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 one of the most satisfactory ways 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 if the use of no-tillage herbicides a complete substitute for tillage.

Conservation tillage involves during the fallow year or in annual cropping to control weeds, vegetation, reduce moisture evaporation, and maintain crop trash on the soil surface to prevent wind and water erosion. Herbs, broadleaf weeds, and other weeds are controlled by some, but not all, weeds such as downy brome, goat grass, and annual grasses, and volunteer cereals such as wheat, barley, and oats are more difficult to control during wet or dry weather. Without the use of chemical fallow, fallow merely transplants the weeds and voluntary vegetation. Chemical fallow can improve moisture storage capacity, retain more straw on the soil surface, reduce the need for mechanical tillage, reduce diseases and insects, and save fuel.

Chemical fallow increase yields

Tests in 1977-1981 in eastern Oregon showed an additional 6 bushels per acre in stubble mulch, 7 bushels per acre in spring chemical fallow plus tillage, and 69 bushels per acre in fall chemical fallow plus tillage. Conventional tillage at Holdman, Oregon, yielded 63 bushels per acre in chemical fallow, 73 bushels per acre in 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.

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 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 yielded 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 42 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 moldboard plow was used for the initial tillage, and it was followed by aod weeding as needed. The Holdman conventional tillage did not include chemicals for weed control in fall tillage. In 1981, plots at Wasco, Oregon, yielded 63 bushels per acre in chemical fallow, 73 bushels per acre in chemical fallow plus tillage, and 69 bushels per acre in spring chemical fallow plus tillage. Yield increases 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 1981.
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.
- Paraquat, glyphosate (Roundup), dicamba (Banvel), and 2,4-D are applied as contact materials in the fall or early spring.

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 effectiveness. 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 in the use of these chemicals is a production cost that offsets part of the value. Some herbicides, such as atrazine, also persist in the soils and require the use of more expensive chemicals than have shorter residual periods. Thus, they may be more cost-effective.

Chemical fallow herbicides are applied in fall and winter when temperatures and weather can delay timely application. Finally, if conditions 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 for use in trashy or straw-covered seedbeds and works well in all minimum tillage systems. This technique requires that the future selective herbicides have (1) resistance to leaching, (2) moderate soil longevity, (3) crop selectivity, (4) broad spectrum weed activity, and (5) safety to the environment. Experiments have been conducted by Oregon State University at Pendleton, and this technique may be practiced 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 a hedge in soil conservation and moisture conservation but can also be used as a hedge in inflationary times.

Reference


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