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WHEAT (*TRITICUM AESTIVUM* L.) CULTIVAR PERFORMANCE AND STABILITY AMONG VARIOUS TILLAGE METHODS IN WESTERN UTTAR PRADESH CONDITION

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ABSTRACT

A 2-year field study was conducted to evaluate the wheat cultivar performance and stability among various tillage methods. 7 tillage crop establishment methods (T_1-Zero till without residue, T_2-Zero till with residue, T_3-Wide raised beds without residue, T_4-Wide raised beds with residue, T_5-Narrow raised beds without residue, T_6-Narrow raised beds with residue T_7, Conventional tillage)in main plot and 10 wheat varieties treatments (V_1-UP 2338, V_2-WH 542,V_3 -PBW 154,V_4-DBW 17,V_5-WH 711,V_6-HD2687,V_7-PBW 343,V_8 –UP2382,V_9-HD1731,V_{10} -PBW 502) in sub plots were tested in SPD by using F test. The experimental findings revealed that T_6 measured maximum average plant height (92.15 cm), dry matter accumulation (141.5 g) and number of tillers (108/mrl). Moreover, T_4 were also noticed significantly higher yield attributes and yield *viz.,* number of grains per spike, spike length, numbers of spikelets per spike and test weight. Whereas, the improvement in average grain yield 11.3/10.9% due to residue retention on wide raised beds/narrow raised beds, respectively over T_7 during both the year. Likewise, DBW 17 noticed maximum growth; yield attributes and yields than rest of its counterparts. The study suggested that treatment T_4 along with suitable cultivars were the best combinations for maximizing the wheat yield.

INTRODUCTION

Wheat (*Triticumaestivum. L*) is the second most important cereal crop of India next to rice and accounts for 31.5% of the total food grain basket of the country and 40 % human population across globe. India produce 95.60 million tonnes wheat with productivity 31.23 from 30.61 m ha during 2013-14 (Ministry of Agriculture 2013).

Conservation agriculture based resource-conserving technologies (RCTs) include any new technologies (cultivars; reduced or minimal tillage; furrow irrigated raised bed, and crop management practices) that are more efficient, use less inputs, improve production and income, and attempt to overcome emerging problems (Gupta and Seth, 2007; Naresh *et al.,* 2008). RCTs involving no or minimum tillage with direct seeding, and innovations in residue management to avoid straw burning (Gupta *et al.,* 2003). Alternative methods have been proven effective to sustain soil health and reduce water demand in the wheat crop in different agro ecological regions by many scientists. But the application of these new tillage and crop establishment methods needs to be tested on a wider scale for water, labor, and energy efficiency (Naresh *et al.,* 2011).We believe that increased emphasis should be given to integrated approaches for agricultural development. There is a need to develop technologies and management practices that can simultaneously enhance production, preserve the natural resource base, and reduce poverty. In the open system of today, it is necessary to reduce the cost of production and to increase the productivity of wheat in order to compete in the international market. Moreover, in the recent years, it has been found that the conservation agriculture is feasible in India in which rows of wheat are planted on the top of the beds and irrigation is done through furrows, the system is better known as Furrow Irrigated Raised Bed (FIRB) planting system. This system permits reduction in cost of inputs i.e. seed, fertilizer and irrigation without reduction in wheat yields (Chauhan *et al.,* 2001).

It has been well established that the zero tillage system reduce the cost of cultivation due to single tractor pass (Chauhan *et al.,* 2000). The generally positive yield effects of zero tillage on wheat are mostly due to timely sowing and efficiency of increased input use and weed control (Mehla *et al.,* 2000). Higher yield of wheat can be obtained with zero tillage residue management practices over a period due to improved soil environment (Sharma *et al.,* 2005).The present investigation was therefore, undertaken to study the effect of different tillage and crop residue management practices on growth and yield of wheat cultivars and to identify alternative tillage systems to conventional sowing of wheat.

