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Effect of Using Stalk Shredder, Conservation Tillage and Seeding Techniques on Wheat Yield Following Corn Harvesting

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Abstract: This study investigated the effect of using stalk shredder, conservation tillage machines and seeding techniques on soil physical characteristics, seedling emergence, crop establishment and grain yield after corn harvesting in Dezfoul, Khouzestan province. Also soil moisture content, bulk density, cone index, soil mean weight diameter and sowing depth uniformity were recorded. A factorial split complete block design was applied with 3 replications. Treatments were including one pass, twice and no stalk shredder (disk) and tillage treatments including combination tillage and disk in main plots followed by flat and raised bed planting in subplots. Twice stalk shredder leaving 5740.3 kg ha^{-1} corn residue, increased soil moisture content after planting, it was also shown lower clod weight diameter (1.526 cm). The best sowing depth uniformity (44.84%) was the most effect of the stalk shredder treatments. Seedling emergence (89.2%) and yield (2.02%) were increased where combination tillage was applied. Raised bed planting was shown higher seedling and rate of emergence with 72.61 and 3.82% than flat planting, respectively. Therefore, combination tillage followed by twice stalk shredder and raised bed planting were the most beneficial treatments for wheat production under conservation tillage.

Key words: Crop residue, conservation tillage, soil moisture content, cone index, clod mean weight diameter, Khuzestan

INTRODUCTION

These days due to its importance in nourishing, what is considered as a strategic product and in all over the world the most investigations in compare to other products is done on this product. Jarallahi (2000) reported that most of farmers harvest with seed and sell serials and corn's straw and stubble due to its high prices and even in some cases they burn them as obtrusive stubble while in advanced countries in order to improve physical, chemical and biological situations of soil they return all of stews and stubble earned from harvest with combine to the earth after splitting the seed. Physical properties of soil are the main determiners in growing of plant until its emergence (Malhi *et al*., 2006). Furthermore, soil moisture context is governed by soil bulk density and soil covering of crop residue (Cavalaris and Gemtos, 2002). Traffic of agricultural instruments has destroyed pores and increases penetration resistance and consequently the soil bulk density increases (Fuentes *et al*., 2004). Cassel *et al*. (1978) investigated penetration resistance in sand soil under operations of moldboard plow, chisel plow and subsoiler and concluded that penetration resistance in different tillage treatments is meaningful in one percent level. On the other hand soil mean weight of clods diameter is 40 and 50% more in compare with reduce tillage and conventional tillage operation (Mahboubi and Lal, 1998).

Barzegar *et al*. (2004) stated that tillage operation and the way of soil management causes changes in preparation method and soil situation and diversity affects on percent and speed germination of plant but generally wheat reaction to conservation tillage operations is changeable and often its yield is strongly dependent on water, air and soil factors. Therefore, wheat yield with conservation tillage might be higher or lower than conventional tillage (Kirkegaard, 1995). With due attention to specific place of Khuzestan among cereal raising provinces, the lack of organic matters in soil in this province specially in its central and southern parts in order to reduce environmental pollution caused by burning and in the direction of stable agricultural goals, it seems essential to investigate solutions for replacing method of remain burning so that producer's profits conserved and causes increase in the quality of soil and environment.

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MATERIALS AND METHODS

This experiment has been done in agricultural year of 86-87 in Shuhan Olya village and kilometer far from Dezfoul city. The experiment was conducted factorial spilt plat and in the form of completely accidental blocs plan repeated 3 times stalk shedder factor was done in 3 levels (one pass stalk shredder, twice stalk shredder and no stalk shredder disk), tillage in two levels (combination tillage and disk) in the form of factorial in main plots and sowing factor in 2 levels (flat and raised bed planting) in sub plots. The parameters under the study in this plan were amount of crop residue remains, weight moisture percent, soil bulk density, con index, soil mean weight diameter, sowing depth uniformity, percent and speed germination, yield and its components.

RESULTS AND DISCUSSION

Table 1 shows that stake shredder and its interaction effect in the amounts of crop residue reaming on the soil surface in tillage has become significant in 1% level. Stalk shredder effect is in a way that despite of the tillage effect not significant, it has been caused that the interaction effect of stalk shredder in level 1% is significant. Comparison of tillage different levels showed that no stalk shredder (disk) leaves about 40% more remains as compared no stalk shredder. The reason is that in the first transitions disk is only able to eradicate the remains but it does not have the ability to bury them while stalk shredder shreds remains easily and in compare to disk it bury them more. When remains reach to less than half, soon it become analyzed and quickly gives nutritive matters to the plant (Bahrani *et al*., 2007).

