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Effect of Different Types of Mulches on Grain Yield and Yield Components of Wheat (*Triticum Aestivum*) under Rainfed Condition

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Abstract

The research experiment was carried out at the research area of Soil and Water Conservation Research Institute, Chakwal, Pakistan to estimate the effects of different types of mulches on the growth, development and grain yield of wheat during rabi season 2010-11. Four different types of mulches (hoeing twice 30-40 & 60-70 DAE, straw mulch @ 2.0 ton ha^{-1}, litter mulch @ 1.5 ton ha^{-1} and gypsum @ 2.5 ton ha^{-1}) were compared with control (no mulch) laid out in a randomized complete block design with three replications. The investigation revealed significant effects of different types of mulches on the germination count m^{-2}, plant height (cm), no. of tillers m^{-2}, spike length (cm), no. of spikelets per spike, biological yield (kg/ha) and grain yield (kg/ha) while there was non-significant difference among the treatments on 1000 grain weight (g). Hence, it was concluded that farmers could apply different mulches particularly gypsum @ 2.5 ton ha^{-1} to achieve highest grain yield (kg/ha) of wheat under rainfed conditions.

Keywords: different mulches, moisture conservation, grain yield, yield components, rainfed, wheat

Introduction

Wheat (*Triticum aestivum*) is an important food crop for Barani areas and also for irrigated areas and plays a very important role in meeting the food requirement of both urban and rural population in Pakistan but its grain yield is low in rainfed areas because of unavailability of moisture at the time of sowing which adversely affect the emergence and plant establishment. The problem is further accentuated due to the heavy infestation of weeds which not only deplete soil moisture but also compete for light, nutrients and space with the main crop, resulting in poor performance of the crop (Ahmed *et al*., 2007). Weeds are one of the most serious pests, reducing the growth and yield of wheat (Young *et al*., 1994). In rainfed area moisture availability is one of the most important limiting factors, which directly affects the plant growth and grain yield in these areas (Ahmed *et al*., 2007).

Mulches play a vital role for conserving the moisture in the soil profile for the success of wheat production, which totally depends on the precipitation received before and during crop growth period. Mulches reduce the evaporation losses. The practice of mulching has been widely used as a management tool in many parts of the world. It dampens the influence of environmental factors on soil by increasing soil temperature controlling diurnal/seasonal fluctuations in soil temperature (Yang *et al*., 2006; Lalitha *et al*., 2001). However, the effect varies with soils, climate, kind of mulch material used and the rate of application. The surface mulch favorably influences the soil moisture regime by controlling evaporation from the soil surface, improves infiltration, soil water retention, decreases bulk density and facilitates condensation of soil water at night due to temperature reversals (Yang *et al*., 2006; Pawar *et al*., 2004). Variation of the soil microclimate by mulching favors seedling emergence and root proliferations and suppress weed population (Singh, 1994; Lalitha *et al*., 2001).

Many researchers (Li *et al*., 2004; Xie *et al*., 2005 and Yang *et al*., 2006) Yang et al., 2006) carried out studies to determine the effect of different mulches on the wheat production. These studies showed that the application of mulches increased grain yield of wheat in comparison with unmulched wheat. The major contributing reasons for mulch rising wheat yield are soil and water conservation, improved soil physical and chemical properties, and enhanced soil biological activity (Yang *et al*., 2006). The core objective of present research work was to investigate the effect of different types of mulches on the plant attributes and grain yield (kg/ha) of wheat under rainfed conditions.

