Factors Affecting Wheat Yields

Yield and Profit results of tillage experiments with prairie sod, stubble land cnd fallow at the University of Saskatchewan, Saskatoon

By John Bracken, Professor of Field Husbandry

The wheat crop of Saskatchewan is over twice as valuable as the total of all other crops grown in the province. Over one-half the total wealth now being produced annually in Saskatchewan comes from her soil in the form of wheat. In 1898 our wheat crop was grown on 276,000 acres—in 1915 it occupied 7,000,000 acres. Eighteen years ago the production of wheat in the province was about 5,000,000 bushels—last year it was 175,000,000 bushels. In 1898 the total value of the wheat crop to the farmer was less than $3,500,000—in 1915 it was $145,000,000. The development of this industry here has been attended with many soil, climatic and economic difficulties. Some of these have been lessened and some overcome, but many yet remain unsolved. This article is to add to the experience of the wheat grower the experimental evidence gathered during the last few years from the investigation work undertaken and carried on by the Department of Field Husbandry of the University of Saskatchewan.

Farming is a business. To be successful it must be profitable. To be profitable the cost of production must be less than the selling price of the product. The price is largely beyond the influence of the wheat grower; the cost of produceion is largely but not wholly within the power of the farmer to control. The causes of failures are due to (1) poor crops, or (2) poor management, either by the individual or by the state. It is not our purpose here to refer to the subject of farm management or the economic questions arising out of the production and distribution of farm crops, but rather to discuss the means of controlling the yield of crops and the relative profits from different methods of production.

> Professor Bracken has one of if not the most extensive series of field husbandry experiments under way at Saskatoon to be found anywhere in America. He is doing a tremendous work, valuable not only to Saskatchewan but to every farmer in the three Prairie Provinces. This article gives the results of some of his tillage experiments with wheat. Prof. Bracken's annual report will contain these and other results in greater detail, and ought to be studied by every western farmer.

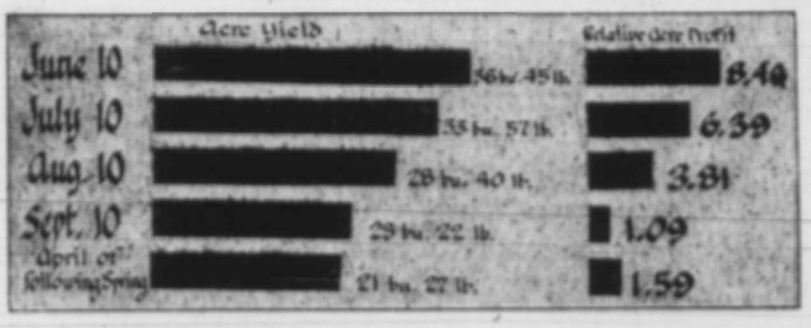

Fig. 1—Showing the influence of time of breaking on the yield and profit of the wheat crop

The conditions that must be provided by nature or by man before crops will grow are six in number: (1) The seed; (2) Plant food; (3) Moisture; (4) Heat; (5) Light; (6) Air. All causes of low yields trace back to an insufficient or poorly balanced supply of one or more of these things. The means at the disposal of western farmers for influencing these conditions and thereby controlling in some degree the causes of poor crops of wheat are: (1) The choice, selection and breeding of crops; (2) Suitable crop management practices; (3) Suitable methods of managing the soil. The first of these includes: (a) The choice of suitable varieties, and (b) Selection and breeding. Crop management includes: (a) The care and treatment of the seed; (b) The time, amount and depth to sow; (c) The time and method of harvesting and curing. Soil management includes: (a) The time, method and amount of tillage—(1) for prairie sod, (2) for stubble land, (3) for summer-fallow; (b) The rotation of crops; (c) The use of manures and fertilizers; (d) Irrigation and drainage; (e) Innoculation with nitrogen fixing bacteria.

In the following only those experiments relating to soil management are discussed.

Soil Management for Wheat

The three chief means of controlling soil conditions that are available to western farmers are: Tillage, the practice of a suitable crop rotation, and the use of fertilizers. The tables that follow and the observations made give the results of some of the tillage experiments carried on at Saskatoon by the Department of Field Husbandry.

Our tillage problems fall naturally into three groups: (1) The tillage of prairie sod; (2) The tillage of stubble land; (3) The tillage of the fallow. In each of these, the things that are important to know for each different set of soil and climatic conditions are the type of tillage machine to use, the time to use it and the amount to use it. The experiments discussed below throw some light on each of these phases of tillage operations as carried out on a heavy loam soil in Saskatoon district.

Time of Breaking Prairie Sod

Time of breaking	Two year aver. yield	Acre value at 70c per bus.	Acre profit	Rel. acre profit on lowest.	Rel. bus. cost
June 10	36 bus. 45 lbs.	25.72	8.44	23.4	.61
July 10	33 bus. 57 lbs.	23.78	6.39	17.7	.66
Aug. 10	28 bus. 40 lbs.	20.07	3.81	10.6	.74
Sept. 10	23 bus. 22 lbs.	16.38	1.09	3.0	.87
Follow. spring	21 bus. 27 lbs.	15.71	1.59	4.4	.86

The relative acre cost is easily secured by subtracting the figures for acre profit from those giving acre value. There should be no difficulty in interpreting this table. It indicates that delay in time of breaking after June 10 decreases the yield of wheat at the rate of 4½ bushels per acre per month, and decreases the acre profit at the rate of $2.45 per acre per month. In other words, one month's delay in breaking means a loss of more than the net profit derived by the average Saskatchewan wheat grower.

