*Progress Report on . . .*

# Distribution Patterns of Soil-Applied Herbicides Using Fluorescent Tracers

SPECIAL REPORT 144

FEBRUARY 1963



Agricultural Experiment Station
Oregon State University
Corvallis

# PROGRESS REPORT ON DISTRIBUTION PATTERNS OF SOIL-APPLIED HERBICIDES USING FLUORESCENT TRACERS

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## Introduction

Research in recent years has shown that certain herbicides are more effective if they are incorporated in the soil profile than when applied to the surface. Results from surface application of volatile materials are frequently erratic. If it rains shortly after application, weed control is usually good, but if there is no precipitation for several days or if temperatures are high, weed control is poor. The extent to which the herbicide is incorporated through the seed germinating zone of the soil is important.

A study to determine the distribution of the chemical in the soil profile accomplished by specific application equipment and tillage methods was started in the fall of 1961. The method used to determine the distribution of the chemical was based on the method reported in WEEDS (January, 1961) by C. G. McWhorter and O. B. Wooten. The use of a fluorescent indicator replaced the herbicide in these tests. The examination of the deposit was accomplished with the aid of a short-wave ultraviolet light, principal radiation 2537 angstroms under dark conditions.

The application equipment and tillage tools used for incorporating the fluorescent chemical, zinc silicate, into the soil were the Russ-Ken Applicator, the Mulch Treader, an experimental spring-tine tiller, a double disk harrow, and a special sweep applicator.

## Method & Results

The Russ-Ken Applicator (Figure 1) consists of a furrow opener of 1/4 x 3" flat steel to scrape the top inch of soil to the side exposing a strip seven inches wide to be sprayed with a herbicide. Flat curved steel weeder blades cover the herbicide with soil leaving the surface level. The chemical is laid down as a distinct band seven inches wide, approximately 1" below the soil surface with the Russ-Ken Applicator.

The Mulch Treader (Figure 2) is similar to the rotary hoe except the spiders are heavier and run at an angle similar to the disk harrow. The term tilling will be used when the rotating fingers on the spider dig into the ground and treading when they drag into the ground. The axle of the Mulch Treader was set at an angle of 76° with the direction of travel for the tests. Zinc silicate sprayed on the soil surface was incorporated into the soil with one and two passes both tilling and treading. The two passes approximated the action of a two-section tandem treader.

The experimental spring-tine tiller (Figure 3) has eight tines, similar to the teeth on a side delivery rake, staggered on one and a half inch spacing, giving a light surface tillage action.

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A double disk harrow was used for the disking tests. The ground was worked into seed bed condition by disking prior to spraying the fluorescent chemical on the soil surface. The chemical was incorporated into the soil by one pass of the disk made crosswise to the previous disking.

The sweep applicator (Figure 4) is a 14 inch, high lift tillage sweep modified to allow for mounting a Spraying System 1/8K3 nozzle below a steel plate welded between the top edges of the wing blades of the sweep. This sweep applicator operates satisfactorily at depths of $1\frac{1}{2}$ inches or greater.

A short-wave ultra-violet light, model S68 mineral light manufactured by Ultra Violet Products with a principal radiation of 2537 Angstroms was used to examine the fluorescent deposits.

The fluorescent deposits were examined visually and were recorded photographically. A portable dark room was set up in the field directly over the area to be photographed.

The tracer distribution was determined by cutting a trench across the treated area about 2 inches deeper than the maximum penetration of the tracer. One side of the trench was carefully cut away with a sharp edged implement. Care was taken to keep from disturbing the distribution pattern. During preparation and photographing the profile the ultra-violet light was placed in the bottom of the trench. Replicates were taken by cutting back the side of the trench approximately four inches. A cord dipped in the fluorescent chemical calcium silicate was stretched across the soil surface at the top of the profile. Figures 5 through 10 were taken with the camera mounted 36 inches from the soil profile. The camera contained black and white film with an ASA rating of 400. Time exposures were taken at 7.5, 15, 30 and 120 seconds at F3.8. The third part of the code number indicates the exposure selected.

