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A progress report on evaluation of soil incorporators - dye techniques

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Evaluation Of Soil Incorporators

—Dye Techniques

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On the Cover

Figure 1. Vertical soil cores being removed for laboratory analysis of dye content by fluorometer.

EVALUATION OF SOIL-INCORPORATORS—DYE TECHNIQUES

BY W. L. BARRENTINE, O. B. WOOTEN, AND J. T. HOLSTUN, JR.[1]

Development of trifluralin[2] and granular formulations of CIPC requiring soil-incorporation for effective weed control has been closely associated with the availability of implements designed specifically for soil-incorporation.

Both trifluralin and granular CIPC are currently recommended by the Mississippi Weed Committee for pre-emergence use on limited cotton acreage. To obtain effective weed control and remain within the tolerance limits of the cotton plant, the 1965 recommendations give the depths to which trifluralin should be incorporated as ½ to 1 inch ~~and ½ inch~~ and CIPC granules ½ inch.

Because of the increasing importance of soil-incorporation and the increasing availability of implements, a study was begun at the Delta Branch Experiment Station in 1964 to develop techniques for evaluating soil-incorporators. The objective of the first phase was to determine quantitatively, the depth and uniformity of incorporation provided by incorporators in current farm use.

Materials and Methods

This study was conducted on a Bosket very fine sandy loam having a soil moisture of 15 percent. Both ground-driven and power-driven (PTO) types were evaluated including the following:

1. Ground-driven — open steel mesh wheel; 2-gang rotary hoe, full floating; lawnmower reel gauged by a mesh wheel less the chain drive; and 2-gang rotary hoe with the rear section driving the front section by chain linkage at a ratio of 2 to 1.
2. Power-driven — PTO tillage units with L-shaped blades.[3]

A tank mixture of 25 ml of 40 percent Rhodamine B dye per gallon of water was applied to an 18-inch band at a broadcast rate of 40 gallons per acre. Four standard or check samples were taken before incorporation from left to right at 2-inch intervals across the band with a 2-inch soil tube. Theoretically, the total amount of dye applied to a given 2-inch diameter surface area was contained within each sample.

The various implements were then used at the maximum depth possible to incorporate the dye and the soil rolled to give a smooth surface. All ground-driven implements were rear mounted on the same tractor and were run at a ground speed of 4 MPH.

Four soil cores, three inches deep, two inches in diameter, spaced two inches apart, were taken across the incorporated band (Figure 1). Each core was divided into depth increments of 0 to 0.5, 0.5 to 1, 1 to 2, and 2 to 3 inches. This sampling procedure was repeated at two additional locations approximately 10 feet apart down the row. The dye was extracted from the soil with methanol and the concentration determined by fluorometric methods.

Results and Discussion

The percentage of the surface applied dye at depths of 0 to 0.5, 0.5 to 1, 1 to 2,

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[2]Trifluralin is alpha, alpha, alpha,-trifluoro-2, 6-dinitro-N, N-dipropyl-p-toluidine. CIPC is isopropyl N-(3-chlorophenyl) carbamate.

[3]Gandy Row Wheel, Chem-N-Soil Mixer, Yellow Devil, Mix-A-Product, and Bye-Hoe, respectively. Mention or omission of any trade name implies neither endorsement or criticism by either the U. S. Department of Agriculture or the Mississippi Agricultural Experiment Station. Trade names are given solely for purposes of identification.

and 2 to 3 inches in each core taken across the band at three sample sites after incorporation is shown in Figures 2, 3, 4, and 5. The failure for any one column (or core) to equal 100 percent is attributed to the movement of the dye to or from areas adjacent to the sample core by the incorporator.

The open mesh wheel incorporated the dye largely in the top ½ inch of soil with a greater incorporation on the left side of the band (Figure 2). The depth of incorporation obtained was shallow as expected due to its design and construction. Though alignment was closely checked, improper alignment of the device over the band may account for the greater concentration at the ½ inch depth in the cores taken from the left side of the band. If the row wheel was off-set to the right, the left cores may have contained dye that failed to be incorporated. A shifting of the dye could have also occurred if the row wheel was

