CONSERVATION TILLAGE – A NATIONAL PERSPECTIVE

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ABSTRACT

Nationally, conservation tillage is alive and well. In fact, it is on the verge of becoming one of the most rapidly adopted technologies in the history of American agriculture. Never before have we seen such rapid growth in adoption. Although Conservation Compliance has had a significant impact on adoption, there are other reasons that have also impacted the rapid change in trends, such as moisture conservation, improvement in organic matter content and soil tilth. water quality, and economics. This paper presents the new terminology of crop residue management (CRM), discusses the reasons for present emphasis, lists the benefits of CRM, and presents trends in adoption.

MEANING OF THE TERM CROP RESIDUE MANAGEMENT

In response to the 1985 Food Security Act legislation, many farmers chose to comply with these provisions to maintain eligibility for U.S. Department of Agriculture program benefits. In many cases, farmers selected practices in their conservation plan that left a significant portion of crop residue on the soil surface to help them meet conservation goals. However, some of these tillage practices, especially if in combination with other conservation practices, were to leave surface residue levels that were less than the 30 percent required by the conservation tillage definition. Also, some viewed conservation tillage as meaning only no-till. Therefore, different terminology was needed to capture the impacts of leaving all or a portion of the previous crop's residue on the soil surface. As a result, the term, Crop Residue Management ICRM) evolved to allow better quantification of the benefits of surface crop residue in reducing soil erosion. Any CRM practice encompasses the total cropping year:

a) it begins with planting a crop that will provide sufficient amounts of surface residue to meet the intended management goal. Cover crops can be used to increase crop residue following low residue-producing crops;

b) emphasis is placed on crop harvest to ensure good distribution of crop residue over the width of the header;

c) tillage, when carefully planned to avoid excessive residue burial, can be used effectively to meet the surface residue goal.

In essence, CRM is defined as any tillage and planting system that utilizes practices such as no-till, ridge-till, mulch-till, or other tillage systems that retain all or some portion of the previous crop's residue on the soil surface. The percentage of surface residue that is required is determined on a site-specific basis, considering other conservation practices that may be included in the conservation plan for reducing soil erosion. The objective of crop residue management is to leave sufficient residue cover on the soil surface after planting to meet the intended purpose, whether it is for erosion reduction, increasing water infiltration or moisture conservation, improving soil tilth, or enhancing water quality. Crop residue is a valuable resource but requires special attention to optimize its benefits.

REASONS FOR EMPHASIZING CROP RESIDUE MANAGEMENT

Beginning in the early 1980's, citizens in the United States began voicing more and more concern over the amount of soil erosion and sediment reaching lakes and streams. They voiced these concerns through their congressional representatives. Concern was focused especially on highly erodible fields where growers produced crops and received U. S. Department of Agriculture program benefits.

In 1985, the United States Congress passed the Food Security Act that contained several conservation provisions or sections. One of those provisions was called conservation compliance and was directly related to reducing soil erosion on

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highly erodible croplands where farmers participated in USDA program benefits.

It required farmers who are farming highly erodible cropland to develop a conservation plan by 1990 to remain eligible for U.S. Department of Agriculture program benefits. Between 1990 and 1995, farmers must be actively applying their plan according to schedule and have that plan fully implemented by the end of 1994. In 1990, the Food, Agricultural, Conservation, and Trade Act was passed and reinforced the 1985 conservation provisions.

HOW LARGE IS THE EFFORT

From 1985 to the present, approximately 1.6 million conservation plans have been developed. These plans involve approximately 143 million acres of highly erodible cropland. As of December 1993, approximately 70 percent of the highly erodible land is considered to have all planned practices applied. Our 1993 status review results show that 97 percent of the farmers were found actively applying their conservation plan. Farmers chose some form of crop residue management as one of the practices to help meet their erosion reduction goals on about 75 percent of the acres planned under this legislation. Farmers chose crop residue management primarily because of economic benefits, as well as, for the effectiveness in reducing soil erosion.

The benefits of surface residue in reducing soil erosion is shown in Table 1 (USDA ARS, 1994). About the same reduction in soil erosion caused by the forces of wind can be obtained from crop residue as shown in Table 1 for water erosion.

Crop residue management is not the only practice available to farmers to help them control erosion and maintain their eligibility for U.S. Department of Agriculture Program Benefits. Practices, such as contouring, terracing, contour strip cropping, long-term rotations, wind strip cropping, wind barriers, and field windbreaks are also used.

MOISTURE CONSERVATION

Conserving soil moisture is crucial to agriculture in many areas of the world, especially in dryland agriculture. But even in humid areas, rainfall does not always occur when the growing crop needs it the most. The benefits of maintaining a portion of crop residue on the surface range from postponing the detrimental effects of a short term drought to significantly increasing crop yield by conserving soil moisture. For instance, in the North Central Great Plains, 2.5 to 4 inches of water can be added to soil moisture as a result of good crop residue management. But the most important aspect is that the effect of an additional inch of stored soil moisture relates to about 5 bu/ac more wheat or 7 bu/ac more barley (Bauer and Black, 1991).

The effectiveness of surface residue in reducing moisture evaporation is shown in Table 2 (Linden. et al. 1987). Even with small amounts of surface residue cover, significant reductions in potential evaporation can be realized.

TABLE I--Effect of Percent Residue Cover on Any Day in Reducing Sheet and Rill Erosion Compared to Conventional, Clean Tillage Without Residue.

Residue Cover, % on Any Day	Erosion Reduction, % While Residue is Present
10	30
20	50
30	65
40	75
50	**83**
60	88
70	91
80	94

TABLE 2–Effectiveness of Crop Residue in Reducing Surface Evaporation.

