International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2021; 9(3): 166-169

Received: 10-03-2021
Accepted: 12-04-2021

Bhart
Department of Agriculture, Khalsa College Amritsar, Punjab, India

Rakesh Kumar
Department of Agriculture, Khalsa College Amritsar, Punjab, India

Corresponding Author:
Bhart
Department of Agriculture, Khalsa College Amritsar, Punjab, India

Effect of various types of mulching on growth, yield and quality of different processable cultivars of potato (*Solanum tuberosum* L.)

Bhart and Rakesh Kumar

Abstract
The aim of this study was to assess the effect of various types of mulching on growth, yield and quality of different processable cultivars of potato (*Solanum tuberosum* L.). The experiment was conducted under field conditions at the Student's Research Farm, Khalsa College, Amritsar. The experiment was laid out in split plot design (SPD) which consisted of main plot treatments of mulches such as white polyethylene sheet, black polyethylene sheet, straw mulch and no mulch and sub plot treatments consisted three processable varieties such as Lady Rosetta, Kufri Chipsona-3 and Kufri Surya with three replicates. The results revealed that application of mulch treatments and cultivars affected significantly potato vegetative growth and tuber yield. The cultivation of 'Kufri Chipsona-3' with application of black polyethylene sheet mulch resulted in significantly higher values of growth, yield and quality attributes. This is the best combination for getting higher yield and quality of processable tuber yield under Punjab conditions.

Keywords: cultivars, mulching, potato, processable yield

Introduction
Potato (*Solanum tuberosum* L.) popularly known as 'The King of Vegetables', ranks fourth largest global food crop following rice, wheat and maize. India is the second largest producer of potato in the world after china. In Punjab potato was cultivated on an area about 85.25 thousand ha with production of 27.25 lakh tons (Anonymous 2019) [1]. Amritsar being an integral potato producing district in Punjab contributing 7.7% to total production and standing at 5th position (Anonymous, 2019) [2]. However, major problems in potato cultivation include weeds, diseases, optimum temperature, optimum moisture etc. In response, farmers put herbicide and pesticide application in to practices which in turn leaves residual effect in soil and ultimately the potato quality. For moisture maintenance, additional irrigations are required. Concerning this problem, we carry-out several practices *viz*. manual hoeing, hand weeding, mulching, suitable cultivar etc. Among the various practices type of mulching material and selection of suitable cultivars are one of the prime factors responsible for desirable results in processable potato cultivars. Mulching decreased weed density and increased the crop yields (Sinkeviciene *et al.*, 2009) [19].

The use of plastic mulch, soil properties like soil temperature, soil moisture content, bulk density, aggregate stability and nutrient availability improved plant growth and yield were also positively influenced by the plastic mulch due to the modification of soil microclimate (Sharma and Bhardwaj, 2017) [17].

Varietal adaptation is the important factor which is generally associated with low quality and productivity of this crop. The new improved cultivars have high yield potential, processing quality and resistant to disease and insect pest as compare to old and degenerated cultivars. A total of 90% of potato production in India is from the Indo-Gangetic plains, where the crop is harvested from January to March before on set of long hot summer. Storage under ambient conditions in India plains can result in enormous losses due to shrinkage sprouting and attack by micro-organism. Thus it is necessary to use suitable varieties (Chandra *et al.*, 2017) [5]. So, the present investigation was initiated to find out a suitable mulching material and cultivar for higher potato production under the agro-climatic conditions of Amritsar.

Materials and Methods

The study was carried out during Rabi season 2019-20 under field conditions at the Student's Research Farm, Khalsa College, Amritsar. The soil of the experimental field was categorized as sandy loam. The soil tested low in organic carbon (0.40%) and available nitrogen (168 kg/ha). However, available phosphorus (16.8 kg/ha) and potassium (258 kg/ha) were in medium category. The soil pH (7.8) and electrical conductivity (0.4mhos/cm^2) values were within the normal range.