Color slides were also taken using film with ASA rating 160, at exposures of 30, 90, and 180 at F2.8. The pictures of distribution with a disk (Figures 11,12) were made from color slides with ASA rating of 25 at exposure of 300 seconds at F2.8. Filters used to exclude the ultra violet were Tiffen 2-A and Wratten k-2. While working with ultra-violet light, it is necessary to protect the eyes with goggles that will filter out the ultra violet. The soft glass usually used in corrective lenses does not remove this radiation.

The Russ-Ken Applicator (Figure 5) laid down a distinct band seven inches wide approximately one inch below the soil surface. The Mulch Treader (Figures 6 to 9) had better distribution with two passes than with a single pass. Distribution was better when tilling than for treading. The spring-tine tiller (Figure 10) incorporated chemical lightly into the surface one to one and a quarter inches of soil. The Mulch Treader, spring-tine tiller, and disk (Figure 11) left a large amount of chemical on the soil surface. Disking (Figure 12) placed the chemical in the soil profile as diagonal streaks 6 inches apart. The sweep applicator (Figure 13) deposited a uniform band of chemical 12 inches wide at injection depths of one and a half to seven inches.

EPTC Tests

Sugar beets for seed were planted at three-fourths inch depth August 24, 1962, in unreplicated plots using EPTC incorporated in the row with the Mulch Treader, spring-tine tiller, Russ-Ken Applicator, and sweep applicator. The herbicide incorporation equipment was mounted on the planter frame. The check plots received the same tillage as the treated areas.

Beet population counts (Table 1) were made September 25 on 10 feet of row. EPTC applied with the Russ-Ken and sweep applicator markedly reduced beet emergence. EPTC sprayed on the soil surface and tilled in had no apparent effect on beet emergence. Due to an oversight the Mulch Treader tilling plot was planted twice resulting in approximately twice the beet emergence of other plots.

Table 1

Sugar beet stands 25 days following application of EPTC at planting time

| Incorporation Method | Rate | Beet Population Treated area | Beet Population Check |
|---|---|---|---|
| | lbs./A. | No. Plants | No. Plants |
| Mulch Treader Tilling | 4 | 53 | 64 |
| Mulch Treader Treading | 4 | 36 | 34 |
| Spring Tine Tiller | 4 | 35 | 42 |
| Russ-Ken Applicator | 4 | 12 | 30 |
| Sweep Applicator | 4 | 9 | 37 |
| Sweep Applicator | 3 | 16 | 37 |

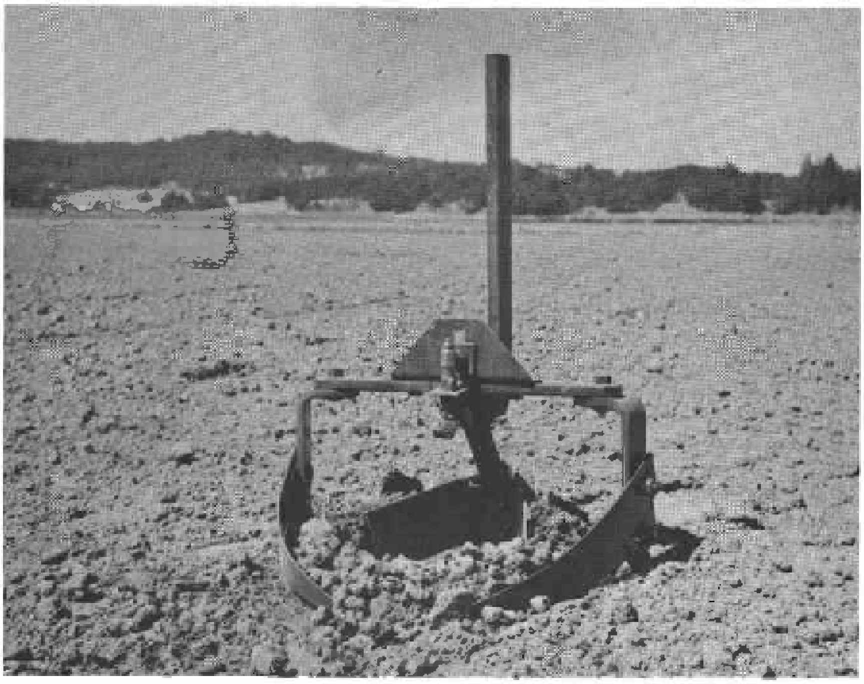

Figure 1
Russ-Ken Applicator; for deposit pattern see figure 5.

