

Wheat seed quality under conservation agriculture system

ASHWANI KUMAR*, ANIL KHIPPAL¹, RAM NIWAS YADAV AND
H. PRASHANTH BABU

Indian Agricultural Research Institute Regional Station, Karnal
ashakmash@gmail.com

ABSTRACT Wheat seed yield and seed quality was studied under conservation agriculture system consisting of six tillage combinations viz., RT-DSR-ZTW (Reduced till Direct seeded rice fb Zero tillage wheat), RT-DSR-ZTW-Sesbania, PUTPR (Puddled transplanted rice) - Reduced till wheat, PUTPR-Rotavator wheat, RT-DSR-ZTW+Rice residue and UPTPR (Unpuddled transplanted rice)-ZTW+Rice residue under rice-wheat cropping system at Krishi Vigyan Kendra, Kaithal in 2010-11 and 2011-12. Treatment RT-DSR-ZTW+Rice residue and UPTPR-ZTW+Rice residue performed significantly better than all other treatments for seed yield and seed quality attributes viz., standard germination, speed of germination, vigour index-I & II in 2010-11; these treatments have significantly outperformed PUTPR-Reduced till wheat and PUTPR-Rotavator wheat, the tillage techniques most commonly followed for seed production in wheat. The crop residues retained as surface mulch in RT-DSR-ZTW+Rice residue and UPTPR-ZTW+Rice residue would have helped in regulating the soil temperature, moisture and organic carbon in 2010-11. The greater yield response was mainly due to the cooler weather conditions during the grain filling period and all the treatments were at par for seed yield in 2011-12. Treatments RT-DSR-ZTW, RT-DSR-ZTW-Sesbania, RT-DSR-ZTW+Rice residue and UPTPR-ZTW+Rice residue performed significantly better than PUTPR-Reduced till wheat and PUTPR-Rotavator wheat for seed quality parameters except germination.

Key words: Wheat, zero tillage, rice residue, seed quality

Rice and wheat are grown in nearly 13.5 million ha of land in South Asia [1]. Under conservation tillage, a richer soil biota develops and improves nutrient recycling; it may also help combat crop pests and diseases [2]. Zero tillage (ZT) is an important conservation tillage practice, which allows early wheat sowing without land preparation, often with simultaneous basal fertilizer application, and involving only a single pass of a tractor. ZT is particularly useful on clay soils to minimize compaction, induce natural structure formation and produce ecological and economic benefits [3-4]. The future potential for productivity and long-term sustainability of irrigated wheat in rice-wheat cropping system is at risk due to the conventional tillage system. Therefore, technologies that reduce production costs, save water and improve seed yield, while

sustaining environmental quality have become more important.

Conservation tillage may be a viable option for better resource conservation. Crop residues are important natural resource in the stability of agricultural ecosystems. About 25 percent of N and P, 50 percent of S and 75 percent of K uptake by cereal crops can be retained in crop residues, making them valuable nutrient sources [5].

High quality seed lots may improve crop yield in two ways; first, because seedling emergence from the seedbed is rapid and uniform, leading to the production of vigorous plants, and second because percentage seedling emergence is high, so optimum plant population density could be achieved under a wide range of environmental condition [6]. These are the main reasons for farmers, who are interested to buy and cultivate vigorous seeds. Clearly, seed quality changes during seed

*Corresponding author

¹Indian Institute of Wheat & Barley Research, Karnal

Received: January 2013

Revised: September 2013

Accepted: November 2013

development and maturation with changing field conditions. Therefore, an effort was made to study the effect of various conservation agriculture techniques on seed yield and seed quality in wheat.

MATERIALS AND METHODS

Randomized block design (RBD) with three replications and plot size 20 x 10m was applied to lay out the experiment with six treatments *viz.*, Reduced till direct seeded rice followed by zero tillage wheat (RT-DSR-ZTW), Reduced till direct seeded rice followed by zero tillage wheat then green manuring by *Sesbania aculata* (RT-DSR-ZTW-*Sesbania*), Puddled transplanted rice (PUTPR)-Reduced till wheat, PUTPR-Rotavator wheat, RT-DSR-ZTW+Rice residue and Unpuddled transplanted rice (UPTPR)-ZTW+Rice residue under rice-wheat cropping system at Krishi Vigyan Kendra, Kaithal in 2010-11 and 2011-12. The experiment was started from rice crop followed by wheat. Rice crop was harvested at maturity. Wheat cv. DBW 17 was sown at field capacity moisture. At maturity, whole plot was harvested and threshed for seed yield data of wheat crop. Five samples of wheat seeds from each treatment replicated thrice were analyzed for seed quality parameters *viz.*, Germination (%), Speed of germination, Seedling length (cm), Vigour index I, Seedling dry wt. (g/10 seedlings), Vigour index II [7]. All the collected data were subjected to statistical analysis [8].