The experiment was laid out in split plot design (SPD) which consisted of main plot treatments of mulches such as white polyethylene sheet (M_1), black polyethylene sheet (M_2), straw mulch (M_3) and no mulch (M_4) and sub plot treatments consisted three processable varieties such as Lady Rosetta (V_1), Kufri Chipsona-3 (V_2) and Kufri Surya (V_3) with three replicates. Well decomposed farmyard manure @ 50 tons per hectare was applied at the time of soil preparation. Recommended dose of fertilizer is 187.5kg of N (412.5 kg of urea), 62.5kg of P2O5 (387.5 kg of single superphosphate) and 62.5kg of K2O (120 kg of sulphate of potash) per hectare was applied to the crop. Half dose of nitrogen along with full dose of phosphorus and potassium was applied at the time of sowing while rest of the nitrogen was applied at the time of earthing-up one month after planting. The crop was planted manually in third week of October in 2019. The seed tubers were treated with Emisan @ 2.5g per liter of water for 30 minutes. The sowing was done on ridges maintaining a distance 60 cm apart in rows with plant to plant spacing of 20 cm. After planting of potato on ridges as per treatments, plastic mulch of 20 micron thickness, black or white polyethylene (as per treatments) in color and was spread on soil plot wise, covering tightly with sufficient soil from all the sides. A three inch slit was cut along each row zone to facilitate the germination of tubers. The polyethylene sheet was folded to one end at the time of irrigation and fertilizers application and was again spread tightly. The field was irrigated immediately after planting. Later on timely irrigations, normal cultural operations and plant protection measures were used to ensure healthy crop. The haulms of the crop were removed with sickle in end January and left in the soil itself for 15 days. The tubers were lifted in 1st week February. The experimental data were statistically analyzed using with standard procedures of the Split Plot Design (SPD).

Result and Discussion

Effect of mulching material

Data presented in the Table-1 revealed that mulching has very positive effect on emergence, tuber initiation and number of stems per hill. Days taken to emergence and tuber initiation were least under black polyethylene sheet followed by white polyethylene sheet, straw mulch and no mulch. Obtained results from no mulch plots may be attributed to lower soil temperature, which may effect on enzymatic reaction which affection on buds initiation and growth consequently the increase the number of days to emergence. The results were conformity with recorded by El-Zohiri and Samy (2013) [7]. Maximum number of stems (6.1) was recorded with black polyethylene sheet followed by white polyethylene sheet, straw mulch and no mulch. The same was concluded by Singh and Ahmed (2008) [18]. Vegetative growth parameters of potato plants expressed as plant height, leaf area index and dry matter accumulation significantly increased when potato crop was planted using colored polyethylene sheets compared with no mulch treatment at all growth stages. This might be due to faster emergence facilitated by higher temperature and moisture content of the soil due to plastic mulching and our results were in agreement with the finding of Goel *et al.* (2020) [9], Farrag *et al.* (2016) [8], Caruso *et al.* (2013) [4], Dvorak *et al.* (2012) [6] and Zhao *et al.* (2012) [20].

Data presented in Table-2 and (fig.1) showed that, there were significant differences among mulches and no mulch treatment. In this concern, highest average number of tubers per plant was recorded with black polyethylene sheet and lowest in no mulch treatment. Higher number of tubers recorded under black polyethylene sheet mulch treatment may be due to the more congenial soil temperature which resulted in better tuber initiation. Similar results were observed by El-Zohiri and Samy (2013) [7]. There were also statistically differences total tuber yield and processable tuber yield. Maximum average total tuber yield and processable tuber yield q/ha of 386.1 q/ha and 275.6 q/ha recorded with black polyethylene sheet which were significantly superior to 270.4 q/ha and 165.4 q/ha with no mulch treatment respectively. These results support the hypothesis that yield differences associated with colored plastic mulches were due to differences in the spectral characteristics of reflected light, which differed from one to another. Potato is reported to increase tuber yield when plants are mulched with plastics (Farrag *et al.*, 2016) [8] and straw mulch compared with plants grown in bare soil. However, mulching treatments shows the non-significant difference on non processable tuber yield. Similar results were observed by Azad *et al.* (2015) [3].

Data in the Table-3 revealed that, the effect of mulching on the quality parameter *viz.* tuber dry matter content, reducing sugars, sucrose content and chip color score shows non-significant results.