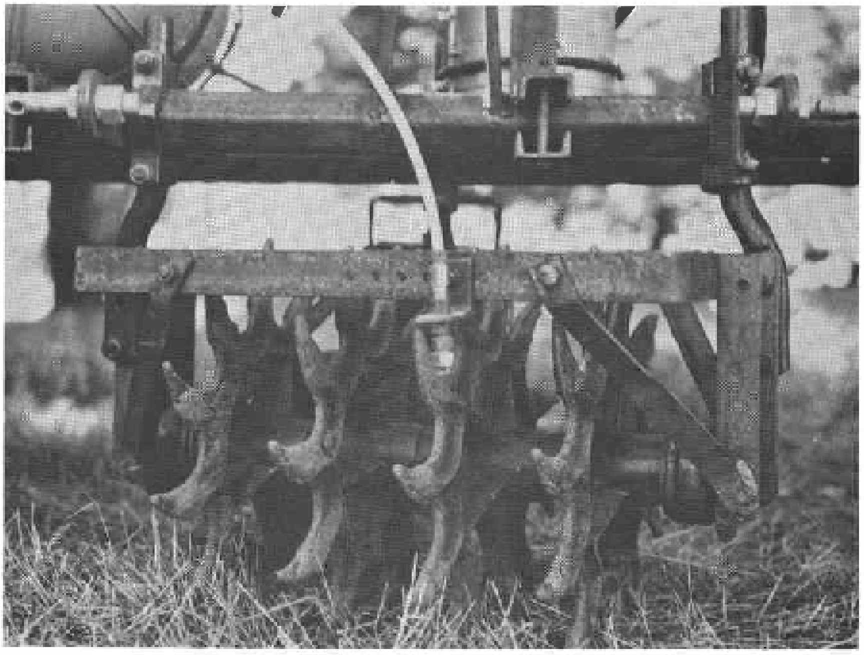

Figure 2
The front view of a short section of the Mulch Treader set for treading; for deposit pattern see figures 8 and 9.

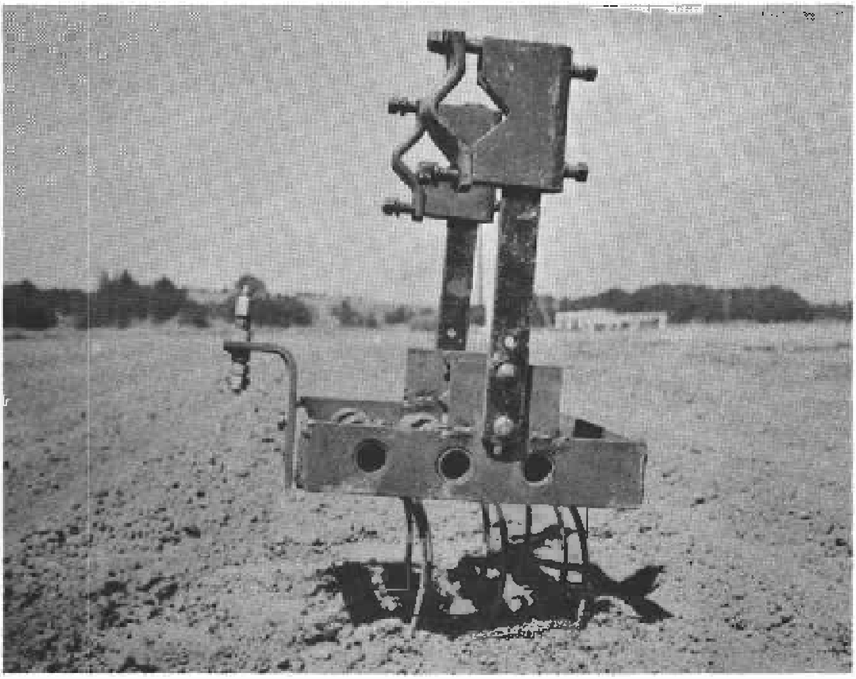

Figure 3
Experimental Spring-tine tiller; for deposit pattern see figure 10.

