FS 299
October 1983

Chemical Fallow in Dryland Grain Fields in Oregon

Downy brome and other weedy grasses infest three million acres in Washington, Oregon, and Idaho. They are difficult to control with tillage practices such as stubble mulch, trashy fallow, reduced tillage, minimum tillage, no-till, and sometimes even the moldboard plow (Rydrych 1974). There are some innovations in chemical fallow that can be used to supplement tillage so that trashy seedbeds and straw layers do not favor weed establishment. Weedy grasses, volunteer grains, and broadleaf weeds can be controlled by chemical treatment when weather is unfavorable for tillage or soil disturbance is not desirable (Rydrych 1979).

What is chemical fallow?

Chemical fallow means the use of appropriate herbicides to replace one or more fall or early spring tillage operations (Rydrych and Muzik 1968). Fall grain stubble often becomes infested with downy brome (cheatgrass), goat grass, wild oats, volunteer cereals, and other weeds that can form a dense sod and impede spring tillage operations. Applying a fall or spring herbicide to this weedy growth will remove competition and make excessive tillage unnecessary. A crop rotation where land is fallowed in alternate years to conserve soil moisture and control weeds is common practice in the wheat-producing areas of the Pacific Northwest. This has been the most satisfactory way to maintain grain production in areas that average less than 15 inches of precipitation annually and where supplemental irrigation is not available. Chemical fallow serves as a substitute for tillage during periods of unfavorable weather or excessive spring moisture. Only in the case of no-till are herbicides a complete substitute for tillage.

Conservation tillage is used during the fallow year or in annual cropping to control weedy vegetation, reduce moisture evaporation, and maintain organic trash on the soil surface to prevent wind and water erosion. Most broadleaf weeds are controlled by simple tillage, but grass weeds such as downy brome, goat grass, and annual ryegrass, and volunteer cereals such as wheat, barley, and rye are more difficult to control during wet, humid weather. Without the help of chemical fallow, tillage merely transplants the grass weeds and volunteer vegetation. Chemical fallow can improve moisture storage efficiency, retain more straw on the soil surface, reduce the need for mechanical tillage, reduce diseases and insects, and save fuel.

Chemical fallow increases yields

Tests in 1977-1981 in eastern Oregon showed an additional inch of moisture was stored in chemical fallow in higher rainfall areas and one-half inch extra storage in marginal, low rainfall areas compared to conventional tillage without herbicides (Rydrych 1979). Chemical fallow tests in stubble mulch and no-till resulted in a 10-bushel per acre increase in winter wheat yield in the high moisture areas and a 5-bushel per acre increase in areas with marginal moisture. Yield also was enhanced by a reduction of tillage operations. The 10-bushel increase in yield plus a reduction of two tillage operations was worth $24.00 per acre based on a wheat value of $3.50 per bushel after deducting chemical costs (Rydrych 1979).

Other eastern Oregon experiments in 1980 showed similar results. A low rainfall site at Holdman, Oregon, yielded 38 bushels per acre in conventional fallow, 44 bushels per acre in fall chemical fallow plus tillage, and 40 bushels per acre in spring chemical fallow plus tillage. Conventional tillage at Holdman involved the use of a chisel plow to keep trash and stubble on the soil surface. A chisel plow was used for the initial tillage and was followed by rod weeding as needed. The Holdman conventional tillage did not include chemicals for vegetation control in fall stubble. In 1981, plots at Wasco, Oregon, yielded 63 bushels per acre in conventional fallow, 73 bushels per acre in fall chemical fallow plus tillage, and 69 bushels per acre in spring chemical fallow plus tillage. Yield estimates based on moisture storage alone showed that an additional 6 bushels per acre can be obtained over conventional tillage systems (Cook et al. 1982). This advantage has been expressed in stubble mulch, no-till, trashy fallow, moldboard plow, chisel plow, and disk cultures. To preserve this 6 bushel per acre yield potential created by chemical fallow in the fallow year, an effective weed control program is necessary in the growing crop to control downy brome, goat grass, wild oats, and broadleaf weeds.

Chemical fallow can reduce power requirements, eliminate sod formation, reduce tillage during inclement weather, reduce soil compaction, and allow earlier planting. Germinating weeds and volunteer cereals in fall stubble act as a host for insects and disease organisms. Weeds and volunteer wheat can form a heavy sod that requires repeated tillage operations in the spring to prepare a weed-free seedbed. Chemical fallow also gives farmers the option of delayed spring tillage when wet weather early in the season does not permit good soil preparation.

Cost of chemical fallow

The use of chemical fallow can have economic benefits that offset the extra cost for herbicide (Cook et al. 1982). Tillage costs in the Pacific Northwest increased 9 percent in 1978, 14 percent in 1979, 15 percent in 1980, and 17 percent in 1981. Tillage and chemical cost equilibrium was reached in

OREGON STATE UNIVERSITY EXTENSION SERVICE

Extension Service, Oregon State University, O.E. Smith, acting director. Produced and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. Extension work is a cooperative program of Oregon State University, the U.S. Department of Agriculture, and Oregon counties. Extension invites participation in its programs and offers them equally to all people.

