Productivity Studies in the Weyburn Map Area

D.W. Anderson and D.B. Wilkinson
Saskatchewan Institute of Pedology
University of Saskatchewan
Saskatoon, Saskatchewan

INTRODUCTION

The Saskatchewan Institute of Pedology is currently revising the soil survey of that portion of Saskatchewan covered by Report Number 12, producing maps of larger scale, increased detail and with more precise separations of the soils into associations and map units. To assess the significance of the more precise classification a study of the comparative agricultural productivity of the different soil series or profiles was initiated in the Weyburn Map Area. Because of the importance of Solonetzic soils in this area the study concentrated on comparing the productivity of the different types of Solonetzic soils, weakly developed Solonetzic or Solonetzic-Chernozemic intergrade types and normal Chernozemic soils. Additional objectives of the study were to obtain basic data relating yield to soil and other environmental properties to serve as inputs for a predictive model for crop production, and to assess the practicability of lengthening crop rotations on Dark Brown Chernozemic soils.

METHODS

Five sites approximately 20-25 ha in area were selected (Table 1). At each site two representative transects were chosen and profiles typical of different soil series were selected at random. There were 15 profiles or plots at each site, generally five replicates of the three most commonly occurring series (Figure 1). At each plot soils were sampled to 60 cm depth at seeding and available plant nutrients, salinity levels and pH were measured. Access tubes were installed for monitoring soil moisture with the neutron moisture meter at 18-day intervals through the growing season. Crop condition was observed at similar intervals. Precipitation was measured and recorded by the cooperating farmers. Estimates of total and grain yields were obtained by sampling duplicate square meter areas. After harvest soil pits were dug, soil profiles described and the B and C horizons sampled to 1.2 m depth.

Wheat on summerfallow was grown at all sites with the normal management practised by the farmer cooperators.

The soil profiles or series studied were:

AMA - Orthic Dark Brown, Amulet Association
BKW - Solonetzic Dark Brown, Brooking Association
BKY - Solodic Dark Brown, Brooking Association
TCS - Dark Brown Solonetz, Trossachs Association
TCT - Dark Brown Solodized-Solonetz, Trossachs Association
TCU - Dark Brown Solod, Trossachs Association

Table 1. S.E. Productivity Study - 1975.

Cooperator	Location	Growing Season Prec. (mm)	Series	# of Replicates	kg/ha Yield
H. Schnell	1 & 12-1-12-2	278	AMA	4	2650
			BKY	4	2312
			BKW	6	2171
			TCU	1	2162
*H. Halverson	S½-36-1-12-2	175	BKW	1	2606
			TCU	5	2343
			TCS	5	2278
			TCT	4	1893
H. Lievaart	NW-6-2-10-2	180	BKY	1	2401
			BKW	3	2115
			TCU	4	2084
			AMA	3	2002
			TCS	4	1602
*K. Memory	NW31-1-10-2	176	BKW	1	3017
			BKY	1	2253
			TCU	4	2100
			TCS	6	1861
			TCT	3	1655
N. Flaten	NW8-8-16-2	84	TCS	4	1072
			TCU	3	1024
			TCT	8	832

