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Effect of Sowing Methods on Growth and Yield of Wheat (*Triticum Aestivum* L.) Through Zero and Other Tillage Method

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Abstract: The study was carried out during the year 2017-18 to check the effect of sowing methods on growth and yield of wheat (*Triticum aestivum* L.) through zero and other tillage methods, variety Sunheri was sown through different sowing methods. Randomized complete block design (RCBD) was used with three treatments T_1 = Drilling zero tillage, T_2 = broadcasting after tillage and T_3 = drilling after tillage. The experiment was replicated three times. The observations were recorded on plant height (cm), tillers m^{-2}, spike length (cm), spiklets $spike^{-1}$, grains $spike^{-1}$, seed index (1000-grain wt., g), biological yield (kg ha^{-1}) and grain yield (kg ha^{-1}). The results of the study summarized that the wheat variety sown by drilling (after tillage) showed remarkably superior performance with 81.03 cm plant height, 452.67 tillers m^{-2}, 14.46 cm spike length, 17.33 spikelets $spike^{-1}$, 45.33 grains $spike^{-1}$, 50.66 g seed index (1000-grain weight), 6866.7 kg ha^{-1} biological yield and 3595.50 kg ha^{-1} grain yield. Drilling after tillage was followed by sowing method broadcasting after tillage with 77.06 cm plant height, 313.33 tillers m^{-2}, 9.26 cm spike length, 14.66 spikelets $spike^{-1}$, 36.00 grains $spike^{-1}$, 40.00 g seed index (1000-grain weight), 6533.3 kg ha^{-1} biological yield and 3060.0 kg ha^{-1} grain yield. On the other hand drilling with zero tillage sowing method showed small 76.10 cm plant height less number of 320.67 tillers m^{-2}, 8.00 cm spike length, 12.00 spikelets $spike^{-1}$, 33.66 grains $spike^{-1}$, 36.00 g seed index (1000-grain weight), 6500.0 kg ha^{-1} biological yield and 3071.7 kg ha^{-1} grain yield. It is concluded that the crop sown by drilling after tillage produced more grain yield of 3595.50 kg ha^{-1} as compared to drilled with zero tillage 3071.7 kg ha^{-1} and broadcasted after tillage (3060.0 kg ha^{-1}).

Keywords: Wheat Variety, Sowing Methods Effect, Growth and Yield, Zero and Other Tillage Method

1. Introduction

Wheat (*Triticum aestivum* L.), is an annual, self-pollinated and photo periodically long day plant. It belongs to poaceae family, tribe hardene and genus tritium. It is most important cereal crop for the majority of world's populations and staple food of about two billion people (36% of the world population). Wheat is an important and richest source