Materials and Methods

Experimental site and procedure

The study was conducted to find out the effect of different mulches techniques on the wheat yield at the research area of Soil and Water Conservation Research Institute (SAWCRI), Chakwal, Pakistan during rabi season 2010-11. For this purpose different mulches treatments were used i.e. T2= Soil mulch (hoeing twice 30-40 & 60-70 DAE) , T3= Straw mulch @ 2.0 ton ha^{-1}, T4= Litter mulch @ 1.5 ton ha^{-1} and T5= Gypsum @ 2.5 ton ha^{-1} (applied once for 3 years) against T1= Control (no mulch) treatment. Gypsum was incorporated in the soil at SAWCRI farm before onset of monsoon in gypsum plots. Other treatments were done after the sowing of

wheat crop in 1st week of November; however fertigation @ 120-80-60 NPK kg ha^{-1} was done at the time of seed bed preparation in sandy loam soil. Wheat variety (Chakwal-50) @ 50 kg/ha seed rate was cultivated by hand drill at 20 cm apart row spacing having 3 replications and 5 treatments were maintained in Randomized complete block design (RCBD)

Data recorded

The data were recorded for germination count m^{-2}, no. of tillers m^{-2}, plant height (cm), spike length (cm), no. of spikelets $spike^{-1}$, 1000 grain weight (g), biological yield (kg/ha) and average grain yield (kg/ha). Soil moisture contents were recorded up to the depth of 60cm at planting, tillering, and grain filling stages

Statistical analysis

Data collected was analysed by using Statistix version 8.1 software and the means were compared by using the Least Significant Difference (LSD) test.

Results and Discussion

Monthly rainfall, minimum and maximum temperatures during the present research experiment are given in (fig-1). Soil moisture contents ranged from 8 to 10% at 0-30 cm depth and 10-11.50% at 30-60 cm depth and the maximum moisture contents were found in the plot where T5 (gypsum @ 2.5 ton ha^{-1}) applied (table-2).. It is clear that wheat production in rainfed agriculture is only successful when surface moisture evaporation losses should be minimized through soil amendments and breaking the capillary tubes of the soil. The results of analysis of variance presented that the effect of different types of mulches were significant for all the characters under studied except the 1000 grain weight which was not significant (table-1). The present investigation exposed that various types of mulching significantly prejudiced the different plant characteristics of wheat viz., germination count m^{-2}, no. of tillers m^{-2}, plant height (cm), spike length (cm), no. of spikelets $spike^{-1}$, biological yield (kg/ha) and average grain yield (kg/ha) (table-1). Mulch application had significant effect on germination count m^{-2}. T5 (gypsum @ 2.5 ton ha^{-1}) produced maximum germination count than control treatment (fig-2). The increase in germination count with different types of mulches is endorsed to soil moisture preservation. Due to mulch swathe evaporation losses reduces from soil surfaces thus enhancing moisture content availability for germination of seeds. The present results are in corroborated with the findings of (Chaudhry & Faizullah, 1989).

As the inference from the present study it is cleared from fig: 3, 4, 5, 6, 7 & 8 that amongst different types of mulching treatments, T5 (Gypsum @ 2.5 ton ha^{-1}) gave maximum number of all the characters under studied. On the other hand, control treatment recorded the minimum growth. The proper development of plant attribute was accredited to adequate soil moisture contents in close proximity to root zone and due to mulching practices the minimum losses from evaporation. The total preservation of moisture contents and availability of moisture contents also leading to advanced uptake of nutrient from soil to plants resulted better growth and development of plant, as compared to control treatment. These results are in agreement with the investigations of (Ahmed *et al*., 2007; Shafiq *et al*., 1994 and Yang *et al*., 2006).

Grain yield is the important component of plant performance under a set of growing conditions. Any physiological or agronomic parameter at a given stage of growth would be of further use only when its effect is reflected on yield either way (Ludlow and Muchow, 1990). It was examined that all the mulching treatments were significantly increased the average grain yield (kg/ha) of wheat as compared to T1 (control). Fig-9 depicted that among all the mulching treatments, higher average grain yield (kg/ha) was recorded in T5 (Gypsum @ 2.5 ton ha^{-1}). It shows that T5 treatment (Gypsum @ 2.5 ton $ha^{-1)}$ might have motivate favorable environment conditions beneficial to achievement of maximum grain yield (kg/ha) in wheat. The present inferences are in corroborated with the research findings of Rashid *et al*., (2008); Shah *et al*., (2011) and Yang *et al*., (2006) who also recommended the use of different types of mulches especially gypsum @ 2.5 ton ha^{-1} for achievement of higher grain yield (kg/ha) of wheat.

