Comparative study of wheat genotypes of north eastern plains zone in zero tillage and surface seeding under rice-wheat system

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Abstract

Field experiments were conducted to assess the genetic potential of improved and promising wheat genotypes under different tillage options (zero and surface seeding), for their suitability to eastern and far-eastern parts of India. We concluded that in undulating areas where soil moisture is very high, cultivars NW 1014, Raj 3765, HUW 234 and HUW 468 performed better and gave higher yields when sown through surface seeding. Zero-tillage technology was found more useful than other tillage options, because it helped to advance wheat sowing by 10–15 days in otherwise late-sown areas, and cultivars such as DBW14 could be successfully cultivated under zero tillage conditions for late sown conditions and genotypes are PBW 343, CBW 38 and HUW 468 timely sown were found suitable, because they outyielded others. Genotypes which showed good grain yield, number of tillers, acceptable maturity, plant height, and 1000 grain weight compared to the others. These improved cultivars already are released in the region and many have been used in breeding programs as parents.

Keywords: Zero-tilage, surface seeding, wheat cultivars

Introduction

The holistic approach to produce ever greater amounts of food with strategies like high intensive inputs (water, nutrient, fuel etc.), extensive tillage and burning of previous crop residues have costing degradation of natural resources, reducing carbon sequestration and increasing in emission of green house gases (Reyonlds and Tuberosa, 2008). In view of this, conservation agriculture are expected to play more important role in meeting the future demands of food production with better resource use efficiency, less energy consumption and of course environmental preservation through the principles of minimum soil disturbance and residue retention on surface. Keeping in view the above facts and time factor in areas where rice-wheat cropping system prevails, it is of utmost importance to reduce the cost of production and cut in time period, which is required for land preparation under conventional tillage practices. The zero tillage and surface seeding are the two important conservation tillage practices by that cost of cultivation can be reduced by less fuel consumption in field preparation. Furthermore, wheat sowing can be advanced by 8-10 days (the time which is used for field preparation) which is required in areas under rice-wheat cropping system especially in north eastern plain zone, where wheat sowing is delayed because of late vacation of paddy field and excessive moisture. The North Eastern Plains Zone includes area of the eastern UP, Bihar, Jharkhand, West Bengal, Assam, and Orissa provinces. Although the yield potential of wheat in this part of country is about 4.5 tons per hectare but generally, farmers realize a yield of just 2.2 tons per hectare (Singh *et al*., 2009). The constraints to realize the potential yield and the effects of a rice-wheat cropping system on wheat production have been discussed (Shoran *et al.*, 2003). Wheat is grown during the winter but late receding of rains coupled with a delayed harvest of the preceding wet-season crops, such as rice force wheat to be sown late. It has been reported that wheat sown after November, reduces grain yield by 30 Kg ha^{-1} per day; whereas, the decrease after December is 50 Kg ha^{-1} per day (Singh *et al*., 2007). To advance wheat sowing and minimize losses, following surface seeding and zero-tillage technologies need to be practiced (Singh *et al.,* 2004 and Singh *et al.,* 2007) observed that root length and their weight showed significant difference due to genotypes and planting system at early growth stages of bread wheat. Significant differences existed among the genotypes for all early stage characters indicating that sufficient genetic variability exists to exercise early stage selection. Keeping above facts in the view, the present study was carried out with objective to evaluate the wheat genotypes to assess their genetic potential under different tillage options for their suitability to rice-wheat areas particularly in the eastern parts of the India.

Material and methods

Field experiments were conducted to assess the genetic potential of improved and promising wheat genotypes under different tillage options (zero and surface seeding). The experiments were planted during crop season 2010-11 and 2011-12 at Directorate of Wheat Research, Karnal located at 29°43'N latitude and 76°58' E longitude at an altitude of 245 meter above mean sea level for both the years. Here the climate is sub-tropical with mean maximum temperature ranging

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Table 1. Productivity of different wheat genotypes under zero tillage and surface seeding conditions