Part of the increased cost of the early breaking is necessarily due to more tillage, and the remainder to the cost of handling the greater crop that it produced. It is interesting to note that in the fall preceding the 1916 crop the June 10 breaking contained in the upper acre six and two-third inches of soil, 182 tons of water; the July breaking, 139 tons; the August breaking, 100 tons, and the September breaking, 92 tons.

Deep Versus Shallow Breaking

Our experiments in 1915 and 1916 show that backsetting does not increase the yield when the native vegetation, grasses, etc., is completely killed by once plowing followed by surface cultivation. Backsetting seems to be useless under such dry conditions as obtained in the summer and fall of 1914. The sod did not rot and backsetting that year of shallow broken land decreased the yield in 1915 almost seven bushels per acre in comparison with deep breaking that was surface cultivated as needed. There was practically no difference in yield, however, under the same treatment in 1916. It is, however, on the second crop after breaking that the advantage of more than one plowing becomes apparent. Land unplowed even tho well disced if it be full of grass will only give yields far below that rendered fairly free of grass by backsetting. On such a crop of wheat in 1913 we secured a yield of over 14½ bushels per acre, whereas land broken deep, i.e., only plowed once and wholly surface cultivated gave only 4 1-6 bushels. These latter tests were on land containing considerable quack grass, whereas the former were conducted on less grassy land in a very dry season.

Various Effects of Surface Cultivation

The effects of different kinds and amounts of surface cultivation on the yields of Marquis wheat from land broken and later backset is shown. The breaking and backsetting were both done in the same season and the yields are from the first crop in each case.

Broken and Backset Same Season—First Crop

	1915 Crop	1916 Crop
Double disced, packed and harrowed	34 bus. 10 lbs.	36 bus. 36 lbs.
Double disced and harrowed	33 bus. 13 lbs.	36 bus. 27 lbs.
Harrowed only	28 bus. 12 lbs.	35 bus. 17 lbs.

In 1914 backsetting left the soil very rough, dry and lumpy and the more surface cultivation it was given the higher the yield. Both double discing and packing proved very profitable. In 1915, however, backsetting in itself left the soil in perfect tilth and the extra work increased the yield hardly enough to pay for the extra cost. When the soil is mellow and in fine tilth after backsetting, as is generally the case where the sod is well rotted, packing and double harrowing seem to be all the tillage necessary. Only when the soil is lumpy and rough or grassy does discing seem well warranted.

Yields of approximately two bushels more per acre from land packed immediately after breaking and before backsetting were obtained over land which was not packed down before backsetting. In both cases the land was well harrowed before seeding. Firming the breaking as soon as possible after breaking facilitates the rotting of the sod by forcing it against the more moist sub-soil. Such packing pays on all soils not infested with creeping rooted plants. On such soils it is sometimes wise to leave the furrow slice unpacked so that it may dry out and thus aid in killing such creeping rooted weeds.

Summary Results on Breaking Prairie Sod

Our chief observations and experiments on breaking prairie sod may be summarized as follows: The chief functions of tilling prairie sod in semi-arid climates are (1) To kill the native vegetation; (2) To store moisture in the soil and conserve it there, and (3) To prepare a suitable seed bed or home for the plant. The best means of achieving these functions seem to be: (1) Break early during the rainy season; (2) Plow all the land and turn the furrow over flat; (3) Pack after breaking; (4) Disc deep breaking as soon as possible after it can be done without turning up sods; (5) Cultivate sufficiently during the season to control the growth of native weeds and grasses, and to prevent baking; (6) If once plowing does not kill the grass and small shrubs, backset after the sod has decayed; (7) Don't backset if sod is not rotted; (8) Land intended to be backset should be broken shallow; that not to be backset deeper; (9) Backsetting should be made firm and then harrowed; (10) Cropping spring breaking except to corn is undesirable in dry areas; (11) Scrub land should be plowed deeply, as much of the vegetation as possible turned under, and the land packed and surface cultivated but not backset; (12) The more humid the district the later the plowing may be done.

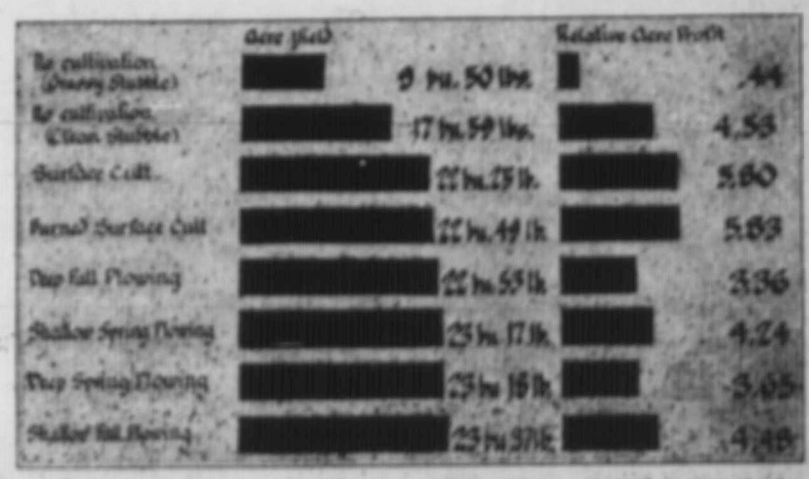

Fig. 2—Showing the influence of different methods of tilling stubble on the yield of wheat and the relative acre profit. Experiment described on next page.

The Tillage of Stubble Land

An interesting series of experiments showing the yields from stubble land under different systems