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IMPACT OF CROP RESIDUES MULCH ON WEEDS CONTROL AND SOME AGRONOMIC ASPECTS OF WHEAT

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ABSTRACT

To study the effects of different mulching materials (maize and guar), their levels (1.0, 1.5, 2.0, 2.5 t ha $^{-1}$) and application methods (surface and shallow incorporation) on wheat, an experiment was carried out at the New Developmental Farm of the University of Agriculture Peshawar during winter 2009-10. Plant emergence was comparatively quicker (12 days) in plots having maize residues than guar residues (13 days). Maize residues had higher (93) emergencem^{-2} as compared to guar residues (84). Weeds weight m^{-2} was lower (31 g) in maize residue plots as compared to guar residues plots (53 g). Days to physiological maturity hastened with maize residues (146 days) than guar residues (147 days). Surface method accelerated emergence (12 days) and improved emergence m^{-2} (95), as compared to shallow incorporation. However, surface application decreased (35 g) weeds growth as compared to shallow incorporation (49 g). It is concluded that surface application method of crop residue can enhance the days to emergence, increase emergence m^{-2}, decrease weeds growth and enhance physiological maturity of wheat.

Key words: crop residues, emergence, mulching, *Triticum aestivum*, weed control, wheat.

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INTRODUCTION

Wheat (*Triticum aestivum* L.) is the major staple food of Pakistan and is grown over 7 m ha in irrigated areas with an average

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yield of 2759 kg ha^{-1} (MINFAL, 2010). In irrigated areas of Khyber Pakhtunkhwa wheat is grown on 0.313 m ha with an average yield of 1860 kg ha^{-1}.

The soils of Khyber Pakhthunkhwa are mostly low in organic matter, nitrogen, phosphorous and zinc (Idris *et al*., 2001). To overcome the problem of nutrient deficiency and increase wheat yield production, farmers are using chemical inorganic fertilizer for wheat production. However, the chemical fertilizers are more costly and farmers cannot afford the prices of these fertilizers in such quantity which the wheat crop need so less production occurs (Ahmad, 2000). The above mentioned conditions, combined use of inorganic and organic fertilizer/manures have significant role to maintain soil fertility level and crop productivity (Tendon, 1998; Lampe, 2000).

Crops yield is influenced by a lot of factors when mulching is used. Among this one main factor is Weeds which determining crop yield, and mulches are important for control of different types of weeds (Bilalis *et al.*, 2002; Radics and Bognar, 2004; Jodaugienė *et al*., 2006). Mulches have both positive and negative effects on crops and its impacts on weeds. Mulches reduce water evaporation from soil and help in stabilizing soil temperature to the great instant (Lal, 1974; Ji and Unger, 2001; Kar and Kumar, 2007). Crop residues management strategies in sustainable agriculture emphasize the conservation and supplementation of organic matter. Maintaining or even increasing soil organic matter at a highest level is attainable, which requires crop residues management practices that maximize the returned to the soil (Berzsenyi and Gyorffy, 1997). Besides increasing crop productivity, mulching increased the number of seedlings on low moisture conditions. (Moldehaver, 1987), reduced inter plant evaporation and water consumption (Wang and Zhao, 1991). Literature further confirmed an increase in water storage capacity (Zhao *et al*., 1996), higher water use efficiency (Gu *et al*., 1998) and weed suppression (Roy, 1989).

Keeping in view the long term sustainability and soil productivity and the role of mulching of residue management in crop production, the present research work was carried out to study the impact of crops residues mulching on performance of wheat.

MATERIALS AND METHODS

An experiment was conducted at New Developmental farm of Khyber Pakhthoonkhawa Agricultural University Peshawar, during winter 2009-10. Two crop residues (maize stover and guar stover) having four levels (1, 1.5, 2 and 2.5 t ha^{-1}) each was mulched on soil surface and through shallow incorporation. A control treatment (no mulch) was also included. Experiment was laid out in randomized complete block design having four replications. A plot size of 5 x 3 m was kept. Uniform agronomic practices were applied for all treatments. A basal dose of 60 kg P2O5 ha^{-1} was applied at time of sowing, split doses of nitrogen at the rate of 135 kg ha^{-1} were applied at the time of seedbed preparation, and the remaining half dose was applied at the time of first irrigation. All possible combination of various treatments was as follows:

