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Cropping Practices: Central Great Plains

24-1 CROPPING PRACTICES

The majority of the cropping practices in the Central Great Plains region are built around the practice of summer fallow. This dominant practice comprises approximately one third of the cultivated hectarage in each crop year. Individuals from other areas may consider this system wasteful of land resources, but it is necessary, economically sound, and well proved by research (Smika, 1970). In the Central Great Plains, the normal rainfall distribution is such that for winter wheat the fall and spring growth generally must be made from stored soil water. Therefore, no attempt should be made to eliminate the practice of summer fallow immediately before the seeding of winter wheat in this area. As a result of summer fallow, winter wheat production has stabilized, and with proper management the practice offers greater soil and water conservation than any continuous cropping system, thereby utilizing these resources with maximum efficiency. The management objectives of fallow are (i) fallow land should be weed free from harvest to planting 14 months later, (ii) stubble should remain upright during as much of the fallow period as possible to trap snow in the winter and reduce evaporation potential during the rest of the year, (iii) 1680 to 2240 kg/ha of straw mulch should be present at seeding, and (iv) large clods should be maintained during fallow and after seeding. These objectives maximize soil water storage and nitrate supplies, assure better crop seed germination, and reduce wind erosion potential.

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24–1.1 Crop Rotation

Crop rotation is not widely practiced in the area, primarily because of the lack of crops other than winter wheat that consistently produce yields that give an economic return compared with what can be obtained with winter wheat. Crops that can be grown in the area include sorghums (both grain and forage types), proso millet and foxtail millet, spring and winter barley, rye, spring oat, sunflower, broomcorn, and corn (Table 20–1). Winter barley frequently suffers significant winter kill, and spring barley and oat usually are injured by hot, drying winds at filling/ripening of the grain. Sunflower appears to have potential as markets develop and as cultural methods are developed. Broomcorn, a specialty crop confined largely to southeastern Colorado, is no longer a significant crop because most of the market is now satisfied by synthetic products.

Beginning in 1971, a practice known as ecofallow was introduced, in which a cropping sequence of winter wheat followed by either grain sorghum, corn, or millet followed by fallow is used. This practice relies largely on the use of herbicides for weed control, with minimal mechanical tillage for weed control. Ecofallow hectarage is increasing each year but still represents less than 15% of the total arable land in the Central Great Plains. Grain sorghum is grown more in the eastern and southern portions of the area, and millet is more important in the drier, cooler portion. Corn hectarage is interspersed throughout the entire area and is showing the greatest increases. Before 1920, dryland corn production exceeded wheat production, but before ecofallow dryland corn production was relatively minor (Greb et al., 1974). The summer crop in the ecofallow system also has the advantage of creating conditions that can disrupt certain insect cycles and does not permit selected weed species to develop in a wheat-fallow system. With ecofallow, four crops are produced every 6 years, whereas with wheat-fallow only three crops are produced every 6 years, with the advantage that the other crop is grown at a time different to wheat and is not subject to the same adverse climatic conditions at the same time.

The wheat-fallow cropping system is presently used by the majority of the dryland farmers. Research has shown this system increases the probability of harvesting a crop that is advantageous for the farmer, and the system is also easy to manage. The fallow period reduces many agronomic problems, e.g., crop volunteer and some weeds, but encourages such weeds as downy brome, cheatgrass, tansy mustard, and jointed goatgrass, all of which are winter annuals and have the same growing habit as winter wheat. The best control for these winter annual weeds is the use of a summer crop in the rotation (Ramig and Smika, 1964) as in ecofallow.

24–1.2 Continuous Cropping

Continuous cropping is not widely practiced in the Central Great Plains but is practiced on occasion in the eastern portion of the area where precipitation is generally greater. In the drier western portions of the area, continuous cropping, if practiced, is largely confined to sandy soils. These soils have low water storage capacity, which negates the benefit of summer fallow; and good water infiltration rates, which maximize water storage from single rainstorms.

