8

CHAPTER 8. CROP MANAGEMENT

Successful crop management depends on understanding how crops develop and grow, how various factors affect crop growth and development, and how each factor can be modified or managed (Chapman and Carter 1976). Since we are dependent on farm crops for food and fiber, it is imperative that crops be managed successfully, that farm productivity be maintained.

Successful crop management involves more than the maintenance of annual production, however. Successful crop management involves long-term maintenance of fertile soil, and planting of appropriate numbers of acres that result in reasonable balances between supply and demand on the world market. Such long-term goals are affected on the production end by weather variables, and on the marketing end by economic variables. The latter are very much affected by politics, both domestic and foreign.

Wildlife on farms are directly affected by crop management practices, and indirectly by economic and political conditions. It is the former which are discussed in this CHAPTER 8, providing some information useful to wildlife students in understanding the habitat changes resulting from crop management.

The characteristics of cereal crops, forages, vegetables and fruits, and textile crops were discussed in CHAPTER 5. The planting, tending and harvesting practices associated with these crops are discussed here in CHAPTER 8.

TOPIC 1. THE GROWING SEASON

The growing season is defined as the period of time between the last killing frost in the spring and the first in the fall. It's length for different crops is not quite that simple, however, since different crops tolerate different below-freezing temperatures. Nevertheless, it is a good guide to general conditions, and the map of growing season lengths illustrates the general north-south gradient (Figure 8-1). Areas of land near large bodies of water, such as the Great Lakes, and even smaller inland lakes have longer growing seasons because the water, with its large heat capacity, ameliorates local conditions. Such areas have miniature "maritime" climates.

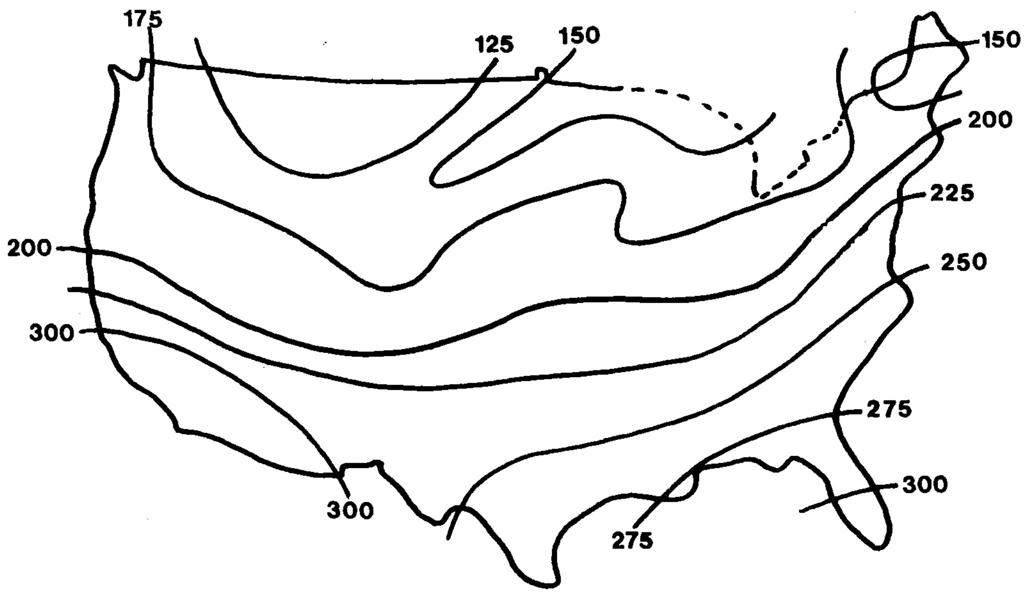

Figure 8-1. Generalized map of the lengths of the growing seasons in the United States.

UNIT 1.1. SUNSHINE

The amounts of sunshine and rainfall are major determinants of the growing conditions. Farm crops need both. Intense sunlight, such as at solar noon and during the afternoon, causes plants to be light-saturated, meaning there is more energy reaching the plant than can be used in photosynthesis. With adequate moisture, this is not a problem as transpiration serves to keep the plant tissue cool enough to prevent heat damage. When moisture is not adequate, the leaves begin to wilt, and if temperatures are high enough, the permanent wilting point is reached and the plants do not recover. Production is markedly decreased in fields where some of the leaves have suffered from drought and high temperatures. In severe conditions, entire crops can be ruined.