Treatments

T0= control (no mulch / standard practice)
T1= Maize Stover @ 1tha^{-1} + surface mulch
T2= Maize Stover @ 1.5tha^{-1} + surface mulch
T3= Maize Stover @ 2tha^{-1} + surface mulch
T4= Maize Stover @ 2.5tha^{-1} + surface mulch
T5= Maize Stover @ 1tha^{-1} + shallow incorporation
T6= Maize Stover @ 1.5tha^{-1} + shallow incorporation
T7= Maize Stover @ 2tha^{-1} + shallow incorporation
T8= Maize Stover @ 2.5tha^{-1} + shallow incorporation
T9= Guar Stover @ 1tha^{-1} + surface mulch
T10= Guar Stover @ 1.5tha^{-1} + surface mulch
T11= Guar Stover @ 2tha^{-1} + surface mulch
T12= Guar Stover @ 2.5tha^{-1} + surface mulch
T13= Guar Stover @ 1tha^{-1} + shallow incorporation
T14= Guar Stover @ 1.5tha^{-1} + shallow incorporation
T15= Guar Stover @ 2 tha^{-1} + shallow incorporation
T16= Guar Stover @ 2.5t ha^{-1} + shallow incorporation

Data were collected on the following parameters of wheat as per standard procedure. The data on days to emergence were recorded by counting number of days taken by each treatment from the date of sowing until the completion of emergence. Data on emergence m^{-2} was recorded by counting the number of plants in two central rows in each sub plot and were converted into average number of plants emerged m^{-2} according to formula.

$$\text{Emergence m}^{-2} = \frac{\text{Plants counted}}{\text{R-R x Number of Rows x R. Length}}$$

For recording data on weed weight per square meter, weeds were pulled by hand in area of one square meter and sun dried and weighted by electric balance in laboratory. Data on days to maturity were recorded from the date of sowing until when the crop were physiologically matured in each treatment. Complete loss of green color from the plant was used as criterion. Statistical analysis for entire data was subjected individually to analysis of variance technique accordingto the appropriate design and means was compared by using LSD test (Jan *et al*., 2009).

RESULTS AND DISCUSSION

Days to emergence

Data regarding days to emergence are presented in Table 1. Statistical analysis of the data showed that crop residues (CR) and its method of application (M) had significant effect on days to emergence. However, crop residues level (L) had no significant effect on days to emergence. All interactions were non-significant except M x L. The difference between control and means of the rest treatments was non-significant.

Guar residue applications delayed emergence (13 days) as compared to maize residues (12 days). Shallow residue incorporation prior to sowing delayed emergence (13 days) as compared to surface application of crop residues (12 days). The interaction response of Method x level (MxL) showed that 2 t ha^{-1} residues incorporation through shallow method delayed emergence, whereas surface application had enhanced emergence. However, the application of 2.5 t ha^{-1} showed opposite response for shallow and surface application of residues because Maize residues showed the quickest emergence when it was placed on surface as compared to guar residue by using shallow incorporation. It might be due to the fact that soil having abundance of organic matter holding more soil moisture at root zone and provide a conducive environment for early emergence. The results are in line with the findings of Lim *et al*. (1997) who reported early emergence in barley by rice straw.

Emergence m^{-2}

Data regarding emergence m^{-2} are given in Table 1. Analysis of the data showed that the crop residues and its method of application had significant effects on emergence m^{-2}. However, crop residues level had non-significant effect on emergence m^{-2}. All interactions were non-significant for emergence m^{-2} except M x L. The difference between control and means of the rest treatments was non-significant.

Maize residues application resulted in higher emergence m^{-2} (93) as compared to guar residues (84). Surface crop residues application had higher emergence m^{-2} (95), as compared to shallow residue (82). The interaction response of method of application x level (M x L), showed that surface application at the rate of 1.5 t ha^{-1} had higher emergence m^{-2} but further increase in the rate of crop residues decreased emergence, whereas shallow crop residues incorporation method had higher emergence at 2.5 t ha^{-1} and decreased with decreasing in level of crop residues.

Low emergence m^{-2} was occurred in plots where guar residues with shallow method were used and more plants emerged where maize residues with surface method was used. The results are opposite to that of Brown and Dicken (1970) who explained that surface managed residues decomposed more slowly than incorporating residues indicating that N immobilization potential of surface residues is lower than that residues mixed with the soil. The interaction response of method x level (M x L), showed that surface application at the rate of 1.5 t ha^{-1} had higher emergence m^{-2} but further increase in the rate of crop residues decreased emergence, whereas shallow crop residues incorporation method had higher emergence at 2.5 t ha^{-1} and decreased with decrease in level of crop residues.

Table-1. Days to emergence and emergence m^{-2} of wheat as affected by crop residues, levels and applications methods.