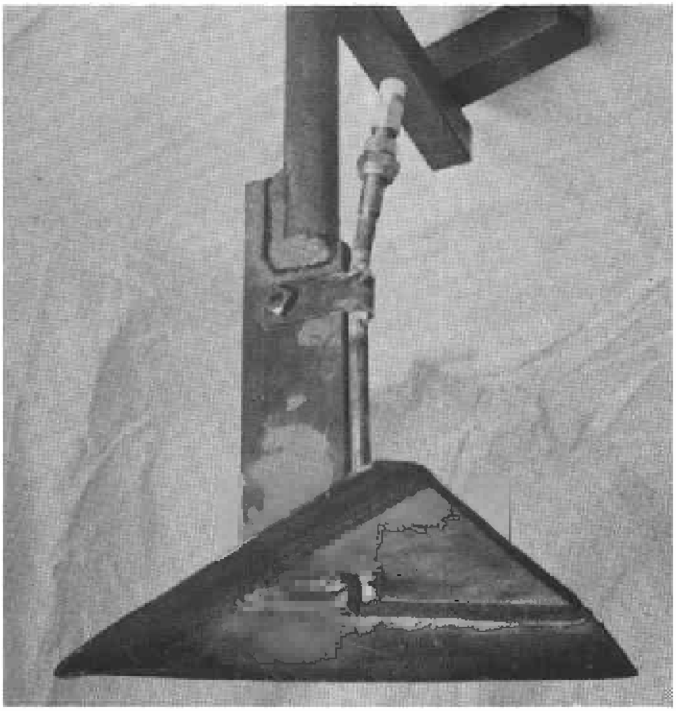

Figure 4
Sweep Applicator; for deposit pattern see figure 13.

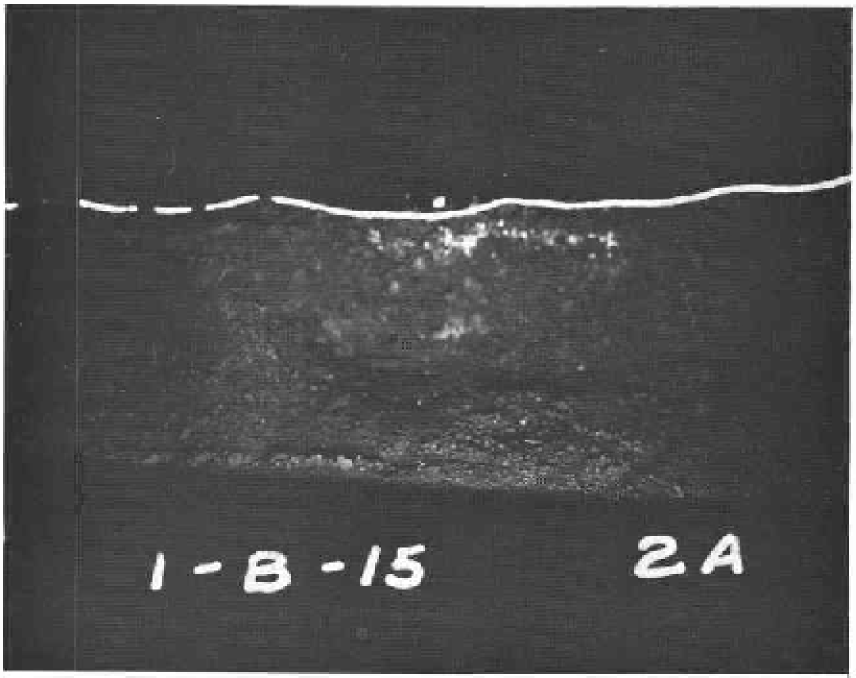


Figure 5
Distribution of a fluorescent tracer that was applied with the Russ-Ken Applicator. The white line across the photograph represents the soil surface.