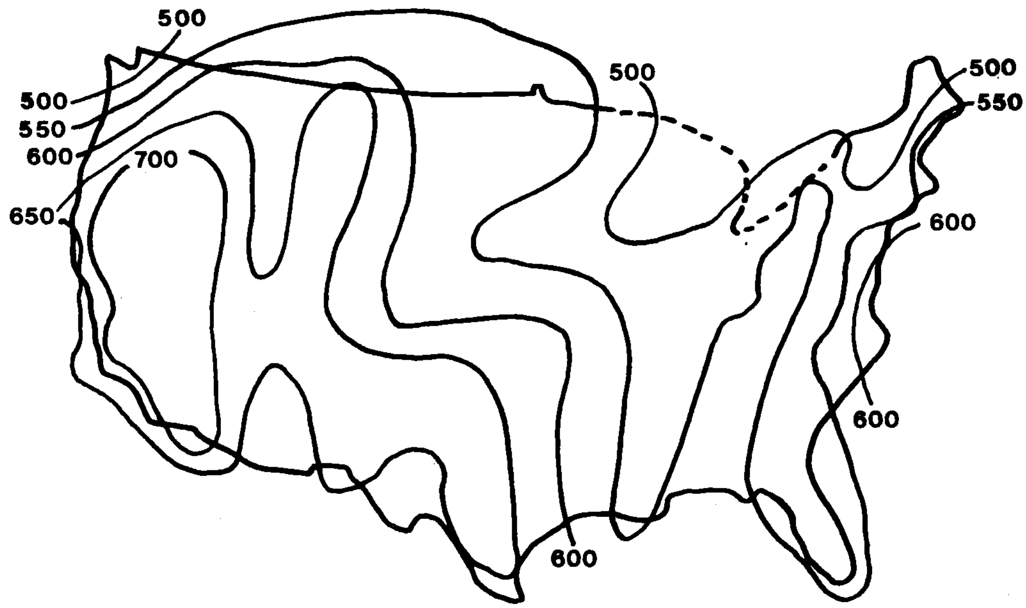

Figure 8-2. Generalized map of the average of solar energy (langleys per day) on a horizontal surface in July in the United States. (Redrawn from Sellers 1965, p.26). Langley = cal. per sq. cm.

UNIT 1.2. PRECIPITATION

The amount of rainfall is obviously important in determining crop production. Water and CO_2 are combined, with the energy of sunlight, to produce the CHO products of photosynthesis. Different crops have different water needs, so crops grown regionally are obviously selected on the basis of suitable growing conditions.

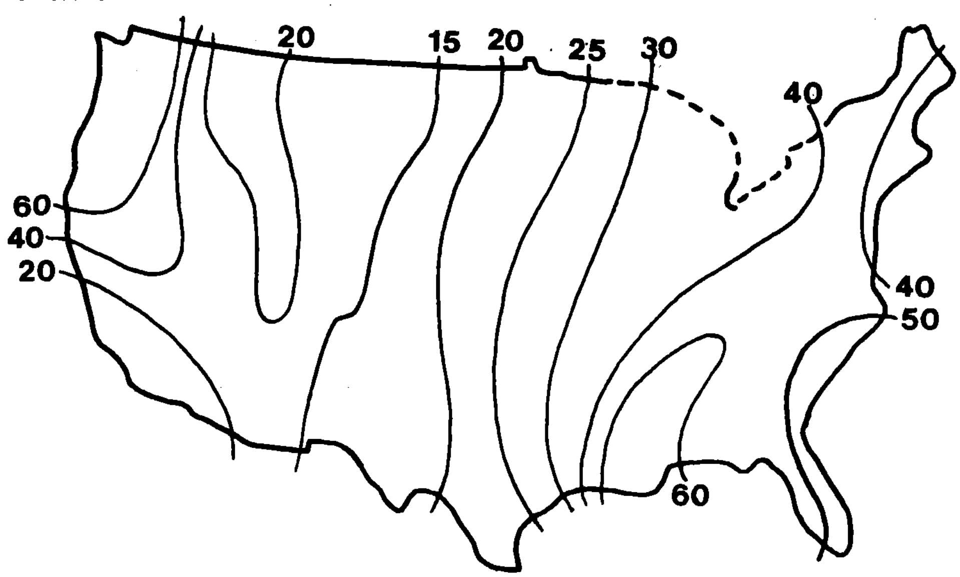

Figure 8-3. Generalized map of the average annual precipitation (in inches) in the United States. (Redrawn from Yearbook of Agriculture 1957, p.342).

The total amount of rainfall is not the only important precipitation parameter, however. The distribution of rainfall through the growing season is especially important. Soil moisture must not be excessive during spring seedbed preparations. If the soil is too wet, heavy machinery causes the soil to compact, resulting in clods or chunks; seedbed preparation is best completed when there is no free water in the capillary spaces in the soil.

Sufficient soil moisture must be present for imbibition of water by the seeds. The seed swells, the embryo undergoes rapid cell division, and the root and stem begin to grow downward and upward, respectively. The stem reaches the soil surface (the planter must be set to place the seed at the proper depth) and leaves begin to emerge.

Soil moisture is very important to the seedling as it has a small root system and increasing nutrient requirements due to rapid vegetative growth. Too much soil moisture causes the leaves to turn yellow as the root system dies; the delicate seedling cannot survive. Too little available moisture causes excessive water loss from the leaves and they wither and die. If moisture conditions are adequate, the root system and above-ground vegetation grow in balance, and the plants become more tolerant to changing environmental conditions as they grow older and become better established.