Historically, sandy soils are generally not considered to be good for wheat production, but they have proved their value for summer crops. The differentiation between soil and crop types is dramatic, often enabling an observer to note changes in soil type within a short distance by the crop grown.

Corn is grown continuously, but grain and forage sorghums are the most popular crops grown in continuous cropping systems. The availability of newly adapted hybrids, especially of the grain types, has resulted in a proliferation of high-yielding cultivars with a wide range of maturity dates.

Throughout much of the area, proso and foxtail millet are important summer crops. Neither crop is widely grown continuously, because millets do not leave enough residue to protect the soil from blowing. Both millets are grown where the season is too short or too cool for sorghum. Either type is planted from late May through mid-July and can often be harvested 60 days after planting. Briggs and Shantz (1913) showed that proso millet is an especially efficient user of water.

Land devoted to alfalfa and grass for hay should also be considered as continuously cropped. Alfalfa grows especially well on land with a high water table. Taller grasses are usually associated with sandy soils and are preferred for hay. The short types, buffalograss and blue grama, do not grow tall enough for harvesting as hay. Alfalfa is usually harvested only once each year unless a high water table is present, where up to three harvests may be possible. Sweetclover is another potential crop. It grows well, and like alfalfa, it is fairly easy to establish.

Cultural practices for continuous cropping generally involve more soil manipulation though the use of disks or chisels or even moldboard plows to incorporate the crop residue and to destroy growing weeds than those practices used when fallow is part of the crop rotation. Because continuous cropping is usually practiced on the lighter soils more prone to wind erosion, these practices augment the wind erosion problem, but tradition and frequently lack of proper equipment deter farmers from changing their tillage practices. With the advent of herbicides in recent years, some operators are adopting techniques in their farming to reduce erosion potential as well as to increase profits.

Drills and surface planters are widely used, and various forms of listers are extensively used throughout the Central Great Plains. The lister may be used after the soil has been disked or otherwise tilled or without working the soil at all in an attempt to minimize wind erosion, which is a constant threat throughout late spring. When listing is done without prior tillage, the new row is established between the previous year's row (breaking out the middle). This permits last year's stubble to protrude from between the new rows, aiding greatly in reducing wind erosion problems.

Early establishment of weeds between crop rows that are killed by blade cultivation but left standing has been used by some operators to provide wind erosion protection. Although the weeds consume precious soil water, damage from blowing soil may be more severe than that from loss of water and nutrients.

Continuous cropping removes no more nutrients from the soil than the alternate crop–summer fallow system, which is probably attributable to continuous cropping yields being much less than those with a fallow cropping system. Thus, less nutrients are taken off in crop removal. Hobbs and Brown (1965) reported that the loss of total N in the soil was 15% with continuous small grains, 20% for alternate small grain and fallow, 33% for continuous row crop, and 40% for alternate row crop and fallow.

24-2 SEEDBED PREPARATION

A typical time sequence of summer fallow operations, conventional stubble mulch, and minimum tillage systems for the western portion of the Central Great Plains, as developed at both North Platte, Nebraska, and Akron, Colorado, are summarized in Table 24-1 (Greb et al., 1974).

If a farmer follows either of these fallow tillage systems, an optimum seedbed will result with soil covered by crop residue and many large clods, both of which are needed to reduce the hazard of wind erosion and to ensure adequate seedbed soil water for seed germination and plant establishment.

All tillage implements conventionally used in summer fallow tend to loosen the soil surface, with the exception of the mulch treader types. The experienced operator, who begins tillage operations at 10 cm deep or more, tries to reduce depth with each succeeding operation to develop a firm, moist seedbed in which to plant.

The development of herbicides has made no-till cropping possible throughout the Central Great Plains. This practice leaves a firm, moist seedbed and ensures seed germination and plant establishment without destruction of the previous crops' residue necessary for wind erosion protection. The recent introduction of air seeders has made no-till fallow-wheat production a viable option.