* Fertilized

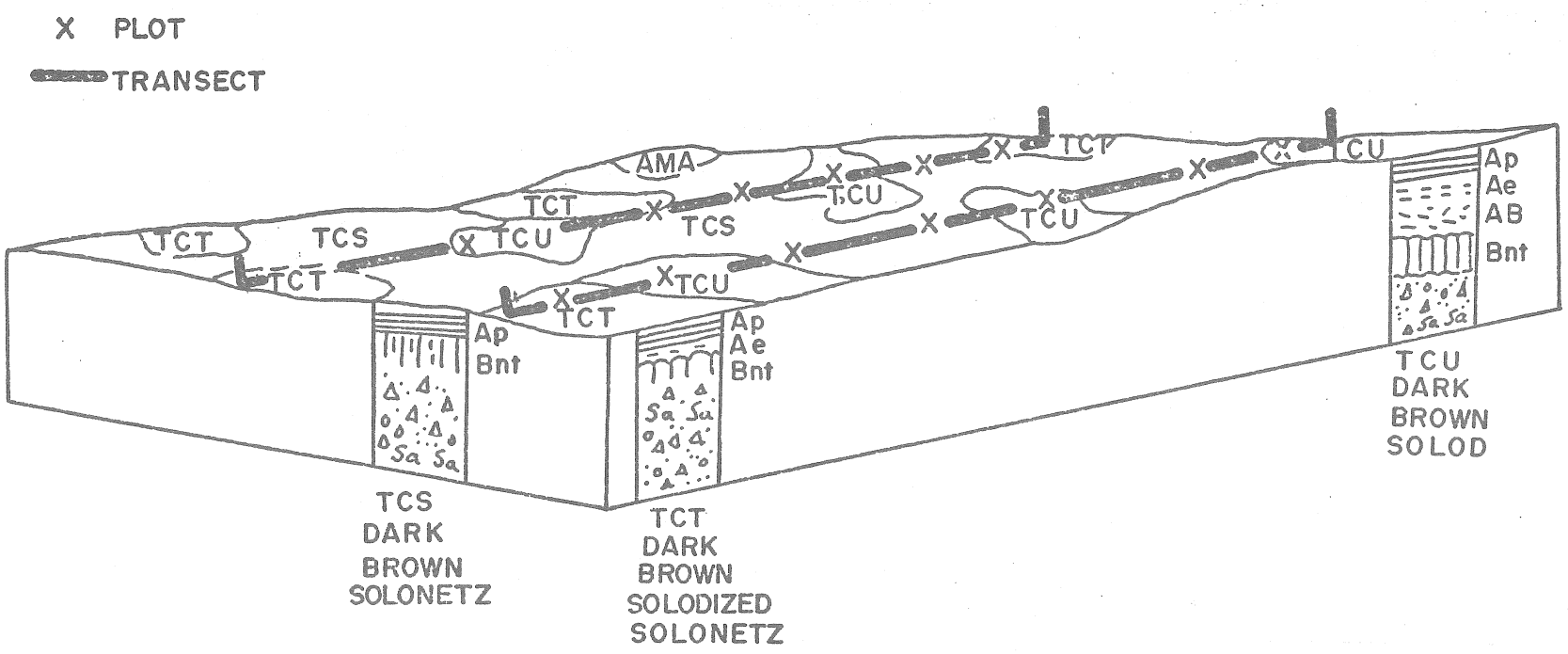

FIG. I. SOIL DISTRIBUTION AND POSITION OF SAMPLE PLOTS AT A TYPICAL SITE WHERE SOLONETZIC SOILS ARE DOMINANT

The BKW and BKY series are weakly developed Solonetzic soils, with soil profiles that have many of the characteristics of Solonetzic soils such as strong subangular blocky structure, clay and organic matter coatings in their B horizons but lacking the amount of B horizon development and salinity characteristics of the more strongly developed Solonetzic soils. The TCS, TCT and TCU soils are strongly developed Solonetzic soils.

RESULTS AND DISCUSSION

Yields at the Flaten site were considerably less than at the sites of the Torquay-Outram area (Table 1). The smaller amount of growing season rainfall at that site was partially responsible for the differences, although the more strongly Solonetzic characteristics of the soil and general occurrence of saline soil at lesser depths were probably contributing factors also. Yields were generally lowest for the Solodized-Solonetz (TCT) series, with increase in yields in the sequence TCS (Solonetz), TCU (Solod) to highest and approximately equal yields for the weakly developed Solonetzic or intergrade series (BKW, BKY) and Orthic Dark Brown (AMA) series. A significant negative correlation ($r = -0.41$, $R^2 \times 100 = 16.1$) between yield and NO_3-N to 60 cm depth at seeding was surprising, and is probably related to other factors such as the tough, impermeable B horizons and higher salinity characteristic of the series (TCT, TCS) with the largest amounts of NO_3-N. Some evidence for this is the significant negative correlation ($r = -0.53$, $R^2 \times 100 = 28$) between yield and soluble sodium percentage (SSP) of the B horizons. SSP has been used as a criterion for differentiating Solonetzic and Chernozemic soils, increasing with degree of Solonetzic B horizon development and with salinity level. The mean SSP values observed for the BKW and BKY indicate that designating these soils as Solonetzic-Chernozemic intergrades was appropriate, although the range of values observed suggests that no single criterion will adequately separate these two groups from the typical Chernozemic and Solonetzic soils.

At the Memory site, depth of extraction of moisture (Figure 2) was greatest for the TCU or Solod soils, a probable consequence of the relatively friable, permeable nature of the soil profile. Where tougher, impermeable B horizons occur as in the TCS and TCT (Solodized-Solonetz) the plant roots were able to extract significant amounts of moisture only from the mean surface depths, with little change in moisture content of the depths greater than 45 cm. Similarly, the depths of moisture extraction was greatest for the Chernozemic AMA soil and reduced in the more strongly structured BKY and BKW soils (data not shown).

