THE ESTIMATION OF RUNOFF FROM HIGH PRESSURE SPRAY IRRIGATION IN SUGARCANE FIELDS ON THE COAST OF NATAL[1]

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Summary

Surface runoff of high pressure spray irrigation water has been measured at Tongaat by means of a portable runoff lysimeter. The effects of soil compaction, slope and trash blanket have been estimated from a multiple regression analysis involving these separate parameters.

Introduction

Runoff of irrigation water has long been a thorn in the flesh of the irrigation farmer, but to date no real attention has been directed to this problem. The reasons for this are simple: firstly, no method of determining quantitative runoff has been devised for irrigated fields, and secondly, the losses incurred due to runoff have received a "blind eye", or have not been appreciated.

With the ever increasing need for greater efficiency in farming in order to realise better crop returns, investigations into infiltration and runoff of irrigation water were stimulated.

Cleasby[4] described the irrigation systems in operation by the Tongaat Sugar Co., Ltd., in which some 1,500 acres fall under high pressure sprinklers delivering approximately 1 in./hr. It is on these sections that runoff is so severe, and a portable runoff lysimeter was devised to measure runoff in various fields under different trash management, slope, and soil compaction conditions.

Methods

Since irrigation control has been based on evaporation data, the need arose for a measure of runoff which could utilise the sprinkler water applied in any normal irrigation programme. With such an instrument, it becomes possible for runoff determinations to be carried out in any field at any time. Several lysimeters were constructed in order to facilitate replication. The apparatus is described below:

The eight foot square bottomless lysimeter was constructed of four separate corner pieces of $\frac{1}{8}$ in. by 8 in. flatiron, and connected to a drum sealed with polythene by 50 ft. of hosepipe. These portable lysimeters are carried into the field and hammered into the ground to a depth of six inches. The flexible nature of the design enables a fairly rough soil surface to be accommodated.

Several rain-gauges placed outside, and two gauges inside, allowed the total water applied to be calculated. The dimensions of the lysimeter are such that 1 inch of applied spray irrigation totalled 33 gallons of water over the area enclosed. Runoff was therefore very easily converted to a percentage of total application by multiplication of runoff water gallons by 3.

For each determination ground slope was measured (by means of a beam and spirit level) and compaction read with a Proctor penetrometer.

Whilst this method of determining runoff can and has been adapted on a variety of soil types, sufficient data for statistical analysis has only been collected on the Windermere series. From the limited amount of evidence obtained on other soils, it would appear that the same principles apply, provided their infiltration capacities are in the neighbourhood of 1 to 2 inches per hour.

Results

In table 1 percentage runoff is shown together with the soil compaction and slope measurements. Presence or absence of trash blanket is denoted by the figures 1 or 0, respectively.

TABLE 1

Percentage Runoff with Related Soil Conditions

Soil Compaction (lb./sq. in./100)	Slope	Trash (1) or bare (0)	Runoff %
8	1 in 4 0	0	50
7	1 in 6 4	0	20
8	1 in 3.5	1	45
8	1 in 3 5	1	43
10	1 in 4.0	0	71
7	1 in 5 0	0	22
6	1 in 6 9	0	16
9	1 in 5 0	0	55
8	1 in 5 0	0	40
3	1 in 5 3	1	6
4	1 in 3.5	0	18
3	1 in 6.5	0	12
5	1 in 4.0	0	32
2	1 in 3 0	1	3
1	1 in 10 0	0	1
1	1 in 5.3	1	1

Compaction values are averages of some 400 readings taken in the immediate neighbourhood of the lysimeters. These values multiplied by 100 represent the resistance to penetration in lb./sq. in.

A multiple regression analysis was carried out on the data in table 1, and it was found that the effect of compaction on runoff was very highly significant, whilst the variation in slope and presence or absence of trash blanket did not contribute significantly to runoff.

In consequence, a simple regression equation relating runoff and compaction was calculated. This equation takes the form

$$R = 6.7\,C - 10.3,$$

where R is percentage runoff, and C is compaction in lb./sq. in. divided by 100.

Figure 1 shows this regression line together with a plot of runoff against compaction data.

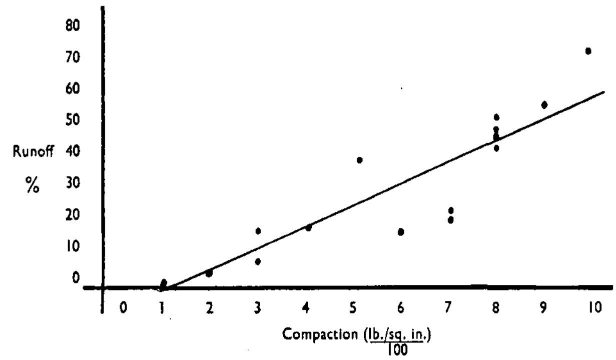

FIGURE 1

Conclusions

The results obtained in this investigation have had two important consequences, namely, an appreciation of the extent of runoff, and the significance of soil compaction.

As a result of this work remedial measures have already been initiated on irrigated sections at Tongaat. These involve a conversion to low pressure scheme design, where possible, and the inter-row subsoiling of ratoons after harvesting. Where the terrain is not suited to the use of low pressure equipment, or in cases where the expense involved in altering the scheme cannot be met, the subsoiling of ratoons provides an efficient remedial measure against runoff. During the course of this investigation it was found that subsoiling continued its check on runoff for periods of eight months or more.

References

1. Joint contribution from the Tongaat Sugar Company, Limited, and the Department of Soil Science, University of Natal.
2. Research Agronomist, The Tongaat Sugar Company, Limited, Maidstone, Natal.
3. Senior Lecturer in Soil Science, University of Natal.
4. Cleasby, T. G. (1960). The overhead irrigation of sugar cane in Natal. Wright-Rain Symp. Afr. & Irrig.

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