Table 24-1. Typical time sequence of summer fallow operations for the western portion of the Central Great Plains (Greb et al., 1974).

Time	Conventional tillage	Minimum tillage
Early July	Harvest wheat	Harvest wheat
25 July–5 Aug.	Blade 10 cm deep to destroy summer and fall weeds in wheat stubble	Apply residual and contact herbicide
1–10 Sept.	Cross blade 10 cm deep to kill volunteer wheat, if needed	--
20 April–10 May	One-way disk if heavy volunteer or excessive stubble, otherwise blade 10 cm deep	--
15–25 June	Blade 8 cm deep	
15–25 July	Rod weed with semichisels 8 cm deep	Sweep 8 cm deep
20 Aug.–1 Sept.	Cross rod weed 8 cm deep	Rod weed 6 to 8 cm deep
10–20 Sept.	Drill wheat with deep furrow hoe drill 25- to 35-cm row spacing, plant seed 5 cm below bottom of 10- to 15-cm furrows	

24-3 SEEDING RATES

Major equipment companies designed and developed implements for the more humid regions that often failed to meet the special needs of semiarid dryland farming. Hargreaves (1957) in her review of dryland farming comments briefly on the special development of machinery for semiarid agriculture.

Where water is limited, regulation of plant population is essential. Too many plants per unit area may induce a drought before the crop attains desired production. For example, W. G. Stewart (1978. Personal communication) concluded that more grain sorghum production failures occurred in eastern Colorado because of overplanting than for any other reason. The recommended 2.3 to 3.4 kg/ha planting rates for dryland grain sorghum are often difficult or impossible to obtain due to design limitations of equipment, grower prejudice, or lack of farmer experience. The above rates will result in a plant stand of 33 000 to 100 000 plants/ha based on a count of 44 100 seeds/kg and 33 to 67% stand establishment (Fenster, 1977; Braunworth et al., 1977). As a general rule, dryland seeding rates are one-third to one-half those rates recommended for humid or irrigated agriculture.

Grain sorghum is frequently grown in 1-m wide row spacings where Greb (1962) showed that 1-m wide rows provide a bank of stored soil water to be used by the crop as grain sorghum root extension develops during the summer season. However, at Temple, Texas, with higher precipitation, Adams et al. (1976) found row widths of 50 to 76 cm yielded better than 101-cm rows if weeds were controlled and plant population was the same.

Summer crops are often seeded with adjustment or minor modification of the same drill used for winter wheat. For example, a certain number of spouts in the grain box may be plugged, thus giving a row effect. This technique reduces equipment costs, but the result is not necessarily the most desirable planting tool. Most farmers producing row crops possess row crop planters, often altered to (i) permit planting at reduced seeding rates and (ii) list so as to reduce wind erosion potential and facilitate seed placement in moist soil.

In the Central Great Plains where tillage has been performed for weed control, the surface soil (6 to 10 cm) is often dry, and planting must be beneath this dry surface into moist soil. Thus, some mechanical means is required to move the dry soil away from the row—generally a lister or deep furrow drill.

24-4 SOIL FERTILITY

Soil fertility studies with winter wheat have been performed since 1946 in the region (Greb et al., 1974). Results of experimental trials have been variable, but generally, response to N application has been more consistent than to other nutrients. Response of wheat to N has varied with time of application, cropping system, and soil type.

Research investigations in Nebraska with fertilizer have been more extensive perhaps than in the other states of the Central Great Plains. Conclusions to date indicate that nitrate release during the fallow season reduces the requirement for applied N (Olson and Rhoades, 1953). However, indications are that wheat on fallow land is increasingly responding to applied N (Nebraska Agric. Exp. Stn., 1952–1970; Smika, 1970). Peterson and Vetter (1971) considered N response to be an effect of both increased time of cultivation since the land was broken from native grass and improved cultural practices, especially those that increase soil water storage. The overall result is higher grain yields with the associated removal of more N from the land.