RESULTS AND DISCUSSION

Seed yield and quality parameters were significantly affected by tillage and residue treatments during 2010-11 but not in 2011-12. The experiments conducted across two years suggested the superiority of treatment RT-DSR-ZTW+Rice residue over other in terms of seed yield and quality parameters (Table 1 and 2). Even though it was not high for all the studied parameters across the years, for most of them it was significantly differing with other treatments in 2010-11.

Table 1. Seed quality parameters under various conservation agriculture treatments during 2010-11

Treatment	Seed Yield (q/ha)	Germination (%)	Speed of germination	Seedling length (cm)	Vigour index I	Seedling dry wt. (g/10 seedlings)	Vigour index II
RT-DSR- ZTW	40.00b	89.50b	34.31b	23.53bc	2106bc	0.276ab	24.70ab
RT-DSR-ZTW- <i>Sesbania</i>	41.80b	90.50a	34.41ab	24.31ab	2200ab	0.280ab	25.34a
RT-DSR-ZTW+ Rice residue	45.80a	90.00ab	34.44ab	24.07b	2166b	0.281a	25.29a
UPTPR-ZTW+ Rice residue	45.00a	90.50a	34.78a	24.77a	2242a	0.287a	25.97a
PUTPR-Reduced till wheat	39.20c	88.66b	32.83c	23.00c	2039c	0.259b	22.96b
PUTPR-Rotavator wheat	36.70d	85.33c	32.33d	22.43c	1914d	0.241b	20.57c
CD (p=0.05)	1.96	0.90	0.46	0.67	83	0.021	1.89

Table 2. Seed quality parameters under various conservation agriculture treatments during 2011-12

Treatment	Seed Yield (q/ha)	Germination (%)	Speed of germination	Seedling length (cm)	Vigour index I	Seedling dry wt. (g/10 seedlings)	Vigour index II
RT-DSR- ZTW	50.60	90.50	34.87a	25.23b	2283b	0.296bc	26.79c
RT-DSR-ZTW- Sesbania	50.20	92.50	34.71ab	25.82ab	2388a	0.320b	29.60b
RT-DSR-ZTW+ Rice residue	51.00	90.33	34.34b	26.08a	2356ab	0.341ab	30.80b
UPTPR-ZTW+ Rice residue	50.80	91.50	34.88a	25.87ab	2367ab	0.367a	33.58a
PUTPR-Reduced till wheat	50.00	90.66	33.87b	24.67bc	2237bc	0.289c	26.20c
PUTPR-Rotavator wheat	49.70	90.00	33.93b	24.23c	2181c	0.291c	26.19c
CD (p=0.05)	NS	NS	0.49	0.74	78	0.027	2.46

Seed yield

Seed yield is found to be the maximum in RT-DSR-ZTW+Rice residue and/or UPTPR-ZTW+Rice residue across all the two years of testing. In 2010-11, maximum seed yield was observed for RT-DSR-ZTW+Rice residue (45.80q/ha) followed by UPTPR-ZTW+Rice residue (45.50q/ha) with both the treatments showing their stability and on-parity for the trait. It was surprising to observe that seed yield was non-significantly differing and was much higher during second year of testing *i.e.*, 2011-12 (Fig. 1) due to the prolonged winter or cooler temperatures in the month of February and March (Grain growth period of wheat). Behl *et al.*, [9] also reported that high temperature (> 28°C) during grain filling stage is the single most important factor that limits productivity of wheat in India. The increase in temperature hastens the phenological development of crop, reduces total duration of crop growth, grain filling, and finally lowering grain yield and its quality [10]. In addition, both the above said treatments found to be at par as for as seed yield is concerned in both the seasons. It was also very interesting to note that, both the farmers practicing methods of cropping systems *viz.*, PUTPR-Reduced till wheat and PUTPR-Rotavator wheat noting lowest seed yields among all the tested treatments.

