

CHEMICAL SUMMERFALLOW IN SOUTHERN SASKATCHEWAN

C.H. Anderson,
Research Station,
Research Branch, Agriculture Canada,
Swift Current, Saskatchewan. S9H 3X2.

INTRODUCTION

As early as 1947, T.S. Aasheim, Project leader, Soil Conservation Service of the United States, observed the use of 2,4-D and wondered whether this herbicide could be used to reduce the number of tillage operations necessary for fallow preparation. This was the beginning of chemical fallow studies throughout the northwestern United States, some of which were reported as early as 1956 by workers in Montana (5). An excellent summary of chemical fallow studies in the winter wheat-growing area of Wyoming was published by Alley and Chamberlain in 1962 (1). This report assisted Canadian workers in their search for one-shot chemical fallow treatments. Research Branch scientists in western Canada were searching for new techniques to improve moisture and residue conservation and in 1956 undertook a cooperative study at six locations in the three western provinces (6). Follow-up chemical studies in Saskatchewan were reported in 1968 (7), 1969 (2), and 1971 (4), as well as studies of direct placement of seed into the soil without the benefit of preseeded tillage in order to further conserve moisture and crop residue in the year of seeding (4).

Industry has also been involved in chemical fallow research in western Canada. In the sixties, Chipman Chemicals conducted extensive trials with Gramoxone (paraquat). This product is used throughout parts of the United States in minimum tillage programs. More recently Ciba-Geigy Canada Ltd. conducted extensive trials in Western Canada in close cooperation with the Research Station at Swift Current in the development of "Falogard", an after-harvest application of liquid atrazine. This treatment has been approved by the Canada Weed Committee (Western Section) for use on certain specified soils in the Brown soil zone of Alberta and Saskatchewan.

EARLY STUDIES WITH ATRAZINE IN THE UNITED STATES

A comprehensive summary of chemical fallow studies prepared by Alley and Chamberlain in 1962 (1) evaluates studies initiated by the Wyoming Agricultural Experiment Station. Experiments were conducted at the Archer Agricultural Substation and the Sheridan Agricultural Substation and in cooperation with a number of commercial wheat growers throughout the region. Major emphasis was placed on the evaluation of the triazine compounds, especially atrazine. This chemical controlled both the grass and broadleaved weeds for the complete fallow year, with limited residual damage to fall planted winter wheat. No distinction was made between fall and spring applied atrazine treatments. The overall results with atrazine were summarized as follows:

1. Atrazine will control both grass and broadleaved weeds for a complete summerfallow period.

2. The residual effect of this compound is not completely understood when subjected to different soil and climatic conditions.
3. New compounds and analogues of existing compounds, with more solubility and selectiveness, may hold more promise for this area.
4. Yields of winter wheat have been, in many cases, equal to, or in excess of, those from mechanically fallowed lands.
5. The residual effect of atrazine persists for a longer period of time in clay soils than in sandy soils.
6. Reduction in wheat yield has resulted only on the clay soils. Wheat has tolerated rates of 2 and 4 lbs/ac of atrazine on sandy soils.
7. There is a need and a definite potential for the chemical-fallow program.

STUDIES WITH ATRAZINE IN WESTERN CANADA

In 1974 Ciba-Geigy reported on 22 tests involving the fall application of atrazine for fallow weed control. Their work showed that at the rates recommended, fall applied atrazine controlled most germinating weeds including wild oats and volunteer grain until early summer and did not injure the succeeding grain crops. Green foxtail (*Setaria viridis* (L.) Beauv.) was not controlled. On some sandy soils rates as high as 2 lb/ac were applied without injury to the grain crops following. However, crop injury did occur on some soils, notably those soils having a high lime content in the surface soil. The clay soils of the area are examples of those soils exhibiting detrimental residual effects on following crops. These data support the findings of Alley and Chamberlain (1) that the residual effect of atrazine persists for a longer period of time in clay soils than in sandy soils.

Studies with fall applied atrazine have been underway at Swift Current since 1972. As reported to the Canada Weed Committee (Western Section) in 1974 and confirmed in 1975, atrazine controlled most weed growth (green foxtail and foxtail barley excepted) over the summerfallow period on a clay loam soil; there was no evidence of permanent injury to wheat with up to 1 lb/ac of the chemical and yields were not reduced (Tables 1 and 2). In some years the 1 lb/ac rate reduced the plant stand where wheat was direct seeded and yields were likewise reduced. Ciba-Geigy reported equally encouraging results from fall-applied atrazine on loam and sandy soils at sites in Alberta and Saskatchewan.

On the basis of the studies carried out at the Research Station, Swift Current and by Ciba-Geigy at numerous sites in southeastern Alberta and southwestern Saskatchewan, the Canada Weed Committee (Western Section) approved the use of atrazine as a fallow treatment in 1975 as follows: "For minimum tillage fallow on the Brown soils of southwestern Saskatchewan and southeastern Alberta (do not use on clay soils with high levels of CaCO₃ at the surface), apply atrazine at 0.60 lb/ac to stubble following harvest. Normal cultivation or spraying of weed escapes should be started next season as required."