UNIT 1.3. TEMPERATURE

The amounts of sunshine and rainfall both contribute to temperature conditions during the growing season. When there is a good balance between the two, temperatures are not likely to be detrimental to crop production. If it is too dry with many days of sunshine, temperatures tend to be high as less solar energy is absorbed in the process of evaporation, not only from plant surfaces but the soil surface too. If rainfall is excessive sunshine must also be less and temperatures are generally lower. These three conditions combine to affect crop production, which in turn affects livestock production, and that results in changes in food supplies and costs. Farming is clearly not an isolated business; conditions on the farms affect all of society, for it is the farms that supply the nation's food supplies, and they are fundamental to life.

Annual temperature rhythms may be calculated with a sine wave as described in Moen (1982). The monthly averages for Ithaca, NY and many other areas may be plotted as remarkably symmetrical sine waves. The equation for calculating temperatures for any day of the year, based on the monthly averages in Ithaca, NY, is, in BASIC syntax:

$$PRTC = 7.8+(SIN((JDAY*0.9863)-103.3))*(-12.8)$$

where PRTC = predicted temperature in Celsius, and
JDAY = julian day.

General temperature patterns, represented mathematically as above, are useful, not for predicting air temperature on a particular day but for evaluating the effects of changing temperatures through the year. Like vertical wind velocity profiles described earlier, such numerical statements provide a great deal of generalized information about habitat conditions that is well-suited for computer analyses in relation to both agricultural and wildlife management.

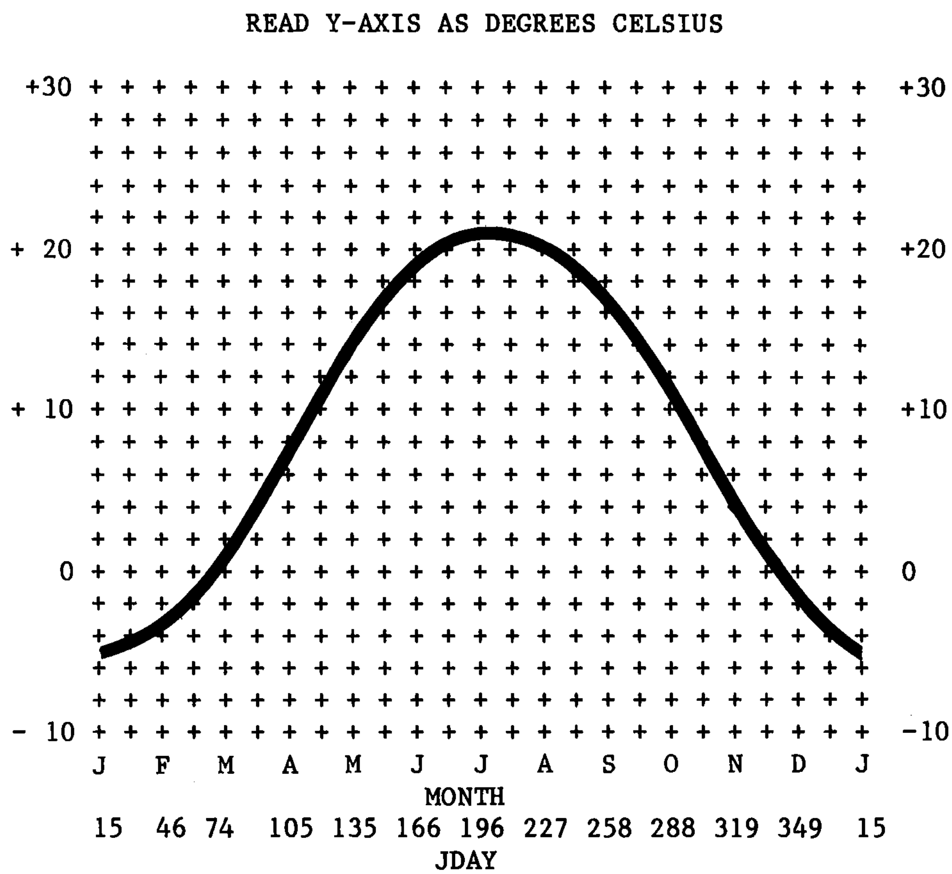

Figure 8-4. Generalized sine wave temperature curve through the annual cycle for Ithaca, NY.

TOPIC 2. PLANTING OF CROPS

Successful crop management begins with the preparation of a suitable seedbed for the kind of crop being planted. Germination is a critical time in the life of a plant, and the conditions in the soil during germination and as the young plant emerges from the soil are very important determinants of the later vigor of the maturing crop.

