STEEP
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Research and Extension in land management technology for farm profits and conservation of soil and water.

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CHEMICAL FALLOW IN OREGON DRYLAND GRAIN

Downy brome and other weedy grasses infest three million acres in Washington, Oregon, and Idaho. These weeds are difficult to control when using conservation tillage practices such as stubble mulch, trashy fallow, reduced tillage, minimum tillage, no-till, and even when moldboard plowing (Rydrych 1974). There are options 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 and Maxwell 1983).

What is chemical fallow?

A crop rotation where land is fallowed in alternate years to conserve and accumulate moisture and to control weeds is a common practice in the wheat-producing areas of the Pacific Northwest. This has been a 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, the use of herbicides to replace one or more tillage operations (Rydrych and Muzik 1968), serves as a substitute for tillage during the fallow year or 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 a fallow year or in annual cropping to control weedy vegetation, reduce 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, goatgrass, annual ryegrass, and volunteer cereals such as wheat, barley, and rye are more difficult to control, especially during wet, humid weather. Without the help of chemicals, tillage merely transplants the grass weeds and volunteer vegetation.

Cost of chemical fallow

The use of chemical fallow can have economic benefits that offset 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 costs have moderated recently and increased only 2 percent in 1982, decreased 5 percent in 1983, and showed little change in 1984. Vegetation management costs reached equilibrium in 1979 when relative costs of herbicides and tillage were about the same. Tillage costs began escalating at a faster rate than herbicides in 1980 (Rydrych and Maxwell). Herbicide costs were relatively stable from 1976 to 1978, increased 5 to 10 percent from 1979 to 1982, and stabilized to one percent between 1983 and 1984.

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How can chemical fallow benefit farmers?

- Reduce soil erosion.
- Increase moisture storage efficiency.
- 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 habitat.

Chemical Fallow increases yields

Tests in 1977-1981 in eastern Oregon showed that additional soil moisture was retained in chemical fallow in high and low rainfall areas compared to conventional tillage without herbicides (Rydrych 1979). Experiments on a low rainfall (11-inches) site at Holdman, Oregon, in 1980, produced 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 was by a chisel plow to keep trash and stubble on the soil surface. The initial tillage was supplemented by a rod weeder as needed.

Plots at Wasco, Oregon (1981) showed similar results; conventional fallow produced 63 bushels per acre, fall chemical fallow plus normal tillage produced 73 bushels per acre, and 69 bushels per acre in spring chemical fallow plus tillage.

Yield estimates based on moisture storage showed that an additional 5 bushels per acre can be expected over conventional tillage systems (Cook et al. 1982).

Chemical fallow tests from 1982-1984 do not show a soil moisture advantage because of above normal rainfall during the period. Given average weather conditions, chemical fallow should conserve moisture. Chemical fallow tests in stubble mulch and no-till resulted in higher winter wheat yield in all production areas and a reduction of at least two tillage operations during initial land preparation.

Tests in 1984 in eastern Oregon showed that conventional tillage without chemical fallow is a losing proposition in either stubble mulch or moldboard plow cultures. The results of these tests are recorded in Table 1. The yield increases were probably due to disease suppression in the fallow year, because there were no significant differences in moisture storage.

The advantage of chemical fallow has been shown in stubble mulch, no-till, trashy fallow, moldboard plow, chisel plow, and disk cultures. To preserve additional yield potential created by chemical fallow during the tillage phase in a wheat-fallow or annual cropping rotation, it is essential that effective weed control be maintained during the crop year to control cheatgrass, goatgrass, wild oat, and broadleaf weeds.

Table 1. Winter wheat yield as influenced by chemical fallow in stubble mulch and moldboard plow in eastern Oregon.

