Interchangeable slip plow plates were used on a common frame to test the effect of varying widths on draft forces required by the slip plow and measure differences in the amount of soil loosened. This was the third in a series of tests described in the article on page 1.

Aljibury, Ayers, Branson, Marsh, Meyer, Quick, Rible, Rauschkolb, Schulbach, Wildman.

Edited by R. S. Rauschkolb, Extension Soils Specialist, University of California, Davis.
DRAFT REQUIREMENTS & SOIL LOOSENING BY SLIP PLOWS

This project was carried out under controlled soil testing conditions as part of the author's sabbatical research at the National Tillage Machinery Laboratory at Auburn University, Auburn, Alabama. The purpose was to test small slip plows as an alternative to subsoilers on rippers for loosening surface soils compacted by tillage and field traffic. It was assumed from the start that slip plows would require more power than subsoilers, but would also loosen more soil -- potentially a considerable advantage. Therefore, the studies centered on developing as efficient a slip plow as possible, one that would loosen a maximum amount of soil per unit of force required to pull it.

The first of three tests involved the position of the cutting edge of the slip plow in relation to the vertical standard holding the slip plate, shown by the sketch in Figure 1.

The slip plate was 8 inches wide and its angle to the horizontal was constant at 30°. Tests were replicated 4 times at 15 inches deep in two pre-compacted soils, and sandy loam and a clay loam. Moisture content and bulk density were about 8% and 1.6 g/cc, respectively, for the sandy loam, 14% and 1.45 for the clay loam.

Table 1: Draft forces in pounds as related to cutting edge position.

<table>
<thead>
<tr>
<th>Cutting edge distance in front of standard-inches:</th>
</tr>
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<tbody>
<tr>
<td>Norfolk Sandy Loam</td>
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<tr>
<td>Decatur Clay Loam</td>
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</tbody>
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Table 1: Draft forces in pounds as related to cutting edge position.

Draft force, shown in Table 1, decreased as the distance from the cutting edge to the standard, increased.
Moving the cutting edge forward decreased the amount of unbroken soil contacted by the standard, thus lowering the draft force.

In the second test the angle of the slip plate (see Figure 2) was varied while the cutting edge position remained a constant 13 inches in front of the standard. A 6 inch wide slip plow was used throughout. Slip plate angles were 20°, 25°, 30°, 40°, and 50° to the horizontal. Draft forces for this test are shown in Table 2.

Draft forces were relatively high for both the low and high angle slip plows, and were the lowest at about 25° for the sandy loam soil and between 25° and 30° for the clay loam. The higher force at low angles is thought to be caused by greater friction on the slip plate. At high angles, however, the higher force is more likely to be related to the crowding of soil in front of the tool.

The final test used the information from the two previous tests to build a slip plow that was most efficient with respect to cutting edge position and slip angle. Upon this frame, different widths of slip plates were mounted (see cover photo). The purpose of this test was to see whether increased efficiency of soil loosening was accomplished by widening the slip plate. Draft forces for this test are shown in Table 3.

At first glance it might seem that the 12 inch wide slip plow was considerably more efficient at loosening soil than the 6 inch tool. That would indeed be the case if the former loosened twice as much total soil as the latter. However, when the trenches were cleaned out and all loosened soil removed, it was found that the 6 inch slip plow loosened considerably more than half as much.
Soil as the 12 inch plow. The efficiency of soil loosening will be the subject of an article in the next issue of SOIL and WATER.

-- Bill Wildman

STATUS REPORT ON NPDES IRRIGATION RETURN FLOW PERMITS - from CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL BOARD (CVRWQCB)

At this time CVRWQCB has 20 applications on file from irrigation entities or groups throughout the Central Valley's 6.8 million acres of irrigated land. At the July regional board meeting the first two National Pollutant Discharge Elimination System (NPDES) irrigation return flow permits were adopted. These permits were for the Sacramento Valley Water Quality Committee (a group covering about 1 million acres of irrigated land) and the Mendota-Crows Landing Return Flow Group (covering about 400,000 acres). There were 47 co-signers to the Sacramento Valley Water Quality Committee permit and 17 co-signers to the Mendota-Crows Landing Return Flow Group permit.

At the August regional board meeting four more permits were adopted for almost 500,000 acres on the east side of the San Joaquin River. These permits were for the Stanislaus-Tuolumne Rivers Water Quality Committee (4 co-signers), Merced Irrigation District, Turlock Irrigation District, and Columbia Canal Company and Newhall Land and Farming Company's Columbia Ranch.