of protein and energy [1]. Despite higher yield potential, average yield in Pakistan is much less than most countries of the world. Wheat covers 37% of total cultivated area and shares 70% of Rabi area in Pakistan. In Pakistan, wheat occupies 9.0 million hectares and produces 25.7 million tons annually with a standard harvest of 2845 kg ha^{-1} [2]. In Pakistan it is being eaten throughout the country three times a day. Though grown under a wide range of climates and soils, wheat is best adapted to temperate regions with rainfall between 30 and 90 cm. Therefore, today wheat is grown all over the world, with different varieties sown according to the various climates. Wheat producing regions/countries are China, India, United States, Russian Federation, France, Australia, Germany, Ukraine, Canada, Turkey, Pakistan, Argentina, Kazakhstan and United Kingdom.). It is the staple food for the people of Pakistan and meets the major dietary requirements, supplies about 60% of the calories and protein of the average diet [3]. Like other field crops, wheat responds differently to various agro-management practices especially planting methods. Sindh province is a major contributor of wheat after Punjab in Pakistan where most of the area under wheat comes after cotton crop. Therefore, wheat sowing under cotton-wheat cropping system is delayed which causes significant yield reduction. Usually low yields are obtained by conventional methods of wheat planting. Wheat cultivation by drilling on raised beds has been investigated for its suitability in cotton-wheat cropping system [4] and obtained better grain yields over flat beds and broadcast seeding. The use of drilling on raised beds for wheat production facilitates double-cropping and offer significant advantages in controlling soil moisture, both irrigation and drainage, and are amendable to narrow row spacing as compared to rest sowing methods [5]. The [6] concluded from a field experiment in Uttar Pradesh, India, that in wheat, strip drilling resulted in higher growth and grain yield (5.67 t ha^{-1}), followed by zero tillage drilling, conventional sowing and bed planting. The broadcast sowing generally gave lower yield than sowing in rows [7]. Zero tillage (ZT) improves environmental quality owing to less greenhouse gas emissions and air pollution made possible by the reduced use of diesel fuel and stoppage of burning of residues (when planting could be done into surface mulch). In many agricultural regions it can reduce or eliminate soil erosion. It increases the amount and variety of life in and on the soil, including disease-causing organisms and disease organisms. The most powerful benefit of zero tillage is improvement in soil biological fertility, making soils more resilient. Farm operations are made much more efficient, particularly improved time of sowing and better traffic ability of farm operations. Tillage remains relevant in agriculture today, but the success of zero tillage methods in many contexts keeps farmers aware that multiple options exist. In some cases low-till methods combine aspects of till and zero tillage methods. For example, some approaches may use a limited amount of shallow disc harrowing but no plowing. Reducing fuel, labor, and equipment costs are the most quantifiable benefits of not doing any tillage. Improved soil structure is another big benefit. Tillage disrupts the natural structure of soil and releases some of the carbon soil organisms thrive on. Soil biology plays an important role in providing crops with the water and nutrients they need. Wheat can produce optimum yield with row spacing and N application methods interaction with zero tillage [8]. No-till farming or zero tillage or direct drilling is a way of growing crops or pasture from year to year without disturbing the soil through tillage. Zero tillage is an agricultural technique, which increases the amount of water that infiltrates into the soil and increases organic matter retention and cycling of nutrients in the soil. It refers to the arable land on which no tillage is applied between harvests and sowing or a minimum tillage practice in which the crop is sown directly into soil not tilled since the harvest of the previous crop.

2. Materials and Methods

The experiment was conducted at the experimental fields of Agriculture Research Institute Usta Muhammad, Jaffarabad, and Balochistan during Rabi 2017-18. The treatment details were as under:

Experimental design = Randomized complete block design (RCBD)

Replications = Three, Net plot size = 6 m x 5 m (30 m^{-2}), Variety = Sunher

Treatments (Sowing methods) = 03

T_1 = Drilling (zero tillage), T_2 = Drilling (after tillage), T_3 = Broadcasting (after tillage)

Observations recorded:

1. Plant height (cm)
2. Tillers per meter sequere (m^{-2})
3. Spike length (cm)
4. Spiklets $spike^{-1}$
5. Grains $spike^{-1}$
6. Seed index (1000-grain wt., g)
7. Biological yield (kg ha^{-1})
8. Grain yield (kg ha^{-1})

Statistical Analysis

The data was subjected to statistical analysis using MSTAT-C. The LSD test was applied to compare treatments superiority, where necessary (Russel and Eisemsmith, 1983).

3. Results

The study was carried out during the year 2017-18 to check the effect of sowing methods on the growth and yield of wheat (*Triticum aestivum* L.) variety Sunheri at the experimental field of Agriculture Research Institute, Usta Muhammad Jaffarabad-Balochistan, during Rab, 2017-18. The observations were recorded on plant height (cm), tillers per meter sequere (m^{-2}), spike length (cm), spiklets $spike^{-1}$, grains $spike^{-1}$, seed index (1000-grain wt., g), biological yield (kg ha^{-1}) and grain yield (kg ha^{-1}) were recorded for analysis. The data on the above parameters are presented in Tables 1-8 and analysis of variance as Appendix I-VII.