Conclusion

The results revealed that maximum wheat grain production 3650 kg/ha was achieved by T5 (gypsum applied @ 2.5 ton ha^{-1}) followed by straw mulch 3475 kg/ha, litter mulch 3110 kg/ha and soil mulch 3100 kg/ha against control (no mulch) 2850 kg/ha. Hence, it was concluded that farmers could apply different mulches especially gypsum applied @ 2.5 ton ha^{-1} to achieve highest grain yield (kg/ha) of wheat under rainfed condition.

Table-1: Statistical Analysis of grain yield (kg/ha) and yield components of wheat under different mulches treatments

SOV	df	GC	NT	PH	SL	SPS	TGW	BY	GY
Treatment	4	99.4333**	1193.90**	254.900*	6.56667*	16.2667**	19.3640^{ns}	2137212**	323211*
CV	-	8.54	11.79	9.13	11.84	14.34	8.90	7.39	5.77
LSD (0.05)	-	4.95	8.38	10.96	1.62	3.09	3.13	526.38	153.09

*Significant at 5% probability level, **Significant at 1% probability level, ^{ns}: Non significant, GC= Germination count m^{-2}, NT= No. of tillers m^{-2}, PH= Plant height (cm), SL= Spike length (cm), SPS= No. of spikelets per spike, TGW= 1000 grain weight, BY= Biological yield (kg/ha), GY= Grain yield (kg/ha)

Table-2: Effect of different types of mulches on average moisture (%) taken on different wheat growth stages studied during 2010-11

Treatments	Soil Depth	Planting Time	Tillering Stage	Grain filling stage
Control	0-15	8.5	7.5	7.0
	15-30	10.0	8.0	8.0
	30-45	10.5	9.4	8.5
	45-60	11.5	10.0	9.5
Soil mulch (hoeing twice 30-40 & 60-70 DAE)	0-15	8.5	8.0	8.0
	15-30	10.0	9.5	8.5
	30-45	10.5	10.0	9.0
	45-60	11.5	11.0	10.0
Straw mulch @ 2.0 ton ha^{-1}	0-15	8.5	8.0	8.0
	15-30	10.0	6.0	8.4
	30-45	10.5	6.5	10.0
	45-60	11.5	7.5	10.5
Litter mulch @ 1.5 ton ha^{-1}	0-15	8.5	8.0	7.5
	15-30	10.0	10.0	9.5
	30-45	10.5	10.5	10.0
	45-60	11.5	11.0	10.0
Gypsum @ 2.5 ton ha^{-1}	0-15	8.5	8.5	8.0
	15-30	10.0	9.5	9.5
	30-45	10.5	10.0	10.0
	45-60	11.5	11.20	11.0

