Proceedings of the Iowa Academy of Science

Volume 76 | Annual Issue Article 24

1969

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Abstract. Although Iowa farmers have made good progress in applying soil conservation practices, much soil and water is still lost from farm land. Increased acres of row crops with a corresponding decrease in meadow and pasture land has caused concern due to increased erosion by wind and water. The leaving of crop residues on the surface of the soil instead of covering them by plowing can provide good soil protection. Mulch tillage techniques on continuous row cropped land can equal crop rotations with meadow in controlling soil loss. Crop residues left on the soil surface over winter also helps to provide food and some cover for many species of wildlife.

Iowa farmers have made substantial progress in their efforts to control soil and water loss. Many agricultural programs have advanced and conservation practices were applied to many farms over the past years. The application of practices such as contour farming, terraces, and the establishment of grassed waterways have been accepted by Iowa farmers.

In other phases of soil conservation activity, crop rotation practices to control soil and water loss have declined from records previously attained.

Problems. Soil loss caused by high winds has been steadily increasing in Iowa over the last few years. This has been especially noticeable in the north central and northwestern areas of the State. Farms over the entire State that have not been terraced or contour farmed are losing more soil and water. These losses of top soil not only are causing a deterioration of a valuable natural resource but displaced soil particles are causing problems with pollution. Sediment in our water renders it unfit for human use, chokes our streams and rivers, and fills our lakes and reservoirs. Fine soil particles in the air we breathe cause respiratory ailments as well as problems in housecleaning by our homemakers.

ROW CROP ACRES ARE INCREASING IN IOWA

The growing of grass and legumes in crop rotations has been one of the best controls for reducing soil and water loss on cropland. Not only is the soil protected while in grass, but the stabilizing effect of the grass roots in controlling the erodibility of the soil when plowed is well known.

The acreage of corn land in Iowa has remained relatively stable over the last few years, between 10-11 million acres. Since 1955,

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soybean acreages have almost tripled, increasing from slightly over 2 million acres to nearly 6 million in 1968.

During this same period, meadow and pasture land has decreased by nearly 3 million acres. The greatest change in land use has occurred in North and Northwest Iowa. The additional millions of acres of clean-tilled crops are leaving more land exposed to the elements of nature. This is especially true when land is plowed in the fall of the year and left exposed until planting time next May.

Crop Residue on the Soil Surface Versus Meadow in Rotation

Roughage provided by meadows and pastures were once used to feed large numbers of horses and dairy cattle. These roughage-consuming animals have decreased in most areas of the State.

Why Meadows Were Grown on Farms. In addition to maintaining meadows and pastures for livestock feed, farmers planted grass for other reasons. Grass in rotation with corn helped to supply organic matter to the soil. The organic matter produced, together with the dense fiberous root system of the grass plant, improved the structure and porosity of the soil. Both these features help to increase the infiltration of water into and through the soil profile. More rainfall entering the soil means less water run-off. Even after plowing, a furrow slice from meadowland is much less erosive than a furrow slice of soil from a corn or soybean field.

Farmers planted legumes to provide nitrogen for the corn crops that followed. Meadows also helped to control weeds by smothering them as they grew in the field. Weeds are fewer in a field when corn follows meadow. Meadows help break up insect and disease growth cycles for the pests and pathogens that live and prey on grain crops. These and many other reasons are noted as the need for crop rotations in Iowa's agriculture.

Less Need For Meadow Today. Iowa farmers can now buy nitrogen fertilizer for their corn crops much more cheaply than they can grow legumes. Most weed problems can usually be handled by herbicides. Insecticides control most insect pests that prey on corn and soybeans and new crop varieties are resistant to many crop diseases.

If a farmer does not need hay for livestock, only the need to control erosion is left as the reason for growing grasses and legumes in rotation with grain crops. During the present price-cost squeeze, plus the higher return of corn and soybeans, fewer farmers are using meadows for soil protection per se.

Highest Soil Loss in May and June. Clean-plowed land for row crops is vulnerable to erosive action of falling raindrops and to abrasion of running water. It is also left unprotected to the high velocity of prevailing winds until growing plants provide a protective canopy over and between the row, or they grow tall enough to prevent the wind from reaching the soil surface. This protection, depending upon the species of crops planted, does not usually occur until late June or early July. Unfortunately, during this period of little soil protection, the season's most intense and heaviest rainfall occurs. A recent report on research done in Southwest Iowa showed that 50% of the annual rainfall occurred from the time of plowing in April to 60 days after planting. During this same period, up to 95% of the annual erosion occurred. After 60 days of growth, the well-fertilized corn was tall enough to offer soil protection.

Crop Residue on the Soil Surface. If corn, soybeans, or other row crops can be planted in such a way as to leave the residue from the previous crop as a protection of the soil surface, most of the soil loss during this critical period of May and June could be prevented.

