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Frequency of Different Tillageimplements onwheat Seed Bed Preparation Affect Its Yield

Ammara Khan[1*], Muhammad Saleem[2], Abdul Rehman[3]and Babar Hassan[4]
[1*]*Assistant Research Officer (Engineering), Adaptive Research Farm, Sargodha, Pakistan*
[2]*Senior Subject Matter Specialist (Agronomy), Adaptive Research Farm, Sargodha, Pakistan*
[3]*Assistant Research Officer (Engineering), Adaptive Research Farm, Karor, Pakistan*
[4]*Assistant Research Officer (Plant Protection), Adaptive Research Farm, Sargodha, Pakistan*
Corresponding Author: Ammara Khan (ammaras94@yahoo.com)

Abstract:*The study was conducted at Adaptive Research Farm, Sargodha during 2015-17 to evaluate the effect of different tillageimplement combination and their frequency on growth and yieldof wheat crop. Experiment was laid out using Randomized Complete Block design with three replications and six treatments. The results showed that treatment T4 containing two passes of rotavator, two passes of cultivator followed by planking results significantly increase in germination of wheat crop during both years. Similarly, all treatments significantly affectedthe root and shoot length of wheat plants. Maximum root and shoot length was observed in T4. Results also revealed that maximum number of productive tillers were observed in T4 and T3 followed by T5. During both year of study treatments in which rotavator was used performed significantly better as compared to other treatments. Maximum yield (kg/ha) was observed in T4 during the first year while in 2nd year of experiment T3, T4 and T5 were non-significantly different from oneanother. The study concluded that the combine effect of rotavator gave better results than large number of passes of cultivator and other implements.*

Key Words: *Rotavator, disc harrow, cultivator, planker, seed bed, yield*

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I INTRODUCTION

Tillage is mechanical manipulation of soil and itsprimary purpose is to change the soil structure which createsfavorable conditions for the development of plants (Abolanle et al., 2015)i.e. germination of seed, emergence of seedlings, growth of cultivated crops and consequently its yield (Carman, 1997). Normally farmers in Pakistan don't take into account the structural properties of soil for seed bed preparation, which is very important in growth of plants after emergence. Type and frequency of tillage implements playvery important role in alteration of soil structure and preparation of seed bed. Previous studies showedthat different tillage implements affect the size, aggregation of soil particles and clod size (Adam, 1992). Studies also showedthat movement of water becomes restricted if soilparticle size becomelarger, simultaneously limitize the root growth and ultimately affect the growth of plant (Jaggi et al. 1972). It can be concluded that the degree of sorting increased with the increased number of passes, but it was also found that aggregate size distribution was only influenced up to second pass of an implement, further passes didn't affect it significantly (Ojeniyi and Dexter 1979). Planting wheat after cotton crop is a common practice in the province of Punjab in Pakistan. Due to late harvesting of cotton, farmers did not accomplish seed bed preparation at appropriate time. The tillage practices used in preparing seed bed usually accounts habitual practices rather than adopting a particular practice for a particular crop considering its physiological features. All suggested tillage practices for one crop may not necessarily be effective for other crop. Repeated tillage with same implement also delays planting of crop as it requires longer period of time for seedbed preparation and makes difficult for the wheat to fully utilize the available growing period (Leye, 2007). Due to shortage of time farmers in Pakistan broadcast seed of wheat by preparing seedbed using only cultivator instead of drilling, as row planting requires well prepared seed bed, ultimately it causes reduction in yield. Past research focused on reduction of tillage operations required for seed bed preparation, however just reduction in tillage operations using same implements can compromise wheat yield thus making the practice unacceptable (Townsend et al., 2016). So there is need to find out tillage system or tillage frequency of different implements that can prepare fine seedbed with shorter time and can reduce tillage frequency without compromising yield of wheat. Keeping this in view the current study was designed to understand the traditional (only cultivator) and improved tillage system/implements in term of their effect on the

yield of wheat crop. In this experiment disc harrow, rotavator, cultivator and planker have been used as primary tillage implements to evaluate their effect on growth and yield of wheat.

II MATERIALS AND METHODS

The experiment was conducted at Adaptive Research Farm, Risala # 5 Sargodha, during the two consecutive years, 2015-17. Experiment was laid out in Randomized Complete Block Design (RCBD) with six treatments and three replications, using plot size of 15 x 30 m. The gross plot size was 8100 m^2. After application of pre-sowing irrigation in standing cotton crop, when soil moisture reached at the field capacity level cotton sticks were harvested and field was prepared by using following implements underdifferent number of frequencies as given below.