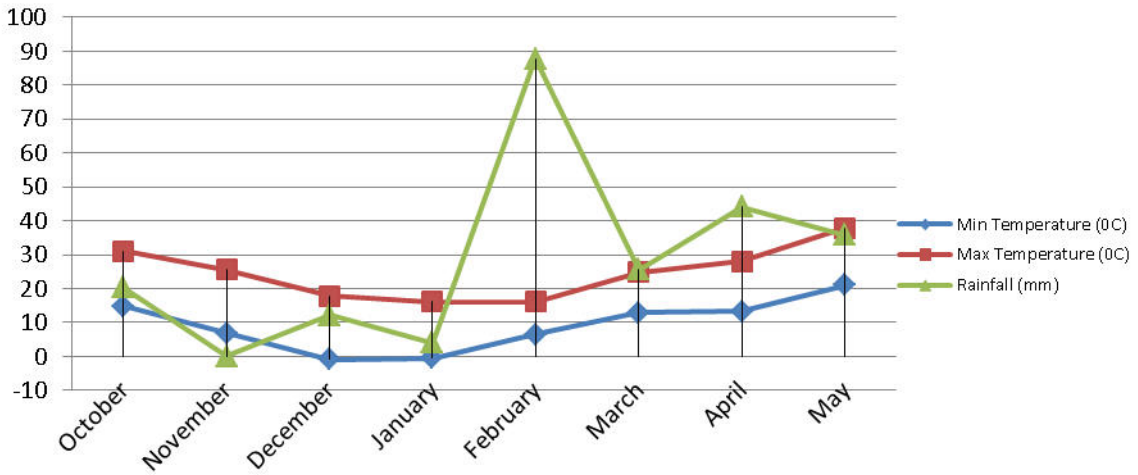

Fig-1: Meteriological data recorded at soil and water Conservation Research Institute Chakwal, Pakistan during rabi season 2010-11