UNIT 2.1. SEEDBED PREPARATION AND PLANTING METHODS

A properly-prepared seedbed has good "tilth," which is a term applied to the physical condition of the soil in relation to plant growth (Chapman and Carter 1976). Soil with good tilth has proper granulation (soil particles neither too large nor too small), stability of aggregation (soil particles do not crumble too easily), good aeration (plant roots have oxygen available),and proper moisture characteristics, such as moisture content, rate of water infiltration, drainage, and capillary capacity.

The methods used to prepare seedbeds and the condition of the soil during seedbed preparation are very important determinants of the soil environment during germination and plant growth. Methods change as a result of new technology, economics, and the availability of energy resources. Current methods range from no-till planting in last year's crop residues to intensive seedbed preparation with several kinds of tillage equipment.

CONVENTIONAL METHODS

Seedbed preparation has traditionally begun with the incorporation of the previous year's crop residues into the soil, a primary tillage operation. This is done in the fall if time permits and soil erosion does not result from exposing the soil during the winter. If fall plowing is not advisable, then seedbed preparation begins in the spring.

Incorporation of crop residues into the soil is usually done with moldboard plows or disc plows. As soon as the residue is in the soil, decomposition begins to occur, and organic matter is added to the soil. The primary tillage operation changes the field from a stubble-covered or litter-covered habitat to a mostly-bare soil surface (Figure 8-5). Waste grains from the harvesting operations are no longer available, and the stubble and litter which provided shelter and protective cover are gone.

After primary tillage, secondary tillage operations begin. Discs harrows, field cultivators, spring tooth harrows, and spike tooth harrows are used, depending on soil conditions. The resulting soil layer should be fine enough to minimize cooperation, resulting in the good contact between the seed and moist soil necessary for germination, and it should be as free of living weeds as possible. Good seedbed preparation involves weed control as well as physical preparation of the soil. The fields provide no suitable food or cover for wildlife at this time.

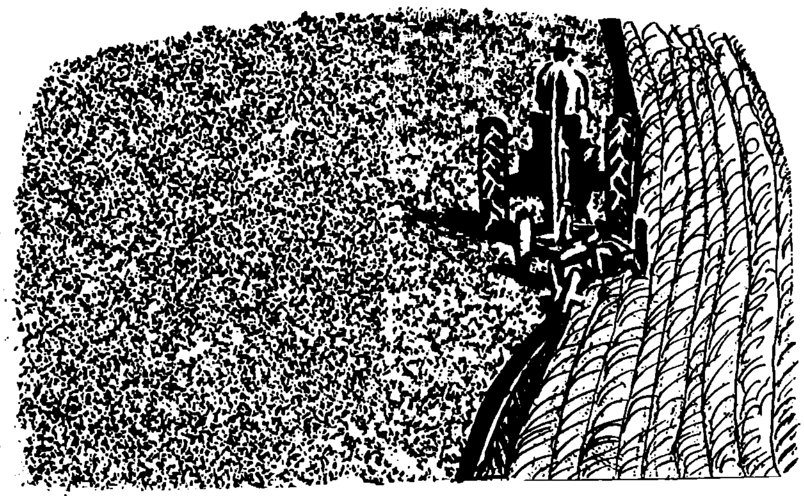

Figure 8-5. Primary tillage operations change fields from a source of food and cover for wildlife to nearly bare soil.

Crops are planted with drills or broadcast seeders. Grain drills plant the seeds in rows a few inches apart, while row crop drills plant the seeds in rows from 20 to 40 inches apart. Broadcast seeders spread the seed in the soil surface for later incorporation into the soil with a harrow.

The rate of planting is a very important factor in the planting operation. Optimum seeding rates result in plant populations that are not so thick that excessive competition results between plants, or so thin that maximum productivity could not be reached.

The depth of planting is also very important, as seeds planted too near the surface may not absorb adequate moisture for germination, and seeds planted too deeply may not germinate as well or reach the soil surface after germination. Planting depths may be controlled on drill-type seeders, and the type of disc or tooth harrow used after broodcast seeding determines the depth of seed coverage.

After planting, the seedbed is sometimes firmed by packing. Most drills have some kind of packing wheels that firm the soil over the seeds. Packers or rollers may also be pulled behind the drill or used after broadcast seed to make a firm seedbed over the entire field.

NO-TILL PLANTING

No-till planting is a recent practice that has been given some impetus as a result of energy shortages and higher prices. No-till planting involves no primary tillage; the plow layer is not turned over. There may or may not be secondary tillage operations; seeds are planted in last year's stubble with pressure drills that place the seeds in the soil. The stubble or trash may be broken down further or left as it is. In any case, weed-control chemicals are applied in order to reduce (essentially eliminate) competition from other plants. The amount of secondary tillage done is dependent on the need to apply the herbicides uniformly; clumps of trash and clods of soil prevent uniform applications.

Reduced tillage offers many advantages over conventional methods, with new considerations of the effects of chemicals on non-target species of plants and animals. These effects are both direct and indirect. The chemicals may be directly toxic to plants that have wildlife benefits, and indirectly toxic to animals who no longer find suitable cover and food in these habitats. No-till farming has significant soil and water conservation benefits, however.

