Benefits of Paddy Straw Management Technologies Used by Potato Growers in Jalandhar District of Punjab

ABSTRACT

This study was conducted in the Jalandhar district of Punjab in 2020-21, chosen purposefully due to its status as the region with the highest potato cultivation area. The list of potato growers was obtained from the District Horticulture Department in Jalandhar. Five blocks—Nakodar, Adampur, Bhogpur, Jalandhar East, and Jalandhar West—with the maximum potato cultivation area were selected from this list. A sample of 200 potato growers was then chosen using a proportionate cum random sampling method. Following the adoption of paddy straw management technologies, 52.5 per cent of potato growers reported a decrease in fertilization costs. Additionally, 37 per centobserved an improvement in soil health, while 40.5% noted an increase in potato yield. The majority of potato growers incorporated paddy straw into their potato fields. However, an equal percentage of growers (17 per cent) either used paddy straw to make bales or burned it. Notably, the adoption of paddy straw chopper, mulcher, and mould board plough by potato growers led to a significant increase in potato yield. Therefore, statistically significant differences were observed in all five technologies used for paddy straw management in potato cultivation.

Comment [A1]: Percent

Keywords: Paddy Straw, Potato,Benefits

1. INTRODUCTION

Potato (*Solanum tuberosum)* is a major vegetable crop which has 2.14 million hectares in India. Throughout the world, potato follows only rice and wheat as a food crop for human consumption. Cultivated potatoes have spread to 160 countries worldwide from the Andes of South America where they originated. When potato has become a staple in a rising number of people's diet, minor variations in potato nutritional composition can have significant impact on human health. It is a strong source of vitamin C, other vitamins and potassium. Many potato compounds contribute to antioxidant function, and growing interest in pigmented flesh cultivars. (Ellen *et al* 2009). Paddy straw management is a key issue to paddy farming in northwestern India (Punjab, Haryana, and Uttar Pradesh). Paddy straw is used as animal bedding and for the production of biogas, fodder, power and compost in states such as West Bengal, Gujarat, Maharashtra, Assam, Bihar, Tamil Nadu, and Jammu & Kashmir. (Lohan *et al* 2018)

In Punjab, cereal crops account for three-quarters of total residue output. According to research, 30-70 per cent of paddy residue is burned on fields. (Lohan *et al* 2018). On a local, regional, and global scale, burning agricultural biomass pollutes land, air, and water. The heat generated by the burning of straw enters the soil, causing moisture loss and the death of beneficial bacteria. The loss of 5.5 kg, 2.3 kg, 25 kg, 1.2 kg nitrogen, phosphorus, potassium, and sulphur, as well as organic carbon, is thought to occur when a tones of stubble is ignited. (Gupta *et al* 2004)

Comment [A2]: Sulphur

The total stubble burnt on the Punjab region as of 15 May 2005 was found to be about 4,315.35 km^2. Among these, Amritsar had 673.99 km^2 of burnt area followed by Jalandhar, Ludhiana, Firozpur and Patiala districts while Roopnagar had the least burnt area (41.36 km^2) (Ramesh *et al* 2016). According to reports, 51% of farmers burn paddy straw to save money, 48% for time savings and 48% for lack of machine availability, while 11% of farmers burn paddy straw for other reasons (Sidhu and Beri 2009).Approximately 20 million tons of paddy straw was produced in Punjab alone which was not relished by animals because of high silica content, due to which 80 per cent of paddy straw was burnt on the fields for its management. It was considered as useful method for the management of paddy straw from the

perspective of farmers. But with the burning of paddy straw on the fields, harmful gases were emitted which was one of the reasons for the environmental pollution. In addition to human and animal health hazards due to air pollution, it causes loss of vital components such as nitrogen, phosphorus, Sulphur and potassium from the top soil layer, making the land less fertile and unviable for agriculture in the long run (Kaur *et al*, 2021). There has been a lack of significant practical effort to measure the economic effects (such as increased yields and resource depletion and conservation levels). Such a lack of knowledge is perhaps the key reason, the farmers for poor adoption of the technologies, seriously threaten the sustainability of natural resources and economic viability of farming. (Singh *et al* 2010)

To solve the problem of burning, there were various alternative ways to manage paddy straw which were ecofriendly and also manages paddy straw at proper time without delaying in sowing operation of potato crop. Punjab Agricultural University recommended some alternate techniques such as Baler, Mulcher, Paddy straw chopper, Rotavator, Mould board plough. So it is crucial to study the economic and environmental benefits of paddy straw management technology in sixth largest Potato producing state in India i.e. Punjab.

