RESPONSE OF SOFT WHEAT, BARLEY, AND RAPESEED TO NITROGEN AND WATER AT THE SOUTH SASKATCHEWAN RIVER IRRIGATION PROJECT

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The 1973 season concluded the third year of a cooperative project between the Department of Soil Science and the Conservation and Land Improvement Branch of S.D.A. at the South Saskatchewan River Irrigation Project to investigate the factors limiting yields of the crops soft wheat, barley, and rapeseed.

At the start of the project the main focus of the study was on the response of these crops to fertilizer elements, mainly nitrogen. Subsequently, the role of irrigation and water management in crop production has received more attention.

In this paper, I want to point out some of the highlights of our findings.

Types of Experiments

Over the past three years we have set out two main types of experiments; one in which tillage and seeding operations were performed by the cooperating farmers and we applied broadcast fertilizer treatments after seeding. The farmers then controlled irrigation and we went back when the crop was mature and harvested the plots.

The second type of experiment was one in which the land was donated by the cooperating farmers. We carried out all operations on the plots - tillage, seeding, fertilizer treatments, irrigation management, weed control, and harvesting. These latter studies were carried out on two soils types, an Asquith very fine sandy loam and an Elstow loam. On these plots we were able to study the effects of different amounts of irrigation and various irrigation schedules on the crop yields as well as crop response to applied fertilizer.

All of the fertility treatments were set out in a randomized complete block design and replicated 4 or 6 times.

Fertility Trials - Results

In the nutrient response trials, nitrogen was the main plant nutrient under investigation. The nitrogen was applied broadcast at rates up to 300 lb/acre. Additional treatments

were included to determine the crop response to a split application of nitrogen as well as to added phosphate, potassium, and sulfur.

In general, the yield responses for irrigated soft wheat, barley and rapeseed were quite similar to those observed the previous two years. As with the previous years' results there was no significant yield response to split nitrogen applications above the single application or to nutrients other than nitrogen on any of the crops.

The data obtained this year for the response of these crops to nitrogen was combined with that obtained on the previous two years, and the average yield increase was plotted against applied nitrogen for various levels of soil nitrogen (Figure 1). The response pattern is fairly clear depending on the crop and the soil test level of nitrogen. This information will form the basis for fertilizer recommendations on these crops under irrigation.

Irrigation Schedules and Water Management

On the plots where we controlled the irrigation system as well as the fertility treatments, irrigations were scheduled by means of tensiometer readings.

Plots were irrigated when the readings of shallow tensiometers (6-9") reached 0.5 atmospheres. The amount of irrigation water applied was determined (within the limitations of the irrigation system) by the readings of deep tensiometers and consideration of the soil moisture storage capacity.

On one series of plots, the effects of moisture stress on crop yields was studied. Plots of soft wheat, barley, and rapeseed were set out in this study on Asquith very fine sandy loam and Elstow loam. Each of the plots was divided into four subplots to receive a different moisture stress treatment. In this experiment the fertility treatments were limited to a check, 100 and 200 lb of nitrogen / acre and a split nitrogen treatment of 50 + 50 lb/acre.

When irrigation was required, according to tensiometer readings, it was applied to all but one of the subplots. At each irrigation a different subplot was stressed:

subplot A missed the first irrigation,
subplot B missed the second irrigation,
subplot C missed the third irrigation,
subplot D received all irrigations.

Thus the effect of moisture stress at different times in the growing season on crop yield could be observed.

The type of results obtained from this study is illustrated using barley as an example crop.

First, the amount of water applied was compared to the amount required. An estimate of the amount of moisture required by the crop was obtained by using the figures obtained by Mr. L.G. Sonmor[1] for consumptive use of water by cereals. This estimate was compared to the amounts of water applied by rain and irrigation. The patterns of water application for the crop barley are shown in Figure 2a for the Asquith plot and 2b for the Elstow plot.

The yields obtained from these two sites are shown in Figure 3. At the Asquith site on the fertilized treatments it is apparent that a stress early in the growing season (i.e. missing the first irrigation) causes the greatest reduction in yield. The overall difference in yield due to water regime was about 20 to 25 bus/acre on both fertilized treatments.

