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Happy seeder zero tillage equipment for sowing of wheat in standing rice stubbles

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Abstract

The present study was conducted to evaluate happy seeder zero tillage (HSZT) technology compared to conventional method (CM) for sowing of wheat crop during 2014-15 and 2015-16 in agro-ecological zone of Gujranwala. The data showed that HSZT produced maximum germination count (223; 205.36m^{-2}) followed by CM (167; 179m^{-2}). Significantly highest number of fertile tillers was recorded by HSZT (213 and 282.36m^{-2}) compared to CM (216 and 293m^{-2}). Highest thousand grain weight (g) were recorded by HSZT (37.19 and 39.81) followed by CM (32.61 & 35.61). Maximum yield was recorded by HSZT (3030 and 3920kgha^{-1}) compared to CM (2836 & 3478kgha^{-1}). HSZT gave maximum net income (Rs.112938ha^{-1}) with a CBR of 1:1.51 compared to CM with net income Rs.102602ha^{-1} with CBR 1:1.33. At the end it was concluded that happy seeder zero tillage is a good option for growers of rice tract as it ensures timely sowing of wheat crop in a single pass. On the other hand crop sown by HSZT is also less affected by rain/over irrigation. HSZT not only ensures maximum yield but also save fuel, energy, hence it is a most economical practice.

Keywords: Happy seeder zero tillage, Conventional Method, save energy; time; fuel; Economics, Gujranwala Punjab-Pakistan

Introduction

Wheat (*Triticum aestivum* L.) is a major edible food item and most important crop of rice-wheat system in Punjab-Pakistan. In rice-wheat cropping system late maturity of Basmati Super delayed the sowing of wheat. Sowing of wheat is further delayed due to pre-sowing irrigation followed by land preparation that takes more 7-10 days depending upon the prevailing climatic conditions. To overcome this problem different tillage operations are used that vary depending upon the soil types. In fine textured soils, 4-6 ploughing and planking operations are quite common resulted in higher energy utilization and delay sowing of wheat crop. Rice-wheat cropping pattern occupies 27.44 million hectares of developed soil in the Asian subtropics (Dawe et al., 2009). Therefore, a need was developed to optimize the energy usage by improving tillage practices and developing efficient tillage operations for sowing of wheat crop. Conservation tillage practice is attractive practice for farmers because of potential reduction in

production costs compared to conventional method (Botta *et. al*., 2006). Extending resource conserving technologies developed for wheat and rice remains a major challenge for the researchers and the farmer's (Chauhan *et. al.*, 2003). A diverse range of tillage systems are being practiced throughout the world (Gupta et al., 2002). This affects the distribution and location of crop residues left behind after harvest. Proper selection of the tillage system is highly dependent on the climatic conditions, soil properties, available fleet of the tillage machinery, In conventional method, there is a probability of obtaining higher crop yield; because of low working capacity of the tillage machinery and need for high-capacity tractors, costs of such tillage system was the highest (Erenstein et al., 2007 and 2008). In zero tillage system and happy seeder zero tillage technology, the costs of tillage is lower and the impact on the environment, soil, and biodiversity is positive. In direct sowing technology, the savings of fuel can be 20-25Lha^{-1}. Operational costs were minimum in ZT. Cost of production in hectare was recorded maximum in conventional tillage. Fuel consumption was found lowest in happy seeder zero tillage compared to conventional tillage. Happy seeder proved to be better compared to conventional tillage techniques (Grey et al. 1996). The main purposes of reduced tillage are to conserve soil environment, protect soil against wind and water erosion, fertilizers, and pesticides into water reservoirs, increase biodiversity, reduce fuel consumption, time saving, reduce the self-cost of the cultivated agricultural products (Fischer, 1994; Hobbs and Gupta, 2003). However decreasing tillage intensity can allow reducing number of tillage operations and thus the number of tractor and tillage implement trips over soil (Qaisrani et al., 2014). In application of the reduced tillage system, the amount of water conserved in the layer at a soil depth of 0-50 cm is by 1 to 32 m^{2}ha^{-1} greater than that in the soil treated by the conventional tillage method (Rusu et al. 2010). Therefore the present study had been planned to evaluate the happy seeder zero tillage equipment for sowing of wheat in standing rice stubbles during 2014-15 and 2015-16 in agro ecological zone of Gujranwala.

