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EQUIPMENT USED FOR INCORPORATING HERBICIDES

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Preplant incorporated herbicides are used on many acres of agronomic crop land in the Midwest. Many of these herbicides are incorporated out of necessity, while others are incorporated to reduce their dependency upon rainfall for activation. The most widely-used tool for herbicide incorporation is the tandem disk. Its popularity stems from its availability and multifaceted use as a conventional tillage tool. In recent years, tillage systems have changed, and also new and different kinds of tillage and incorporation equipment have been developed. With these factors to consider, a new look at the overall approach to herbicide incorporation should be made.

The choice of equipment and method of incorporation, like the choice of herbicides to use for a particular weed problem, must fit the overall production system. No one tool or method of incorporation is best for all situations. Factors such as roughness of the soil surface, soil moisture and soil type may play a bigger role in the success of herbicide incorporation than the tillage tool used for the incorporation. However, when used properly, most any tillage tool can give adequate soil incorporation of herbicide in a variety of soil types and conditions.

The incorporation process involves two types of herbicide distribution: horizontal and vertical. Both distribution types must be achieved for uniform herbicide placement and adequate weed control without causing crop injury.

Two Pass Incorporation Tools

Tandem disk harrows invert soil similarly to a moldboard plow. They also tend to place herbicide deeper in the soil than most other incorporation tools.

Travel speed and operating depth have the greatest effect on vertical placement of herbicides that are incorporated with a disk. Increasing the speed incorporates to a shallower depth and increasing operating depth incorporates to a deeper depth. Large disks operated at 4 inches or less do not make sufficient soil contact to properly invert the soil and result in very little soil mixing. When operated at depths of 6 inches or greater, herbicides are incorporated too deeply. Disk blade spacing and depth of operation seem to be more important than blade diameter in determining soil mixing. Research at the University of Illinois has shown that small disks (blades less than 22 inches and 7 1/2 inches apart) work better than large disks (blades 22 inches or greater and 9 inches or more apart). Herbicides are generally incorporated one-half to three-quarters, the operating depth of the disk, which is normally about 4 to 5 inches. The Illinois research, involving granules coated with a fluorescent dye, showed that 89 percent of the granules were in the top 3 inches of soil after one pass with a disk. After two passes, the granulars moved deeper with only 74 percent in the top 3 inches.
Adequate incorporation requires two passes with a disk. A single pass results in areas of high chemical concentration (hot spots) where crop damage can occur and areas of low or no herbicide where weeds are not controlled. A second pass with a disk will give much more even horizontal distribution. For example, if a herbicide was applied at 2 pounds per acre and disked in with only one pass, the actual rate would vary from 0.7 to 4.0 pounds per acre (35 to 200 percent of the intended rate). A second pass which can be perpendicular or parallel to the first will give an actual rate range of 1.2 to 3.2 pounds per acre. High speeds and larger gang angles on the disk give better soil mixing and herbicide distribution. If there is a large difference in turning time required to cross disk, make the second pass in the same direction as the first. Timing of the second pass is not critical if the herbicide is sufficiently covered on the first pass. Thus, the second pass can be delayed until the final seedbed preparation is made.

Field cultivators also require two passes for proper incorporation. The second trip should be made at an angle to the first and not parallel like the disk. Best results are obtained when the field cultivator is operated at 3 to 4 inches deep and at speeds of 5 to 7 mph. The field cultivator must be operated level. If the rear row of shanks is operating too deeply, then untreated soil will be brought to the surface, resulting in reduced weed control. Shovels or sweeps are better than points but with good soil tillage, either is adequate. A light drag or harrow should be mounted behind the cultivator to level the ridges and give a light mixing action.

A combination of disk harrow and field cultivator may be used for the two incorporation trips by using a disk for the initial incorporation followed by a field cultivator to prepare a more uniform seedbed. If the ground is rough chiseled, then it is generally recommended that the soil be leveled before applying herbicides. This could require three passes with a tillage tool. If only two passes can be made, then a choice between applying the herbicide to a rough surface and incorporating twice or leveling the surface and incorporating once must be made. An alternative approach would be to spray between the front and rear gangs of a disk then follow with a second incorporation pass. The front gangs will smooth out the rough ground, and a total of 1 1/2 incorporation passes can be made.

One-pass Incorporation Tools

Ground driven tools such as the do-all or other such seedbed conditioners with combinations of field cultivators, reel-type mixers, and/or spike-toothed harrows can be used to incorporate herbicides. These tools can give adequate incorporation with one pass if all factors and conditions are right. Good soil tilth is essential. These one-pass tools do not incorporate herbicides as deeply as field cultivators or disk harrows and usually operate at depths of less than 4 inches. With one pass 50 to 80 percent of the herbicide is left in the top 2 inches of soil when the equipment is operated 3 to 4 inches deep. The distribution is usually as good with one operation with these tools as with two operations with the disk or field cultivator. All ground-driven, multipurpose tools such as the do-all must be driven at high ground speeds in soils with good tilth. Low speeds and/or wet soils will not provide adequate mixing of the herbicides. With these multipurpose type finishing tools, increasing the rows of teeth and/or tines increases the uniformity of the once-over incorporation.

Power driven tools such as the rotavator and rotterra are excellent once-over incorporating tools. PTO-driven rotary tillers will by far give the most uniform herbicide incorporation of all tillage tools. These incorporators are, however, expensive and must be operated at speeds of 4 mph or less.

Rolling cultivators and harrows such as spike-toothed or spring-toothed harrows can be used for shallow incorporation of herbicides. Rolling cultivators are also excellent tools for incorporating herbicides on a band. These tools require high forward speeds for good soil mixing.

Further information on incorporation equipment can be obtained from the following articles: "What's the Best Tool for Incorporating Herbicides?", Progressive Farmer, January 1979; and "Soothe Your Chemical Incorporation Worries" Farm Journal, Mid-January 1980.