1979 when relative costs were about the same. Since that time, tillage costs have been escalating at a faster rate than the cost of herbicides. Herbicide costs were relatively stable from 1976 to 1978 but increased from 5 to 10 percent from 1979 to 1982.

How can chemical fallow benefit farmers?

- Reduce soil erosion.
- Increase moisture storage.
- Allow delayed spring tillage.
- Equal or exceed yield of conventional tillage.
- Reduce tillage operations (average of two).
- Allow early planting (better erosion control and higher yield).
- Reduce disease and insect vectors.

Herbicides for chemical fallow

In 1983, 10 herbicides have been registered for use in chemical fallow in the Pacific Northwest. Propham (IPC), metribuzin (Sencor or Lexone), atrazine, cyanazine (Bladex), dalapon (Dowpon), and pronamide (Kerb) are soil-applied in stubble in the fall and are primarily active through the soil. Paraquat, glyphosate (Roundup), dicamba (Banvel), and 2,4-D are applied as contact materials in the fall or early spring.

Soil-activated herbicides must be applied on the fallow soil surface to coincide with fall rains and be in place when weeds begin to germinate. Atrazine, cyanazine, metribuzin, dalapon, and pronamide can be applied from August to December. Propham is temperature sensitive and should not be applied until soil temperatures average less than 50° F. However, propham is less affected by straw than most herbicides and is relatively efficient on trashy seedbeds.

Apply paraquat and glyphosate to weed foliage. If a long residual is required, then combine paraquat and glyphosate with soil-activated herbicides. They also can be used to control weeds in cereals just prior to planting or just before the crop emerges. The selection of a chemical fallow herbicide is determined by soil type, organic matter, weather conditions, and cultural practice. Most of the residual types, except atrazine, have a short residual soil life and do not build up in the soil.

Disadvantages of chemical fallow

Surface debris encourages weedy grasses such as cheatgrass and other bromes, wild oats, and goat grass. Chemicals are required to control these weeds in reduced tillage culture. Seedbeds with excessive organic residue tend to absorb selective herbicides and reduce their efficiency. This requires more effective herbicides and higher rates than on conventional seedbeds.

Chemicals are applied to stubble land several months before a crop is planted. Interest on the cost of these chemicals is a production cost that offsets part of the value. Some herbicides such as atrazine tend to persist in light soils and require use of more expensive chemicals that have shorter residual could be more cost-effective.

Chemical fallow herbicides are applied in fall and winter when temperatures and weather can delay timely application. Finally, if weeds in the crop are not controlled efficiently, all chemical fallow benefits are lost by competition.

Future techniques for chemical fallow

Basically, chemical fallow is used to replace mechanical energy (diesel) with chemical energy (herbicides). To date, all chemical fallow herbicides have been applied to undisturbed stubble or minimum tilled seedbeds. In some cases nonselective herbicides are applied just before planting or just before the crop emerges (chemical seedbed preparation).

Future techniques will involve such practices as "Inversion" (OSU TM), where application of herbicides directly on the soil surface is followed by shallow tillage or no tillage. In either case, the technique can be used in chemical fallow as a seedbed preparation or just before planting as a selective practice for cereal production. Placement selectivity is mandatory for a successful inversion program. If a nonselective herbicide is used, it must decompose prior to planting or be kept near the soil surface so that crop seeds can be placed below the treated zone. Inversion is designed to work in trashy or straw-covered seedbeds and works well in all minimum tillage systems. This technique requires that future selective herbicides have (1) resistance to leaching, (2) moderate soil longevity, (3) specific crop selectivity, (4) broad spectrum weed activity, and (5) safety to the environment. Experiments have been conducted by Oregon State University at Pendleton, and inversion may be practical in the future as new techniques are developed.

Chemical fallow can be of economic value at a time when energy and production costs are escalating and new methods are needed to cut costs. Chemical fallow was first considered as a hedge in soil erosion and moisture conservation but can also be used as a hedge on inflation.

References

Gordon H. Cook, A. W. Macnab, G. Fitterer, and Donald J. Rydrych. 1982. Dryland wheat production and marketing costs of Oregon's Columbia Plateau—1982-83. Oregon State University Extension Service, EM 8238, pp. 1-9.

D. J. Rydrych. 1974. Competition between winter wheat and downy brome. *Weed Sci.*, 29:211-214.

D. J. Rydrych. June 1979. Chemical fallow—a management option. Oregon Agricultural Experiment Station, Oregon State University, Special Report 547, pp. 66-68.

D. J. Rydrych and T. J. Muzik. 1968. Downy brome competition and control in dryland wheat. *Agron. J.*, 60:279-280.

This publication was compiled by Donald J. Rydrych, Associate Agronomist (Associate Professor), Oregon State University, Columbia Basin Agricultural Research Center, Pendleton, and Darrell C. Maxwell, Area Extension Agent (STEEP), Oregon State University. Work was conducted under Project 242 and was supported in part by the Oregon Wheat Commission. This work is STEEP related.

Publication made possible by a grant from Extension Service USDA for a special program to extend research results developed by a project entitled "Solutions to Environmental and Economic Problems (STEEP)." STEEP is a special research program conducted by USDA Agricultural Research Service and the Agricultural Experiment Stations of Idaho, Oregon, and Washington.