Table 1: Effect of various mulching material and processable cultivars on growth attributes

Dry matter accumulation (g/plant)	90 DAS	Mulching material	20.97	22.41	19.06	17.82	1.66		15.98	21.55	22.67	1.08
	60 DAS		22.15	23.5	20.11	18.14	1.83		17.70	22.22	23.0	1.24
	30 DAS		3.93	4.01	3.41	2.77	0.33		3.21	3.6	3.79	0.28
Leaf area index	90 DAS		3.25	3.57	3.07	2.83	0.26		2.89	3.24	3.41	0.13
	60 DAS		3.34	3.71	3.18	2.89	0.40		3.03	3.34	3.47	0.24
	30 DAS		1.50	1.64	1.24	1.04	0.18		0.77	1.53	1.77	0.11
Plant height (cm)	90 DAS		53.5	57.0	52.6	49.0	4.2		46.8	54.3	58.0	2.4
	60 DAS		48.2	52.0	45.5	43.2	3.9		45	46.8	50.1	2.9
	30 DAS		24.9	26.7	23.5	22.2	2.9		22.9	24.6	25.4	1.3
Number of stems per hill			5.6	6.1	5.3	4.8	0.33		5.7	5.9	4.8	0.25
Days taken to tuber initiation			23.33	22.88	24.22	25.22	0.50		26.25	23.58	21.91	0.43
Days taken to 50% emergence			13	12.1	13.9	14.3	0.5		14.7	13	12.3	0.4
Treatments			White polyethylene sheet	Black polyethylene sheet	Straw mulch	Control (no mulch)	CD(0.05)		LR	Kufri Chipsona-3	Kufri Surya	CD(0.05)

Table 2: Effect of various mulching material and processable cultivars on yield attributes

Total tuber yield (q/ha)	Mulching material	349.9	386.1	300.1	270.4	23.8	Cultivars	253.0	388.6	338.3	15.4
Non-processable tuber yield (q/ha)		108.7	110.5	94.7	104.9	NS		87.5	119.1	107.4	12.4
Processable tuber yield (q/ha)		241.2	275.6	205.4	165.4	21.9		165.5	269.4	230.8	16.1
Number of tubers per plant		8.9	9.5	8.5	7.9	0.9		6.7	10.4	9.0	0.5
Treatments		White polyethylene sheet	Black polyethylene sheet	Straw mulch	Control (no mulch)	CD(0.05)		LR	Kufri Chipsona-3	Kufri Surya	CD(0.05)

Table 3: Effect of various mulching material and processable cultivars on quality parameters

Chip color Score	Mulching material	2.73	2.73	2.72	2.72	NS		3.0	2.4	2.9	0.006
Sucrose content (mg/100g FW)		106.1	106.05	106.14	106.18	NS		129.1	90.5	98.7	0.23
Reducing sugars (mg/100g FW)		19.3	19.2	19.4	19.4	NS		24.2	14.7	19.1	0.30
Tuber dry matter content (%)		21.6	21.7	21.6	21.5	NS		22.6	21.6	20.6	0.13
Treatments		White polyethylene sheet	Black polyethylene sheet	Straw mulch	Control (no mulch)	CD(0.05)	Cultivars	LR	Kufri Chipsona-3	Kufri Surya	CD(0.05)

Effect of cultivars

Data presented in the Table-1 revealed that cultivar has very positive effect on emergence, tuber initiation and number of stems per hill. Days taken to emergence and tuber initiation were least under Kufri Surya followed by Kufri Chipsona-3 and LR. This might be due to the early maturity nature of kufri Surya. It was further revealed that Kufri Surya has lowest number of stems while Kufri Chipsona-3 has maximum number of stems. Similar results were also reported by Kaur and Khurana (2017). Vegetative growth parameters of Kufri Surya potato cultivar plants shows significantly results expressed as plant height, leaf area index and dry matter accumulation at all growth stages followed by Kufri chipsona-3 and LR. This can be ascribed to the fact that different genetic make- up of cultivars. Our results were in agreement with the finding of Kumar *et al.* (2015) [11] and Mehara *et al.* (2018) [13].