Advantages of HSZT

- Planting of wheat crop without land preparation in standing rice stubbles
- Uniform drilling of seed and fertilizer in single pass
- Conserve irrigation water
- Timely planting of wheat
- Chopped residue used as mulch
- Less weed infestation was recorded
- Enhanced soil fertility and micro-environment
- Low cost of production

Materials and Methods

The present study was conducted to evaluate happy seeder zero tillage (HSZT) technology compared to conventional method (CM) for sowing of wheat crop during 2014-15 and 2015-16 in agro-ecological zone of Gujranwala. Conventional sowing of wheat was done by broadcasting method after well prepared land and happy seeder zero tillage used after combine harvesting in standing residues of rice crop. In conventional methods, 2 ploughings with disc harrow followed by 1 planking and one ploughing with cultivator followed by planking while in HSZT for wheat sowing in a single pass. In HSZT the tines chopped the residues of flayal/harvested rice crop increased the productivity of the soil. The experiments were laid out in a randomized complete block design and replicated in different tehsils with a net plot size of an acre for each treatment. Wheat variety Faisalabad-2008 was sown during 2nd fortnight of November using a seed rate of 125 kgha^{-1}. Nitrogen (N) and Phosphorus (P) were applied at the rate of 125kgha^{-1} and 85kgha^{-1} respectively in the form of urea and diammonium phosphate (DAP). Half of the N and whole of P_2O_5 was applied at the time of sowing and the remaining half N was applied at 1st irrigation by broadcast method in both practices. The working time, fuel consumption, and costs used in the tillage and sowing systems, the working widths of the tillage was calculated. However the power tractor was used for operating HSZT. The direct and indirect costs were calculated however after analyzing these cost net return, net benefit and benefit cost ratio were calculated (Kahloon et. al., 2012).

Results and Discussion

Germination Count (GC m^{-2})

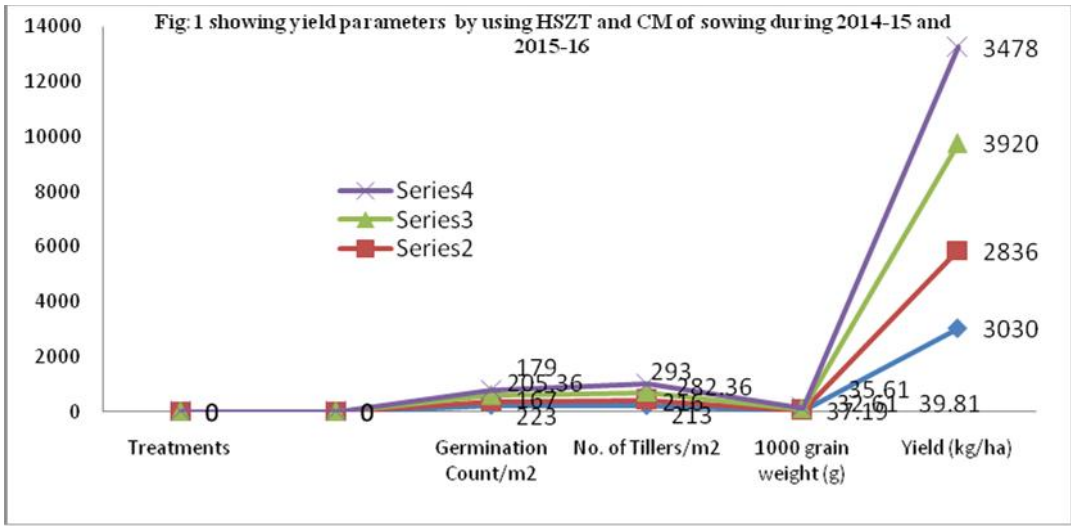
From Fig: 1, it is clear that HSZT showed significantly higher germination count (223 and 205.36) followed by broadcasting (167 and 179 m^{-2}) in both the years 2014-15 and 2015-16 respectively. Our results are in accordance to Zamir *et. al*., 2010 who gave maximum GC in zero tillage (192.47 to 194.60 m^{-2}).