Surface Cover,	% Relative Potential Evaporation
0	10
10	0.90
20	0.78
30	0.70
40	0.67
50	0.63
60	0.61
70	0.59
80	0.58

BUILDING ORGANIC MATTER

Under intensive, continuous conventional cropping, organic matter levels of soil have decreased from their original levels. Although this decline has leveled out in many instances under long term tillage, many soils have organic matter contents that are one-half or less than existed before cultivation began (Bauer and Black, 1983).

Bringing the organic matter content back to its original level is a very slow, almost impossible. process. However, many farmers using some forms of crop residue management for several years report a rather dramatic increase in organic matter levels. One example comes from Jim Kinsella, who farms near Lexington, Illinois. He reports that organic matter levels have increased from 1.87 percent to almost 4.0 percent in about 15 years under his no-till operation (Kinsella, 1992). This dramatic increase occurred in the upper few inches of the soil, with less dramatic increases deeper in the profile. However. increasing organic matter levels in the upper few inches of the soil surface is extremely important when considering soil erosion.

Increased organic matter at the soil surface will reduce the impact of raindrops on the soil surface and increase soil aggregate stability and infiltration, thereby reducing soil erosion. Organic matter is an extremely important component of the soil. Without it, we are left with a less productive, more erodible condition.

WATER QUALITY

Over 50 percent of the drinking water in the United States is supplied from surface water sources, and the world's percentage is even higher. Crop residue management is a means to help maintain or improve surface water quality. Properly managing crop residue helps keep soil in place which is vital to maintaining the long term viability of agriculture, as well as, maintaining or improving surface water quality. By keeping soil in place through maintaining crop residues on the surface, soil erosion is dramatically reduced, thereby reducing the pollutants, including sediment, pesticides, nutrients, and organics that reach our streams, rivers. and lakes by surface water runoff. And, infiltration generally increases under crop residue management which reduces the amount of water available for runoff. Data from natural runoff studies on small watersheds show crop residue management systems effective in reducing runoff of several soluble pesticides studied with no-till reducing herbicide runoff by 70 percent compared to moldboard plow systems (Fawcett, 1994).

ECONOMICS

Any conservation practice in today's agriculture must be economical or it simply will not be widely adopted by farmers. Recent data collected from farmers show that crop residue management systems are economical and give equal or higher net returns than conventional tillage on most soils (CTIC, et al., 1993).

One of the more enticing attributes of crop residue management is that many growers can

implement this practice with their present equipment, often without any or only minor changes. Some will need to change the type points or soil engaging tool used such as switching from a twisted shovel, to a straight point, or sweep in order to leave more residue on the soil surface.

Others may need to switch to new or different types of equipment, but they are the minority. Reducing the number, depth, and speed of tillage operations, and using less aggressive soil engaging tools are the primary areas that U.S. growers are considering when implementing crop residue management. However, in the last two to three years, no-till has increased dramatically.

THE CROP RESIDUE MANAGEMENT INITIATIVE

The Soil Conservation Service feels that crop residue management systems are one of the most economical ways to begin reducing soil erosion, and should be the first conservation practice that farmers consider when developing a conservation plan. In fact, crop residue management should be one of agriculture's highest priorities.

As a result, the U.S. Department of Agriculture implemented a comprehensive Three-Year Crop Residue Management Action Plan involving 9 USDA agencies (USDA, 1991). This plan is placing emphasis on:

* collection and distribution of economic information that comes from farmers who are practicing good crop residue management systems,
* increased technical training for USDA field staffs,
* increased contact with farmers,
* conducting more on-farm demonstrations,
* dramatically increasing the flow of information and effectively increasing support for crop residue management by building alliances involving key agricultural entities.

The USDA Crop Residue Management Initiative is in cooperation with the Conservation Technology Information Center which is leading the crop residue management marketing program. The marketing program involves formation of a national agricultural alliance between nine agencies within the U.S. Department of Agriculture, industry, farm media, commodity groups, and grower associations, to place emphasis on, and build support for, crop residue management. Over 65 key agricultural entities make-up this National Alliance. This alliance has fostered the formation of 20 similar state alliances and several local alliances with emphasis on working through agricultural dealers. As a result, growers will receive more consistent and timely information. The alliance has developed a common theme and logo. The common theme is "Crop Residue Management...gaining ground in the 90's".

CROP RESIDUE MANAGEMENT TRENDS

In 1989, crop residue management systems that left 15 percent or more of the surface covered with residue were just about equal to those systems that left less than 15 percent surface cover. Today, systems that leave greater than 15 percent make up 60 percent of the planted acres. By 1995 systems that leave greater than 15 percent will make up nearly 75 percent of the planted acres. By the turn of the century, these systems will be over 80 percent of the planted acres.

U.S. tillage trends clearly show the rapid decline in acres leaving less than 15 percent surface cover and that no-till is increasing at a much faster rate than other crop residue management systems. For full season corn, the adoption rate of no-till is rapidly outpacing the other forms of crop residue management. Mulch-till, although accounting for the largest percentage of crop residue management systems, has increased, but at a much slower rate over the last three years. The trend to no-till is even more dramatic with full season soybeans with no-till, drilled soybeans rapidly becoming the preferred method. In 1993, no-till cotton had the greatest percentage increase, but presently makes up only a small portion of the total cotton acreage. No-till cotton acreage, however, is expected to increase dramatically in the next few years ICTIC, 1993).

CONCLUSION

Crop residue management systems are economically viable and environmentally sound. The technology of crop residue management is advancing very rapidly. Equipment, herbicides, and management principles are available today to produce crops efficiently, economically, and environmentally on most soils using crop residue

management systems. There is no more important time than now for agriculture to achieve its conservation mission. The degree of our success will shape future legislation that directly impacts all of agriculture.

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