Generally, early N fertilization has increased grain yield, whereas later application affects grain quality more. Goris and Ludwick (1978) found limited yield increase from fertilizer N applied after seeding, but protein content consistently increased. Recent findings have shown that protein content of wheat grain may be a good guide as to whether yield responses to N fertilizer can be obtained. Indications are that if grain protein is below 11.1%, a yield response will be obtained; from 11.1 to 12.0% protein yields may be limited by N; and when protein is higher than 12%, N fertilizer probably will not increase yields (Goos et al., 1980).

Yield response of wheat to fertilizer N may be uncertain on the medium- to heavy-textured soils because application time may be critical (Smika and Grabouski, 1976). The sandy soils of the region almost always respond to N (Brengle and Greb, 1963).

Wheat may occasionally respond to applied P, especially on sandy soils or on eroded medium-textured soils (Brengle and Greb, 1963).

24-5 FUTURE PRACTICES

Present research indicates many cropping practice changes may be adopted in the near future.

24-5.1 Minimum-till and No-till Fallow

Wittmuss et al. (1973) defined these terms as follows. Minimum tillage is the minimum soil manipulation necessary for producing crops or meeting tillage requirements under existing soil and climatic conditions. Minimum tillage does not define a system but generally refers to a system with fewer operations than a conventional system. Herbicides are usually used for weed control, seedbed preparation, or both.

No-till is a system whereby a crop is planted directly into soil nontilled since harvest of the previous crop.

Research in the Central Great Plains has shown the value of minimum-till and no-till systems. The systems increase water storage during the fallow period, decrease erosion potential, and decrease fuel (and horsepower) re-

Table 24-2. Influence of surface residue on soil water storage of precipitation during fallow (Greb et al., 1967).

Residue level	Precipitation stored
kg/ha	%
0	16
1680	19–26
3360	22–30
6720	28–33
10 080	34

quirements. Wicks and Smika (1973) compared five fallow treatments at North Platte, Nebraska. They found that the no-till treatment (herbicide only) had the least weed growth, most stored soil water, greatest surface mulch, and highest grain yield.

Unger (1974) points out that soil water storage is reduced by poor management practices associated with poor control of weeds and volunteer crop, poor residue management, and excessive and untimely tillage. Under both minimum-till and no-till systems, herbicides replace tillage to obtain weed control. Eliminating or reducing tillage permits crop residues to be maintained, thus protecting the soil surface against wind and water erosion, reducing runoff, reducing surface sealing (and thus maintaining higher infiltration rates), and reducing evaporation. All of these factors increase soil water storage. Crop residue is extremely important in increasing water storage, as Table 24–2 (Greb et al., 1967) shows. Further expansion of the importance of residue and the elimination of tillage for water storage has been shown by Smika (1980), where water storage efficiency of 40% was obtained with minimum tillage fallow, and a 49% storage efficiency was obtained with no-tillage fallow.

Because the main purpose of summer fallow is to store soil water, operators should adopt practices that keep residue on the soil surface and minimize or eliminate tillage. The equipment and techniques necessary to accomplish the operations are now available, and no adverse effects associated with the maintenance of crop residue have been documented in the Central Great Plains.

24–6 RESEARCH NEEDS

No-till and minimum-till operations change the microclimate of the soil where the crop grows. In addition to conserving more precipitation, soils are cooler because of the shading effect of the stubble. Several points concerned with these environmental conditions should be researched:

1. Crop varieties (especially wheat in the Central Great Plains) that can tolerate slightly cooler soils and somewhat more shading should be examined.
2. Plant diseases and insects may become a problem, or potentially there could be a shift in populations of pests.

3. Optimum tillage-herbicide combinations should be developed for the major soil types.
4. Fertilizer requirements and optimum time for their application should be determined.
5. The use of herbicides is essential to a successful no-till or minimum till system. Research may point the way to more effective herbicides than are presently available, but the plant breeder should consider the development of varieties more resistant to present and future chemicals.

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