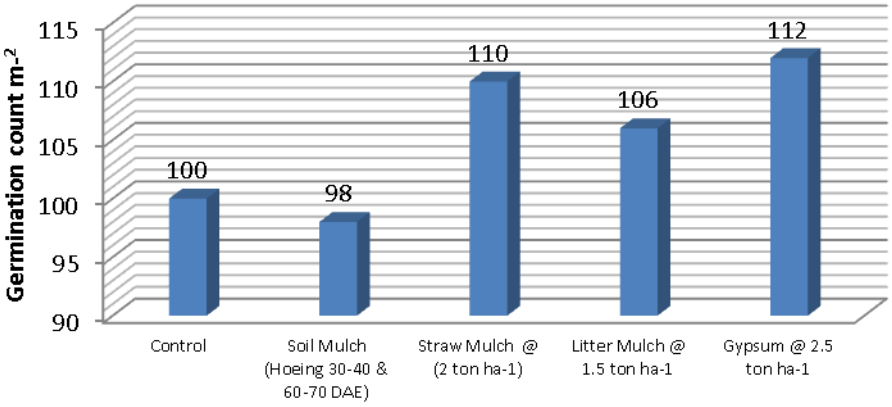

Fig 2: Effect of different mulches on germination count in wheat

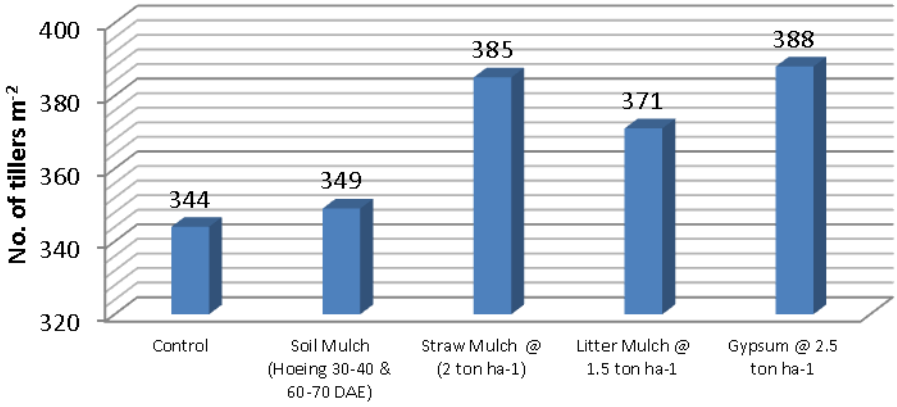

Fig 3: Effect of different mulches on No. of tillers m^{-2} in wheat

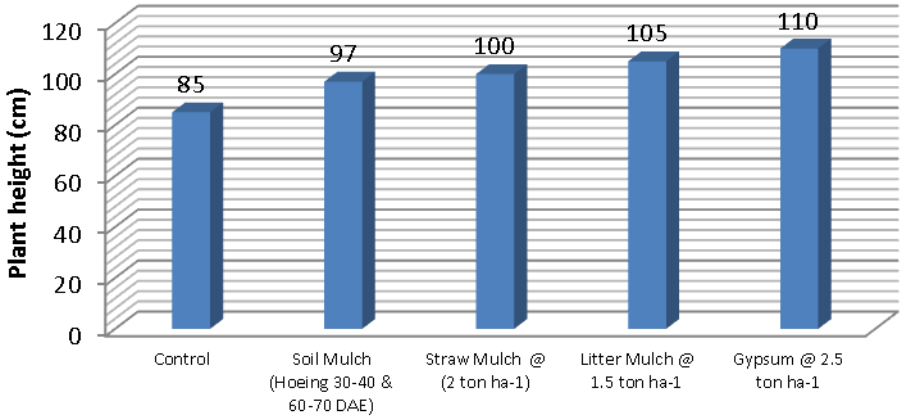

Fig 4: Effect of different mulches on plnat height (cm) in wheat

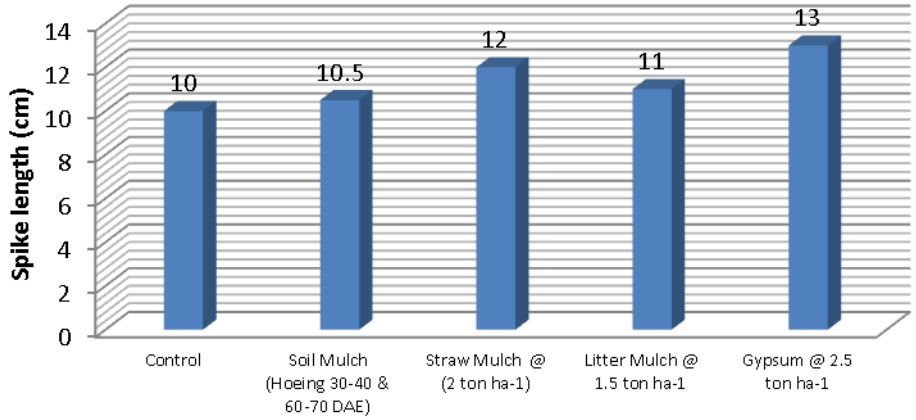

Fig 5: Effect of different mulches on spike length (cm)in wheat

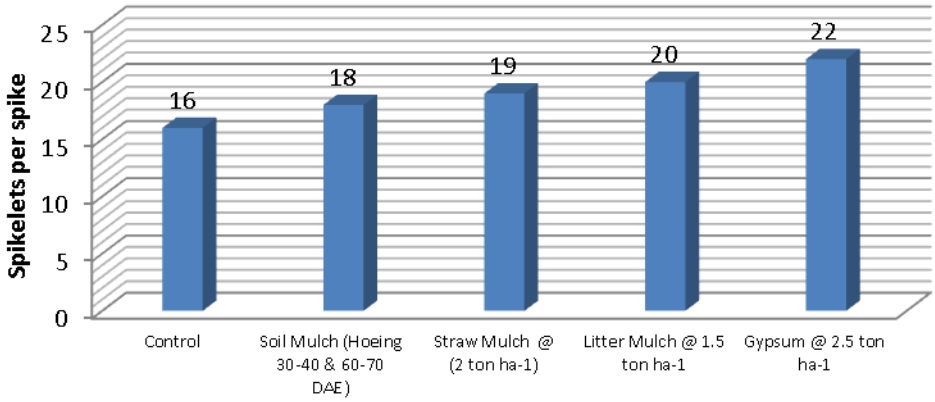