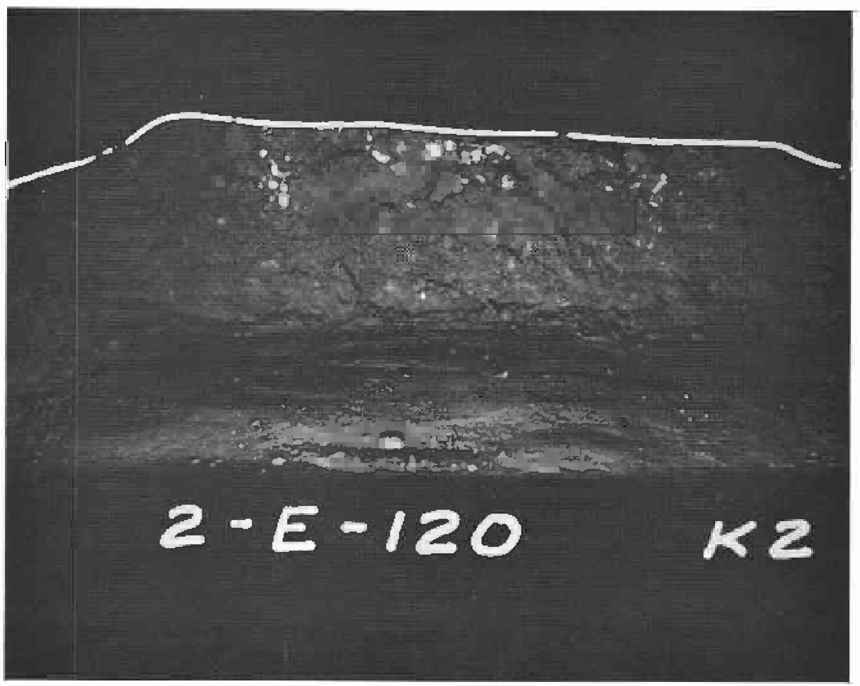


Figure 6
The distribution of a fluorescent tracer in soil following one pass of the Mulch Treader tilling. The white line represents the soil surface.

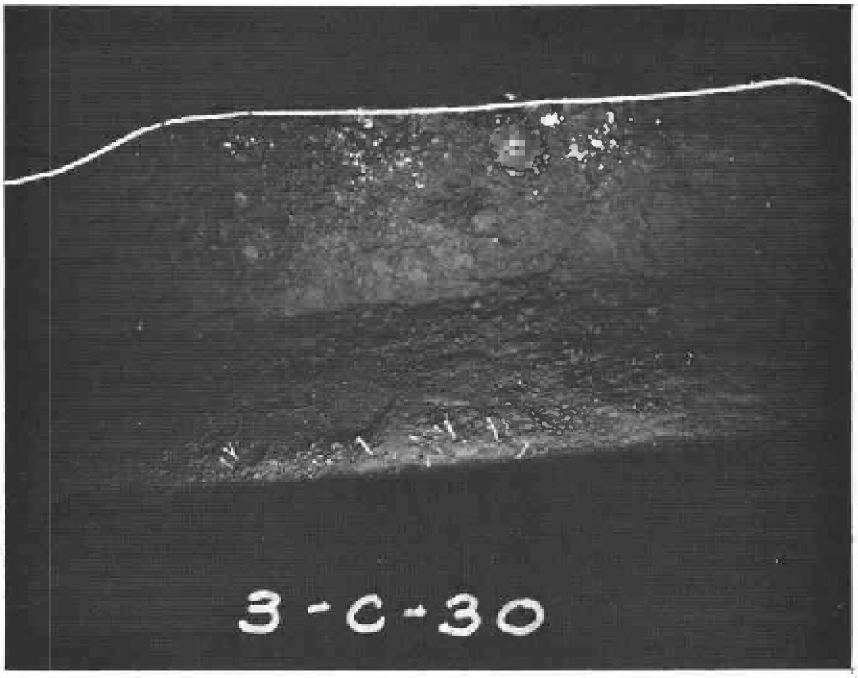


Figure 7
The distribution of a fluorescent tracer in soil following two passes of the Mulch Treader tilling.