3.1. Plant Height (cm)

The results regarding the plant height of wheat variety Sunheri as influenced by different sowing methods are presented in Table 1. The analysis of variance (Appendix-) suggested significant (P<0.05) influence of sowing methods on the plant height of wheat. It is evident from the results that the wheat plants grew tallest (81.03 cm) when the crop was sown under T_2 = Drilling (after tillage), T_2 = followed by broadcasting (after tillage) with 77.06 cm plant height. However, the minimum plant height (76.10 cm) was observed with T_1 drilling (zero tillage). It was found that drilling (after tillage) was optimum level for wheat so far the plant height (cm). The LSD test demonstrated that the differences in plant height (cm) different sowing methods were significant (P<0.05).

Table 1. *Plant height (cm) of wheat variety as affected by various sowing methods.*

Treatmentsi	R-I	R-II	R-III	Mean
T_1 = Drilling (zero tillage)	76.2	75.9	76.2	76.10 B
T_2 = Drilling (after tillage)	80.6	81.3	81.2	81.03 A
T_3 = Broadcasting (after tillage)	77.2	76.4	77.6	77.06 B

S. E.±	0.3528
LSD 0.05	0.9794

3.2. Number of Tillers Per Meter Sequere (m^{-2})

The results in regards to tillers m^{-2} wheat variety Sunheri as affected by different sowing methods are presented in Table 2 and its analysis of variance as Appendix-I. The analysis of variance showed that the variety was significant (P<0.05) for number of tillers. It is evident from the results that the wheat variety had more (452.67 m^{-2}) number of tillers per meter sequere when the crop was sown under (T_2) drilling (after tillage), followed by drilling (zero tillage) (T_1), (320.67 m^{-2}), respectively. However, the minimum number of tillers (313.33 m^{-2}) were recorded with broadcasting (after tillage) (T_3). It was found that broadcasting (zero tillage) was optimum level for wheat so far the tillers m^{-2}. The LSD test demonstrated that the differences in tiller m^{-2} different sowing methods were significant (P<0.05).

Table 2. *Number of Tillers per meter sequere (m^{-2}) of wheat variety as affected by various sowing methods.*

Treatmentsi	R-I	R-II	R-III	Mean
T_1 = Drilling (zero tillage)	350.0	300.0	312.0	320.67 B
T_2 = Drilling (after tillage)	460.0	446.0	452.0	452.67 A
T_3 = Broadcasting (after tillage)	300.0	330.0	310.0	313.33 B

S. E.±	16.609
LSD 0.05	46.113

3.3. Spike Length (cm)

The results about the spike length (cm) of wheat variety Sunheri as affected by different sowing methods are presented in Table 3 and its analysis of variance as in Appendix-II. The analysis of variance showed that there was significant difference for spike length under different sowing methods. It is evident from the results that maximum spike length (14.46 cm) was recorded when the crop was sown under (T_2) drilling (after tillage), followed by (T_3) broadcasting (after tillage) that resulted in average spike length (9.26 cm), respectively. However, the minimum spike length (8.00 cm) was observed at (T_1) drilling (zero tillage). It was found that drilling (after tillage) was optimum level for wheat so far the spike length (cm). The LSD test demonstrated that the differences in spike length (cm) different sowing methods were significant (P<0.05).

Table 3. *Spike length (cm) of wheat variety as affected by various sowing method.*

Treatmentsi	R-I	R-II	R-III	Mean
T_1 = Drilling (zero tillage)	8.1	8.0	7.9	8.00 B
T_2 = Drilling (after tillage)	16.2	14.3	12.9	14.46 A
T_3 = Broadcasting (after tillage)	9.8	9.4	8.6	9.26 B

S. E.±	0.6546
LSD 0.05	1.8175

3.4. Spiklets Spike^{-1}

The results in regards to spiklets spike^{-1} for wheat variety Sunheri as affected by different sowing methods are presented in Table 4 and its analysis of variance as Appendix-IV. The analysis of variance showed that there was significant (P<0.05) different for spikelets spike^{-1} under different sowing methods. It is evident from the results that maximum spiklets spike^{-1} (17.33) were observed when the crop was sown under (T_2) drilling (after tillage), followed by (T_3) broadcasting (after tillage) that resulted in average spiklets spike^{-1} (14.66). However, the minimum spiklets spike^{-1} (12.00) were observed under (T_1) drilling (zero tillage). The results indicated that drilling (after tillage) (T_2) could be considered as an appropriate sowing method. The LSD test demonstrated that the differences in spiklets spike^{-1} for different sowing methods were significant (P<0.05).