MATERIALS AND METHODS

The field experiments were carried out at the Crop Research

Centre of Sardar Vallabhbhai Patel University of Agriculture &Technology, Meerut (U.P.) located at 29^0 04',N latitude and 77^0 42' 'E longitude at an altitude of 237 meters above the mean sea level during *rabi*2011-12 and 2012-13 at a same site in both the years. The region is characterized by a sub-tropical and semi-arid climate with a hot dry summer (March–June), wet monsoon season (late June–mid September) and a cool, dry winter (Oct.–Feb.). Average annual rainfall is 726 mm (constituting 44% of pan evaporation) of which about 80% is received during the monsoon. The soil of experimental field was sandy loam in texture consisting of 642 g kg^{-1} sand, 185 g kg^{-1} silt and 173 g kg^{-1} clay. According to FAO classification, soil was deep alluvial fine sandy mix developed under a hypothermic regime (Typic Ustochrept).The soil samples taken from 0 to 15 cm depth were analyzed and the pH of the soil was 8.0,organic carbon 4 gkg^{-1},olsen P 14.1mg^{-1}and available K 90.6 mg kg^{-1} of soil. The treatments consists of seven tillage crop establishment methods (T_1-Zero till without residue, T_2-Zero till with residue, T_3-Wide raised beds without residue, T_4-Wide raised beds with residue, T_5-Narrow raised beds without residue, T_6-Narrow raised beds with residue T_7, Conventional tillage)in main plot and ten wheat varieties treatments (V_1-UP 2338, V_2-WH 542,V_3 -PBW 154,V_4-DBW 17,V_5 -WH 711,V_6 -HD2687,V_7-PBW 343,V_8 –UP2382,V_9 -HD1731,V_{10} -PBW 502)in sub plots. Zero Tillage without residue-T_1, Zero tillage with residue-T_2, Wide raised beds without residue-T_3, Wide raised beds with residue-T_4, Narrow raised beds without residue-T_5, Narrow raised beds with residue-T_6, Conventional tillage-T_7. The study was made in split plot design with three replications. Half dose of N and full dose of P and K through urea, single super phosphate and muriatic of potash, respectively, were applied at sowing and remaining half N was applied at first irrigation. Wheat was sown on 30th November and 27th November 2011 and 2012 and harvested on 12 April and 9 April, in 2012and 2013,respectively.Other management practices were adopted as per recommendations of the crop under irrigated conditions. Growth parameters and yield attributes were recorded at harvest stage. The yield was estimated by the produce obtained from net plot area, treatment wise and finally expressed at 14 % moisture. Two years data was statistically analyzed.

RESULTS AND DISCUSSION

Growth attributes

Maximum plant height influenced significantly due to tillage crop establishment treatments (Table 1). The maximum height (92.6 and 91.7 cm.) was obtained under T_6 treatment, while the lowest one (80.3 and 79.5 cm.) from T_1 treatment.Result revealed that the effect of varieties on the plant height was statistically significant. Higher plant height (92.0 and 91.0 cm.)) was obtained from PBW 502 and lower was HD1731 (79.7 and 78.9 cm.) during both the years respectively.The plant growth was affected significantly with the residue retained due to improvement in moisture supply. Similar result was observed by Bohra *et al.* (2005)

Higher number of tillers per plant was recorded in all those crop tillage establishment with residue retained treatments where moisture supply was more. Number of tillers per plant were significantly higher (113.6) and (111.2) under T_4 treatment as compared to T_1 treatment during both the years, respectively. As regarding to varieties the V_4 produce (110.8 and 109.3) higher numberof tillers per unit area as compared to the other varieties, while the minimum number of tillers was in V_9 (95.0 and 94.0) in 2011-12 and 2012-13. Similar trends in number of tillers were also observed in wheat Phogat *et al.* (2007)and Mollah *et al.* (2009)

Dry matter accumulation meter^{-1} row length under all the treatments (sowing on raised beds with residue) at every stage of crop, successive improvement in moisture supply brought about significantly increase in dry matter accumulation over conventional tillage in both the years. Maximum dry matter accumulation (148.15 and 146.46g) was obtained under T_4 treatment and minimum (123.87 and 120.43g) under T_7 treatment during both the years.In respect of variety V_4 produce maximum 148.6 and 146.52 g dry matter accumulation meter^{-1}row length and lower (115.72 and 114.04) in V_9. The grain yield per plant improved with increased moisture supply and good genetic character.Similar result was also observed by Mollah (2009) and Hussain (2011)

Yield attributes

In the present experiment, the wide raised beds with residue (T_4) observed taller spike length than other tillage methods during both the years(Table 1). There was 19.6 per cent decrease in the spike length under zero tillage without residue (T_1) as compared to wide raised beds with residue (T_4) in the first year and 25.5 per cent decrease in the second year. Though, variety DBW-17 was measured significantly higher spike length than rest of its counterparts and lowest spike length was observed in variety U. P 2382.Similar result was also observed by Sharma *et al.* (2005) and Ali *et al.* (2012). Moreover,