T1: Disc Harrow (1) + Cultivator (3) followed by Planking (2)
T2: Disc harrow (2) + Cultivator (2) followed by planking (2)
T3: Rotavator (1) + Cultivator (2) followed by planking (2)
T4: Rotavator (2) + Cultivator (2) and planking (1)
T5: Disc Harrow (1) + Rotavator (2)
T6: Cultivator (4) followed by planking (2) (Farmer practice)

After preparation of seed bed, crop was sown on Nov 29th, 2016. Wheat cultivar (ARRI-2011) was sourced from Punjab Seed Corporation and crop was sown in lines using recommended seed rate (50 kg/acre). Standard agronomic practices were applied uniformly for wheat crop sown in each block. Urea, Di-ammonium phosphate (DAP) and Sulfate of Potash (SOP) were used as a source of nitrogen, phosphorus and potash respectively. Crop was irrigated three times with canal water until maturity.

The crop was harvested at maturity on 25th April during 2015-16 and 21st April during 2016-17. The parameters studied were germination count/m^2, root length, shoot length, number of grain/ spike, 1000-grain weight and grain yield. The obtained data were analyzed by using Statistix 8.1(Analytical software, Statistix; Tallahassee, Florida, USA, 1985-2005) following Randomized Complete Block Design. Means were separated by using the Tukey HSD test at the 5% level of significance.

III RESULTS AND DISCUSSION

Effect of different tillage implements and their frequency for the preparation of seedbed on growth and yield of wheat was observed for the period of two years (2015-17). Results of Analysis of Variance (ANOVA) for different parameters of growth and yield of wheat are presented in Table 1 and 3. Results showed that during both years all treatments significantly affected the germination of wheat seed as well as all treatments performed significantly different from one another (p<0.05)(Table 1, 3). Maximum germination was observed in T4 which was combination of two passes of rotavator, two passes of cultivator and one pass of planking. Minimum germination was observed in T6 in which only cultivator was used four times followed by planking. Similarly, all treatments significantly affected(p<0.05) the root and shoot length of wheat plants. Maximum root and shoot length was observed in T4. However, root length in T4 (rotavator (2) + cultivator (2) and planking (1)) and T5 (disc harrow (1) + rotavator (2)) was statistically non-significantly different from one another. But in case of shoot length these two treatments performed significantly different from one another. Number of productive tillers was counted when crop reached near to maturity. There was significant effect of each treatment on number of productive tillers/m^2 during both years (Table 1, 3). Results shows that maximum number of productive tillers were observed in T4 and T3 followed by T5. During both years a treatment in which rotavator was used performed significantly better as compared to other treatments. After maturity of crop, number of grain per spike and 1000 grain weight was calculated. The number of grains per spike and 1000-grain weights observed under different tillage treatments for 2015 -2017 isshown in Table 2, 4. Results showed that there was no significant influence of tillage treatments on number of grains per spike during both years (Table 1, 3). In contrast, all treatments performed significantly different from each other in case of 1000 grain weight (p<0.05) during the first year of experiment but treatment effect was non-significant during 2nd year of experiment. Crop was harvested after mid-April during both years and results indicates that there was significant effect of all treatments on the yield of wheat (p<0.05). Maximum yield (kg/ha) was observedin T4 during the first year while in 2nd year experiment T3, T4 and T5 were non-significantly different from oneanother.

Farm implements/machines used for the preparation of seedbed are of different types and have different effects on soil compaction, germination of seed and yield of crop (Leghari et al., 2015; Jamshidi and Tyari, 2014). In the recent decades, research is being focused on reduced tillage to minimize traffic and field operations (tillage, preparing bed for seed, and cultivating). Like the developed countries, In Pakistan, farmers are being pushed to use

combined machines instead of using cultivator for the preparation of seedbed. The results of using combined machines will reducethe energy consumption, time for preparation of seedbed, cost of field operations, increasing the production in unit area and minimizing soil compaction (Akbarnia et al., 2010). In current study results showed that in treatmentswhererotavator was used gave more growth and yield of wheat. This was in agreement with Bahrani et al. (2002) and Mukesh et al.(2013). They concluded that rotavator prepare effective seedbed and increased the germination and yield of crop. Seedbed prepared using rotavator with other implements increased the germination and number of tillers, 1000 grain weight and yield of wheat compared to other combinations of farm implements. This is also in agreement with Parsad, 1996 and Rizwan et al. (2017).

So the seedbed preparation using rotavator and cultivator along with planking is recommended as the best tillage practice in terms of growth, yield and benefit cost ratio for soils of Sargodha region after the harvesting of cotton (Rizwan et al., 2017).

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Table 1: ANOVA of different growth and yield parameters of wheat sown during 2015-16.