Table 4. *Spiklets spike^{-1} of wheat variety as affected by various sowing methods.*

Treatmentsi	R-I	R-II	R-III	Mean
T_1 = Drilling (zero tillage)	11.0	13.0	12.0	12.00 B
T_2 = Drilling (after tillage)	19.0	18.0	15.0	17.33 A
T_3=Broadcasting (after tillage)	15.0	17.0	12.0	14.66 AB

S. E.±	1.2472
LSD 0.05	3.4628

3.5. Grains Spike^{-1}

The results in regards to grains spike^{-1} of wheat variety Sunheri as affected by different sowing methods are presented in Table-5 and its analysis of variance as Appendix-V. The analysis of variance showed that grains spike^{-1} of wheat variety was significant (P<0.05) for different sowing methods. It is evident from the results that maximum grains spike^{-1} (45.33) was observed when the crop was sown under (T_2) drilling (after tillage), followed

by (T_3) broadcasting (after tillage) with average grains spike^{-1} (36.00), respectively. However, the minimum grains spike^{-1} (33.66) were observed with (T_1) drilling (zero tillage). The results indicated that drilling (after tillage) (T_2) could be considered as an appropriate sowing methods for wheat crop. The LSD test demonstrated that the differences in grains spike^{-1} different sowing methods were significant (P<0.05).

Table 5. *Grains spike^{-1} of wheat variety as affected by various sowing methods.*

Treatmentsi	R-I	R-II	R-III	Mean
T_1 = Drilling (zero tillage)	32.0	34.0	35.0	33.66 B
T_2 = Drilling (after tillage)	45.0	41.0	50.0	45.33 A
T_3=Broadcasting (after tillage)	39.0	39.0	30.0	36.00 AB
S. E.±	4.0552			
LSD 0.05	11.259			

3.6. Seed Index (1000-Grain Weight, g)

The results in regards to seed index (1000-grain weight, g) of wheat variety Sunheri as affected by different sowing methods are presented in Table 6 and its analysis of variance as Appendix-V. The analysis of variance showed that there was significant difference for (P<0.05) under different sowing method. It is evident from the results that maximum seed index (50.66 g) was observed when the wheat crop was sown under (T_2) drilling (after tillage), followed by (T_3) broadcasting (after tillage) that resulted in average seed index (40.00 g), respectively. However, the minimum seed index (36.00 g) was observed with (T_1) drilling (zero tillage). It was found that drilling (after tillage) was optimum level for wheat so far the seed index (1000-grain weight, g). The LSD test demonstrated that the differences in seed index (1000-grain weight, g) for different sowing methods were significant (P<0.05).

Table 6. *Seed index (1000-grain weight, g) of wheat variety as affected by various sowing methods.*

Treatmentsi	R-I	R-II	R-III	Mean
T_1 = Drilling (zero tillage)	34.0	37.0	37.0	36.00 B
T_2 = Drilling (after tillage)	50.5	46.0	55.5	50.66 A
T_3=Broadcasting (after tillage)	42.0	45.0	33.0	40.00 AB
S. E.±	4.6208			
LSD 0.05	12.829			

3.7. Biological Yield (kg ha^{-1})

The results in regards to biological yield (kg ha^{-1}) of wheat variety Sunheri as affected by different sowing methods are presented in Table 7 and its analysis of variance as Appendix-VI. The analysis of variance showed that there was significant difference (P<0.05) for sowing method. It is evident from the results that maximum biological yield (6866.7 kg ha^{-1}) was observed when the wheat crop was sown under (T_2) drilling (after tillage), followed by (T_3) broadcasting (after tillage) with average biological yield (6533.3 kg ha^{-1}), respectively. However, the minimum biological yield (6500.0 kg ha^{-1}) was observed with (T_1) drilling (zero tillage). The results indicated that (T_2) drilling (after tillage) could be considered as an appropriate sowing method. The LSD test demonstrated that the differences in biological yield (kg ha^{-1}) different sowing methods was significant (P<0.05).