Comment [A3]: *i.e.*

2. Material and methods

2.1 Study Area

The present study was conducted in Jalandhar district of Punjab. This district was selected purposively for the study as it has highest area (20438 ha) under potato cultivation.(Anonymous 2019)

2.2 Sampling and data collection

List of potato growers was obtained from the District Horticulture Department, Jalandhar. From that list five blocks Nakodar, Adampur, Bhogpur, Jalandhar East and Jalandhar West having maximum area under Potato cultivation were selected. From these five blocks a sample of 200 potato growers were selected by proportionate cum random sampling method.

2.3 Economic benefits

Benefit can be defined as something that produces good or helpful results or effects for paddy straw management in potato. Benefits can be classified in environmental and economical benefits. Paired t-test was used to find out whether the differences in cost of production and yield of potato due to adoption of paddy straw management technologies was significant. Satisfaction of sequence of technology obtained by dichotomous scale yes/no in terms of cost, performance, yield and quality. Expenditure was operationalized in term of total amount in Rs./acre spent on inputs after adoption of paddy straw management technologies in potato as compared to burning.

2.4 Environment benefits

Environment benefitswere referred as less air pollution, more fertile soil and more survival of beneficial insects. For changes in soil and microclimate, the responses were obtained through open ended.

3 Results and Discussion

3.1 Satisfaction of sequence of technology on the basis of cost, performance, yield and quality

SEQUENCE I

Table 1 revealed that the potato growers who were adopted sequence I as PAU super straw management system, paddy straw chopper, mould board plough and rotavator, 70.8 per cent potato growers satisfied in term of cost. All the potato growers were satisfied in term of the performance, yield and quality of produce with sequence 1 as this sequence is recommended by Punjab Agricultural University, Ludhiana.

SEQUENCE II

141 potato growers who were adopted sequence II with mulcher from managing paddy straw, 67.37 per cent of potato growers were satisfied with the cost of the sequence of technology and 97.87,100, per cent of potato growers were satisfied in term of performance, yield respectively and on the basis of quality of produce 99.92 per cent of potato growers were satisfied. This sequence is recommended by Punjab Agricultural University.

SEQUENCE III

Thirty four potato growers who were adopted sequence III as combine harvester, stubble shaver, rake, baler, 70.58, 58.82, per cent of potato growers were satisfied in term of cost, performance respectively and 52.94 per cent were satisfied with the yield of potato, 88.23 per cent of potato growers were satisfied with the quality of produce respectively. This sequence is recommended by Punjab Agricultural University.

Table 1: Distribution of potato growers according to the satisfaction of sequence of technology on the basis of cost, performance, yield and quality

S. no	Sequence	n	Satisfaction f*(%)			
			Cost	Performance	Yield	Quality
A	**PAU RECOMMENDED**					
1	PAU Super Straw Management System+ Paddy straw chopper + Mould Board plough + Rotavator	24	17 (70.8)	24 (100)	24 (100)	24 (100)
2	PAU super straw management system+ Mulcher + Mould board Plough + Rotavator	141	95 (67.37)	138 (97.87)	141 (100)	140 (99.92)
3	Combine harvester + Stubble shaver + Rake +Baler	34	24 (70.58)	20 (58.82)	18 (52.94)	30 (88.23)
	NON RECOMMENDED					
1	PAU Super Straw Management System + stubble shaver + Burning + Rotavator	34	13 (38.23)	12 (35.29)	11 (32.35)	11 (32.35)

(*Multiple Response)

SEQUENCE IV

Thirty four potato growers who were adopted sequence IV as PAU super straw management system, stubble shaver, burning and rotavator, 38.23 per cent of potato growers were satisfied with cost, 35.29 per cent of potato growers were satisfied with performance 32.35 per cent of potato growers were satisfied with yield and quality of produce respectively. This sequence is not recommended by Punjab Agricultural University.

