

NOT FOR PUBLICATION

The contents may not be cited  
without the permission of authors  
concerned.

INTERNATIONAL CONGRESS ON DRYLAND

FARMING

SUMMARIES OF INVITED PAPERS

&  
WORKING PAPERS

VOLUME I

To be held at The Playhouse  
Adelaide Festival Centre,  
Adelaide. S.A.

25th August to 5th September, 1980

ADELAIDE  
SOUTH AUSTRALIA

1980

MINIMUM AND NO-TILLAGE FALLOW FOR WINTER WHEAT PRODUCTION IN THE  
CENTRAL GREAT PLAINS

D. E. Smika

USDA Central Great Plains Research Station, Akron, Colorado 80720.

Under the normal dryland production conditions in the semi arid Central Great Plains, water (less than 500 mm annual precipitation) is generally the factor limiting production which has made the use of fallow a necessity.

Minimum tillage fallow has been practiced in the Central Great Plains for four years and currently is applied on an estimated 10% of the fallow acres. Research on this practice has shown that it provides soil and water conservation and production that are superior to any complete tillage system (1, 2). No-tillage fallow has been included experimentally for several years (1, 2) but the practice has not been accepted to any extent by farmers.

With the minimum tillage system the most widely used practice is to apply the residual herbicide in conjunction with appropriate contact herbicides immediately after harvest (7-10 days) and when the residual herbicide is no longer effective for controlling weeds, subsurface tillage is used for weed control. This requires an average of two operations in the approximately last 60 days before seeding. This is superior to complete tillage but does create excessive drying of the seed zone soil at a time when the expectancy to receive rain is very low.

To determine when tillage can be performed during fallow which results in the most optimum soil water storage and seedbed-seedling establishment conditions, a study was initiated in 1974. Treatments compared to conventional stubble mulch were: tillage immediately after harvest followed by residual herbicide plus contact herbicide application followed by contact herbicide as needed (tillage + herbicides); residual herbicide plus contact herbicide immediately after harvest followed by tillage as needed (herbicide + tillage); and residual herbicide after harvest plus contact herbicide followed by contact herbicide as needed (no-till). A summary of the results to date is presented in the following table.

Variable measured	Unit	Fallow treatment			
		Conventional tillage	Tillage + herbicide	No tillage	
Soil water storage	cm	15.0	18.3*	17.7*	21.2*
Storage efficiency	%	36.0	41.6*	40.0*	49.0*
NO <sub>3</sub> -N at seeding	kg/ha	72.8	89.7	70.9	101.5*
Grain yield	Quintals/ha	25.5	27.9*	28.0*	29.6*
Straw yield	kg/ha	4830	5350*	5210*	5320*
Water-use-eflic.	Quin/ha/cm	0.64	0.67	0.67	0.69
Protein of grain	%	12.4	12.9	12.6	13.1*
Nonerodible aggreg.	%	64.2	68.1*	68.1*	69.4*

\* Denotes significant difference from conventional tillage (P = 0.05).

From the data in the table it can be readily seen that both of the minimum tillage systems have very similar soil and water conservation and production capabilities. However, both are better than the conventional stubble mulch treatment. The no-tillage treatment was superior in all measurements when compared to any of the other treatments.

Of the results obtained, the no tillage treatment made the most efficient use of the water received during both the fallow period and the crop growing period. When one considers the fact that during the fallow period 30% of the precipitation comes in amounts of 0.65 cm or less from which storage is difficult to achieve, the 40% fallow period storage efficiency leaves on 20% of the useable water (8.1 cm) that was not converted to crop production. With conventional stubble mulch tillage 36% of the useable water (14.6 cm) is not converted to crop production. The minimum tillage system converted all but 12.2 cm of the useable water to crop production.

The Great Plains is an area where wind erosion is a constant threat to the production of winter wheat. Therefore the production of residue serves a two-fold role in the control of soil erosion by wind. One role is the actual protection provided by the residue itself. For this purpose the amount of residue required ranges from 1050 kg/ha for medium to fine textured soils to 2450 kg/ha for coarse textured soils. Under conventional stubble mulch tillage, approximately 75% of the residue is destroyed by either natural causes or by the tillage operations. Therefore, in many years on some soil types there is not sufficient residues for soil protection. With no-tillage the natural losses of residue are in excess of 25% and frequently approach 40% of the residue present. Therefore, residue production is essential for wind erosion control. The other role of residue for wind erosion control is that residue is a source of lipids which serve as bonding agents to form aggregates that are large enough in size to not be subject to movement by wind. The data (see table) shows a significantly higher percentage of nonerodible aggregates with minimum and no-tillage treatments than is present with conventional tillage. This is directly attributed to the higher quantities of residue that are present in these systems.

In addition to the soil and water conserving benefits from the use of minimum and no-tillage for winter wheat production there has consistently been a grain yield advantage. This results in greater return to the farmer at no increased expense to the farmer. Thus, in conclusion when minimum and no-tillage fallow are properly managed there are numerous advantages when compared to conventional stubble mulch fallow.

#### References

- Good, L.G. and D.E. Smika. (1978). Chemical fallow for soil and water conservation in the Great Plains. *J. Soil & Water Conserv.* 33: 89-90.
- Wicks, G.A. and D.E. Smika (1973). Chemical fallow in a winter wheat-fallow rotation. *J. of Weed Sci. Soc. of Am.* 21: 97-102.