SUMMARY

A preliminary assessment of the data gathered in this study has revealed differences in yield among the different soil series. Best yields were observed for normal Chernozemic soils and almost equivalent yields for the Chernozemic-Solonetzic intergrade soils. Lower yields were characteristic of the true Solonetzic soils, particularly the Solodized-Solonetz series. Unusual relationships between available N supply and yield demonstrated that soil property-yield relationships are different for Solonetzic soils, pointing to the need for study of this

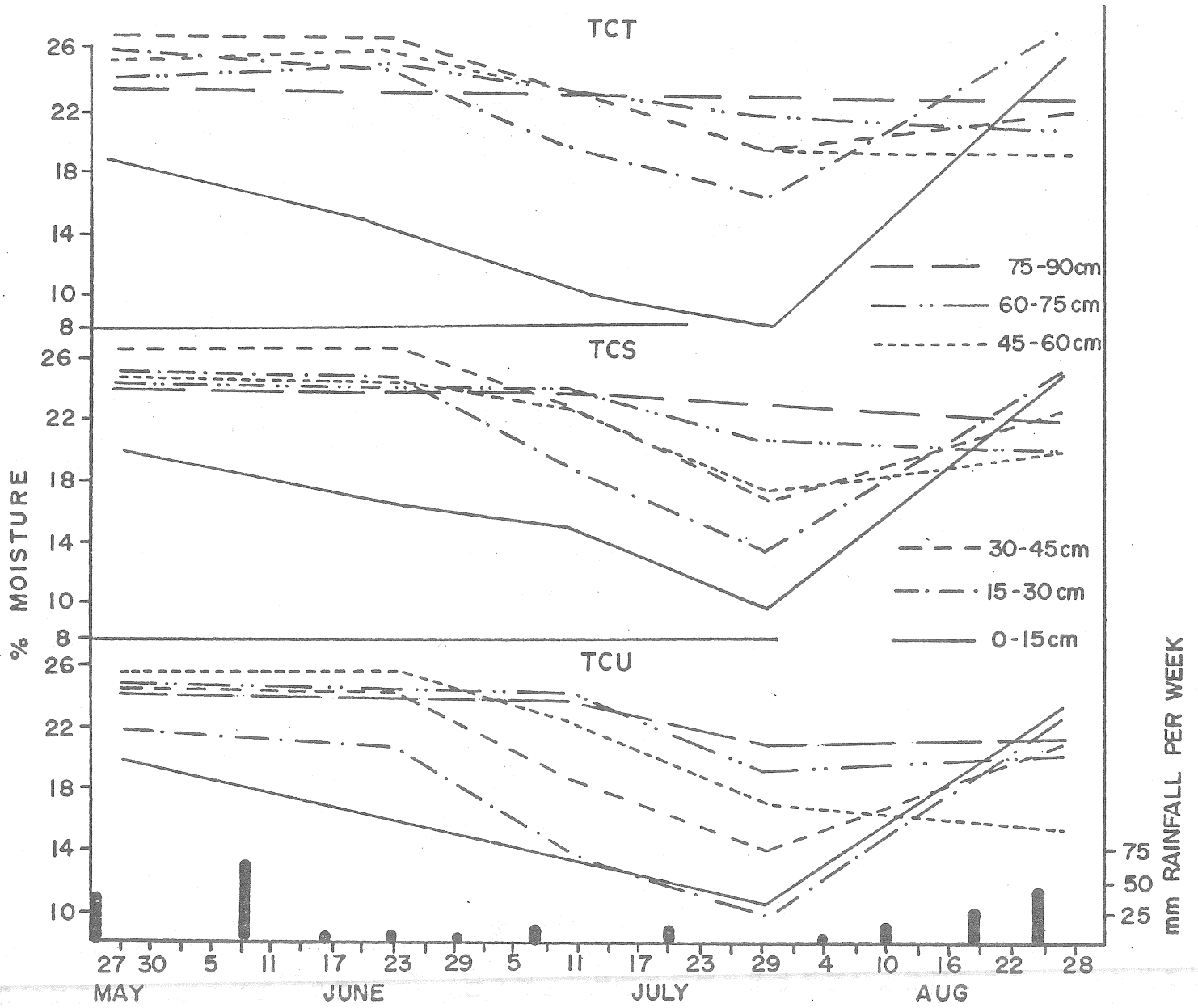

FIG.2 CHANGES IN SOIL MOISTURE OVER THE GROWING SEASON AT THE MEMORY SITE

Table 2. S.E. Productivity Study - 1975.

Series	# of Replicates	kg/ha Mean Yield	kg/ha Mean NO_3-N -60 cm	kg/ha Mean Avail P -15 cm	(SSP) Water sol. Na % in B	C Hor. Cond. mmhos/cm^2 at 25°C
AMA	7	2372±202	86.2±12.2	16.0±1.2	23.6	2.1
BKY	6	2317±145	104.9±19.7	21.8±5.3	33.4	2.9
BKW	11	2272±145	100.1±7.6	18.2±1.3	33.7	2.4
TCU	17	1981±149	110.8±5.7	21.2±2.2	39.1	3.6
TCS	19	1750±159	111.1±9.7	19.6±1.8	58.9	5.9
TCT	15	1297±156	128.4±10.8	18.5±3.2	75.7	8.2

soil group. Different soil series had differences in depth of moisture extraction, a phenomenon probably related to the physical properties of the B horizons. This project is continuing.