Table 7. *Biological yield (kg ha^{-1}) of wheat variety as affected by various sowing methods.*

Treatmentsi	R-I	R-II	R-III	Mean
T_1 = Drilling (zero tillage)	6000	7000	6500	6500.0 A
T_2 = Drilling (after tillage)	5600	7500	7500	6866.7 A
T_3=Broadcasting (after tillage)	6800	5800	7000	6533.3 A
S. E.±	648.93			
LSD 0.05	1801.7			

3.8. Grain Yield (kg ha^{-1})

The results in regards to grain yield (kg ha^{-1}) of wheat variety Sunheri as affected by different sowing methods are presented in Table 8 and its analysis of variance as Appendix-VII. The analysis of variance showed the significant difference (P<0.05) for grain yield (kg ha^{-1}) and different sowing methods. It is evident from the results that maximum grain yield (3595.0 kg ha^{-1}) was observed when the wheat crop was sown under (T_2) drilling (after tillage), followed by (T_1) drilling (zero tillage) with average grain yield (3071.7 kg ha^{-1}), respectively. However, the minimum grain yield (3060.0 kg ha^{-1}) was observed with (T_3) broadcasting (after tillage). It was found that drilling (after tillage) was optimum level for wheat so far the grain yield (kg ha^{-1}). The LSD test demonstrated that the differences in grain yield (kg ha^{-1}) different sowing methods were significant (P<0.05).

Table 8. *Grain yield (kg ha^{-1}) of wheat variety as affected by various sowing method.*

Treatmentsi	R-I	R-II	R-III	Mean
T_1 = Drilling (zero tillage)	2940	3220	3055	3071.7 B
T_2 = Drilling (after tillage)	3360	3750	3675	3595.0 A
T_3=Broadcasting (after tillage)	3060	2900	3220	3060.0 B
S. E.±	134.27			
LSD 0.05	372.81			

4. Discussion

The wheat crop grown under diversified environments may respond to crop management practices differently [9]. Generally, the conventional methods of planting have mostly been replaced by modernized methods and by research their viability has been proved [4]. The use of drilling for wheat sowing facilitates double-cropping and offer significant advantages in controlling soil moisture, both irrigation and drainage and are amendable to narrow row spacing as compared to rest sowing methods [5]. In view of the facts stated above, the study was carried out to effect of sowing methods on growth and yield of wheat (*Triticum aestivum* L.)