Source of variation	Germination/ m^2		Number of productive tillers /m2		Grains/spike		1000 grain weight		Root length		Shoot length		Yield	
	MS	F	MS	F	MS	F	MS	F	MS	F	MS	F	MS	F
Treatments	135.16	5.25	725.5**	21.59	31.43ns	21.82	119.57*	9.69	49.87**	151.19	213.50*	374.27	284380*	140.54
Error	25.73	---	33.6	---	1.44	---	12.39	---	0.33	---	0.57	---	2024	---

Observation of growth and yield parameters of wheat under field conditions. ns = non-significant (p>0.05); * = significant (p<0.05); ** = highly significant (p<0.01).

Table 2: Effect of different treatments for the preparation of seedbed on growth and yield parameters of wheat sown during2015-16.

Treatments	Germination/m^2	Root length (cm)	Shoot length (cm)	Number of productive tillers /m^2	Grains/spike	1000 grain weight (g)	Yield (kg/ha)
T1	244.00 ± 2.58C	7.77 ±0.26C	12.56 ± 0.26D	290.33 ± 3.46C	41.66 ± 0.88	35.00 ± 1.53BC	4284.33 ± 31.2C
T2	255.34 ± 1.19BC	11.59 ± 0.35B	18.00 ± 0.28C	307.33 ± 1.76B	42.33 ± 0.87	37.33 ± 0.88ABC	4543.00 ± 11.9B
T3	259.67 ± 0.88B	12.13 ± 0.08B	19.50 ± 0.13C	311.00 ± 3.48AB	42.33 ± 0.33	34.66 ± 0.66C	4528.33 ± 25.2B
T4	277.67 ± 1.15A	14.24 ± 0.30A	28.23 ± 0.49A	325.00 ± 2.85A	43.33 ± 0.88	40.00 ± 0.57A	4690.00 ± 25.7A
T5	266.00± 3.51AB	13.89 ± 0.09A	23.03 ± 0.54B	315.66 ± 5.13B	43.00 ± 0.57	39.30 ± 0.34AB	4674.00 ± 12.5A
T6	209.33 ± 1.20 D	6.12 ± 0.21C	10.89 ± 0.57D	284.33 ± 2.33C	40.33 ± 0.34	33.35 ± 0.89 C	3879.33 ± 38.5D

Table 3: ANOVA of different growth and yield parameters of wheat sown during 2016-17

Source of variation	Germination/ m^2		Number of productive tillers /m2		Grains/spike		1000 grain weight		Root length		Shoot length		Yield	
	MS	F	MS	F	MS	F	MS	F	MS	F	MS	F	MS	F
Treatments	185.16	4.23	625.5**	28.95	27.11ns	16.80	113.17ns	53.89	51.13**	41.59	201.53*	92.87	294150*	138.74
Error	43.73	---	21.6	---	1.61	---	2.10	---	1.23	---	2.17	---	2120	---

Observation of growth and yield parameters of wheat under field conditions. ns = non-significant (p>0.05); * = significant (p<0.05); ** = highly significant (p<0.01).

Table 4: Effect of different treatments for the preparation of seedbed on growth and yield parameters of wheat sown during 2016-17

Treatments	Germination/m^2	Root length (cm)	Shoot length (cm)	Number of productive tillers /m^2	Grains/spike	1000 grain weight (g)	Yield (kg/ha)
T1	234.00 ± 1.18C	8.17 ±0.26C	13.16 ± 0.16D	280.33 ± 3.46C	43.66 ± 0.88	38.33 ± 1.53	4180.13 ± 31.2B
T2	238.14 ± 2.19BC	12.29 ± 0.35B	21.00 ± 0.21C	307.33 ± 1.76B	45.33 ± 0.87	36.33 ± 0.88	4443.00 ± 11.9AB
T3	241.63 ± 0.18C	13.23 ± 0.08B	24.10 ± 0.16C	321.00 ± 3.48AB	43.33 ± 0.33	37.66 ± 0.16	4528.33 ± 25.2A
T4	281.67 ± 1.15A	14.20 ± 0.30A	29.51 ± 0.40A	334.00 ± 2.85A	43.33 ± 0.88	40.00 ± 0.51	4555.00 ± 23.70A
T5	256.00± 3.51AB	14.00 ± 0.09A	27.13 ± 0.51B	318.67 ± 5.00B	46.00 ± 0.57	38.30 ± 0.34	4524.00 ± 10.5A
T6	204.40 ± 1.20 D	7.89 ± 0.21C	12.81 ± 0.50D	277.33 ± 1.34C	43.33 ± 0.34	36.35 ± 0.80	3879.33 ± 38.5D

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