Effect of different sowing techniques on wheat in rice-wheat cropping system in Samba district, Jammu and Kashmir

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ABSTRACT

Super seeder offers the apparent advantage of timely sowing at reduced time, fuel, labour and drastic reduction in tillage intensity, resulting in significant cost savings as well as potential gains in yield through earlier sowing of wheat. The conventional sowing systems require well prepared fields. After the harvest of rice, field is prepared by 3-4 times tillage operations which consume enormous time, labour and energy besides causing delay in sowing with increased cost of cultivation. Super seeder technology is the most economical approach for handling paddy straw without burning it before sowing. In the present study, the performance of super seeder was tested against conventional method of seed sowing. The results showed that there was a saving of 63.55 per cent in sowing time in direct sowing by tractor-drawn super seeder over conventional method. The depth of sowing of seed by super seeder was found to be 5 cm compared to broadcasting method in which seed remained on top surface of the soil. Super seeder required 25.18 per cent less labour as compared to conventional method. Similarly, fuel consumed by the super seeder was 53.82 per cent less over conventional method. Operational cost and production cost was 33.33 and 16.26 per cent less respectively with the use of super seeder and net return was 22.73 per cent more. Use of super seeder resulted in 14.37 per cent more yield. Farmers who had adopted super seeder method in wheat production were interested to continue with this method of sowing in future.

Keywords: Super seeder; broadcasting; net return; economics; benefit-cost ratio; yield

INTRODUCTION

India is the second largest producer of wheat with a share of around 13.53 per cent of world total production. India produced 109.59 MT of wheat in an area of 31.13 Mha with productivity of 3,521 kg per ha in 2020-21 (Anon 2023). Rice-wheat cropping systems provide staple food to 15 per cent of the world's population (Ray et al 2012). The rice-wheat rotation is the principal cropping system in south Asian countries that occupy about 13.5 million hectares in the Indo-Gangetic plains, of which 10 million hectares are in India.

This cropping system is also very prevalent in Himachal Pradesh and Jammu and Kashmir (Mahajan and Gupta 2009). Delayed sowing due to presence of crop residue reduces crop yield of 30 to 40 kg per ha per day (Baranwall 1995) if crop is sown after mid-November. The delay of every successive day in planting beyond November third week decreases the grain yield progressively (Ali et al 2010). This loss can be saved through early and fast seeding of wheat using tractor-drawn super seeder compared to broadcasting method.

This technology is eco-friendly with environment for the health of soil; it also saves water (Pandhu 2021). Reduction of labour requirement has been the principal motivating force in agricultural mechanization. It is an essential agricultural input in India with the potential to transform the lives and

economies of millions of the rural population. Farm mechanization can facilitate increased output of higher value products and improve the way of life by eliminating the drudgery operations associated with human work in farming (Nikhade and Gunaki 2020). Proper sowing operation should be selected while growing a crop. The basic objective of sowing operation is to put the seed and fertilizer in rows at desired depth and spacing, cover the seeds with soil and provide proper compaction over the seed (Upadhyaya et al 2017).

Despite its importance, there have been issues over residue production and crop management in rice and wheat crops. Although paddy straw burning is a problem in several states, the most notable instances are in Punjab and Haryana (Verma 2019). Burning is the most common practice for managing rice crop residues mainly due to its simplicity, low cost, increased mechanical harvesting, short window between rice harvest and wheat sowing and lack of viable uses for residues. Around 50 MT of rice straw is burned annually, nearly half of which occurs in northwestern India during October/November (Kaur et al 2022). Crop residues incorporate a large number of nutrients in the soil for crop production and affect soil water movement, runoff and infiltration (Sarkar et al 2020). In order to overcome the problem of paddy straw burning, various machineries have been developed in the last decade, such as a straw baler, straw chopper-cum-spreader, zero drills, happy seeder, super seeder etc. In this direction, super seeder is the latest one that needs more popularization and adoption in farmers' fields.

Super seeder is used to sow wheat in the field with standing stubbles after harvesting the paddy crop. For the preparation of seedbed and sowing, no separate implement is required. All these operations along with straw management are done in a single operation. Super seeder consists of rotavator and zero till drill for managing the paddy straw and sowing of wheat. The rotavator cuts the standing stubbles and loses straw that are incorporated into the soil. Seed bed preparation and placement of the seeds takes place in the soil at a time. Super seeder is eco-friendly and it also conserves the soil moisture content (Ajay 2023).

The conventional tillage refers to the intensive tillage with multiple passes of a tractor to accomplish land preparation for wheat sowing. Farmers in Samba district have been rapidly adopting super seeder technology for wheat cultivation.