Crop residue (CR)	Days to emergence	Emergence m^{-2}
Maize	12	93
Guar	13	84
Significance level	*	*
Crop residue levels (L) t ha^{-1}		
1.0	13	83
1.5	12	91
2.0	13	87
2.5	13	93
LSD (0.05)	ns	Ns
Methods		
Surface	12	95
Shallow	13	82
Significance level	*	*
Planned mean comparison	Significance level	
Control vs rest	ns	Ns
Control	12	86
Rest	12	88
Interactions	Significance level	
CR x M	ns	ns
CR x L	ns	ns
M x L	*(Fig. 1)	*(Fig. 2)
CR x M x L	ns	ns

ns = non-significant, * = significant at 0.05 level of probability, **= significant at 0.01 level of probability, CR = Crop Residue, L = Crop Residue Level, M = Mulching method

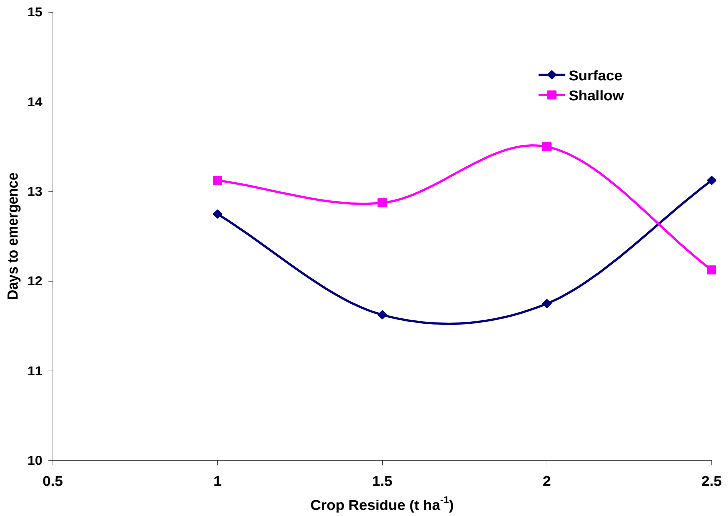

Figure 1. Influence of crop residue application method (M) and its levels (L) on days to emergence of wheat.

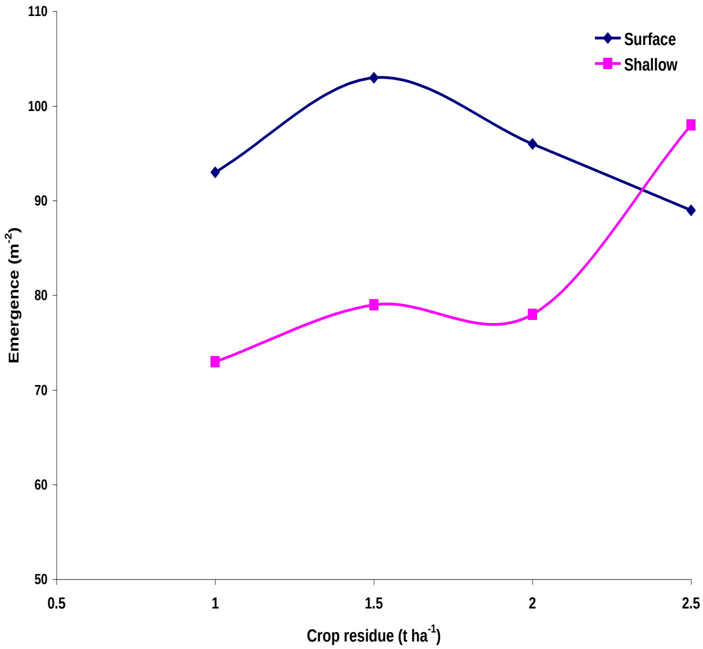

Figure 2. Influence of crop residues application method (M) and its levels (L) on emergence m^{-2} of wheat.

Weeds weight

Data regarding on weeds weight m^{-2} are shown in Table-3. Analysis of data showed that the crop residues and its method of application had significantly affected weeds weight m^{-2}. Whereas crop residues levels had non-significant effect on weeds weight m^{-2}. The interactive response of crop residues x method of application (CR x M) was significant. However all other interactions crop residues x level (CR x L), crop residues x method of application x level (CR x M x L) and method of application and level (M x L) were non-significant. The difference between control and mean of the rest treatments was significant.