When CVRWQCB originally started collecting applications for NPDES permits they were concerned with land areas of more than 3,000 contiguous acres or more than 3,000 non-contiguous acres within the same drainage system. This designation of 3,000 acres originated from the Environmental Protection Agency's (EPA) Federal Register, Vol. 38, No. 120. On March, 1975, United States District Judge Thomas Flannery gave an opinion that EPA cannot lawfully exempt point source discharges of pollutants from regulation under the NPDES program. This decision modifies EPA's exemption of irrigation return flows from areas less than 3,000 acres.

Following the District Court's decision, the Agricultural Water Quality Advisory Committee in May 1975, composed a letter urging all agricultural interests, whether representing more or less than 3,000 acres, to participate in agricultural water quality organizations applying for group permits in the NPDES permit program. The letter stated, in part, "Through organizations of this type," (permit groups) "the agricultural community may effectively make known its needs and concerns so that any implementation of the permits will be compatible with the orderly development of agriculture...and...they may have a constructive impact upon any application of pollution control regulations to agricultural drainage."

The State Water Resources Control Board then requested the Regional Board to incorporate this concept into their ongoing program.

In working with irrigation water dischargers, CVRWQCB has been using the NPDES permit system as a data collection tool for water management and planning rather than a water control or enforcement mechanism. Monitoring is now underway in Basins 5A, 5B, and 5C and is now in the process of being established in Basin 5D. Many dischargers in Basin 5D have thought that because the very limited irriga-
dition water discharges in that area were into natural dry stream beds or into canals or streams where the waters were reused rather than into "waters of the United States", and generally did not leave the district's boundaries, they were not required to file an NPDES permit. However, the United States District Court in Arizona recently held that "navigable waters" (or waters of the United States) is construed to include normally dry arroyos, which, when flowing, may spill into public waters. This implies that irrigators in the 5D Basin could be subject to the NPDES permits.

In place of the permits, however, the Central Valley Regional Board is considering use of a "resolution to monitor". The resolution, an agreement between the Regional Board and the irrigator, would provide for monitoring in Basin 5D similar to that occurring in the other Central Valley Basins.

Another alternative which may be considered is to ask the new Basin 5D (Tulare Lake River Basin) Agricultural Water Quality Management Group to carry out a program to supply information to fill out the data base being collected in the other basins (5A, 5B, 5C).

Laboratory Certification

CVRWQCB has had several requests about just who can do the monitoring for specific conductance and suspended solids for permittees. This work must be done by a laboratory which has an approved certificate from the State of California Department of Health. It is possible for irrigation entities to receive an approval of certification from the Department of Health for analyzing specific conductance and suspended solids. By doing this it would then be possible for such entities to do their own laboratory work. For more information on how to receive this certification, contact Mr. Nathan Moskowitz, Department of Health, 2151 Berkeley Way, Berkeley, CA 94704. The telephone number is (415) 893-7900.

Additional Monitoring Requested
By Fish And Game

The Department of Fish and Game had adverse comments regarding the NPDES irrigation permits that were adopted at the July and August Board meetings. The Department of Fish and Game is concerned about fish kills in agricultural drains and would like to see an increase in monitoring to help determine the source of these kills. The additional monitoring they asked for is ammonia, alkalinity, pH, dissolved oxygen, and temperature. They would also like to have the monitoring of pesticides done when a practical and satisfactory program can be developed. The Regional Board denied the Department of Fish and Game request, and instructed the staff to work with Fish and Game in investigating fish problems in the drains.

CVRWQCB met with Fish and Game and agreed to conduct a joint investigation regarding Fish and Game's concerns. They hope to be able to determine from this investigation what type, if any, impairment of beneficial use is occurring in drains and streams due to agriculture chemicals. If such problems are found, remedies will be sought through the Agricultural Commissioner and others of the agricultural community, rather than through the Regional Board enforcement authority.
Central Valley Regional Water Quality Control Board offices are at:

Sacramento Office:  Walt Ryley
                    Gene Merrill
3201 S Street
Sacramento CA  95816
(916) 452-3977

Fresno Office:  Sarge Green
               Lou Beck
3374 East Shields Avenue
Fresno CA  93726
(209) 488-5116

Redding Office:  Jim Pedri
1815 Sacramento Street
Redding CA  96001
(916) 246-6376

-- Robert S. Ayers

ANALYSIS OF VARIANCE PROGRAM

I have worked out a 49 step analysis of variance program for a programmable pocket calculator. The program is flexible and can accommodate up to 9 treatments and/or blocks. This program is not provided in the manufacturer's manual and they have given me permission to disseminate it to interested readers of SOIL and WATER. Please write or phone me if you are interested.

-- Bill Wildman

Roy S. Rauschkolb
Extension Soils Specialist