Table 1. Wheat on chemical fallow (with preseeding tillage)
1974 to 1976

Treatment	Rate kg/ha	Yield in gms/m			3-year mean
		1974	1975	1976	
Atrazine applied in October	0.84	164	243	144	184
Atrazine applied in October	1.12	171	262	182	205
2,4-D in October plus tillage	0.42	166	239	161	189
Check (no treatment)	--	146	195	119	153

Table 2. Wheat on chemical fallow (direct seeded)
1974 to 1976

Treatment	Rate kg/ha	Yield in gms/m			3-year mean
		1974	1975	1976	
Atrazine applied in October	0.84	158	207	167	177
Atrazine applied in October	1.12	118	211	180	170
2,4-D in October plus tillage	0.42	149	196	244	196
Check (no treatment)	--	98	92	124	105

At present Ciba-Geigy have a restricted registration covering the use of atrazine for summerfallow under the trade name "falogard". Limited quantities were made available to farmers for application in the fall of 1975. These farmers now have first-hand information on its effectiveness as a tillage substitute under their conditions. Further quantities were applied in the late autumn of 1976.

The acceptance of chemicals as a substitute for tillage in summerfallow preparation is the first major change in farming practice recommendations in western Canada since the acceptance of trash cover farming in the late 1930's. This change will signal a concerted effort by researchers to assess other chemicals in a never-ending search for more effective and economical fallow treatments. Responsible researchers

in government and industry must continue, however, to monitor residues in the soil resulting from chemicals used in zero and minimum tillage programs and to determine their effect on future cropping. Further research is also indicated to compare energy requirements of chemical and tillage fallow systems.

BIBLIOGRAPHY

1. Alley, Harold P. and Chamberlain, Earl W. 1962. Summary report of chemical fallow studies. University of Wyoming Mimeo Circ. 166.
2. Anderson, C.H. 1969. Control of winter annual forms of stinkweed and flixweed. Can. J. Plant Sci. 49: 87-89.
3. Anderson, C.H. 1971. Comparison of tillage and chemical summer-fallow in a semiarid region. Can. J. Plant Sci. 51: 397-403.
4. Anderson, C.H. 1975. Comparison of preseeded tillage with total and minimal tillage by various seeding machines on spring wheat production in Southern Saskatchewan. Can. J. Plant Sci. 55: 59-67.
5. Baker, L.O., Krall, James L., Aasheim, T.S. and Hartman, C.P. 1956. Chemical summerfallow in Montana. Down to Earth 11(No. 4).
6. Molberg, E.S., McCurdy, E.V., Wenhardt, A., Dew, D.A. and Dryden, R.D. 1967. Minimum tillage requirements for summerfallow in Western Canada. Can. J. Soil Sci. 47: 211-216.
7. Molberg, E.S. and Hay, J.R. 1968. Chemical weed control on summer-fallow. Can. J. Soil Sci. 48: 255-263.

THE EFFECT OF REDUCING TILLAGE ON SUMMERFALLOW WHEN WEEDS ARE CONTROLLED

WITH HERBICIDES IN THE BLACK SOILS ZONE OF SASKATCHEWAN

by Ken Bowren

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Some 22 million acres of land are summerfallowed each year on the Canadian Prairies (Statistics Canada, April 2, 1976). It was shown at Indian Head by MacKay & Associates in 1889 (Anderson 1975) that land left idle on which weeds were controlled produced greater yields the following year, and thus the practice of summerfallow began on the prairies. When agriculture advanced to the parkland area of western Canada the practice was introduced there as well. Summerfallow is considered to be useful for controlling weeds, increasing soil moisture and nutrients and conditioning the soil for succeeding crop production. On loam soil in tanks at Swift Current, it was shown (Doughty et. al. in 1949) that some 13.5 cm (5.3") (26.8%) of the precipitation (50.5 cm) (20") that fell during the fallow period was conserved in the soil.

In the parkbelt we have shown that summerfallow is an inefficient method of storing soil moisture. On the average only about 10% (5.3 cm) (2.1") of the some 55 cm (22") of precipitation received during the 22 month fallow period is stored in the soil, and in addition about 42% of this storage takes place during the first fall and winter. (Bowren 1975).

In northeastern Saskatchewan, farmers summerfallow for moisture conservation, nutrient buildup, weed control, land management and to prepare the land for special crops or seed production. The production of seed requires that the crop be grown on ground free of certain weeds and volunteer grain of the same or another variety. Special crops such as rape, mustard, peas, etc. often perform better on fallow which has a bit more moisture, a better nutrient status, fewer weeds (there are often no herbicides that can be used to control some of the weeds in these crops) and less trash to impede the preparation of a good seedbed. In some cases a serious weed problem can be handled more economically by summerfallowing the land for one year. Yields on well managed stubble generally range from 65 to 90% of those on fallow.

It was shown at Swift Current (Korven et. al. 1962) that the best results were obtained when summerfallowing was started early in the spring (about seeding time). Under Swift Current conditions, the yield of wheat was usually about 4 bushels higher than when the first tillage on fallow was delayed to June 15, some 2-3 weeks after seeding time. The early tillage was mainly effective in controlling early weed growth and summerfallow started at this time usually required one or two extra tillage operations. No herbicides were used on these fallows.

In a later study at Swift Current (Anderson 1971) reported that if weeds were controlled by herbicides, the first tillage could be delayed until mid-June without affecting the results of the fallow. It was stated that further study was required to fully assess the effect of continually replacing tillage with herbicides on fallow.