Data presented in Table-2 and (fig.1) showed that, there were significant differences among cultivars on yield contributing parameters. The average maximum number of tubers born by the cultivars Kufri Cipsona-3 followed by Kufri Surya and LR. This may be due to the reason that the plants were more vigorous in terms of height and foliage which synthesized more food ultimately leading to higher number of tubers. The highest total tuber yield, processable tuber yield and non processable tuber yield of potato was recorded in kufri Chipsona-3 during the investigation. The cultivar LR recorded the lower yield during investigation. As per the recommendation of PAU with the cultivar Kufri Chipsona-3 has been reported to be high yielding one as compare to other cultivars. The variation is attributed the genetic variation existing among the genotypes. The variation is attributed the genetic variation existing among the genotypes Marwaha *et al.* (2016) [12] and Mehara *et al.* (2018) [13] observed similar variation among different genotypes.

Data in the Table-3 revealed that, among the different cultivars, the cultivar LR had the highest dry matter followed by Kufri Chipsona-3 and Kufri Surya. Similar results were reported by Mehta *et al.* (2011) [14]. Further data revealed that cultivars shows the significantly differences in reducing sugars, sucrose content and chip color score. The cultivar Kufri Chipsona-3 had the lowest reducing sugars, sucrose content and chip color score followed by Kufri Chipsona-3 and LR. The increased in reducing sugars and sucrose content noticed in variety LR and kufri surya at harvest stage may be due to complete death of foliage at this stage and tubers behaving like being stored in low temperature reported by Pandey *et al.* (2008) [15] and Rajani and Singh (2015) [16].

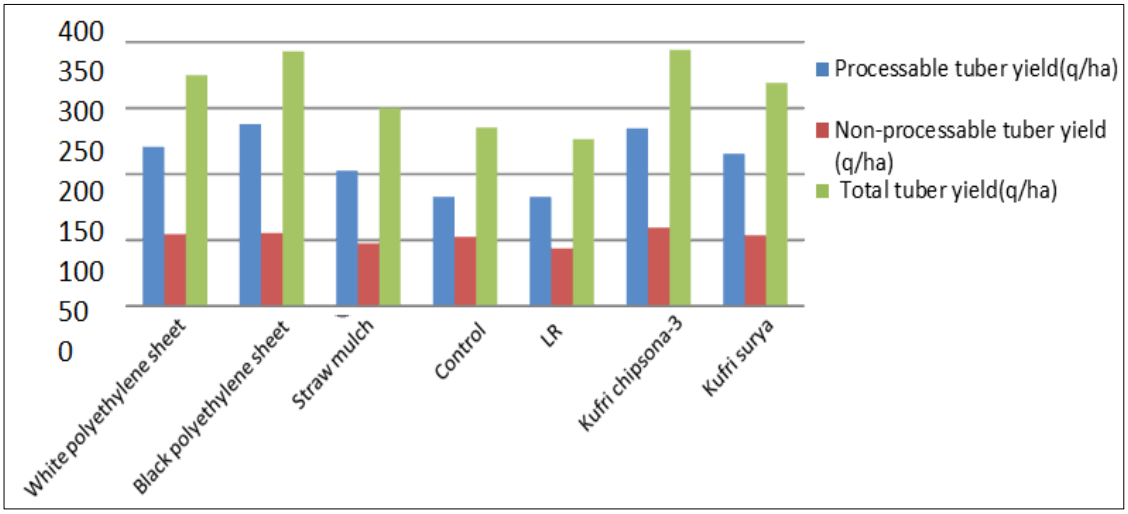

Fig 1: Effect of various mulching material and processable cultivars on yield attributes

Conclusion

On the basis of investigation under agro-climatic conditions of Amritsar, it could be concluded that among four different mulching material, black polyethylene sheet found to be significantly superior for plant height, leaf area index, dry matter accumulation, stem per plant, large size tuber per plant, tuber number per plant, tuber yield (q/ha) as compared to other mulching treatment. Cultivars significantly increased all growth, yield and quality parameter. In case of interaction between the two factors, combination of black polyethylene sheet mulch with Kufri Chipsona-3 produced maximum growth, yield and quality parameter as compared with other combination under Amritsar conditions.