Genotype	Tillage conditions									
	Zero Tillage					Surface Seeding				
	Plant height (cm)	Spike length (cm)	1000 grain wt (g)	Total Biomass (q ha-1)	Grain yield (q ha-1)	Plant height (cm)	Spike length (cm)	1000 grain wt (g)	Total Biomass (q ha-1)	Grain yield (q ha-1)
CBW38	94.99	518.35	37.76	131.17	54.61	99.46	9.70	39.17	120.00	53.96
PBW343	94.55	516.65	38.50	129.87	56.01	93.46	11.94	42.92	104.00	45.58
RAJ3765	87.55	538.3	29.30	116.33	47.60	96.93	11.64	44.82	127.11	56.60
HUW468	94.11	506.65	37.97	109.75	54.23	99.60	11.84	39.26	140.00	56.04
HUW234	95.55	470.00	36.18	111.08	46.57	103.13	11.64	41.96	133.11	56.12
K9107	92.77	513.30	36.07	132.29	51.09	116.00	11.27	43.81	128.00	52.42
DBW39	87.44	495.00	37.01	118.75	51.89	92.46	10.62	43.57	123.33	52.94
NW1012	88.88	476.65	34.36	112.50	44.28	98.20	10.34	40.88	121.78	55.61
NW1014	87.77	480.00	36.28	120.83	50.39	111.06	10.54	40.05	139.55	59.39
K307	90.66	398.30	33.43	125.00	45.67	100.86	13.32	38.68	124.44	44.26
HW2045	82.77	448.3	37.28	110.42	47.52	101.60	13.23	42.56	125.33	54.34
HD2967	80.33	396.65	32.03	103.84	41.47	x	x	x	x	x
HD2733	88.88	478.35	36.20	125.42	49.21	x	x	x	x	x
DBW14	96.44	793.33	40.25	137.96	56.53	x	x	x	x	x
NW2036	94.11	498.35	38.12	121.88	52.81	x	x	x	x	x
Sonalika	x	x	x	x	x	104.73	11.36	47.57	120.66	55.34
CD=0.05	5.73	19.4	2.25	4.11	2.49	2.97	0.99	0.78	12.51	1.11

in between 34-39°C in summer and mean minimum temperature ranging in between 6-7°C in winter. During the crop season minimum and maximum temperature was ranges between 4.9°C and 39.6°C and 129.7 mm and 36.3 mm rainfall was received during 2010-11 and 2011-12, respectively. The soil of experimental field was sandy clay loam with pH 7.7 (1:2.5 soil to water). Initially soil had organic carbon, available nitrogen, available phosphorus and available potash were 0.38 per cent, 185 kilogram per hectare, 18.8 Kg ha^{-1} and 167.5 Kg ha^{-1}, respectively. Recommended dose of fertilizer (150:60:40 kg of N, P_2O_5 and K_2O ha^{-1}) were applied as part of nutrient management. The treatments consisted 15 wheat genotypes (Table 1) evaluated in a randomized block design (RBD) with three replications under zero tillage conditions, whereas a set of 12 genotypes presented in Table 2 were examined under surface seeding condition. The crop was sown on 28th and 7th November in 2010 and 2011, respectively and harvested on 28th April & 1st May in 2011 and 2012, respectively and standard recommended package of practices were followed to carry out the experiment.

Results and discussion

A perusal of data in Table 1 revealed that 'DBW 14' a late sown genotype resulted in significantly highest yield (56.53 q ha^{-1}) though at par with 'PBW 343' a timely sown genotype, CBW 38 and HUW 468 (56.01, 54.61 and 54.23 q ha^{-1}, respectively). Of all the varieties tested RAJ 3765 was earliest maturing type as it took less number of days to mature (days after sowing). Significantly better grain yield was recorded for DBW14 which was 15.06 quintal per hectare higher than genotype HD2967 which gave lowest yield (q ha^{-1}). *Singh et al.* (2009) also reported similar results and revealed that DBW 14 out yielded other varieties. For better grain yield, higher number of effective tillers and 1000-grain weight could possibly be the reason of highest yield of DBW 14 than other genotypes tested.

The results of surface seeding experiment indicated that genotype NW 1014 was the best performer (59.39 q ha^{-1}) under surface seeding conditions followed by Raj 3765 (56.60 q ha^{-1}) and HUW 234 (56.12 q ha^{-1}). Two genotypes, namely Sonalika and Raj 3765 had comparatively higher 1000-grain weight (47.57 and 44.82) thereby showing potential under surface seeding tillage conditions. For spike length, genotype K 307 (13.32 cm) and HW 2045 (13.23) were better than other genotypes. Similarly, NW 1014, HUW 234, K 9017 and HUW 468 genotypes recorded higher plant height and produced more biomass.

The present study showed that by adopting improved conservation agriculture technologies like zero tillage and surface seeding along with suitable cultivars, a higher wheat yield can be obtained the precious resources viz. money, fuel and time can be saved. It can be concluded that cv. DBW14 could be successfully cultivated under zero tillage conditions for late sown conditions and genotypes are PBW 343, CBW 38 and HUW 468 have potential under the similar production conditions for timely sown situations.

Similarly, the wheat genotype NW 1014, Raj 3765, HUW 234 and HUW 468, performed better and gave higher yields when sown under surface seeding. In addition to savings on tillage costs for timely and late-sown conditions, these technologies have the potential for higher productivity even in the areas where wheat sowings are delayed due to the late maturity of previous crops and excessive soil moisture conditions.

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