Hence, a study was carried out to investigate the economics of super seeder and conventional technology in Samba district of Jammu and Kashmir. The present study was undertaken with the objective of comparing the economics of wheat production with super seeder and conventional methods and quantifying the contribution of technology and inputs into the estimated productivity differences due to super seeder.

MATERIAL and METHODS

Present research study was conducted at farmers' fields in Ramgarh and Sadwal blocks of Samba district, Jammu and Kashmir. Experimental plots consisting of three treatments and five replicates were laid out in farmers' fields during 2021-22 and 2022-23. The treatments consisted of three sowing methods viz T_1 (Broadcasting method of seed sowing after three times use of tractor-drawn cultivator), T_2 (Broadcasting method of seed sowing after one time use of rotavator and cultivator) and T_3 (Direct sowing of seed by tractor-drawn super seeder).

The cost concept was considered for the estimation of cost of wheat production. Cost was taken into account to calculate net income and benefit-cost ratio. The cost included all direct expenses paid in cash for crop production such as hired human labour, seeds, fertilizers, plant protection measures, overhead charges and input value of family labour.

The cost of human labour and diesel were taken on actual expenditure basis. Gross income included the total value of main crop and its by-product. Net income was calculated as the difference between gross income and cost of production.

The thirteen-furrow, tractor-mounted super seeder was tested in the laboratory before taking it to the actual field condition. The seeds were passed through the grooves of the fluted roller to check the regularity of flow and damage. The line to line spacing of super seeder was kept at 22.5 cm. The machine was calibrated for 100 kg per ha seed in normal conditions. The calibration for fertilizer per hectare was also done.

All input and output parameters pertaining to wheat production were based on average values of two years with a view to minimize seasonal fluctuations in the variables.

The primary data on grain yield were collected from the beneficiary farmers of OFT and by personal interviews.

Total cost, gross return, net return and benefit-cost ratio were calculated as below:

Total cost = Total variable cost + total fixed cost

Gross return = Main product value + By-product value

Return over total cost (net return) = Gross return – Total cost

Benefit-cost ratio over total cost = Gross return/ Total cost

Regular visits were made by the Krishi Vigyan Kendra, Samba, Jammu and Kashmir scientists to OFT plots so as to ensure timely application of critical inputs and to solve other crop related problems.

RESULTS and DISCUSSION

Data given in Table 1 exhibit that the time taken with broadcasting method after three times use of tractor-drawn cultivator (T_1) and broadcasting method after one time use of rotavator and cultivator (T_2) was 10.70 and 9.80 h per ha respectively, whereas, it took only 3.90 h per ha with direct sowing by tractor-drawn super seeder (T_3). Thus there was a saving of 63.55 per cent in sowing time in T_3 over T_1.

The depth of sowing of seed by super seeder was found to be 5 cm compared to broadcasting method in which seed remained on top surface of the soil.

Labour requirement for sowing of wheat with super seeder was much less as compared to broadcasting method. The study showed that super seeder took only 39.80 h per ha as compared to 53.20 and 48.30 h per ha consumed in T_1 and T_2 respectively. Super seeder required 25.18 per cent less labour as compared to T_1.

Machine was required in T_3 only for 4.90 h per ha as against 10.80 and 8.90 h per ha in T_1 and T_2 respectively, thereby, reducing its requirement by 54.63 per cent in T_3 over T_1. Similarly, fuel consumed by the super seeder was 53.82 per cent less over T_1 as fuel required in T_3 was only 16.30 l as compared to 35.30 and 31.20 l per ha in T_1 and T_2 respectively.

Operational cost, production cost, net return and benefit-cost ratio in case of super seeder were Rs 6,000, 15,882 and 54,000 and 3.40 in T_3, whereas, these were Rs 9,000, 18,965 and 44,000 and 2.32 in case of T_1 and Rs 8,100, Rs 17,875 and Rs 45,500 and 2.41 in case of T_2 respectively. Operational cost and

Table 1. Average field performance for different treatments for sowing of wheat after harvesting of paddy crop in the study year