The number of spike lets per spike was lower in zero tillage without residue (T_1) as compared to wide raised beds with residue (T_4). The zero tillage without residue (T_1) plots produced 26.7 % lesser number of spike lets per spike compared to wide raised beds with residue (T_4) during both of the years, respectively. Moreover among the variety DBW-17 showed its superiority to achieved maximum spike lets per spike as compared to other variety and variety U. P 2382 again give poor performance in all of variety. It may be due to good genetic character of the variety, besides better performance at early stage of the plant. This result was similar as Rahman *et al.* (2010) and Arya *et al.* (2013)

The more number of grains per spike were because of significant increase in spike length and number of spikelet per spike.In the present experiment, the zero tillage without residue (T_1) plots produced 18.9 % less number of grains per spike than wide raised beds with residue in the first year and 13.6 % less in the second year. Fahong *et al.* (2004) and Rahman *et al.* (2010) reported similar results. While, DBW 17 show a similar trends as shown above while U. P 2382 noticed least number of grains per spike as compared to other treatments.

The finding of experiment indicated the test weight was 20.8 %higher in wide raised beds with residue (T_4) than conventional tillage (T_7) in the first year. While, in second year; the test weight was 20.6 % lower in conventional tillage

Table 1: Effect of variety and tillage method on growth and yield attributes

Treatment	Plant height	Number of tillers		Dry matter accumulation		No. of grains spike^{-1}		Test weight (g)		Spike length (cm)			No. of spikelet spike^{-1}	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
Tillage crop establishment														
T1	80.3	79.5	94.1	93.6	124.03	122.98	38.9	38.8	38.38	37.90	7.8	7.0	10.66	9.97
T2	86.8	85.9	103.2	102.6	133.94	131.49	43.0	41.5	40.16	39.28	9.0	8.5	13.11	12.49
T3	85.6	84.7	102.4	101.2	130.98	129.88	44.8	42.8	40.55	40.05	9.1	8.8	13.53	12.65
T4	90.1	89.2	113.6	111.2	148.15	146.46	48.0	44.9	42.57	41.40	9.7	9.4	14.55	13.61
T5	88.5	87.6	100.9	99.8	129.09	127.56	42.3	41.0	39.64	38.77	8.6	8.1	13.00	12.16
T6	92.6	91.7	108.9	107.1	142.40	140.72	46.0	43.6	41.07	40.41	9.5	8.9	13.78	12.88
T7	83.4	82.5	97.4	96.8	123.87	120.43	40.4	40.3	37.75	37.40	8.4	7.8	11.69	10.93
S.Em ±	1.32	1.31	1.38	1.06	1.71	1.54	0.66	0.60	0.22	0.21	0.10	0.05	0.23	0.22
CD at 5%	4.11	4.07	4.33	3.31	5.34	4.79	2.00	1.86	0.67	0.66	0.31	0.17	0.72	0.68
Varieties														
V_1	87.5	86.6	105.8	104.7	138.74	136.82	45.1	43.5	40.35	39.64	9.2	8.7	13.75	12.89
V_2	90.3	89.4	102.0	101.0	134.16	132.33	42.9	41.7	39.93	39.23	8.9	8.4	12.94	12.12
V_3	87.1	86.2	103.9	102.9	135.59	133.72	43.8	42.6	40.07	39.37	9.0	8.5	13.41	12.57
V_4	91.3	90.3	110.8	109.3	148.56	146.52	47.1	45.3	40.78	40.07	9.5	9.0	14.23	13.34
V_5	81.1	80.3	97.1	96.1	121.39	119.63	41.6	41.7	39.38	38.69	8.5	8.1	12.25	11.48
V_6	86.2	85.4	101.4	100.4	132.29	130.46	41.6	38.4	40.04	39.34	8.4	7.9	12.05	11.30
V_7	89.4	88.5	108.0	106.3	143.05	141.07	46.3	44.7	40.54	39.83	9.4	8.8	14.00	13.12
V_8	82.9	82.1	100.1	99.1	124.76	123.03	40.4	38.8	39.85	39.15	8.1	7.4	11.31	10.61
V_9	79.7	78.9	95.0	94.0	115.72	114.04	40.6	39.3	38.99	38.31	8.3	7.9	11.93	11.18
V_{10}	92.0	91.0	105.1	104.0	137.83	135.96	44.0	42.8	40.24	39.53	9.2	8.6	13.20	12.37
S.Em ±	1.58	1.56	1.21	1.19	1.24	1.22	0.80	0.75	0.15	0.15	0.12	0.11	0.33	0.31
CD at 5%	4.42	4.37	3.40	3.33	3.46	3.42	2.24	2.09	0.42	0.41	0.34	0.30	0.93	0.87