The methods used to prepare seedbeds and plant crops are very important to the farmer because the resulting crops provide feed for livestock and cash income from sales of grain. Investments of thousands of dollars in seed and fertilizer are necessary, and care in seedbed preparation and planting is obviously important.

UNIT 2.2. CONTROL OF PLANT PATHOGENS AND INSECTS

One step in the planting of crops that is a very important but rather inconspicuous part of the planting operation is the control of plant pathogens. Since the prevention of disease is generally preferable to trying to cure it, various methods of disease prevention are considered by crop producers.

Plant pathogens may be controlled in three general ways, including genetic control, cultural control and chemical control. These are discussed by Chapman and Carter (1976:184-186), and summarized briefly below.

Genetic control involves the development of new crop varieties that are resistant to rusts, smuts, mildews, and pests. This is a continuous problem, however, as new strains of pathogens develop in response to the resistances of the hosts. A very recent unique genetic development is a new variety of potato with hairs on the leaves which discharge a "glue" that traps insects. Such a cultivor may reduce the use of chemical insect control, an example of a trend in agriculture. Thus plant geneticists and pathologists continue their work at agricultural experiment stations across the country, producing new crop varieties to be planted until they no longer remain productive on commercial farms. New varieties then take their places.

Cultural control involves the use of management practices which upset pathogens at effective points in their life cycles. Crop rotation may result in unfavorable conditions for a pathogen between plantings of their host crop. Cutting of the crop before pathogens mature is also effective in preventing the completion of the life cycle. Use of certified, disease-free seed also prevents the transmission of some pathogens.

Chemical control involves the use of fungicides and pesticides to prevent damage by pathogens to both seeds and plants. "Treated seed" has been coated with chemicals which control selected diseases. Mercury-based fungicides were used for years, but have been banned now due to their effects on non-target organisms. Bags of treated seed are clearly labeled "not to be used as feed for domestic livestock." Wildlife may ingest the seeds after planting, however, resulting in not only a loss of wildlife if lethal doses are consumed, but also an economic loss to the farmer. Female pheasants demonstrated an ability to detect corn seeds treated with fungicide and insecticides, and preferred untreated seeds whenever they were available in a controlled study by Bennett and Prince (1981). The seriousness of the problem depends on the amount and availability of alternate foods within a pheasant's home range. Stromborg (1979) concluded that seed treatment pesticides represent a potential hazard to the reproductive performance of wild pheasants. The effects of pesticides include depressed food consumption, loss of body weight, and reduced or inhibited egg production (Stromborg 1977).

Crops are sprayed to control pathogens on the stems and leaves. Antibiotic sprays which control mildew and other pathogens can be effective but they are expensive, and there are numerous laws regulating the use of chemical sprays in foods and in the environment. Weather conditions during application are also important. Spraying is often done early in the morning when there is no wind to cause drift to non-target areas.

TOPIC 3. TENDING OF THE GROWING CROPS

Crops are tended during the summer to provide weed control, reducing competition between the cultivars and noxious weeds. Mechanical cultivation was used before the formulation of effective herbicides. The recent trend has been toward increased use of herbicides, resulting in very weed-free fields. Corn fields look much different today than they did 20 to 30 years ago as weeds have been almost entirely eliminated.

UNIT 3.1. CULTIVATION

Corn, soybeans, and other row crops were cultivated several times during the growing season before selective herbicides were developed. Now, cultivation is much less common, though it is still done in some areas. Fertilizers may also be applied during cultivation. Ammonia, for example, may be applied in the soil between the rows of corn, providing additional nitrogen at a time when the crop needs it for maximum growth. Nitrogen is often limiting because it is not stored in readily-available form in the soil.

Cultivation can never eradicate weeds completely because it is a mechanical process, and some plants escape the ravages of the cultivator shovels. Further, weed control between the plants within the row has depended on covering of the weeds when they are small, smaller than the corn plants (Figure 8-6). Since this has always resulted in some weeds escaping, corn fields that have been cultivated have a variety of plants and seeds in them for food and cover later in the growing season. Corn fields were prime hunting grounds for pheasants some years ago.

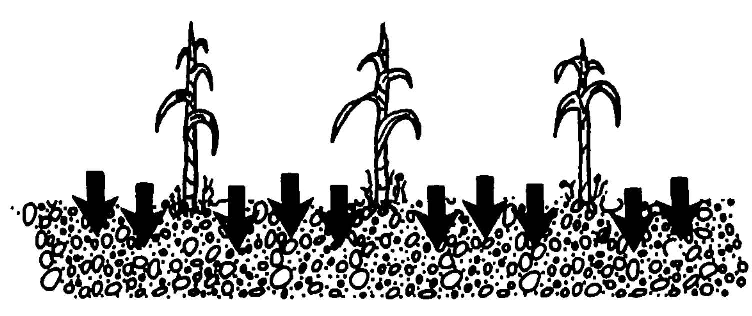

Figure 8-6. Cultivation of corn involves destroying of weeds between the corn rows and covering the weeds up between the corn plants within the row.