Treatment[1]	Rate	Time	Yield[2]
Stubble mulch			
Chem fallow			
Propham	3.00	Fall	4930
Cyanazine	3.00	Fall	4720
Glyphosate	.50	Spring	4530
No herbicide	----	Spring	3730
Plow			
Chem fallow			
Propham	3.00	Fall	4800
Cyanazine	3.00	Fall	4710
Glyphosate	.50	Spring	4220
No herbicide	----	Spring	3440

1. All plots chiseled or plowed in spring.

2. Data are 1984 averages of 4 replications at OSU-CBARC, Pendleton, Oregon.

Herbicides for chemical fallow

In 1984, 10 registered herbicides were available for use in chemical fallow in the Pacific Northwest. Propham (Chem Hoe 135), metribuzin (Sencor or Lexone), atrazine (AAtrex), cyanazine (Bladex), dalapon (Dowpon), and pronamide (Kerb) are soil-applied in stubble in the fall and are primarily active through the soil. Paraquat, and glyphosate (Roundup) are applied as contact materials in fall or early spring (Table 2). Dicamba (Banvel), 2,4-D, and chlorsulfuron (Glean) are applied as foliar active materials.

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 and are soil active. Propham is temperature sensitive and should not be applied until soil temperatures average less than 50°F. However, propham and pronamide are less affected by straw than most herbicides and are relatively efficient on trashy seedbeds.

Table 2. Chemical fallow herbicides for the control of weeds and volunteer cereals in stubble in eastern Oregon.

Herbicides	Rate (lb ai/ac)[1]	Application[2]	Weeds controlled[3]
Propham	3-4	F	G
Metribuzin	0.38-0.62	F	G,B
Atrazine	0.40	F	G,B
Cyanazine	1.6-4.0	F	G,B
Dalapon	3-5	F,S	G
Pronamide	0.25-0.50	F	G
Paraquat	0.75-1.00	F,S	G,B
Glyphosate	0.28-0.75	F,S	G,B
Dicamba	0.25-0.50	F,S	B
Chlorsulfuron[4]	0.33-0.50oz.	F,S	B
2,4-D	0.50-1.00	F,S	B

[1]Rates are given in pounds of active ingredient per acre except in the case of Chlorsulfuron which is given in ounces of active ingredient per acre.

[2]F means fall application, S is for spring.

[3]G is used as an abbreviation for grasses, B is for broadleafs.

[4]Note that for Chlorsulfuron, the rate is given in ounces of active ingredient per acre.

Foliar active herbicides such as paraquat and glyphosate are applied directly to weed growth. If grass and broadleaf weeds are a problem, then combine paraquat and glyphosate with other soil-activated herbicides. Chlorsulfuron and 2,4-D can be combined with other herbicides to provide broadleaf weed control. Selection of a chemical fallow herbicide is determined by crop rotations, soil type, organic matter, weather conditions, and cultural practice. Most residual type herbicides, except atrazine, have a short residual soil life and do not build up in the soil.

Management of chemical fallow

Surface debris encourages weedy grasses such as cheatgrass and other bromes, wild oats, and goatgrass. Chemicals are required to control these weeds in reduced tillage culture. Seedbeds with excessive organic residue tend to favor weed growth and reduce herbicide efficiency. Herbicides can be effective on trashy seedbeds, but require accurate timing and placement on the volunteer weed growth.

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, but is usually recovered later as a result of reduced tillage or higher production. Some herbicides such as atrazine tend to persist in light soils and require a longer fallow period. Shorter residual herbicides may be more efficient on short rotations. Finally, if weeds in the crop are not controlled efficiently, all chemical fallow benefits are lost to the competition.

Future techniques for chemical fallow

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 Trademark Pending), where application of herbicides directly on the soil surface is followed by seeding or shallow tillage. In either case, the technique can be used in chemical fallow as a seedbed preparation just before planting or as a selective practice for cereal production. Placement selectivity, seeding below the layer of herbicide, is mandatory for a successful inversion program. If a nonselective herbicide is used, it must 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 has been shown to work well in minimum tillage systems. Any technique must be cost effective, and experiments conducted by Oregon State University at Pendleton show that 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 against soil erosion and a means to conserve moisture, but now it can also be used as a hedge on inflation.

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