Table 2: Effect of variety and tillage method on yields and harvest index of wheat

Treatment	Grain yield (q ha^{-1})		Straw Yield (q ha^{-1})		Harvest Index (%)	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
Tillage crop establishment						
T1	38.36	38.24	49.65	49.51	43.6	43.6
T2	39.65	39.31	53.13	53.04	42.7	42.6
T3	41.94	41.68	52.58	52.25	44.4	44.4
T4	43.24	42.93	56.72	56.27	43.3	43.3
T5	41.77	41.55	52.12	51.50	44.5	44.7
T6	42.81	42.50	54.33	53.95	44.1	44.1
T7	38.14	38.07	49.12	48.96	43.7	43.7
S.Em±	0.32	0.31	0.54	0.51	-	-
CD at 5%	0.99	0.98	1.67	1.60	-	-
Varieties						
V1	41.70	41.45	53.87	53.26	43.6	43.8
V2	40.55	40.31	52.09	51.97	43.8	43.7
V3	40.89	40.65	52.27	52.08	43.9	43.8
V4	43.62	43.35	55.96	55.58	43.8	43.8
V5	40.21	40.09	50.31	50.25	44.4	44.4
V6	39.91	39.66	51.77	51.51	43.5	43.5
V7	43.08	42.82	54.36	53.85	44.2	44.3
V8	38.30	38.19	51.23	51.05	42.8	42.8
V9	38.94	38.57	49.79	49.99	43.9	43.6
V10	41.27	41.01	53.55	53.15	43.5	43.6
S.Em±	0.50	0.50	0.56	0.56	-	-
CD at 5%	1.41	1.40	1.57	1.56	-	-

(T_7) than wide raised beds with residue. Sharma *et al.* (2005) and Mollah *et al.* (2009) confirmed that the test weight was higher in wide raised beds with residue (T_4) than conventional tillage (T_7). Among the variety, DBW 17 was measured significantly higher spike length than rest of its counterparts. WhileU. P 2382 noticed least number of grains per spike as compared to other treatments.

Yields

The highest grain yield (43.24 and 42.93 q ha^{-1}) was found to be under T-$_4$ treatment during 2011-12 and 2012-13, respectively (Table 1). whereas, lowest yield (38.14 and 38.07 q ha^{-1}) was under T_7 (conventional tillage) treatment during both the years. In varieties highest grain yield (43.62 and 43.35 q ha^{-1}) was produce by $V_4$and lowed 38.30 and 38.19 q ha^{-1}) by V_8.The grain yield per plant improved with increased moisture supply mainly through improvement number of grains per spike, number of spikelet per spike and test weight. Similar trend was observed by Sharma *et al.,* (2003) and Naresh *et al.* (2012)

Highest straw yield (56.72 and 56.27 q ha^{-1})was recorded under wide raised beds (T_4) over remaining treatments. The lowest (38.14 and 38.07 q ha^{-1}) straw yield was produce under treatment T_7.On the other hand variety V_4 and V_9 produce higher (55.96 and 55.58 q ha^{-1}) and lower (49.79 and 49.99 q ha^{-1}) straw yield, respectively during 2011-12 and 2012-13. The increased in the straw yields of crop could be attributed to the significant effect of moisture supply on the vegetative growth of the crop plant. Vegetative growth was vigorous with more number of tillers in residue retained plots. Similar finding was observed by Mollah *et al.* (2009)

No definite trend with respect to the effect of tillage crop establishment on harvest index was observed. However, the highest harvest index (44.4 and 44.7 %) was obtained under T_6 treatment and lowest (42.7 and 42.6 %) under T_2 treatment In respect of variety V_5 show numerically higher (44.4 and 44.4 %) harvest index compared to all of varieties and lower (42.8 and 42.8 %) underV_7 in both the years, respectively. Similar finding was observed by Meena *et al.* (2013)

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