under zero and other tillage methods. The present study indicated that wheat variety Sunheri sown by drilling after tillage showed remarkably superior performance with 81.03 cm plant height, 452.67 tillers m^{-2}, 14.46 cm spike length, 17.33 spikelets $spike^{-1}$, 45.33 grains $spike^{-1}$, 50.66 g seed index (1000-grain weight), 6866.7 kg ha^{-1} biological yield and 3595.0 kg ha^{-1} grain yield. The crop with broadcast after tillage resulted in 77.06 cm plant height, 313.33 tillers m^{-2}, 9.26 cm spike length, 14.66 spikelets $spike^{-1}$, 36.00 grains $spike^{-1}$, 40.00 g seed index (1000-grain weight), 6533.3 kg ha^{-1} biological yield and 3060.0 kg ha^{-1} grain yield. On the other hand, drilling at zero tillage method remained with 76.10 cm plant height, 320.67 tillers m^{-2}, 8.00 cm spike length, 12.00 spikelets $spike^{-1}$, 33.66 grains $spike^{-1}$, 36.00 g seed index (1000-grain weight), 6500.0 kg ha^{-1} biological yield and 3071.7 kg ha^{-1} grain yield. It was concluded that the wheat crop sown by drilling (after tillage) resulted in higher grain yield of 3595.0 kg ha^{-1} than broadcasting after tillage (3060.0 kg ha^{-1}). These results are fully supported by [10] who reported that method of sowing significantly affects the wheat yields and crop sown by drilling method surpassed the performance over conventional methods. The [11] used three sowing methods and found that all growth and yield parameters were significantly affected by the sowing methods. The [12] determined the effect of different sowing methods on wheat yield and reported that the highest grain yield was supported by more number of tillers and numbers of grains $spike^{-1}$ and drilling and raised bed planted wheat performed better than those under broadcast methods. Similarly, [13] observed higher grain yield when crop was sown through drilling method. Direct drilling recorded lower straw yields and nutrient uptake compared to conventional broadcast of seeds, and thus, direct drilling was effective and recommended for wheat cultivation. The [4] carried out studies to investigate the influence of sowing methods on wheat crop growth traits and grain yield. The [14] studied the effect of sowing methods on the crop stand and lodging in wheat in field and reported that the bed planted demonstrated about 50 percent less lodging as compared to flat planting in wheat. The [13] examined the effects of sowing methods on the growth and grain yield of wheat. The results showed that under the fully irrigated conditions, winter wheat yield significantly (P<0.05) increased in case of bed planting of the plant is drier that reduces lodging which has a significant effect on wheat yield. The [15] compared conventional planting method (broadcasting) of wheat sowing with drill planting method for grain yield and its parameters and concluded that broadcast method is suitable for wheat sowing in sandy loam soils of arid area. The [16] found that drilling method of sowing facilitates other cultural practices in the crop and improves crop yields.

5. Summary and Conclusions

5.1. Summary

The study was carried out during the year 2017-18 to check the effect of sowing methods on growth and yield of wheat (*Triticum aestivum* L.) variety Sunher.

The treatments included three sowing methods T_1 = Drilling (zero tillage), T_2 =Drilling (after tillage) and T_3 = Broadcasting (after tillage). The observations were recorded on plant height (cm), tillers m^{-2}, spike length (cm), spiklets $spike^{-1}$, grains $spike^{-1}$, seed index (1000-grain wt., g), biological yield (kg ha^{-1}) and grain yield (kg ha^{-1}). The findings of the study are summarized as follows:

The wheat variety sown by drilling after tillage showed remarkably superior performance with 81.03 cm plant height, 452.67 tillers m^{-2}, 14.46 cm spike length, 17.33 spikelets $spike^{-1}$, 45.33 grains $spike^{-1}$, 50.66 g seed index (1000-grain weight), 6866.7 kg ha^{-1} biological yield and 3595.0 kg ha^{-1} grain yield.

The crop broadcasted after tillage resulted in 77.06 cm plant height, 313.33 tillers m^{-2}, 9.26 cm spike length, 14.66 spikelets $spike^{-1}$, 36.00 grains $spike^{-1}$, 40.00 g seed index (1000-grain weight), 6533.3 kg ha^{-1} biological yield and 3060.0 kg ha^{-1} grain yield.

On the other hand drilling with zero tillage method remained with 76.10 cm plant height, 320.67 tillers m^{-2}, 8.00 cm spike length, 12.00 spikelets $spike^{-1}$, 33.66 grains $spike^{-1}$, 36.00 g seed index (1000-grain weight), 6500.0 kg ha^{-1} biological yield and 3071.7 kg ha^{-1} grain yield.

5.2. Conclusions

It is concluded that the crop sown by drilling after tillage reduced more grain yield of 3595.50 kg ha^{-1} as compared to drilled with zero tillage 3071.7 kg ha^{-1} and broadcasted after tillage (3060.0 kg ha^{-1}).

Author's Contribution

Conceived and designed the experiments: AS Khetran & K Bakhsh.

Performed the experiments: K Bakhsh & ZA Mastoie.

Analyzed the data: K Bakhsh, AS Khetran & ZA Mastoie.

Contributed reagents/ materials/ analysis tools: TA Mastoie, ZA Khetran & BH Mastoie.

Wrote the paper: SJ Shah, K Iqbal & B Baig.

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