Fig 6: Effect of different mulches on spikelets per spike in wheat

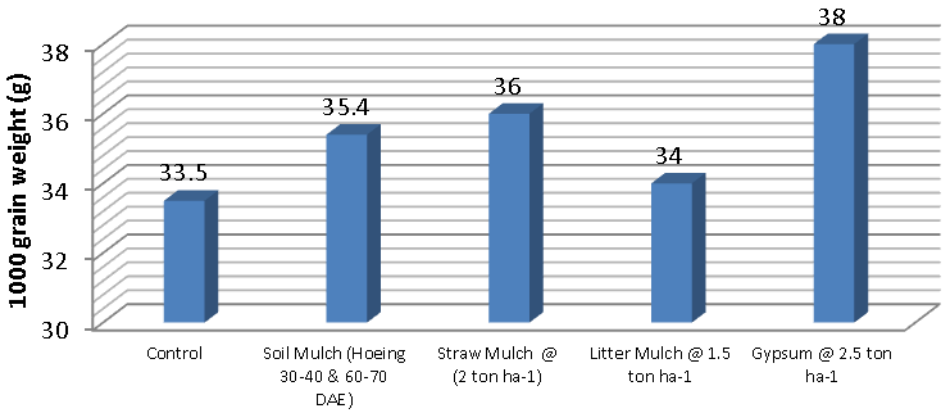

Fig 7: Effect of different mulches on 1000 grain weight (g)in wheat

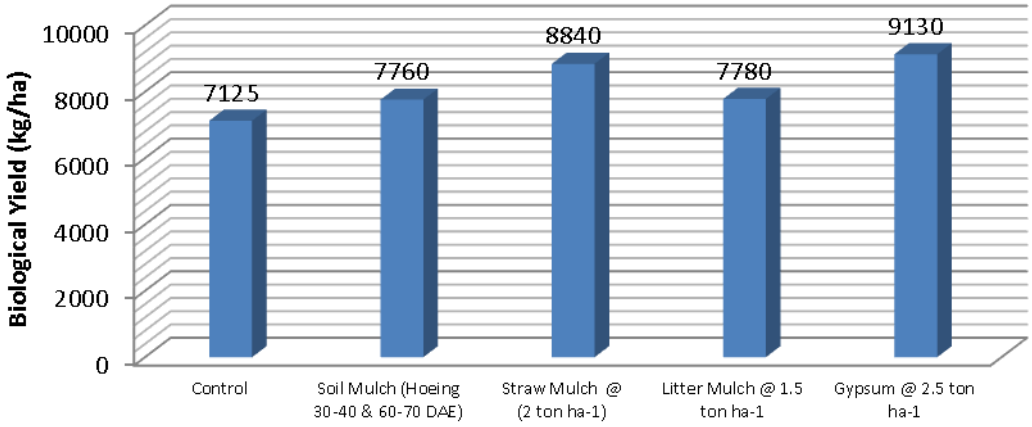

Fig 8: Effect of different mulches on biological yield (kg/ha) in wheat

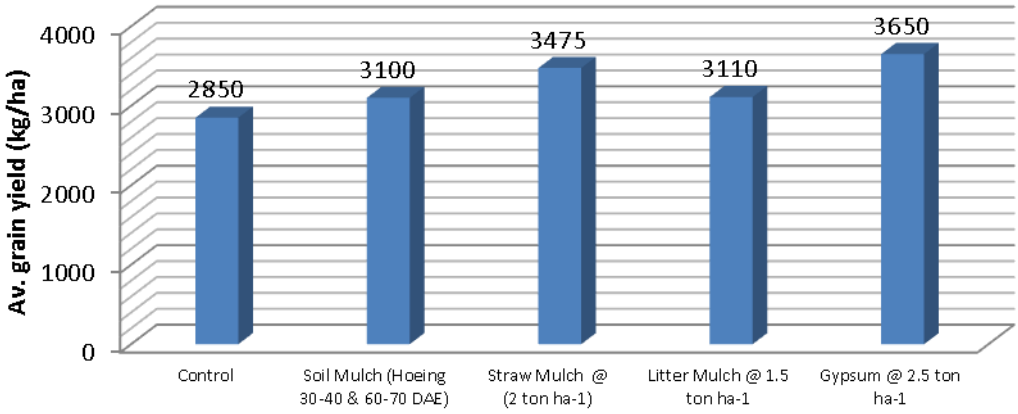

Fig 9: Effect of different mulches on grain yield (kg/ha) in wheat

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