On the Elstow site the differences in yield due to different water treatments were not as marked. This was possibly due to the fact that this soil is somewhat heavier textured and consequently less susceptible to drought. Differences on this site were in the order of 10 bus/acre.

The various water treatments were compared by means of the paired "t" test. In Table 1 the results of this analysis is shown for the three crops at both sites. Without exception, these results show that crops which were stressed late in the season or those which received all irrigations out-yielded crops which were stressed early in the growing season. The statistical level of significance was 5%.

Conclusions

1) Except for soils testing very high in nitrogen we have adequate information for soil test recommendations for nitrogen on irrigated soft wheat, barley, and rapeseed.

2) Consideration should be given to separating barley and wheat for the purpose of soil test recommendations.

3) Water management and scheduling requires further study, but this year's results indicate that it should form a part of the extension and management program and further research at the SSRIP.

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[1] Mr. L.G. Sonmor, Agriculture Canada Research Station, Saskatoon. Personal Communication

Table 1. Rating of yields from various irrigation schedules.

	Elstow Loam	Asquith vfsl
Soft Wheat	A < B < C = D	A < B = C = D B < D
Barley	A = B < C = D	A < B < C = D
Rapeseed	A = B < C = D	A < B = C < D

Differences significant at the 5% level as determined by a paired "t" test.

