

## **Impact of Straw Mulch Application on Runoff and Wheat Yield in Rainfed Hillslope Areas in Zanjan, Iran**

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### **Summary:**

The unsuitable cultivation operations such as plough in parallel to slope direction accelerate soil erosion especially in hillslopes of arid and semi-arid areas. In this paper is attempted to evaluate the impact of straw mulch application after cultivation of wheat at three different slopes in rainfed areas in a part of the Zanjan plain in a crop year. For this purpose the standard plots were established in three slopes of 11, 16 and 30 %. Then two treatments of with and without of straw mulch were applied with three replications. In all of the plots the plough were done in parallel to the slope direction. During the study period delivered runoff was measured in five rainfall events. Statistical analysis of two tillage experiments showed that application of straw mulch decreased delivered runoff from plots and increased wheat yield significantly. Increasing of wheat yield was about 30 % compared to without mulch application. The amount of runoff among slope treatments did not show significant differences. But, this case for wheat yield was significant. The analysis of detailed data from plots demonstrated that application of straw mulch can decrease the slope steepness effects on runoff of hillslopes in semi-arid areas.

### **Introduction:**

Water for dry land crop production is supplied by precipitation. Specially, in arid and semi-arid regions the precipitation is limited and erratic, and sufficient precipitation is seldom received during a growing season for a crop to produce at its potential (Willis, 1983). In addition, most of rainfall events are either occurred small or high intensity that result in fertile topsoil removal by runoff especially in the land of ploughed parallel to the slope direction. This phenomenon accelerates soil erosion by water especially on hillslopes in arid and semi-arid areas, such as most of rain fed lands in Iran, so in both cases results in little water storage in soil (Shangning and Unger, 2001). Nikkami et al. (2005) showed that the perpendicular

plough to slope direction reduced soil erosion in all slope classes significantly. In such areas, those undesirable effects can be reduced by operation of corrected management method such as usage of straw mulch. Much researchs, under both field and laboratory conditions, have shown that use of a surface organic (straw) mulch can result in storing more precipitation water in soil by reducing runoff (Smika and Unger, 1986; Rao, et. Al., 1998; and Schertz and Kemper, 1998). But there is little information regarding a straw mulch how much can affect on runoff in hill slope cultivated land. In this survey the effect of application of straw mulch on runoff and wheat yield in three slope classes were investigated.

### **Methods and Materials:**

The study area is located in north-west of Iran. The most of the plain is under rain fed farming, fallow and abandoned lands. The plain has been occupied by quaternary deposition with low top soil depth and poor fertility. The climate of the study area is Mediterranean, with hot summers and cold winters that is typical of the semi-arid area in Iran. Mean annual rainfall is about 297 mm and approximately 50 percent of the total precipitation falls during March to May with 15, 18.1 and 15.2 % respectively. The elevation of the study area is about 1800 m above sea level. The topsoil is loam with 10-20% gravel that changes with the depth to sandy loam with 40-50% gravel.

The 18 standard plots (22.1 \* 1.8 m) with tanks at the end of each plots for collecting the runoff were stabilized (Fig. 1) in three slopes classes of 0-12, 12-20, and 20-40 % . Then two treatment with and without application of straw mulch were done with three replicates in the split plot format on the base of RCB design. The plough were done in parallel to the slope direction at all of the plots. After wheat cultivation, on the half of plots (9 plots), straw mulch



Fig 1: The tanks for collecting runoff



Fig 2: Plots with and without mulching

was applied uniformly by hand on the whole of plot surface (Fig.2). Rate of mulching was five t ha<sup>-1</sup> in all plots. After each rainfall events, the amount of runoff was measured. In the end of growing season the wheat yield was harvested and the grains weighted.

## Result and Discussion:

During the study period the delivered runoff were measured for six rainfall events. The comparison of two tillage experiments showed that in mulching plots runoff depth was decreased by 19.6, 17.9, and 3.3 time and increased wheat yield by 57.5, 23.4, and 25.8 % relate to without mulch at three slope classes 0-12, 12-20, and 20-40 % respectively. In total, the application of straw mulch decreased runoff by 6.5 time and increased wheat yield about 37.2 % compared to without mulching.

Table 1: Total delivered runoff regarding to six rain fall events from three replicants for two treatments of with and without mulch application in three slope classes

Date of Rainfall	Runoff (lit)					
	Slope class 0-12 %		Slope class 12-20 %		Slope class 20-40 %	
	Without mulch	With mulch	Without mulch	With mulch	Without mulch	With mulch
29/4/2005	1.31	0	0.19	0	105.4	44
6/5/2005	1.48	0	0.18	2.31	11.6	1.26
16/5/2005	23.9	0.4	50.4	0.93	63.3	74.4
17/5/2005	0	0	0	0	2.06	0.38
26/5/2005	93.6	4.7	100.8	3.79	14.5	3.62
31/5/2005	248	13.7	296	17.9	344.8	41.2
<b>Total</b>	<b>368.3</b>	<b>18.8</b>	<b>447.6</b>	<b>25</b>	<b>541.7</b>	<b>164.9</b>

The statistical analysis in SAS program environment showed that differences between two treatments of with and without application of straw mulch for runoff and wheat yield was significant at 1 % level. Also, the differences between slope classes due to runoff were not significant. It seems that differences of rain falling for each slope classe cause in this result. But these differences for wheat yield was significant at 1 % level.

Table 2: Analysis of variance for runoff

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Block	2	3532.1390	1766.0695	0.21	0.8168
A	2	33700.9742	16850.4871	2.00	0.2163
Block*A	4	39563.2056	9890.8014	1.17	0.4095
B	1	640598.8050	640598.8050	75.95**	0.0001
A*B	2	4756.8096	2378.4048	0.28	0.7637
Error	6	50605.5765	8434.2627		
Corrected Total	17	772757.5099			

A: slope classes, B: treatment with and without application of straw mulch, \*\*: significant at 1% level

Bhatt and Khera (2005) also found that compared with non mulching, mulch spread over whole plots reduced runoff by 33%, and reducing maximum soil temperature, helped in conserving soil moisture. Shangning and Unger (2001) found that use of a mulch such as wheat straw on the soil surface is beneficial for controlling evaporation and conserving water by decreasing the initial evaporation rates and increasing the movement of water into the soil.

### **Conclusion:**

As a result, usage of straw mulch decreased runoff and increased wheat yield in all slope classes. It seems that these results to be due to storage of soil water and it's conservation relate to precipitation amount and PE, and also relate to soil properties especially it's texture, depth and amount of organic matters. It means that in equal conditions for rain fall and evaporation, capability of soil for absorption and conservation of water can play the important role for a crop to produce at its potential.

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