INNOVATIONS IN NO-TILL PLANTING AND SPRAYING EQUIPMENT

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INTRODUCTION

The summary of a farmer survey published recently in a popular agricultural chemical magazine indicated that conservation tillage practioners, including no-till producers, were apparently quite satisfied with field results obtained using these reduced tillage cultural practices. Sixty-four percent said that they were very satisfied, and an additional 32 percent said they were at least moderately satisfied. However, the same survey noted that the three most important reasons farmers gave for opposing conservation tillage production practices were inadequate weed control, higher chemical costs, and lack of proper equipment. Both researchers and manufacturers have been aware of the need for improvements in each of the areas of expressed concern, and some of the recent innovations in planting and spraying equipment either directly or indirectly address these perceived problem areas.

PLANTING EQUIPMENT

The line of row-crop planters and drills designed specifically for seeding in previously untilled soil continues to expand. Perhaps of greater importance to the individual farmer is the growing array of available planter component options which may provide the flexibility of making a given machine adaptable to a particular set of planting conditions.

The essential functions which must be performed by the planter include opening the furrow to the desired seeding depth, metering the seed and placing them in the furrow in an acceptable pattern, and closing the furrow and compacting the soil around the seed to insure seed-soil contact necessary for germination. Most current no-tillage planters employ a special attachment ahead of the planter opener to cut through the surface residue and to penetrate the soil to at least the depth of seed placement. Fluted, ripple, and plain rolling coulters are all used extensively because they handle surface trash well and leave the planting surface smooth. Ripple coulters are increasing in popularity in Tennessee because they require less down pressure to penetrate the soil than fluted coulters and generally cut through crop residue more easily. To accommodate uneven ground across the width of the planter, individual coulters attached to the planter mainframe are generally equipped with down pressure springs to insure uniform depth of soil penetration. Ballast required to achieve coulter penetration in tough soil conditions is placed on the planter mainframe which has been designed to accept the necessary additional weight.

The double-disk planter opener is widely used to open the furrow in the track created by the rolling coulter, although a runner-type opener is used on some models. At least one model employs an offset double-disk planter opener to

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penetrate untilled soil without benefit of a leading coulter to reduce the soil strength. A depth control device is essential to insure uniform seeding depth, and several effective models are available.

The difficulty of closing the furrow behind the planter opener depends upon the characteristics of the soil, especially the moisture content. The number of types of soil firming wheels, or presswheels, and other furrow closing accessories available for no-tillage planters has increased substantially. The furrow should be closed completely burying the seed, but excessive compaction of the soil directly above the seed is not desirable. Thus, several of the new firming wheels operate in pairs, one on either side of the furrow, and are oriented at an angle to the vertical so as to apply pressure to the sides of the furrow, forcing it to close. In tests evaluating the performance of commercial no-tillage planting units used for seeding soybeans in wheat stubble at Milan in 1982, a planter equipped with a pneumatic center-rib presswheel operated in Calloway silt loam soil at 21 percent moisture (db) failed to adequately close the furrows leaving an average of 28 percent of the seeds exposed. A similarly equipped planter operated in Memphis silt loam at 20 percent moisture achieved complete furrow closure and excellent seed coverage. This situation vividly illustrates the importance of carefully matching planter components to operating conditions.

SPRAYING EQUIPMENT

The low-volume (LV) chemical application concept has long allured farmers, researchers, and product developers with the potential advantage of eliminating much of the water hauling associated with conventional hydraulic spraying using several gallons of liquid per acre. If chemicals are to be applied directly to the soil as in a preplant incorporated spray, there are research data indicating that volume of carrier and application technique are of little importance as long as a uniform distribution over the ground surface is obtained. However, other factors become important if good weed control is to be assured for crops no-till planted in the stubble of previous crops. For example, sprays applied at planting should thoroughly cover the foliage of existing vegetation to effect post emergence control and uniformly penetrate the stubble enroute to the soil surface to establish preemergence control. Accomplishing these two things with an LV system is the challenge.