Seed quality parameters

Germination (%)

It was significantly affected by tillage and residue treatments during 2010-11 but not in 2011-12 (Fig. 2). As in the case of seed yield the germination percent was also observed to be highest in RT-DSR-ZTW+Rice residue followed by UPTPR-ZTW+Rice residue in first year of testing. Both the treatments showed on-parity with respect to the parameter under consideration. Here the percent germination was found to be maximum for RT-DSR-ZTW-Sesbania (92.50)

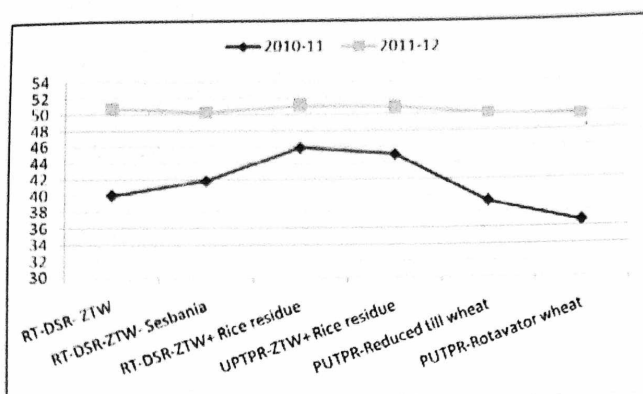


Fig. 1. Seed yield under various conservation agriculture treatments during 2010-11 and 2011-12

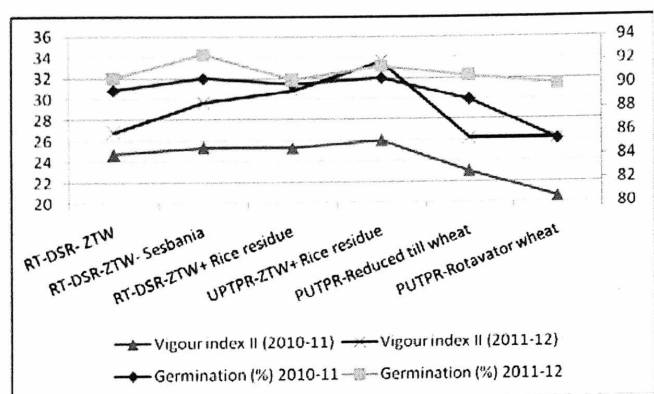


Fig. 2. Seed quality parameters under various conservation agriculture treatments during 2010-11 and 2011-12

followed by RT-DSR-ZTW+Rice residue (91.50). This adds to the knowledge of importance to be accorded to the green manuring crops. The percent germination was 90.50 for UPTPR-ZTW+Rice residue and 90.00 for RT-DSR-ZTW+Rice residue in 2010-11. The germination percent of PUTPR-Reduced till wheat and PUTPR-Rotavator wheat was very low compared to all other treatments.

Speed of Germination

The response of seeds to the hydration varies. This variation was in the initiation of germination or emergence. The seeds may start emerging on the first day or it requires some period for necessary adaptation. Such time requirement will be studied by determining the speed of germination on the basis of the day of starting the germination multiplied by suitable factors. Here in this

study, the treatments under consideration remarkably showed varied periods requirement for germination to start with significant differences among them. Very positively, treatment *viz.*, RT-DSR-ZTW+Rice residue, RT-DSR-ZTW-Sesbania and UPTPR-ZTW+Rice residue took relatively less number of days to germinate than other treatments followed generally by farmers. The Bartlett's germination rate indices also revealed the same trends as was in the case of other parameters.