No stalk shredder treatments (disk) accompanied by disk allocated to it self he most amount of left remains on the earth surface in compare other treatments with the average about 65%. No stalk shredder treatment (disk) accompanied by disk with the average about 65% allocation to itself the most amounts of left remains on earth surface in compare to other treatments (Fig. 1). This result also shows that the 2nd time of transition of disk has not been able to bury remains with too much length. Figure 2 shows that in all depth of sampling the higher percentage of moisture have been related to treatment with no stalk shredder (disk) which leaves more amounts of remains on soil surface in compare with other treatments. These remains operate as an obstacle in soil surface and causes runoff decrease and more penetration of water in soil and consequently increase in soil weight moisture average (Ulger *et al*., 1993). Result of the analysis of average variance of clods thickness

Table 1: Crop residue before planting analysis of variance

		Crop residue on the soil before planting	
Source of differences	df	F	MS
Replication	2	0.01^{ns}	15530.46
Stalk shredder	2	42.32**	54183321.58
Tillage	1	2.87^{ns}	3669200.94
(T×C) Interaction	2	21.72**	27810490.07
Error	10	-	1280422.93
CV	-	16.16	-

Significant differences at the level of 5 and 1% and no significant differences *,**, ns, respectively

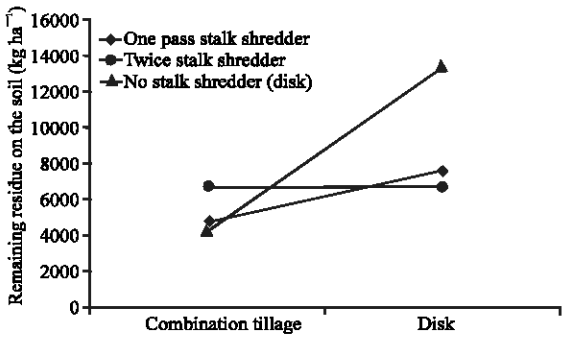

Fig. 1: Interaction effects on stalk shredder and tillage on remaining residue before planting

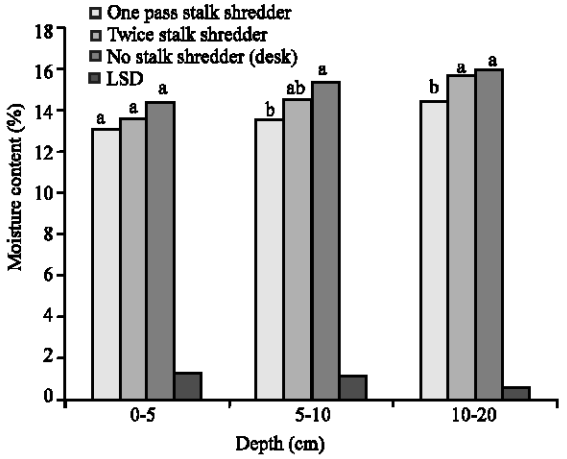

Fig. 2: Effect of stalk shredder on moisture content before planting

and soil cone index (Table 2) shows that main and interaction effects on the weight average of mean weight diameter clods has been significant. Mahbubi and Lal (1998) are also agreeing with interaction effect of different tillage methods on mean weight diameter clods. Also the main effect of stalk shredder and tillage on the soil cone index has not been significant before sowing. This no significant difference has been observed about soil bulk density. The findings of Roozbeh and Pooskany (1382) have shown that no significant difference in different

Table 2: Mean weight diameter and soil cone index analysis of variance

		Mean weight diameter ($Mg\ m^{-3}$)			Soil cone index (Mpa)	
Source of differences	df	F	MS	df	F	MS
Replication	2	2.96^{ns}	0.115	2	0.39^{ns}	0.02
Stalk shredder	2	13.75^{**}	0.534	2	3.12^{ns}	0.15
Tillage	1	58.47^{**}	2.270	1	2.47^{ns}	0.12
(T×C) Interaction	2	20.13^{**}	0.781	2	13.25^{**}	0.64
Error	10	1.59^{ns}	0.039	10	5	0.05
Depth sample	1	134.70^{**}	3.290	6	784.1^{**}	7.55
(T×D) Interaction	2	88.91^{**}	2.170	12	7.74^{**}	0.08
(C×D) Interaction	1	14.75^{**}	0.360	6	1.71^{ns}	0.03
(T×C×D) Interaction	2	6.61^{*}	0.161	12	14.32^{**}	0.14
Error	12	-	0.024	79	-	0.01
CV	-	9.12	-	-	-	10.23

Significant differences at the level of 5 and 1% and no significant differences *,**, ns, respectively