Farmers can now purchase machines which will plant corn and soybeans and leave the majority of the crop residue on the soil surface. Some machines prepare a seedbed for corn in the row leaving the area between the rows undisturbed. Others move the residue from the prepared seedbed in the row into the center between the rows. Other machines prepare a seedbed by tilling or shattering the soil beneath the surface without inverting it, therefore, leaving the residue on the soil surface for its protection. One type of tillage that gives less soil protection from the energies of the falling raindrop is one that mixes crop residue into the upper few inches of the seedbed leaving only a small amount on the surface.

Those machines that prepare a seedbed in the row and disturb only approximately one-third of the soil surface can be compared with other machines that either disturb less soil, or tills beneath the surface, leaving residue well distributed over most of the soil. Obviously, less soil loss will occur when more soil is covered with residue.

The amount of residue left on the surface also affects soil loss. Again, the larger quantities save the most soil. It can be concluded that high rates of residue distributed over a larger area of surface will give the most effective protection.

There are, however, disadvantages that can occur when too much mulch is left on the surface during cool moist seasons. This situation can lower yields by delaying germination and slowing growth in early spring. On the other hand, it can be an advantage in a dry, hot season by conserving soil moisture during seasons of temporary drouth.

Effect of Mulch on Soil Loss. If we would compare the estimated soil loss that could occur with continuous corn planted in a conventional manner of plowing, discing, and harrowing as opposed to mulch tilled corn, we could expect the following results.

If conventionally planted continuous corn loses 10 tons of soil per acre per year under a given set of conditions, it is possible to reduce this loss to nearly 3 tons when 5,000 pounds of residue is distributed over two-thirds of the soil area. This would have the same effect in saving soil as would be expected with a 4-year crop rotation which leaves one-quarter of the land in meadow, one-quarter in oats for grain and the balance in conventionally planted corn (CCOM).

If the same amount of residue (5,000 pounds) were more evenly distributed over most of the soil surface, including the corn row, we would expect the soil loss to be reduced to 2 tons per acre per year. This would be equivalent to the soil loss from a 3-year rotation equally divided between corn, grain, and meadow (COM).

It can be concluded that as far as soil loss by water is concerned, that the proper amounts and distribution of crop residue on the soil surface after corn planting can reduce soil loss on continuous corn as effectively as meadows in rotation with corn.

Comparison of Soil Loss With Continuous Corn

Dist. of residue	Mulch Tilled Lbs. Res./Ac.	Soil Loss Ton/Acre	Rotation Equivalent*
Conventionally Planted Corn, No Mulch		10.0	Continuous Corn
2/2 cover	3,500	5.0	C C C O M
2/3 cover	5,000	3.3	C C O M
2/3 cover	6,500	2.5	C C O M M
90% cover	3,500	3.3	C C O M
90% cover	5,000	2.0	C O M
90% cover	6,500	1.0	C O M M M

*C=Corn, O=Oats, M=Meadow

Mulch and Wind Erosion Control. Mulch tillage systems are equally effective in controlling soil loss caused by either wind or water. Generally, less mulch is required to prevent soil movement by wind. Equally important is height of crop stubble, orientation of residue, and roughness of the soil surface. Factors contributing to wind erosion in Iowa include clean fall plowing and dry, windy winter and spring seasons. Fall-plowed soybean land is the most susceptible. Soybeans leave the soil on which they are grown in a condition more vulnerable to erosion by both wind and water.

When plowed in the fall and left unprotected until spring, soil condition for blowing increases. The winter season's effects of freezing and thawing, wetting and drying of the soil surface, break down the clods and furrow ridges into finely divided and small-grained particles which are easily detached and moved away by strong winds.

Soybean land left unplowed until time to plant, with or without mulch tillage principles, usually offers few problems from wind erosion.

Other Benefits from Mulch Tillage

Reduced acres of grass crops, increased acres of clean-tilled crops plus plowing in the fall has other effects on the environment.

Effects of Tillage on Wildlife. Less meadow and tall growing grass on farm land causes pheasants and other ground nesting birds to seek nesting places in other habitats. These other areas are often less desirable. Land plowed in the fall offers little protection and cover during the winter months and little, if any, nesting cover in the spring.

Unplowed cornfields may provide grain all winter long for many forms of wildlife, ranging from meadow mice to Whitetailed deer.

It is conservatively estimated that most cornfields have from 1 to 5 bushels of grain per acre left in the field after harvest. During open winters, most of this grain would be available for wildlife if a mulch tillage program is followed. Sometimes insects, disease, and weather damage will cause more grain to fall to the ground. This will add to the food supply available to wildlife.

Controlled soil loss from cropped fields provides clear water in streams, creeks, and rivers, and also clear waters in ponds, reservoirs, and lakes. This is not only an advantage for fish and aquatic wildlife species, but this also improves the total environment for man because his welfare and happiness also depend on clean waters, clean air, and clean soil.

Mulch tillage is one conservation practice which will help to improve the quality of our environment. When this is combined with others such as terracing, grassed waterways, woodland and wildlife habitat improvements, then we have a more effective improvement in total environmental quality which we must have for both wildlife and man.

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