UNIT 3.2. HERBICIDES

Small grains are usually sprayed with herbicides for weed control. Spraying may be done with truck or tractor-mounted spray booms or with an airplane or helicopter. Trucks and tractors drive down some grain, but the spray booms are usually 30 to 40 feet wide so the tire tracks are a very small percent of the area covered. Under certain conditions, the grain may recover, too, making the wheel tracks almost invisible. Ground applications are especially suited to small, irregular fields, while aircraft applications are suited to large fields.

Applications of herbicides by either method must be done under certain weather conditions for best results, and to prevent undesirable effects. Heavy rains immediately after application may remove from or dilute herbicides on the leaves and make the application quite ineffective. Strong winds also cause considerable drifting of the herbicides, and this can cause undesirable effects on neighboring vegetation. Orchards and gardens may be particularly vulnerable. Farmers and sprayers are aware of these problems and generally avoid them to the fullest extent, but weather conditions can change to cause unexpected problems.

Herbicides are developed for short-time effectiveness. If herbicides accumulated in the soil rather than breaking down, they would affect germination and early growth of subsequent crops. This, of course, is undersirable. Herbicides must also be very selective, killing those plants considered "weeds" without harming the crop itself.

How does an herbicide operate? It does not "kill" the plant, but rather accelerates growth of the plant so much that the plant kills itself! Herbicides are selective growth hormones that cause target species to grow themselves to death without completing their life cycle.

TOPIC 4. HARVESTING

Harvesting is one part of farm work that is most enjoyable when everything has gone according to expectations. Think of the investment of time and money a farmer has in the crop. Planning, ordering seed, preparing the seedbed, planting, controlling weeds, irrigating in some areas, . . . all are part of the farming operation that leads to the final goal--the harvest.

Harvesting is an exciting time on the farm. Seeing the grain accumulate in the combine's grain tank, the result of a year of planning and labor, is very satisfying to a person who has chosen to till the land in order to reap the harvest. Methods of harvesting of grains and forage crops are discussed in the next two UNITS.

UNIT 4.1. FORAGE CROPS

Hay may be harvested as long-stem hay, or "chopped." Long-stem hay is cut, sometimes crimped or conditioned (a process of squeezing the stems to hasten drying), windrowed with a rake unless it was put into rows by the conditioner, and then baled, in most cases. In some areas, the hay is stacked loose, but this is not commonly done because loose hay is harder to feed. Chopped hay is fed immediately or ensiled.

HAYLAND

Hayland is a semi-permanent habitat that is a source of forage for livestock. Hay is harvested from more than 20% of all cultivated land in the U.S. Most of this (80%) is used right on the farm. The most common hay is alfalfa. Other commonly-grown hays are red clover, trefoil, and timothy. They are often seeded with a "cover crop," a small-grain that is harvested first and then the hay crop is left to produce for two or more years. In areas with good moisture and soil conditions, the hay may be seeded alone and one crop harvested the first year.

Haying is usually done with the mower-conditioner-windrower that cuts and windrows the hay in one operation. It is then allowed to dry in the field until the appropriate moisture content is reached. Hay silage is made when the cut hay is field-wilted to about 40-60% moisture. Hay may be baled when the moisture content has reached about 20%.

Baling is a very common way of harvesting hay. Balers pack the dry hay into rectangular or round bales. Rectangular bales are usually about 15 inches wide, 15 inches high, and 30 inches long and weigh from 40 to 70 pounds, depending on the moisture content of the hay and how tightly the bales were packed. Hay cannot be baled when it is too wet because molds will quickly grow inside the bale. This results in a heating reaction, raising the temperature of the bale high enough to cause chemical reactions in the hay. Protein, for example, may become bound with lignin (the Browning reaction) and make the hay less nutritious. If sufficient mold grows, the heat given off and trapped in the bales may be enough to cause spontaneous combustion. Barn fires sometimes result from hay that was stored too wet.The automatic baler can bale and load up to 20 tons of hay per hour. The small rectangular bales are usually stored in the barn or a storage shed as they absorb rain and mold when left outside. The large round bales shed water better and are usually stored outside for later feeding.

Round hay bales come in two sizes. Small round bales one to two feet in diameter and about 30 inches long have been popular in some areas, and they are easily handled by one person. Large round bales are a recent phenomenon. Such bales are about 4-5 feet in diameter and 6 feet long or more. They weigh up to 1000 pounds, and are handled with hydraulic lifts on tractors. They are more popular in feeding beef cattle or livestock outside, as the cattle will eat into the bale or it may be spread with a tractor-drawn machine that opens up the bale. There is waste as some of the hay is trampled into the ground. Such large bales are not suitable for feeding inside, unless special equipment for moving and opening the bale is available.