References

1. Anonymous. Monthly Report Potato. Agricoop 2019.gov.in.
2. Anonymous. Statistical Abstract of Punjab 2019.
3. Azad B, Hassandokht MR, Parvizi K. Effect of mulch on some characteristics of potato in Asadabad, Hamedan. International Journal of Agronomy and Agricultural Research 2015;6(3):139-147.
4. Caruso G, Carputo D, Conti S, Borrelli C, Maddaluno P, Frusciante L. Effect of mulching and plant density on out of season organic potato growth, yield and quality. Advances in Horticultural Science 2013;27 (3):115-121.
5. Chandra G, Kumar U, Raghav M, Kumar P. Seed tuber yield, quality and storability of potato varieties with varying nitrogen levels in tarai region of Uttarakhand. International Journal of Current Research 2017;9(4):49108-49112.
6. Dvorak P, Hamouz K, Kuchtova P, Tomasek J, Hajslova J, Schulzova V. Effect of mulching materials on potato production in different soil-climatic conditions. Romanian Agricultural Research 2012, 29.
7. El-Zohiri SSM, Samy MM. Influence of colored plastic mulches on germination, growth and marketable yield of potato. International Journal of Product Development 2013;18:405-420.
8. Farrag K, Abdrabbo AA, Hegab AM. Growth and productivity of potato under different irrigation levels and mulch types in the north-west of the Nile Delta, Egypt. Middle East Journal of Applied Sciences 2016;6:774-786.
9. Goel L, Shankar V, Sharma RK. Influence of different organic mulches on soil hydrothermal and plant growth parameters in potato crop (*Solanum tuberosum* L.). Journal of Agrometeorology 2010;22(1):56-59.
10. Kaur R, Khurana DS. Growth, Yield and Quality of different processing cultivars of potato (*Solanum tuberosum* L.). International Journal of Pure and Applied Bioscience 2017;5(6):594-599.
11. Kumar P, Singh S, Kumar R, Rawal S, Singh BP. Effect of tuber planting depth on yield, quality and profitability of potato (*Solanum tuberosum*) processing varieties. Indian Journal of Agronomy 2015;60(1):139-144.
12. Marwaha RS, Pandey SK, Singh SV, Kumar D. Yield, chipping and nutritive qualities of spring grown potatoes in North-Western Plains. Potato Journal 2016;35(3-4):61-63.
13. Mehara H, Mehra M, Jaiswal RK, Kadi AS, Sharma S. Identify the suitable varieties of potato for growth and yield attributing characters. Journal of Pharmacognosy and Phytochemistry 2018;SP1:2927-2933.
14. Mehta A, Charaya P, Singh BP. French fry quality of potato varieties: effect of tuber maturity and skin curing. Potato Journal 2011;38(2):130-136.
15. Pandey SK, Singh SV, Marwaha RS, Manivel P, Kumar P. Performance of newly released 'Kufri Chipsona 3' Indian potato variety during different crop seasons in West-central plains. Indian Journal of Agricultural Sciences 2008;78(2):116-121.
16. Rajani, Singh D. Study of biochemical parameters in potato germplasms under Tarai region of Uttarakhand. Asian Journal of Plant Science and Research 2015;5(12):29-35.
17. Sharma R, Bhardwaj S. Effect of mulching on soil and water conservation- A review. Agricultural Reviews 2017;38(4):311-315.
18. Singh N, Ahmed Z. Effect of mulching on potato production in high altitude cold arid zone of Ladakh. Potato Journal 2008;35(3-4):118-121.
19. Sinkeviciene A, Jodaugiene D, Pupaliene R, Urboniene M. The influence of organic mulches on soil properties and crop yield. Agronomy Research 2009;7:485-491.
20. Zhao H, Xiong YC, Feng M, Wang RY, Qiang SC, Yao TF. Plastic film mulch for half growing- season maximized WUE and yield of potato via moisture-temperature improvement in a semi arid agroecosystem. Agriculture Water Management 2012;104:68-78.