3.2 Change in cost of production and yield of potato after the adoption of paddy straw management technologies by Potato growers.

The result as shown in Table 2 indicated that the t-values for the two tailed significance levels of difference between sample means for the response was 0.000 cost of production due to adoption of all the technologies by the potato growers. It showed that after the adoption of paddy straw management technologies by potato growers results in significantly increased in the cost of production. The results also indicated that for yield, the t - values for two tailed significance level of the difference between sample means for the response was 0.015 for baler, 0.327 for Rotavator and 0.000 for Paddy straw chopper, Mulcher, Mould board plough. The result shown that there was a significant increase in yield of potato after the adoption of paddy straw chopper, mulcher and mould board plough by potato growers. Thus, there were statistically significant differences observed in all five technologies used for paddy straw management in potato.

3.3 Change in expenditure on inputs used in Paddy straw management technologies in potato cultivation

Data in table 3 showed that the changed in expenditure used on inputs used in paddystraw management technologies in potato cultivation. 85 per cent of potato growers observed that increased in

the cost of preparation of land during used of paddy straw management technologies by Rs. 3035 because of high rate of diesel consumption.

Table 2: Paired t-test on change in cost of production and yield of potato after the adoption of paddy straw management technologies by Potato growers.

Paddy straw managing technology	n*	Cost of production (Rs./ha)					Yield (t/ha)				
		Mean	Difference		t-test	Sig (2-tailed)	Mean	Difference		t-test	Sig (2-tailed)
Baler	34	Before	2.102	1.502	8.736	.000	Before	5.023	3.683	2.565	.015
		After	3.605				After	8.707			
Paddy Straw chopper	24	Before	1.126		5.119	.000	Before	1.068	1.583	6.612	.000
		After	1.967	8.408			After	1.084			
Mulcher	137	Before	6.359		14.628	.000	Before	1.060	1.005	6.019	.000
		After	1.137	5.015			After	1.070			
Rotavator	195	Before	1.00		9.149	.000	Before	1.083	.074	1.000	.327
		After	1.622	6.22			After	1.184			
Mould board plough	163	Before	1.002		9.914	.000	Before	6.228	5.093	7.323	.000
		After	2.070	1.068			After	1.135			

*Number of potato growers adopted particular technology

Table 3: Distribution of potato growers on the basis of change in expenditure on inputs used in Paddy straw management technologies in Potato cultivation

S. no	Practices	n	Change in expenditure
1	Land preparation	170	+3035 Rs.
2	Fertilization	105	-1915 Rs
3	Number of Irrigation	14	-1 (unit)
4	Seed rate	0	0
5	Herbicides	15	+183.3 Rs
6	Pesticides	0	0

(n= Number of potato growers who observed change in their expenditure w.r.t. different practices)

52.5 per cent of potato growers reported that there was decreased in the cost of fertilization by Rs. 1915. The dose of fertilizer after adoption ofpaddy straw management technologies was observed to decreased by one or two bags of DAP. Only 7 per cent of potato growers observed that there was decreased in number of irrigation by 1 unit. There was observed that there was no change in seed rate and pesticide application after adoption of paddy straw management technologies. Only 7.5 per cent of potato growers observed that there was increased in cost of herbicides by Rs. 183.