Component	Sowing method			Per cent change from T_1
	T_1	T_2	T_3	
Sowing time (h/ha)	10.70	9.80	3.90	– 63.55
Depth of sowing (cm)	Top surface of the soil	Top surface of the soil	5	-
Seed requirement (kg/ha)	100.00	100.00	80.00	– 20.00
Labour (h/ha)	53.20	48.30	39.80	– 25.18
Machine requirement (h/ha)	10.80	8.90	4.90	– 54.63
Fuel requirement (l/ha)	35.30	31.20	16.30	– 53.82
Operational cost (Rs/ha)	9,000	8,100	6,000	– 33.33
Production cost (Rs/ha)	18,965	17,875	15,882	– 16.26
Grain yield (q/ha)	41.27	42.78	47.20	14.37
Net return (Rs/ha)	44,000	45,550	54,000	22.73
Benefit-cost ratio	2.32	2.41	3.40	-

T_1 = Broadcasting method of seed sowing after three times use of tractor-drawn cultivator, T_2 = Broadcasting method of seed sowing after one time use of rotavator and cultivator, T_3 = Direct sowing of seed by tractor-drawn super seeder

production cost was 33.33 and 16.26 per cent less respectively in case of T_3 as compared to T_1 and net return was 22.73 per cent more. Use of super seeder resulted in 47.20 q per ha grain yield against 41.27 and 42.78 q per ha in case of T_1 and T_2 respectively. T_3 resulted in 14.37 per cent more yield as compared to T_1.

Earlier, Grover and Sharma (2023) reported that zero tillage method of wheat cultivation was economical and attractive option for farming community. The high grain yield and less cost of production per hectare were noted on zero tillage farms as compared to conventional farms. The adoption of zero tillage technology improves farmers' profit, improves their livelihood and eventually reduces poverty.

Verma et al (2017) reported that average yield in zero-tillage method was 24.42 q per ha over conventional sowing (22.08 q/ha). The B-C ratio was observed at higher side in zero-tillage method and it was 2.56 as compared to conventional method sowing of wheat (2.03). The additional wheat production from zero-tillage technology gave about Rs 6,732 per ha additional income.

Raju et al (2012) revealed that in case of wheat, both yield and net return were significantly higher in zero tillage by 5.54 and 24.72 per cent respectively. Similarly, use of human labour, machine labour and irrigation were saved by 13.93, 45.88 and 15.98 per cent respectively in zero tillage than conventional method of wheat production. Zero tillage technology enabled farmers to increase returns and save crucial inputs cost. Hence, this technology promises to be an important alternative for generating higher farm income and saving of scarce resources in resource-starved regions.

Murumkar et al (2015) in their study observed better results by wheat sowing using seed cum fertilizer drill over farmers practice and recorded higher yield. The field capacity, depth of sowing and yield was found to be 0.67 ha per h, 4 cm and 12.10 q per ha respectively compared to 0.50 ha per h, no depth and 6.13 q per ha respectively observed in case of conventional broadcasting method. The mechanized method of sowing resulted in 50 per cent more depth of sowing compared to broadcasting method. The tractor operated seed cum fertilizer drill was found to be better compared to traditional broadcasting method.

Pandit et al (2010) reported a net gain in zero tillage of Rs 4,670 per ha as compared to conventional tillage method. This gain was as a result of reduction in cost of cultivation by Rs 2,011 per ha and an increase in yield by 281 kg per ha. The zero tillage saved 30.95 per cent of human labour and 35.11 per cent of mechanical labour, besides saving 4.15 per cent time for ploughing, 4.32 per cent time for harrowing, 0.43 per cent time for leveling, about 74 kg plant nutrients (NPK) and 0.58 per cent irrigation.

The differences between the yield in two techniques could be due to the differnce in sowing time. In case of super seeder, sowing of the wheat is possible at optimum time of sowing but in case of conventional techniques sowing of the wheat is late due to the presennce of paddy straw in the field which causes reduction in the yield.

Farmers who had adopted super seeder method in wheat production were interested to continue with this method of sowing in future. According to farmers, super seeder method was good in terms of seed germination and yield of wheat than the conventional method. Sowing of wheat crop with it could be accomplished 15 to 20 days earlier than in conventional method. Super seeder considerably reduced the use of tractor and saved time and diesel in field preparation. Many farmers were deprived of wheat sowing by super seeder technique because of high demand and less availability of super seeder machines in the study area.

CONCLUSION

The super seeder technology proved profitable in terms of return, cost and time saving as compared to the conventional techniques of wheat sowing. The higher benefit-cost ratio (3.40) by the super seeder compared to the conventional technique (2.32) showed its importance.

From this study it was revealed that it is possible to save machine labour and irrigation water through super seeder than under conventional method. Due to resource saving, net return is significantly higher in super seeder technology. Hence, this technology is an important alternative to save scarce resources and enhance the net farm income of the farmers. The availability of super seeder needs to be accorded more attention to faster the adoption of this technology in wheat production.

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