Fertile Tillers (m^{-2})

Data in figure-I showed that HSZT produced significantly more fertile tillers (213; 282.36m^{-2}) compared to broadcasting (216; 293 m^{-2}). These results are contradictory to Abbas *et. al*., (2009) who reported that maximum tillers were recorded in broadcasting method. Targeted soil preparation was better with happy seeder zero tillage compared to broadcasting resulted in best nutrient uptake and finally higher number of fertile tillers. Lupton *et. al*., (1974) studied root growth of several cultivars of winter wheat and reported that better development of root gave better genetic makeup and ultimately produced maximum number of productive tillers.

1000 grain weight (g)

From the data in Fig:1, it is clear that during the year 2014-15 and 2015-16 maximum 1000 grain wt. was recorded (37.19 and 39.81) with HSZT which differ significantly from broadcasting (32.61 and 35.61g). This increase in 1000 grain weight was attributed due to better targeted soil preparation, root development and maximum uptake of nutrients. These results are in accordance to Zamir *et. al*., (2010); Soomro *et. al*., (2009), Nasrullah *et. al*., (2010) and Khan *et. al*., (2007).



Grain yield ($kgha^{-1}$)

The data showed that grain yield differ significantly from each other during both the years of study. The highest grain yield 3030$kgha^{-1}$ and 3920$kgha^{-1}$ were obtained in HSZT followed by broadcasting (2836 and 3478 $kgha^{-1}$). This increase in yield may be attributed due to good soil tilth and better resource utilization in better uptake of nutrients. Similar trend of results were obtained by Zamir *et. al*., (2010), Sharma *et. al*., (2008). Izumi *et. al*., (2004) and Merril *et. al*., (1996) those reported that better root development was resulted in better uptake of nutrient resulted in increase in crop productivity and ultimately yield. Similar trend in yield was also recorded by Naresh et. al., (2011). These results are in accordance to the Sidhu et., al., (2007) who reported that sowing of wheat with Happy Seeder tillage without burning of previous crop residues, eliminating air pollution and loss of nutrients and organic carbon due to burning, at the same as maintaining or increasing yield upto 10% compared to conventional method.

Table-1 showing yield (kg/ha) by HSZT and CM of sowing techniques during 2014-15 and 2015-16

Tillage Equipments	2014-15	2015-16	Mean Yield ($Kgha^{-1}$)	Total Income ($Rsha^{-1}$)	Total Cost ($Rsha^{-1}$)	Net benefit ($Rsha^{-1}$)	CBR
Conventional Method	2836	3478	3157	102602	77290	25312	1:1.33
Happy Seeder Zero Tillage	3030	3920	3475	112938	75000	37938	1:1.51

Wheat @Rs.1300 per 40kg or Rs.32.50 per kilogram

Economic Analysis

The economic analysis showed that HSZT is most economical technique compared to broadcasting. HSZT time and energy saving that ensure timely sowing of wheat and produced better yield. HSZT gave maximum net income (Rs.112938ha^{-1}) with CBR of 1:1.51 compared to broadcasting i.e. Rs. 102602ha^{-1} with CBR 1:1.33. These results are in accordance to Sharma *et. al.,* (2008). Li *et al.* (2004); (2005) and Kahloon et. al., (2012) who reported that conservation tillage can help to minimize environmental problems, improve crop productivity and increase the sustainability in rain-fed agriculture. These results are in accordance to Sidhu, et., al., (2007) who reported that the cost of establishment with the Happy Seeder (custom or contract hiring) is about half the cost of establishment using conventional practice.

Conclusion

Timely wheat cultivation is a major problematic issue in Rice-Wheat cropping pattern of agro-ecological zone of Gujranwala. Happy seeder zero tillage is a good option for growers of rice tract especially on clayey soil, as it ensures in time sowing of wheat crop. This equipment not only ensures maximum yield but also save fuel, energy, time of sowing, hence it is a most profitable practice.

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