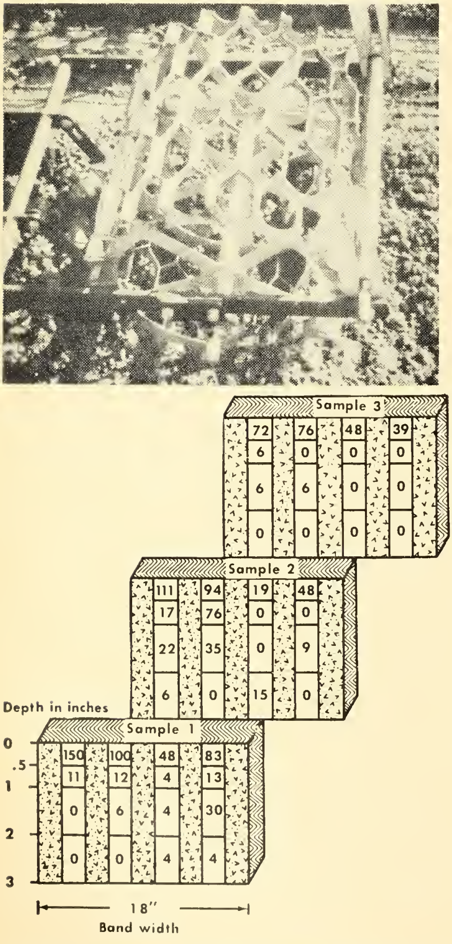

Figure 2. Ground driven open steel mesh wheel.

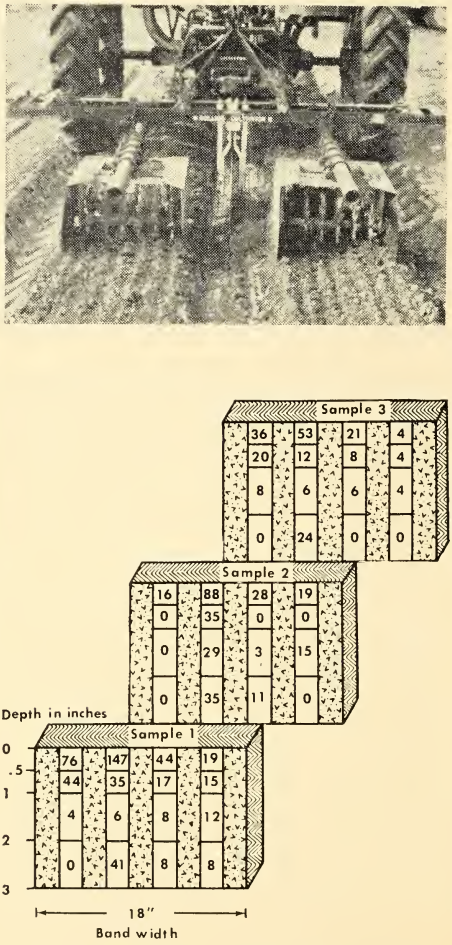

Figure 3. Ground driven rotary hoe.

set at a slight angle to the right when used. However, this might be a characteristic pattern as these factors were held to a minimum.

An incorporation pattern similar to that of the row wheel was obtained with the full floating rotary hoe (Figure 3). A higher concentration was present on the left side of the band to the one-inch depth. However, within the second column from the left a higher concentration was present at the 2 to 3 inch depth than at the 0.5 to 1 and 1 to 2 inch depths. The same factors that may have affected the open mesh wheel pattern may have been involved in this case, but a close check was also maintained when this device was used.

Figure 4 shows a relatively uniform pattern of incorporation to a depth of 1 inch that was obtained with the lawnmower reel device. Less variability was present across the incorporated band in either the 0 to 0.5 or 0.5 to 1 inch

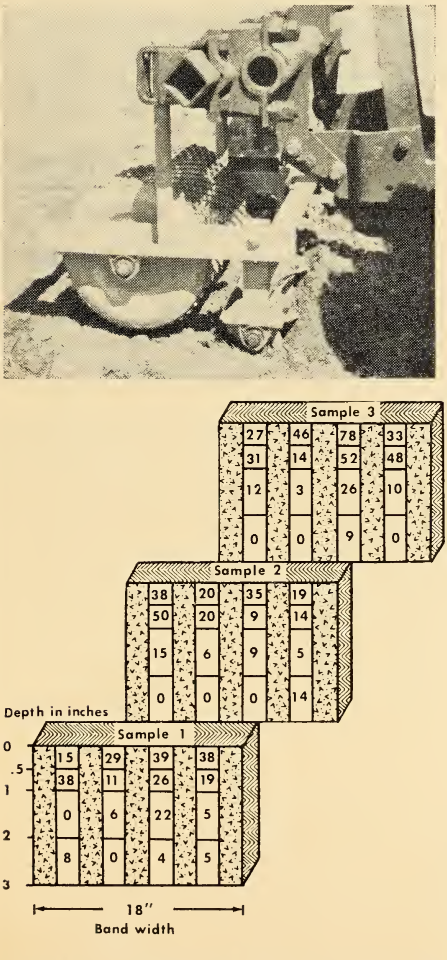

Figure 4. Ground driven lawnmower reel device.

