed condition. Growing practices significantly affected the plant traits, marketable tuber weight and yield. Straw mulch exhibited 21.6 % and 28.7% marketable tuber yield advantage over rain-fed and PI, respectively. Marketable tuber yield in PI and rain-fed treatment did not show any statistical differences. Genotypes showed the significant variations in all the traits. The highest marketable tuber yield produced in the genotypes T-304351.109 (28.8 t/ha) and T-397029.1(26.9 t/ha). Out of three growing practices, straw- mulch showed the best results for plant and yield traits. Further study is needed to screen the potato genotypes under different growing practices with detail observation of soil temperature, soil moisture, weed biomass at rain-fed condition as well as their storability performance at farm conditions. Thus, growing of high yielding genotypes T-304351.109 and T-397029.1 along with straw-mulch can be the best approach to increase potato productivity at rain-fed condition.

ACKNOWLEDGEMENTS

Authors would like to thank NARC for financial support from the project titled "Development of Improved Production Technologies in Vegetable Crops at Karnali Province, No. 325). We thank to NPRP for providing seed tubers of potato genotypes to carry-out this research. Authors are grateful to the staffs of HRS, Dailekh for their kind cooperation during the field experiments.

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