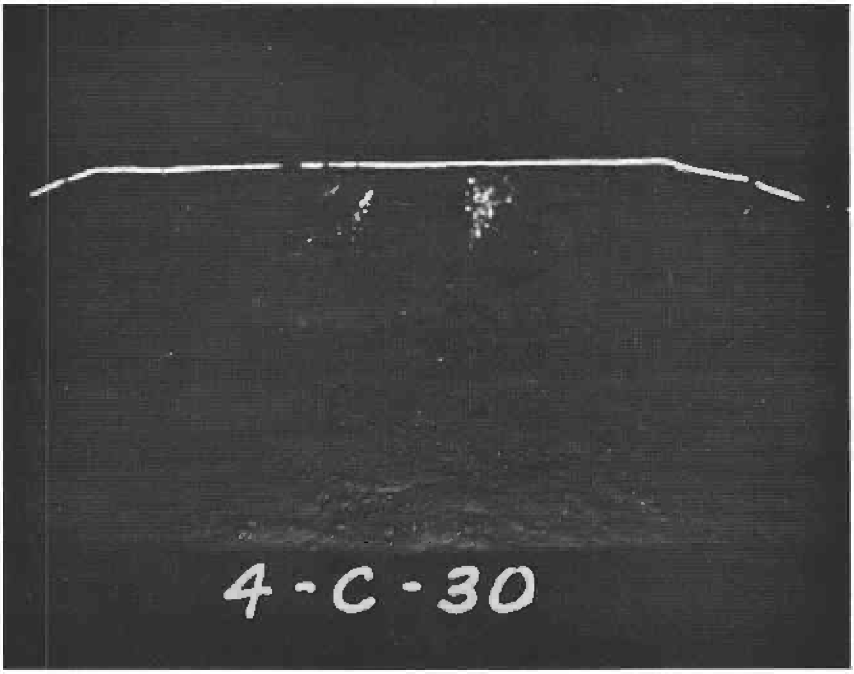


Figure 8
The distribution of a fluorescent tracer in soil following one pass of Mulch Treader treading.

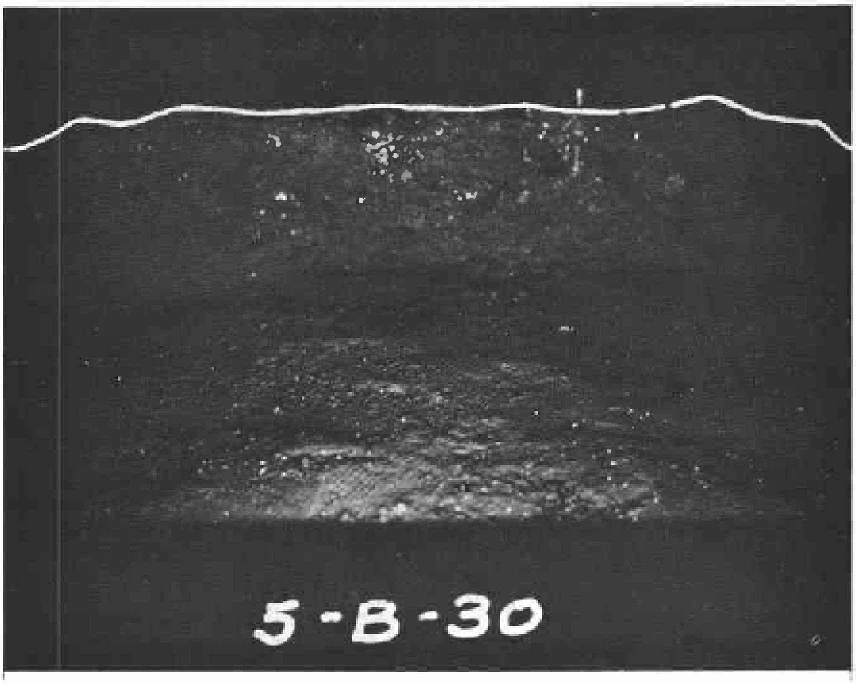


Figure 9
The distribution of a fluorescent tracer in soil following two passes treading.