Seed vigor indices

Commercial classification of the seed vigor index-I in the present study varied from the extremes of excellent (RT-DSR-ZTW-Sesbania-2388) and poor (PUTPR-Rotavator wheat-1914). In both seasons vigor index-I showed significant differences for the treatments. It was highest for RT-DSR-ZTW+Rice residue and RT-DSR-ZTW-Sesbania in first and second years of testing respectively. During 2011-12, the three treatments *viz.*, DSR-ZTW+Rice residue, UPTPR-ZTW+Rice residue and RT-DSR-ZTW-Sesbania were at par but in 2010-11 the treatment UPTPR-ZTW+Rice residue was significantly lower than DSR-ZTW+Rice residue and RT-DSR-ZTW-Sesbania. The lowest vigor index-I was observed for PUTPR-Reduced till wheat. In addition to vigor index-I, the assumption in Vigor index-II is that, it measures the dry matter accumulation rate of the normal seedlings. Seeds with better level of reserve macromolecules are assumed to have better rate of dry matter accumulation, so far as there is no dormancy problem. Vigor index-II, therefore, can be used as an indicative of the seed food reserve, which is very important in seed vigor. As in the case of vigor index-I, the treatments with rice residue and *Sesbania* over performed in comparison to farmers practicing systems. The treatments *viz.*, RT-DSR-ZTW+Rice residue, RT-DSR-ZTW-Sesbania and UPTPR-ZTW+Rice residue had

highest vigor index-II (Fig. 2), indicating the seeds produced in these systems having more vigor pro macro-molecules.

Treatments with zero tillage and rice residues gave better results for seed yield and quality because mulching with plant residues raises the minimum soil temperature in winter due to reduction in upward heat flux from soil and decreases soil temperature during summer due to shading effect and retention of crop residues on soil surface enhances infiltration. Residues act as reservoir for plant nutrients, prevent leaching of nutrients, increase cation exchange capacity (CEC), provide congenial environment for biological N fixation, increase microbial biomass and enhance activities of enzymes such as dehydrogenase and alkaline phosphatase [11] and [12].

The present study showed that seed yield and seed quality parameters are positively affected by the conservation agriculture treatments with residue retention and the environmental temperature during the crop growth period. Keeping in view the long term effects of conservation agriculture treatments, it is recommended that these findings may be further revalidated.

REFERENCES

1. GUPTA RK AND SETH A (2007). A review of resource conserving technologies for sustainable management of the rice-wheat cropping systems of the Indo-Gangetic plains (IGP). *Crop Prot* **26**: 436-47.
2. HOLLAND JM (2004). The environmental consequences of adopting conservation tillage in Europe: reviewing the evidence. *Agri Ecosys Env* **103**: 1-25.
3. McGARRY D, BRIDGE BJ AND RADFORD BJ (2000). Contrasting soil physical properties after zero and traditional tillage of an alluvial soil in the semi-arid subtropics. *Soil Tillage Res* **53**(2): 105-15.
4. KILICH AND GURSOYS (2010). Effect of seeding rate on yield and yield components of durum wheat cultivars in cotton-wheat cropping system. *Sci Res Essays* **5**(15): 2078-84.
5. SINGH Y (2003). Crop residue management in rice-wheat system, Addressing Resource Conservation Issues in rice-wheat systems of South Asia. A resource book, Rice wheat consortium for Indo-Gangatic Plains (CIMMYT).
6. GHASSEMI-GOLEZANI K AND MAZLOOMI-OSKOOYIR (2008). Effect of water supply on seed quality development in common bean (*Phaseolus vulgaris* var.). *Int J Pl Prod* **2**: 117-23.
7. ISTA (1999). International rules for seed testing. *Seed Sci Tech* (supplement) **27**: 1-335.
8. GOMEZ KA AND GOMEZ AA (1984). Statistical procedures for Agricultural Research. 2nd Edn., An IRRI Book, John Wiley & Sons, New York.
9. BEHL RK, SHEIKHS, ASSEFA M, JINDAL Y AND ASHWANI KUMAR (2010). Heat tolerance and adaptability in Bread Wheat (*Triticum aestivum* L. em. Thell) genotypes. In. Resource Management Towards Sustainable Agriculture and Development, Eds.: RK Behl, J Kubat and T Kleynhans, Agrobios, 2010, xxii, 358p.
10. SINGH NB, SINGH YP AND SINGH YPN (2005). Variation in physiological traits in promising wheat varieties under late sown conditions. *Ind J Pl Physio* **10**(2): 171-5.
11. IARI (2012). Crop residues management with conservation agriculture: Potential, constraints and policy needs. *Ind Agril Res Ins*, New Delhi, pp: 32.
12. PATHAK H, SAHARAWAT YS, GATHALA M AND LADHA JK (2011). Impact of resource-conserving technologies in the rice-wheat system. *Greenhouse Gas Sci. Technol* **1**: 261-77.