Water use efficiency of maize under different managements of crop residue and tillage

Mohammad Esmaeil Asadi

Department of Agricultural Engineering Research, Agricultural and Natural Resources Research Center of Golestan Province, Gorgan, Iran

iwc977127@yahoo.com

http://www.ganrrc.org.ir

Abstract

A field experiment was conducted to determine the water use efficiency (WUE) of silage maize variety SC704 in Golestan Province, which is situated in south east of Caspian Sea, north part of Iran in 2010 and 2011. The experiment was laid out in a randomized complete block design with strip plot arrangement where each treatment was replicated three times. Wheat residual treatments were kept as main plots and tillage treatments as sub plots. Wheat residue treatments were burnt management referred to as R1, 50% residue (R2), and 100% residue (R3). Tillage treatments were conventional tillage (T1), reduced tillage (T2) and no tillage (T3). Border irrigation was used for all plots.

Yield and yield components, water consumption and finally WUE of irrigation water were measured and determined. The results imply that the highest and lowest average water consumption during the growing season was R1 and R3 treatments, respectively with 3737.9 and 2968.7 m^3 ha^{-1}. The higher water volume used in R1 treatment can be attributed to evaporate more moisture from the soil surface. The research also revealed that maintaining crop residues can improve yield and WUE of silage maize significantly. The lowest and the highest value of WUE were R1 as7.2 and R3 as10.2 kg m^{-3} respectively.

Introduction

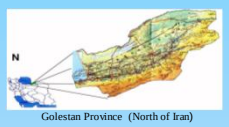
Crop residues (straw of wheat) are generally burned immediately after harvest to facilitate seedbed preparation for the succeeding crops (Maize, soybean and rice). In recent years, the popularity of conservation tillage, including zero or no-till, has grown steadily in all over the world because of reduced cost and improved soil conservation. In 1999 no-tillage farming, synonymous of zero tillage farming or conservation agriculture, was adopted on about 45 million ha worldwide, growing to 72 million ha in 2003 and to 111 million ha in 2009, corresponding to an growth rate of 6 million ha per annum (Derpsch et al., 2010).

No-tillage and other conservation practices can increase grain WUE and yields (Wiese et al., 1998; Norwood, 1999, 2000).

Objectives

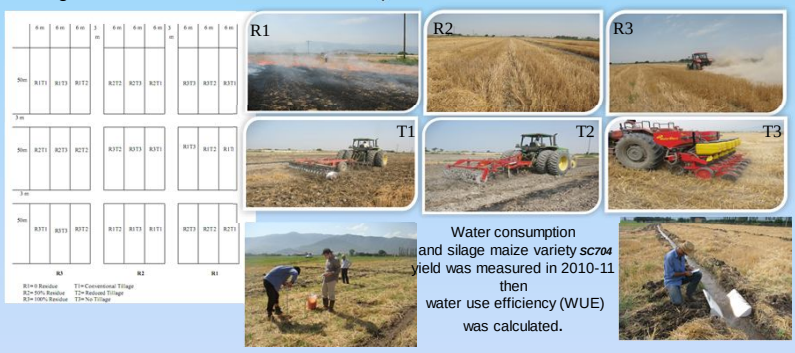
Goals were to use conservation tillage to preserve water used for irrigation, increase the water productivity, and alleviate the environmental impacts of conventional tillage methods and surface irrigation such as increased soil water evaporation, runoff and erosion.

Materials and Methods



Golestan Province (North of Iran)

The experiment was laid out in a randomized complete block design with strip plot arrangement where each treatment was replicated three times.



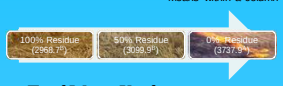
Water consumption and silage maize variety *SC704* yield was measured in 2010-11 then water use efficiency (WUE) was calculated.

Results

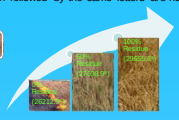
Different Tillage Managements

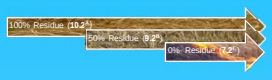
Tillage	Yield (kg)	Volume of water (m^3)	WUE (Kg. m^{-3}. ha^{-1})
T1	29122.3^{A}	3200.3^{A}	**9.6**^{A}
T2	28457.2^{A}	3283.7^{A}	**8.8**^{AB}
T3	25927.8^{B}	3322.5^{A}	**8.1**^{B}

Means within a column followed by the same letters are not significantly different (P < 0.05).

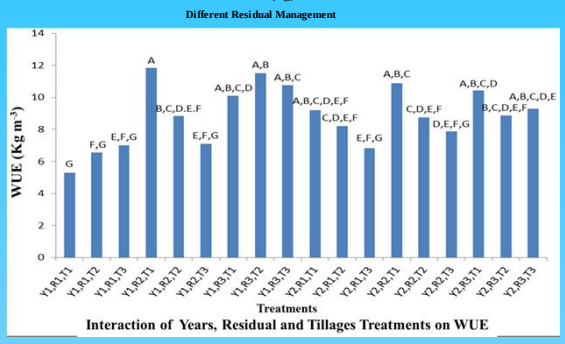


Total Water Used (m^3)


Yield (kg)



WUE (kg m^{-3})



Conclusion


The results revealed that it is recommended to use conservation tillage (no till and reduced tillage) keeping crop residues to obtain highest crop water use efficiency of maize and highest yield in the irrigated area, especially in the areas that are under water scarcity conditions.


Traditional wheat filed straw burned after harvest resulted in the smallest amount of WUE suggesting that the practice of burning crop residues has potential to reduce the soil water content and soil organic matter in the long term.


The greater amount of WUE in 50 and 100 residues retained and conservation tillage suggests that these treatments, over a time, will achieve the greatest soil productivity. Based on this experiment, retaining straw as stubble on the soil surface is recommended for long-term sustained productivity and less variable costs.


Continuous no-till needs to be managed very differently in order to keep or increase yield on the field. Residue, weeds, equipment, crop rotations, water, disease, pests, and fertilizer management are just some of the many details of farming that change when switching to no-till.


The main problems to adoption of conservation tillage continue to be, knowledge on how to do it (know how), mindset (tradition, prejudice), inadequate policies as commodity based subsidies, availability of adequate machines and availability of suitable herbicides to facilitate weed management.


These difficulties and worries must be overcome not only by farmers but also by agricultural researchers, extension experts, university professors, politicians and all stakeholders involved in the farming industry if a greater adoption is aimed to be achieved.

References

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please don't burn me

Let's stay on the soil surface