The small rectangular bales are the most popular for feeding dairy cattle. The bales, which may be tied with wire or twine, open into layers as a result of the packing action of the baler, and these layers may be easily separated for feeding.

The timing of the hay harvest is important. If it is too early, total production is not as high as it would have been with a later cutting. If it is too late, the quality of the hay is less. Peak protein content, a very important nutrient for growing stock and milking cows, is reached before the hay, alfalfa for example, blooms (Figure 8-7).

READ Y-AXIS AS PERCENT PROTEIN

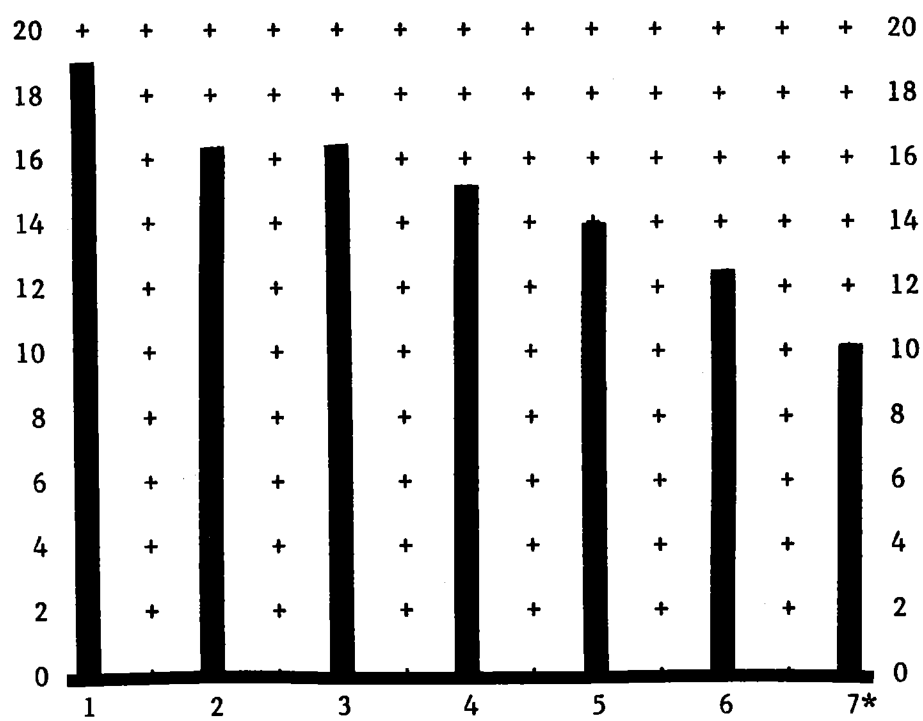

Figure 8-7. Changes in the protein content of alfalfa hay (as fed basis) with maturity. (Data from Crampton and Harris 1969, pgs. 481-482). See KEY* on p. 192.

KEY* TO THE NUMBERS ON THE X-AXIS, FIGURES 8-7 and 8-8:

1. Immature
2. Pre-bloom
3. Early bloom
4. Mid-bloom
5. Full-bloom
6. Mature
7. Over ripe

Delays in cutting during blooming and later results in hay with lower protein (Figure 8-7).

The protein content of harvested forage is of importance to the farmer, of course, who is feeding these nutrient resources to livestock. Suppose the protein content of a stand of alfalfa is 16.5% when harvested in the early bloom stage, harvest, and 2 tons of hay per acre were harvested from 100 acres of hay. That harvest contains 33 tons of protein. If harvest is delayed two-three weeks and the protein content drops to 11% but the harvested biomass is 2.5 tons per acre, the total protein in the harvest is 27.5 tons, a loss of 5.5 tons. If the market price of protein supplement is $266 per ton (see p. 211), the loss to the farmer is $1463 worth of protein. Such losses often occur as a result of rain-delayed harvests. It is hard for the farmer to justify, on an economic basis, a delay in hay harvesting for the production of pheasants. More mature and therefore more lignified hay is less digestible (Figure 8-8) and it is also less palatable to livestock. This is another reason why the timing of the cutting is of direct nutritional and therefore of economic importance to the farmer.

