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How Burning and Other Methods of Removing Irrigated Crop Residues Affect Yields and Soils (1981)

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How Burning and Other Methods of Removing Irrigated Crop Residues Affect Yields and Soils.[1]

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Burning crop residues has long been discouraged for many reasons. It pollutes the air, leaves the soil surface exposed to wind and water erosion and possibly volatilizes some nitrogen at the time of burning. Now, with crop residues proposed as a source of energy, we need to know how residue removal affects not only crop yields but also soil physical and chemical characteristics.

Several methods of managing residues have been studied for ten years at the Garden City Experiment Station. The treatments included removing the residue: 1) by burning; and 2) by physically removing as much top growth as possible; and incorporating either normal or twice normal quantities of residue. In addition, nitrogen was applied at 50 and 100 lb/A rates.

Yields did not differ significantly the first eight years of the experiment (Table 1). However, in the past three years removal and burning treatments have begun to produce lower yields than the other treatments. In 1979, yields from the two plots with residue removed were lower than from plots with residues incorporated. These results are consistent with other experiments which indicate that it may take as long as ten years to begin to observe yield reductions from burning.

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The plots were sampled to a depth of 6-feet in the fall of 1979 to evaluate the soil chemical properties under these management practices. Chemical analyses included pH, organic mater, P, K, Zn, Na, Mg, and Ca on the surface 6 inches and residual NO_3^- and total N on the entire 6 foot profile. Analyses of the data showed no differences in P, Zn, Na, Mg, or Ca due to the residue management treatments. However, there were significant differences in pH, organic matter (O.M.) and potassium (K) (Table 2).

Table 1. Effect of residue treatment on yields of winter wheat.

Residue Treatment	Yield: Avg. 1971-78	Yield: 1979
	(bu/A)	
Normal Residue Incorporated	66	74
Physical Removal	66	67
Twice Normal Residue Incorporated	65	72
Burning	66	71

Table 2. Soil pH, organic matter (O.M.) and potassium (K) as affected by 10 years of residue removal or incorporation.

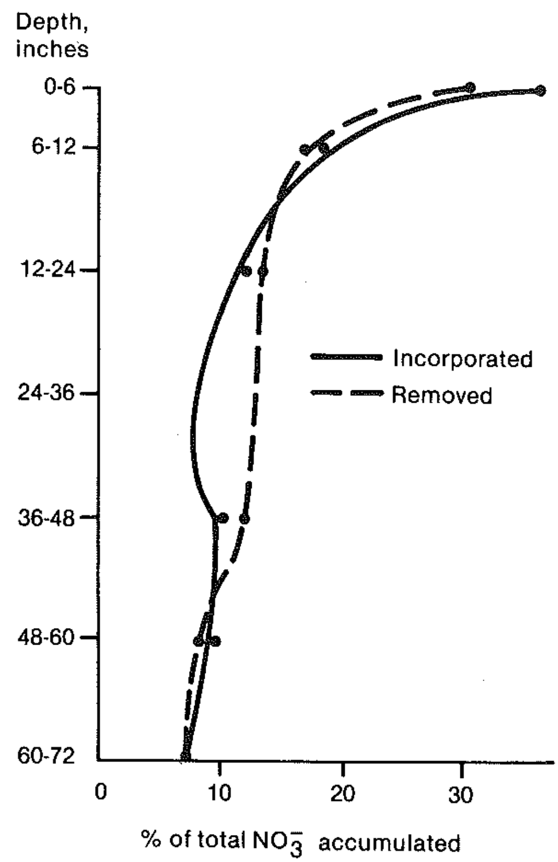
Residue treatments	pH	O.M.	K
		%	lb/A
Normal Residue Incorporation	7.65	1.8	1182
Physical Removal	7.70	1.7	1120
Twice Normal Residue Incorporation	7.60	1.9	1198
Burning	7.80	1.7	1100

Continuously removing residues (physically or by burning) decreased soil O.M. as expected because residues were not being returned to the soil. In addition, pH increased where the residue was removed. Both the pH and O.M. are very important in managing soils. Organic matter helps to maintain stability of soils by acting as a cementing agent for soil particles so granular structure of the surface soil is maintained. Organic matter also supplies some micronutrients needed for plant growth.

Soil pH affects the availability of some nutrients; as pH increases, the availability of nutrients such as P, Fe and Zn decreases. In addition, pH and O.M. are critical in some herbicide programs. The levels found after ten years' burning and removal (Table 2) are approaching these critical levels, so they may affect the rate herbicides are degraded.

Potassium is also declining where residues have been removed (Table 2). This is expected since residues are high in K. However, the concentrations observed in this experiment are still in the very high soil test category and will not limit crop production.

Nitrate-nitrogen (NO_3^--N) analyses showed no statistical differences in the total quantity of this nutrient accumulated in the six-foot profile. However a higher percentage of NO_3^--N has been leached deeper in the physical removal and burning treatments, (See figure below). This may reduce NO_3^- availability to plants if it is leached below the zone of greatest root activity. We attribute the greater leaching to incorporating reduced quantities of residues on the two removal treatments. In these situations there is little tie-up of N during residue decomposition and it remains susceptible to leaching as NO_3^- during high rainfall or irrigation.



Although no immediate deleterious effects on crop yields or soil properties were observed due to residue burning or removal, the continual long-term practice of these residue management treatments will have negative effects on soil pH, O.M., K and NO_3^--N. These changes may eventually have negative effects on crop yields.