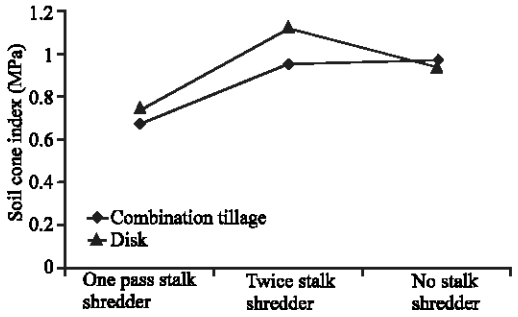

Fig. 3: Interaction effect of stalk shredder and tillage soil cone index

tillage methods of wheat on the soil cone index up to depth of 30 m. On the other hand tillage operation rather in the same depth in all treatments is a reason of not significant of factors under study on the soil cone index. Twice stalk shredder and no stalk shredder (disk) shred soil 21-41% more in compare to one pass stalk shredder. The existence of more remains on the soil surface in disk treatment could be a reason of existence larger clods on the soil (Wuest *et al*., 2008). High working speed combination tillage cause decrease in the mean weight diameter clods compare to disk. The depth of 0-5 cm has allocated the most amount of mean weight diameter of clods to itself.

The reason is that during tillage operation clods are created as the result of soil sectional fracture operation. Smaller clods more among larger ones as the result of gravity force and they go to lower depths and separation phenomenon occurs. Therefore, it is logical that clods located in lower depths have smaller weight average diameter. This result is conforming to Madeira *et al.* (1998) findings. One pass stalk shredder accompanied by disk allocated the most amount (2.07 cm) and twice stalk shredder accompanied by combination tillage, the least amount (0.99 cm) of mean weight diameter clods. These results are conforming to Sing and Panesar (1991) findings. Interaction effect of stalk shredder in tillage has became significant on soil cone index in level 1%. The highest cone index (1.11 Mpa) is related to twice stalk shredder treatment with disk (Fig. 3). It seems that one more movement if tractor has caused more compression in soil and consequently increase cone index of soil. The findings of Fuentes *et al.* (2004) is a reason to confirm this issue. The other reason could be stated as better operation of tillage compare to disk.

After twice stalk shredder tillage operation with combination tillage could decrease soil penetration resistance more compare to disk. Also it seems that whatever mean weight diameters of colds is larger for the reason or soil pores, cone index would decrease and with decrease in mean weight diameters of colds, soil cone index would increases (Roozbeh and Pooskany, 1382). The least amount of cone index (0.671 Mpa) is related to one pass stalk shredder accompanied by combination tillage of course, it does not have much difference with one pass stalk shredder accompanied by disk. With increase in depth, cone index increase was observed too.

The results of the analysis of variance of stalk shredder, tillage and sowing method on depth of planting uniformity shows that stalk shredder with probability of 95% has a significant effect on depth uniformity but all other factors have not have significant effect on depth uniformity.

The reason could be that different levels of tillage which affects shredding and distribution of corn remains, could affect sowing depth. Also, Carr *et al.* (2003) stated that when previous crop product remains distribute non uniformity, holding a uniform and proper sowing becomes difficult which may cause sprouting and seed weak settlement, slow growing growth and consequently decrease operation.

Twice stalk shredder with the average 44.84% allocated the higher seed settlement depth uniformity in soil to itself. After that one pass stalk shredder and no stalk shredder (disk) are settled in order with average of 39.65 and 29.93% (Fig. 4).

Sowing method in level 1% has shown significant effect on emergence speed. Sowing on mound has followed increase in temperature and quicker warming of soil which its consequence is speed increase and emergence percent. Moreover, using of two types of sowing machine has its own effect on physical factors of soil and causes significant differences between sowing method treatments on speed and emergence percent. (Barzegar *et al*., 2004). Also it seems that utilization of sowing machine equipped with shaper in mound surface and planted near seed location, leaves fewer remains and

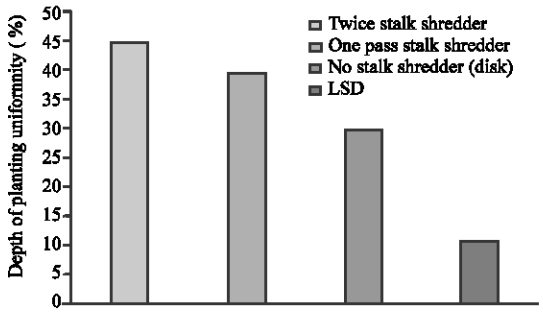

Fig. 4: Effect of stalk shredder on depth pf planting uniformity

causes quicker soil warm and seed germination. Interaction effect of stalk shredder in tillage on emergence percent (Fig. 5) shows that twice stalk shredder accompanied by combination tillage and disk to themselves in order with the average of 89.5 and 78.9% allocated highest percents of emergence to themselves. Generally, it could be said that those treatments in which twice stalk shredder is supplied have had higher emergence percent and no stalk shredder treatments (disk) lower emergence percent.