Control treatment had lower weeds weight m^{-2} (25.80) as compared to rest (42.20). The higher weeds weight (53 g) by using guar crop residue compared to maize residues (31g). Surface application method of crop residue had less number of weeds weight m^{-2} (35 g) as compared to shallow application of crop residues (49 g). The interaction between crop residues x method of application (CR x M) showed that maize with surface method resulted higher weeds weight m^{-2} (119 g) as compared to maize with shallow method of application (106 g). Guar crop residues resulted higher weeds weight m^{-2} (135 g) than shallow method of application of crop residues (126 g).Fewer weeds were found in plots where maize residues were used by surface application method. While by using guar residues by shallow methods gives more weeds in wheat plots. These results are agreed with Ferors and Goldhammer (1991) who found that by application of surface mulch, soil moisture was conserved, and vegetative growth period increased and weeds decreased. The interaction between crop residues x method of application (CR x M) showed that maize with surface method resulted higher weeds weight m^{-2} as compared to maize with shallow method of application.

Days to physiological maturity

Data regarding days to physiological maturity are presented in Table-3. Crop residues had significantly affected days to physiological maturity, whereas crop residues levels and application methods had no significant effects on days to physiological maturity. The interactive responses of crop residues x method of applications (CR x M), method of application x level of crop residues (M x L) and CR x M x L and CR x L were found non-significant. The difference between control and mean of the rest treatments was non-significant.

Table-3. Weeds weight and days to physiological maturity of wheat as affected by crop residues, levels and applications methods

Crop residue (CR)	Weeds weight m^{-2}	Days to physiological maturity
Maize	31	146
Guar	53	147
Significance level	**	**
Crop residue levels (L) t ha^{-1}		
1.0	38	147
1.5	44	147
2.0	45	147
2.5	42	146
LSD (0.05)	ns	Ns
Methods		
Surface	35	147
Shallow	49	147
Significance level	**	Ns
Planned mean comparison	Significance level	
Control vs rest	*(Fig. 8)	Ns
Control		146
Rest		147
Interactions	Significance level	
CR x M	**	**
CR x L	ns	Ns
M x L	ns	*
CR x M x L	ns	ns

ns (non significant), *(significant at α = 0.05), **(significant at α = 0.01)
CR = Crop Residue, L = Crop Residue Level, M = Mulching method

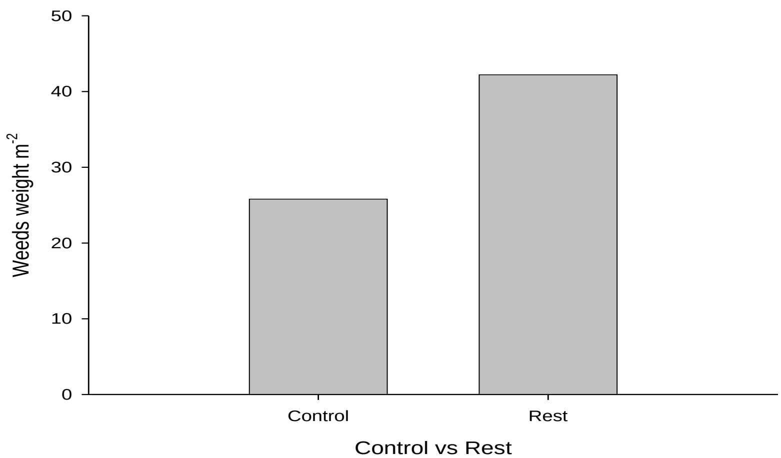

Figure 5. Comparison of weeds weight in control and rest treatments for wheat

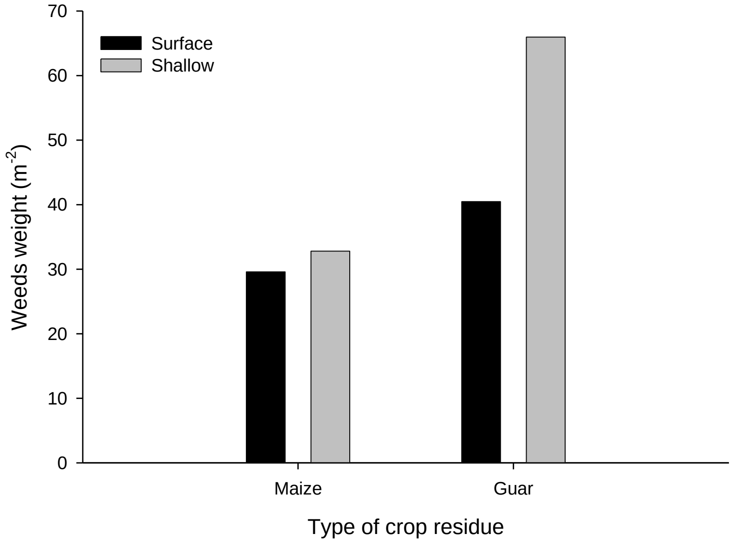

Figure 6. Influence of types of crop residue (CR) and its application methods (M) on weeds weight (m^{-2}) of wheat