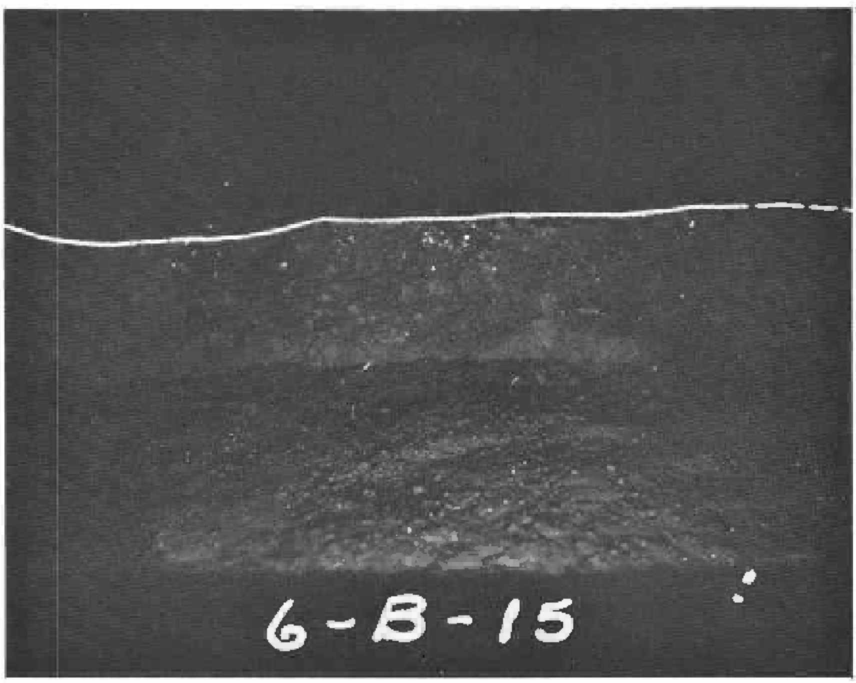


Figure 10
Distribution of a fluorescent tracer in soil following one pass of the tine tiller.

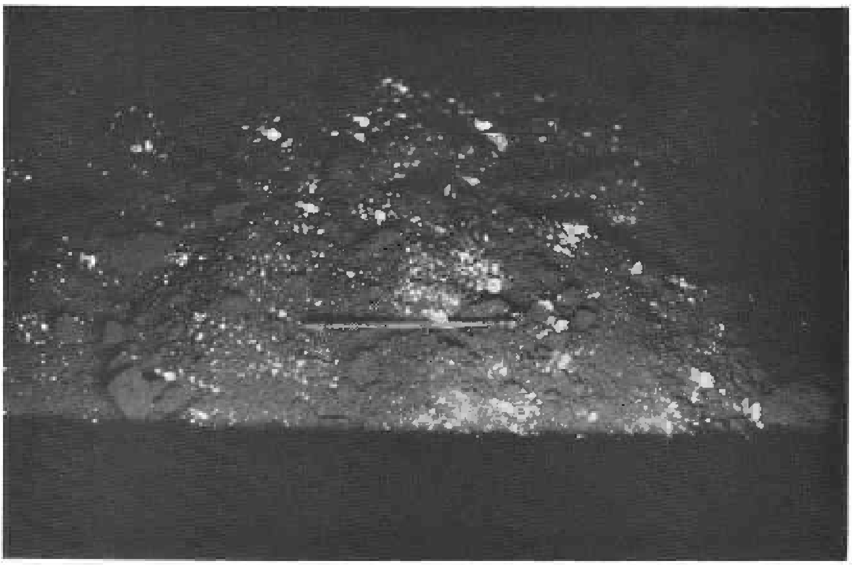

Figure 11
The distribution of a fluorescent tracer on soil surface following one pass of disk harrow typical of surface for Mulch Treader and tine tiller.