The reason could be know as effect of twice stalk shredder on uniform and better shredding of corn remains, being less the mean weight diameter of clods, seed better situation and sowing depth uniformity and consequently increase of speed emergence in these treatments. Findings of Finlay *et al.* (2003) is also reason on these consequences confirm. It is observed that combination tillage accompanied by flat planting allocated to itself the most yields with average of 4692.96 kg in hectare (Fig. 6). Being higher the amount of spike in square meter in this treatment. Also emergence percent in this treatment is higher than other treatments.

Although, it have not has significant differences on emergence percent it could be observed that this slight differences causes no significant of the interaction effect on tillage in sowing method on yield performance of seed. Day *et al.* (1976) when investigated the effect of two methods of sowing in flat surface and raised bed planting on wheat yield, observed that sowing method and mount of seed in hectare does not have any effects on the amount of spike in square meter while Hossain *et al.* (2004) stated that amount of spike in sowing on the mound method is more than flat sowing method.

The reason could be that raised bed planting has more access to environmental factors in compare to flat planting. Combination tillage treatment with flat planting with average of 471 spikes in square mete r allocated the

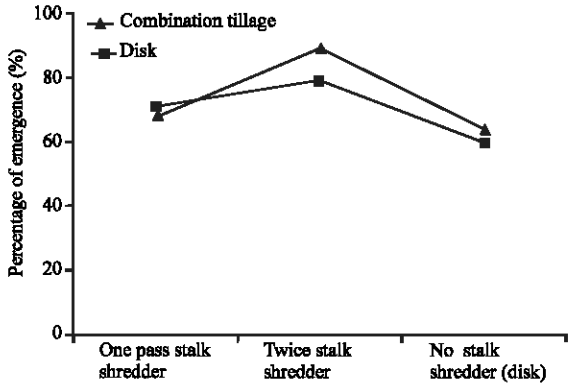

Fig. 5: Interaction between stalk shredder and tillage on emergence percentage

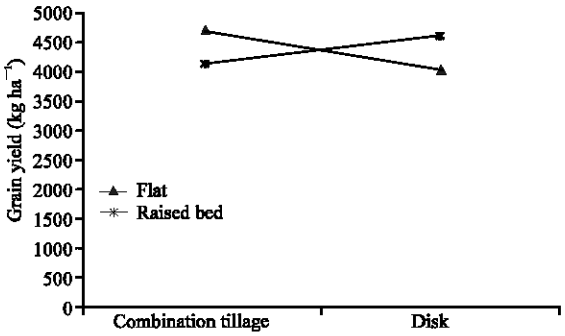

Fig. 6: Interaction effect of tillage and planting methods on grain yeild

Table 3: Effect of comparison mean stalk shredder on 1000 grain weight

Stalk shredder	1000 grain weight (g)
Twice stalk shredder	30.312[a]
No stalk shredder (disk)	30.077[a]
One pass stalk shredder	28.58[b]

Similar lsetters on each column shows significant statistical difference ($p \geq 0.05$)

higher amount to itself. Different levels of stalk shredder in level of 1% have a significant effect on thousand seeds weight Table 3.

This is related to the change in soil moisture content under different levels of stalks shredder. Twice stalk shredder with the average of 30.312 gr has allocated to itself the heaviest weight of 1000 seeds which this treatment has not significant difference with no stalk shredder treatment (disk) with the average of 30.077 g but with one pass stalk shredder with the average of 28.581 with 99% probability it has significant difference (Table 3). It seems that the small size of colds (1.53 cm) and penetration resistance lowness (1.53 mega pixel), higher speed and percent emergence in twice stalk shredder treatment causes increase of 1000 seeds weight in this treatment.

CONCLUSION

Twice stalk shredder with leaving 5740.3 kg in ha from wheat remains and a significant effect on the average of soil weight moisture after sowing and lowest mean weight diameter of colds (1.526 cm) and the higher percent of sowing depth uniformity (44.84) has been identified as the most appropriate stalk shredder treatment. Combination tillage with effect on cone index decrease and 89.2 emergence percent and 2.02% yield increase in compare to disk has settled on the upper location.

Raised bed planting had in order 72.61 and 3.82% and speed emergence in compare to flat planting. Therefore, twice stalk shredder in combine with combination tillage and accompanied by sowing method in the from of raised bed planting was known as the best treatment in this area for conservation and improvement of the soil quality and for gaining higher percentage and speed emergence and in long period of time for higher yield acquisition.

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