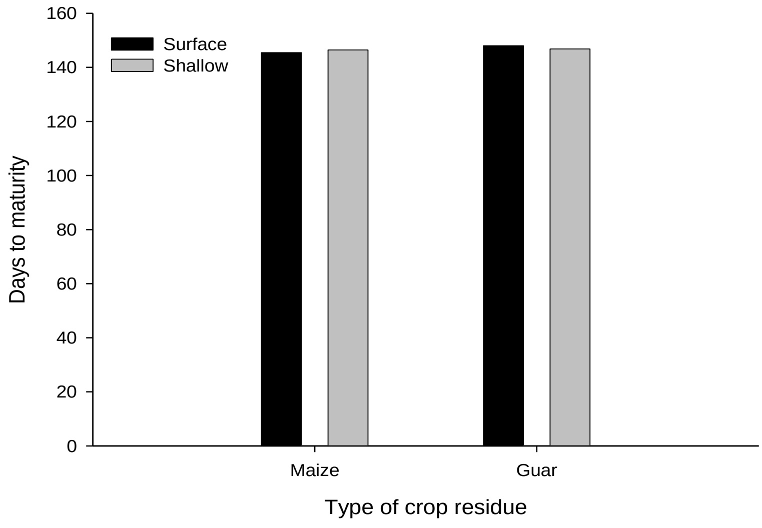

Figure 7. Influence of types of crop residue (CR) and its application method (M) on days to maturity of wheat.

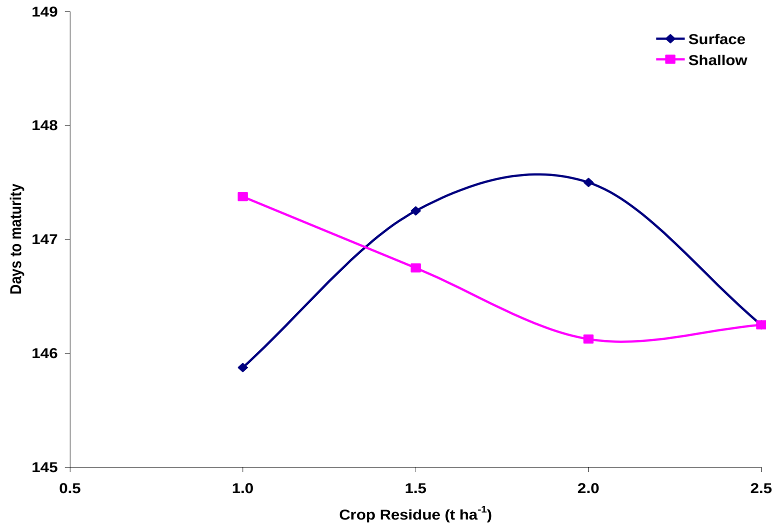

Figure 8. Influence of crop residue application method (M) and its levels (L) on days to maturity of wheat

Maize crop residues enhanced days to physiological maturity (146 days) as compared to guar crop residues which delayed days to physiological maturity (148 days).The interaction between crop residues x method of application (CR x M) indicated that maize with surface application method enhanced days to physiological maturity (145 days) while maize crop residues applied with shallow incorporation delayed days to physiological maturity (146 days). Guar residues with surface method of application delayed days to physiological maturity (148 days) as compared to shallow method (147 days).The interaction between method of application x level of crop residues (M x L) indicated that surface method of application of 1 t ha^{-1} crop residues of maize and guar crops delayed physiological maturity (148 days) whereas shallow application had enhanced the days to physiological maturity (146 days) at the same level of crop residues.

Control plots have early days to maturity as compared to the plots where mulch was used. The results are in contrast with Azam *et al.* (1991) who achieved earlier physiological maturity in plots where residue was added than the plots where no crop residues were used. The interaction between crop residues x method of application (CR x M) indicated that maize with surface application method enhanced days to physiological maturity while maize crop residue applied with shallow incorporation delayed days to physiological maturity. The interaction between method of application x level of crop residues (M x

L) indicated that surface method of application of 1 t ha^{-1} crop residue of maize and guar crops delayed physiological maturity whereas shallow application had enhanced the days to physiological maturity at the same level of crop residues.

CONCLUSION

It is concluded from the results that maize residues give good results than guar residues. Surface application of crop residues significantly affected days to emergence, emergence m^{-2}, weeds weight m^{-2}, enhanced physiological maturity.

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