Rotary atomizers known as controlled droplet applicators (CDA) are currently being widely marketed as LV applicators. The CDA produces spray droplets fairly uniform in size with the characteristic size being determined by the liquid flow rate through the spinner, the disk rotational speed, and the physical properties of the liquid being sprayed. By contrast, any flat fan hydraulic nozzle produces a broad spectrum of droplet sizes, some quite small and others relatively large. Gebhardt and Webber of Missouri compared the droplets produced with a CDA applying three gallons per acre to those produced by a flat fan nozzle applying 20 gallons per acre. They noted that the CDA produced few very small droplets (less than 100 micrometers in diameter) compared to the flat fan nozzle. To assure reasonably thorough coverage of plant foliage with LV, the liquid must be broken into small droplets: the CDA can accomplish this task.

Two problems have consistently been identified by researchers using CDA for LV application of contact herbicides for post emergence weed control. They

are (1) swath displacement by cross winds and (2) lack of canopy penetration desirable for thorough foliar coverage of target weeds. Since the droplets formed for LV foliar application are necessarily small, wind can displace virtually the entire swath down range. Therefore, exercise caution when using contact materials near susceptible crops. Droplets are discharged radially outward from the CDA spinner in a horizontal plane above the target plant. Thus, the only force acting to deposit the droplets on the plant foliage is gravity, unless wind adds a lateral driving force. Studies have shown that foliage penetration can be enhanced by tilting the atomizer at an angle of up to 45 degrees.

Use of crop oil as a pesticide carrier or diluent has generated considerable interest in the past two or three years. This interest has generally coincided with the distribution and adoption of LV applicators, particularly the CDA. Crop oils used with LV applicators offer, among others, the following reported advantages:

1. Reduced evaporation. Small droplets of water carrier evaporate rapidly under certain weather conditions. This evaporation creates even smaller droplets more easily moved away from the target surface by wind. Since crop oil carriers are much less volatile, the droplet will remain essentially the same size throughout its flight.

2. Increased spread factor. When a droplet impacts on a plant surface, the material spreads to cover an area greater than the diameter of the original droplet. The spread factor of a vegetable oil droplet is three to four times that of water. This phenomenon may be of especial importance in control of weeds with contact herbicides using LV applicators.

3. Resists washoff. Tests indicate that oil droplets deposited on plant tissue form a film after a period of time. When this film has been established, the chemical is not readily removed by rainfall.

4. Better plant penetration. Some evidence has been presented to show that oil penetrates plant tissues better than water. Research studies have also indicated that oil seemed to boost the activity of some herbicides to produce better weed control than the same herbicide carried in water.

An investigation is currently underway at Milan which focuses upon comparing LV application with conventional application rates for both preemergence and post emergence herbicides in no-till soybeans planted in wheat stubble. LV applications are being made with both CDA and low capacity hydraulic flat fan nozzles. Both water and crop oil-in-water carriers are used in each system.

Progress is being made in ultra low-volume chemical application technology. Commercially promising prototype machines which generate fluid droplets each carrying an individual electrical charge are currently being used to apply foliar pesticides at rates of less than one-half pint total solution per acre. Electrostatic charging helps create very small droplets which are necessary to assure thorough foliar coverage at such low application rates. The small droplets are then in turn attracted to oppositely charged biological targets (plant foliage) so that drift and waste of pesticide are minimized. A tractor-mounted electrostatic sprayer model is currently being used in Milan for application of a post emergence over-the-top grass herbicide in no-tillage soybeans. A hand-held electrostatic sprayer unit is being used similarly with emphasis upon Johnsongrass control.

There is renewed interest in post emergence directed sprayers for use in no-till soybeans. There already exist preemergence soil surface-applied herbicides which effectively control a broad spectrum of weeds. These have been recently complemented with some highly acclaimed over-the-top post emergence herbicides. However, from the standpoint of total cost of herbicides necessary to produce a crop, post emergent directed spraying may offer an economically attractive alternative. Accordingly, a study is currently in progress at Milan to evaluate seven commercial and experimental directed spray applicators operated in soybeans planted with 20-inch row spacing. Each of the sprayers features devices for shielding the soybean plants from the spray being applied between the rows. Nozzles recommended by the various manufacturers range from flood-type to flat fan and even spray.

A CLOSING COMMENT

Recall the three most frequently mentioned reasons for opposing no-tillage or conservation tillage production practices in general. Equipment innovations and technique refinements in the areas of planting and chemical application for no-tillage production will surely go far to negate these arguments against no-tillage farming.

PERTINENT LITERATURE

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