A - Missed first irrigation

B - Missed second irrigation

C - Missed third irrigation

D - Received all irrigations

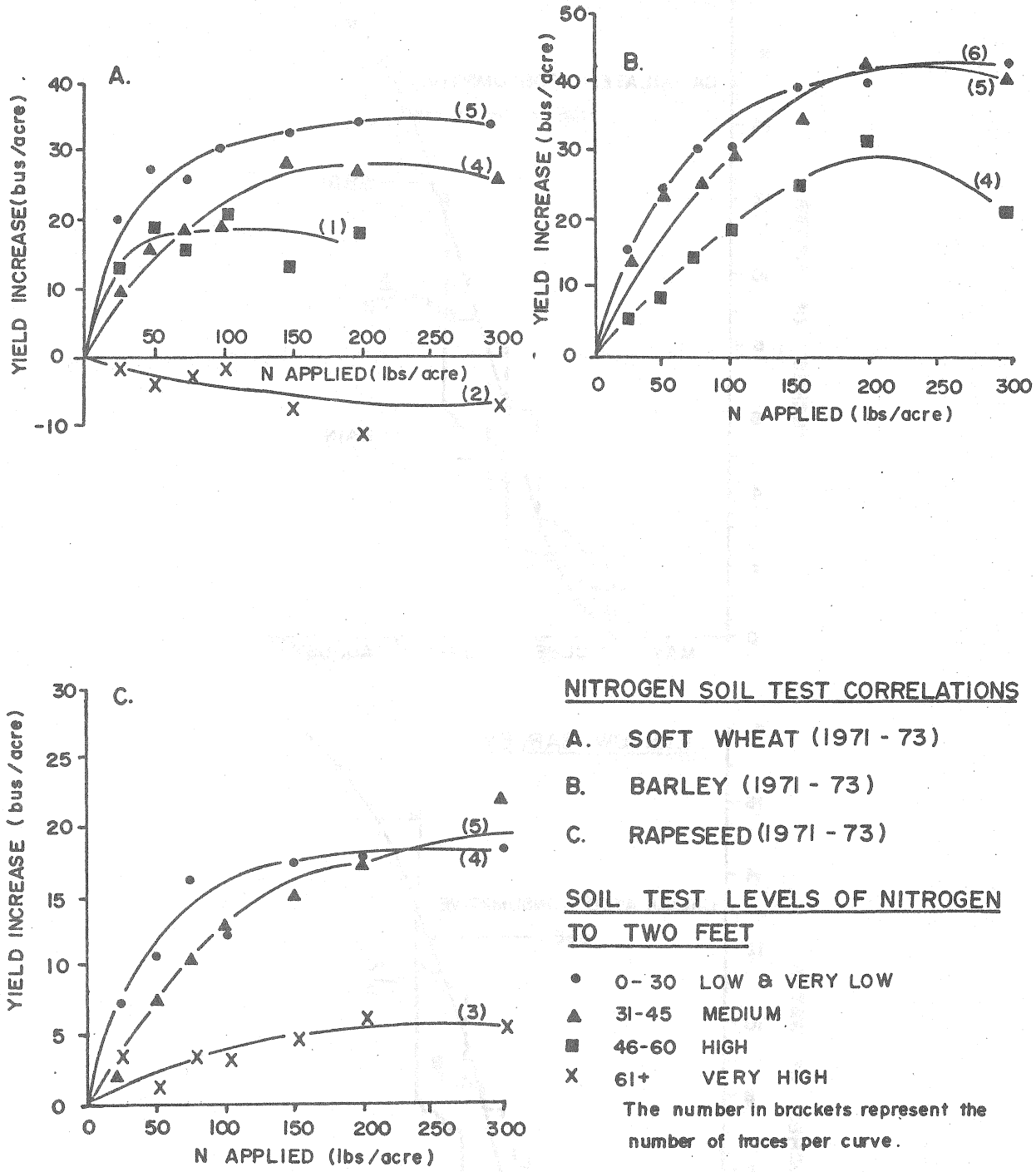

Figure 1. Response of irrigated crops to applied nitrogen.

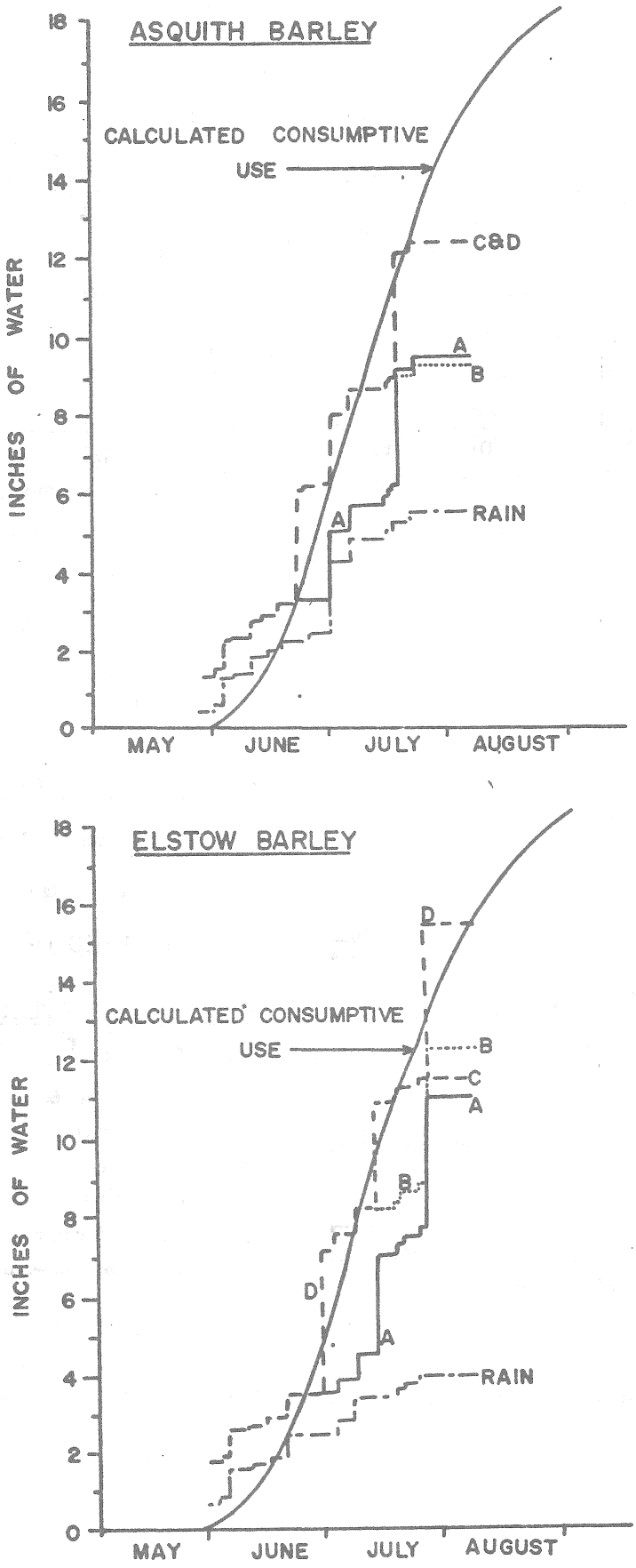

Figure 2. Amounts of water applied on the planned moisture stress experiments. The smooth consumptive use curve is calculated from pan evaporation data. A, B, C, and D refer to the different irrigation schedules.