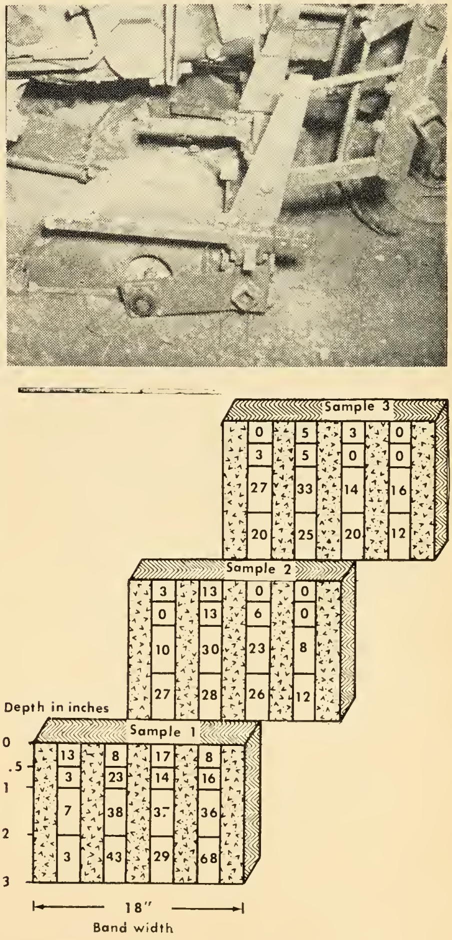

Figure 5. Power driven unit.

depths than that of the open steel mesh wheel or the rotary hoe. This was also true between the 0 to 0.5 and 0.5 to 1 inch depths within each core.

No satisfactory results were obtained using the 2-gang, chain linkage rotary hoe. With the soil conditions of this study, the drag on the rear driving section slowed the front section resulting in an accumulation of soil between the rotary tines and complete stoppage of both hoe sections.

At the ground speed of 4 MPH, the power-driven (PTO tillage units gave an inversion of the dye treated soil (Figure 5). Untreated soil was brought to the surface inch and the dye treated surface soil was placed at depths of 1 to 3 inches. A more uniform pattern might have been obtained with a slower tractor ground speed. The PTO drive was at maximum rpm so no attempt to obtain a more uniform pattern was possible by increasing the 360 rpm of the tillage units.

During the course of this study, it was noted that the depth of dye incorporation obtained by the ground-driven implements was somewhat less than the depth of operation. For this reason the authors wish to stress that the incorporation of a herbicide to a specific depth may require operating at a greater depth, depending upon the implement used.

Realizing that some incorporation is necessary to obtain effective weed control with trifluralin or granular CIPC because of volatilization and the requirement of soil moisture for activation, horizontal uniformity is perhaps as important as verticle uniformity. Without uniform incorporation, there is the possibility of having "blank" areas within the treated band which may allow weeds to emerge.

When run in the floating position, depths not more than 1 to 1½ inches should be expected from the full floating rotary hoe or the lawnmower reel device, and not more than ½ inch from the open mesh wheel with conditions similar to those of this study. For depths greater than 1 to 1½ inches, the power-driven (PTO) type implements are required, though depths greater than 1 to 1½ inches are not recommended by the Mississippi Weed Committee because of possible crop injury. Regardless of the implement used, one should give particular attention to proper alignment when mounting and while using. If the device is offset, tilted or running at an angle to the treated band, the herbicide will likely be deposited in streaks of high and low concentrations, shifted to one side, or thrown off the row.

This work is being expanded to devise more precise techniques and include evaluation of devices such as disc harrows, bed-conditioners, and other implements that are being used for incorporation of herbicides. It is hoped that the information gathered will not only be of value to the farmer and research worker, but will also provide a method of measurement which manufacturers can use to design better soil-incorporators and which chemical formulators can use to determine the degree of incorporation needed.