Table 4: Distribution of potato growers on the basis of uses of paddy straw

n=200

Sr.	Uses	f* (%)
1	Incorporation	150(75)
2	Paralichar	10(5)
3	Giving to tribal people	7(3.5)
4	Burning	34(17)
5	Bales	34(17)
6	Storage	12(6)
7	Packaging	8(4)

(*Multiple Response)

3.4 Uses of paddy straw

Data in table 4 showed that the use of paddy straw taken by the potato growers. 75 per cent potato growers did the incorporation of paddy straw into the field of potato whereas equal per cent of potato growers such as 17 per cent used paddy straw as making bales and burnedthe paddy straw. 6 per cent and 4 per cent of potato growers used paddy straw as storage and packaging material. 3.5 per cent reveals that tribal people of that area picked the paddy straw from the field. 5 per cent of potato growers made Paralichar of paddy straw in the field. The finding are contradicted with Kaur (2020) that 22.96 per cent are aware about biogas plant.

3.5 Changes in soil and microclimate observed after using paddy straw management technologies in potato cultivation

Table 5: Distribution of potato growers according to changes in soil and microclimate observed after using paddy straw management technologies in potato cultivation

n=200

S. no	Changes	f*	Percentage
1	More fertile soil	74	37
2	Leveled land	11	5.5
3	Decrease in air pollution	53	26.5
4	Lesser number of irrigation in succeeding crop	16	8
5	Increased potato yield	81	40.5
6	Increased in population of beneficial insects	12	6

(*Multiple Response)

Table 5showed that the changes that were observed by the potato growers in their soil and

microclimate after using paddy straw management technologies in potato.The change in soil such as soil become fertile observed 37 percent potato growers. Only 5.5 percent respondents found that the soil become leveled after using these technologies and decrease in air pollution after the adoption of paddy straw management technologies in the potato filed observed by 26.5 percent potato growers. With non-burning of paddy straw in the potato field, the 6 percent potato growers observed that the beneficial insects which are important for the soil are survived in large amount as compared to burning of paddy straw. Eight percent potato growers observed that after using paddy straw management technologies in the potato field, there was decrease in number of irrigation in succeeding crop

4 Conclusion

Based on study, 200 potato growers of Jalandhar district of Punjab. It can be concluded that 52.5 per cent of the potato growers reported there was decrease in the cost of fertilization after adoption of paddy straw management in potato. Nearly one third of the potato growers observed that there was improvement in soil health and 40.5 per cent of potato growers observed in increased in potato yield.Majority of the potato growers did the incorporation of paddy straw in the field. There was a significant increase in yield of potato after the adoption of paddy straw chopper, mulcher and mould board plough by potato growers. Thus, there were statistically significant differences observed in all five technologies used for paddy straw management in potato.

REFERENCES

Kaur A (2016) *An economic assessment of conservation agricultural practices with special emphasis on happy seeder technology for rice-wheat system in Punjab*. Ph. D. dissertation, Punjab Agricultural University, Ludhiana, India

Kaur A (2020*) Problems and prospects of paddy straw management technologies in Bathinda district.*M.Sc thesis, Punjab Agricultural University, Ludhiana, India

Lohan S K, Jat H S, Yadav A K, Sidhu H S, Jat M L, Chaudhary M, Peter J K and Sharma P C (2018) Burning issues of paddy residue management in north-west states of India. *Renew SustEnerg Rev***81**:693-706.

Negi S C, Ramesh and Rana S S (2016) Resource conservation technologies (RCTs)-Needs and future prospects.*Indian J* **37**: 257-67.

Sidhu B S and Beri V (2009) Rice residue management: Farmer's perspective. *Ind J Air Poll Cont***8**: 22-34.

Sidhu S, Vatta K and Dhaliwal H S (2010) Conservation agriculture in Punjab-Economics implication of technology and ractices Ind. *J Agri Econ***65**:133-38

Ellen M, Kubow S and Donnelly D (2009) Potatoes and Human Health. *Critical Review Food Science Nutrition*, 49(10), 823-40.

Gupta N (2019) Paddy Residue Burning in Punjab Understanding Farmers Perspectives and Rural Air Pollution.Council on Energy, Environment and Water.

Anonymous (2019) Punjab burned 13% less paddy straw this year while Haryana jumped by 16%. Retrieved from http://www.indiatoday.in/on 24-03-2020