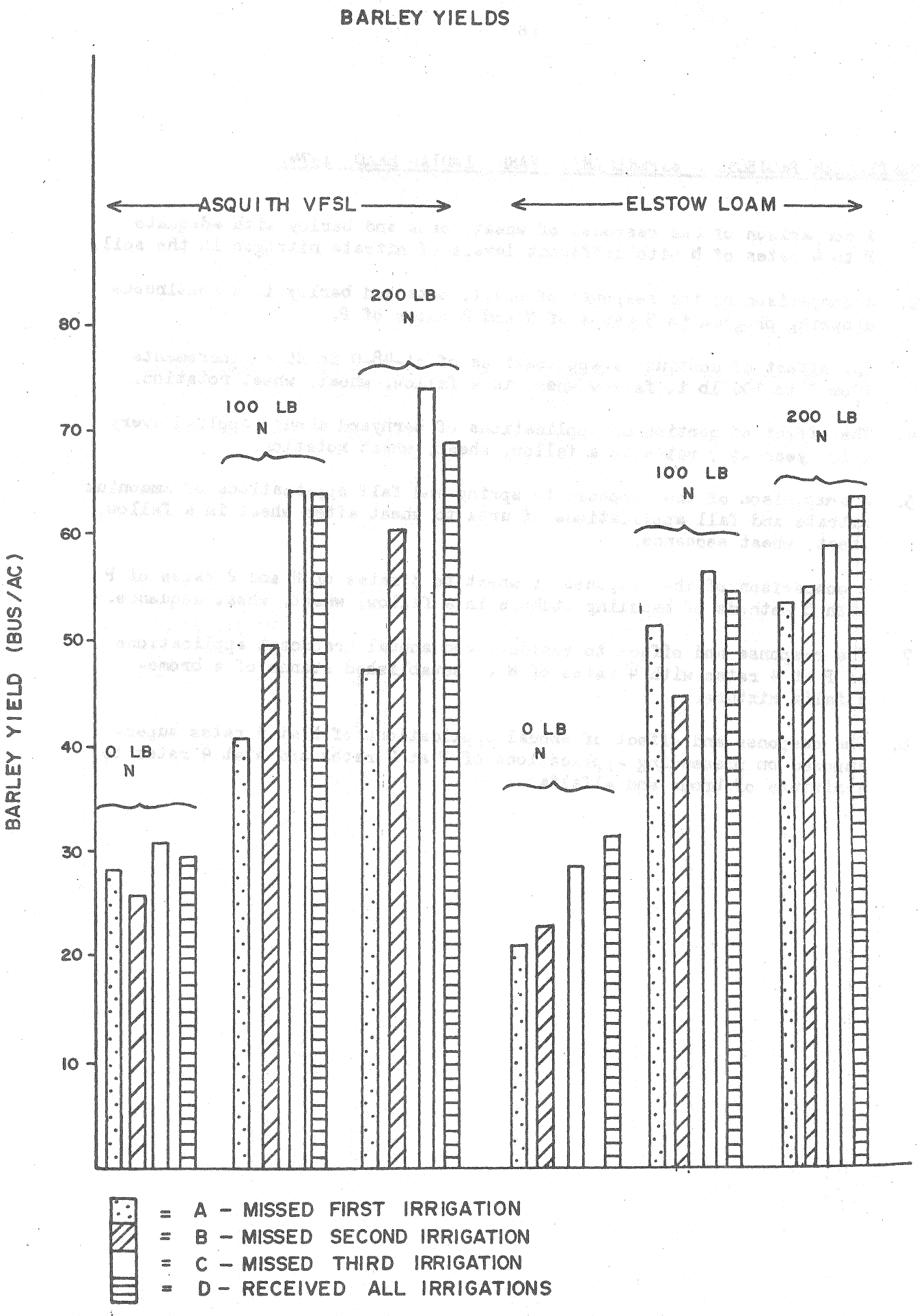

Figure 3. Yields of barley obtained under different irrigation schedules.