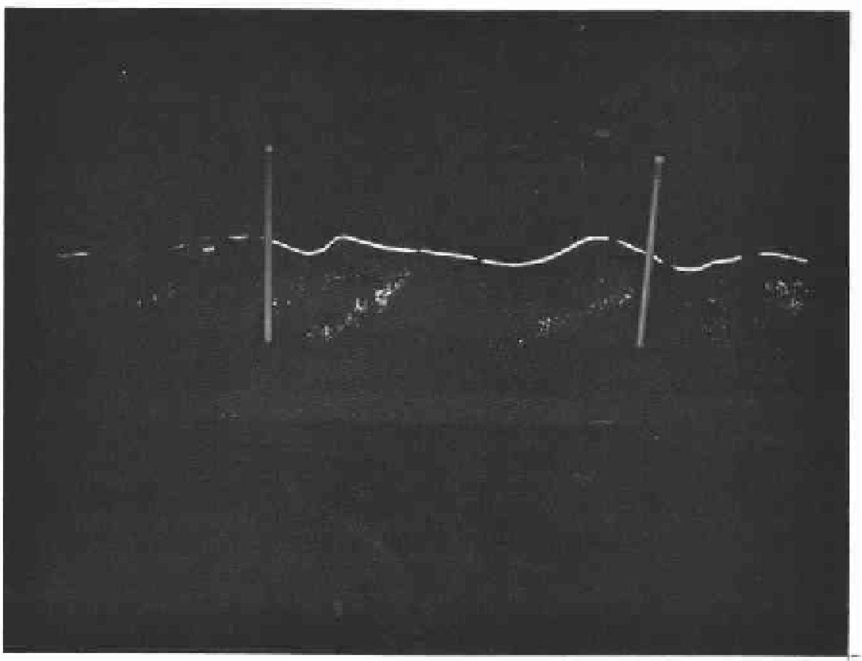

Figure 12
The distribution of a fluorescent tracer in the soil following one pass of double disk harrow. Pencils are one foot apart.

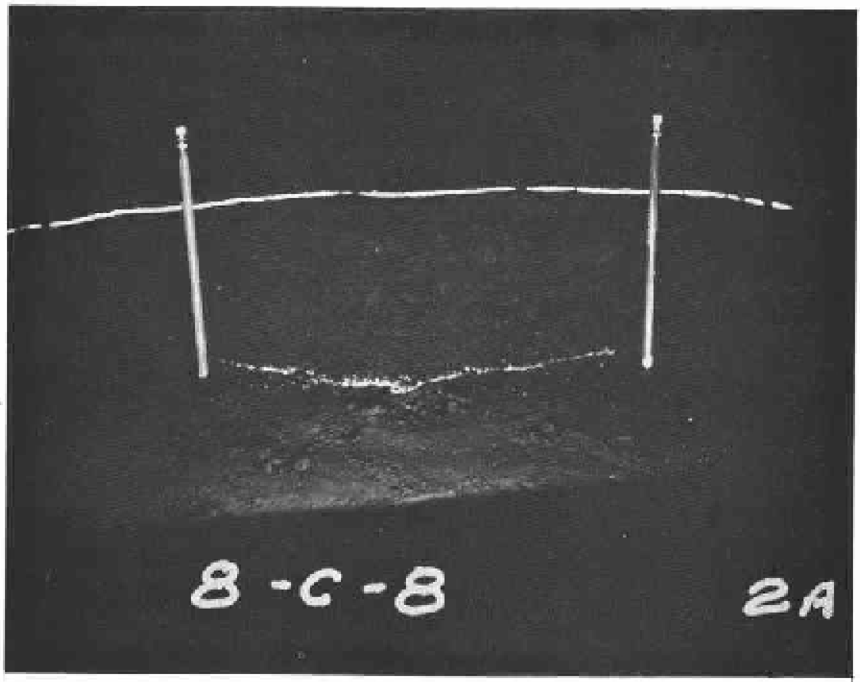


Figure 13
The distribution of a fluorescent tracer in the soil following application with a sweep applicator equipped with a 1/8K3 nozzle.