READ Y-AXIS AS PERCENT DIGESTIBLE

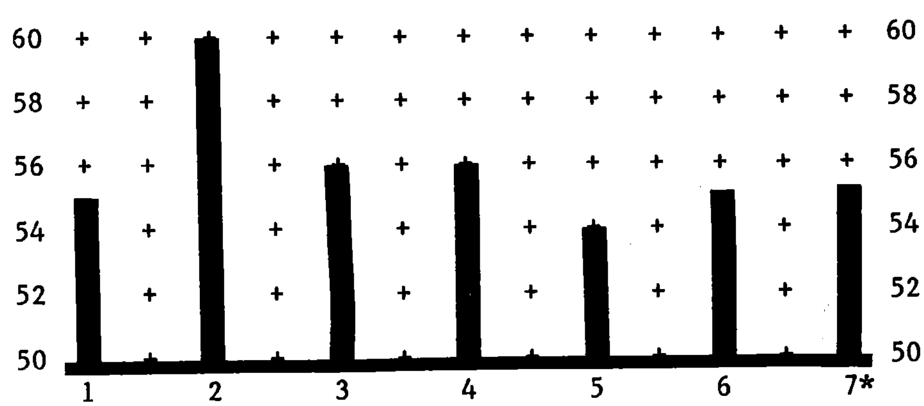

Figure 8-8. Changes in the digestible energy coefficient of alfalfa hay with maturity. (Data from Crampton and Harris 1969, pgs. 481-482). *A key to the numbers on the X-axis is at top of page.

Conditions during hay harvest also affect hay quality. If the hay is allowed to dry too much, the leaves tend to fall off more, resulting in coarser, less leafy hay. This is called "shattering." Since the leaves are the most nutritious part of the hay, leaf loss represents significant nutrient and therefore economic losses. If wet weather occurs when the hay is in the field, then it must be left until drying weather condition occurs. Windrowed hay must sometimes be turned over in order to expose the hay at the bottom of the windrow for drying. An extra turning of the hay increases leaf loss and hay quality. Excessively wet weather may cause severe problems in harvesting long-stem hay in some areas. Thus, alternative methods of hay harvesting have developed.

Hay may be chopped and fed green or put into silos for hay silage. This is a common practice in areas with wet summer weather, such as New York State. Hay may be cut and chopped in one operation if it is to be fed immediately. This practice, common in confined dairy herds, is done once or twice a day, and the chopped hay is blown onto specially designed wagons that also serve as feed bunks.

Hay that is to be chopped for silage is cut, windrowed, and allowed to dry some before chopping. It is chopped at much higher moisture levels than long-stemmed hay that has cured and is ready for baling. Silage is made by placing the field-wilted hay in an air-tight container where it is fermented and made more palatable and digestible to cattle. Silos may be trenches in the ground, bunk-type silos with concrete walls, or upright silos. Upright silos are conspicuous features of the farm landscape as they often extend 60 or more feet into the air. Further, many farms have 2 or more silos which may be used for both corn silage and hay silage. Silage is augured out of the silo, dropped to a conveyor on a feed bunk or into a cart or truck for distribution to the cattle.

Land that is planted to crops that will be harvested as hay is left in hayland for two or more years. Thus, there is spring cover that is often selected as nesting sites by quail, pheasant, and waterfowl. The vegetation may be appealing to the birds, but harvesting methods cause the destruction of a large portion of the nests. The first of two or three crops of hay is harvested in June, sometimes in the early part of June before the eggs have hatched. As the mower or mower-windrower approaches the nest, the incubating hen remains on the eggs until absolutely necessary to leave, and even then it may be too late and the hen is killed by the equipment. The operator usually cannot see the well-concealed hen, of course. Flushing bars have been recommended, but these are only partially successful in chasing the hen off the nest in time for machinery to be stopped. If the hen is flushed and the machinery stopped, the small patch of uncut hay surrounding the nest is not the same expanse of habitat that the field was before cutting, and the nest may be abandoned or more subject to predation.

PASTURES

Temporary pastures are those planted with species that are nutritious and capable of withstanding repeated grazing. Pastures are usually seeded with a mixture of plants, some maturing earlier in the summer and some later. This keeps the pasture productive through the entire growing season.

Temporary pasture Temporary pasture includes fields that are set aside as pasture for one or maybe a few years at most. Such pastures are part of the rotation system for the fields, so they are tilled periodically and planted to other crops. They may have permanent fences around them, or temporary single-strand electric fences. Such fences are effective in keeping dairy cattle in, and provide ease in putting up and taking down. Temporary pastures are sometimes grazed in strips or blanks to allow the vegetation to recover. Three strips, for example, might be rotated weekly, providing one week of grazing and two weeks of regrowth (Figure 8-9).

Figure 8-9. An example of a pasture layout for rotational grazing.

Temporary pastures must be close enough to the barn to allow easy access for the twice-a-day milking that occurs. They are grazed frequently enough to prevent establishment of dense nesting cover, and grazing rotations, are usually shorter than the incubation periods of game birds. The pastures are usually short by the end of the fall, providing little or no winter cover. Thus, they are not particularly good wildlife habitat.

UNIT 4.2. GRAINS

Almost all of the small grain acreage is now harvested with combines. The grain is harvested when the kernels are hard and have reached about 12-14% field moisture. If they are harvested with a higher moisture content, then the moisture must be reduced in a grain dryer (Figure 8-9) before the grain can be stored. Storage of grain with excessive moisture results in molds growing on the grain, making it unfit for consumption.

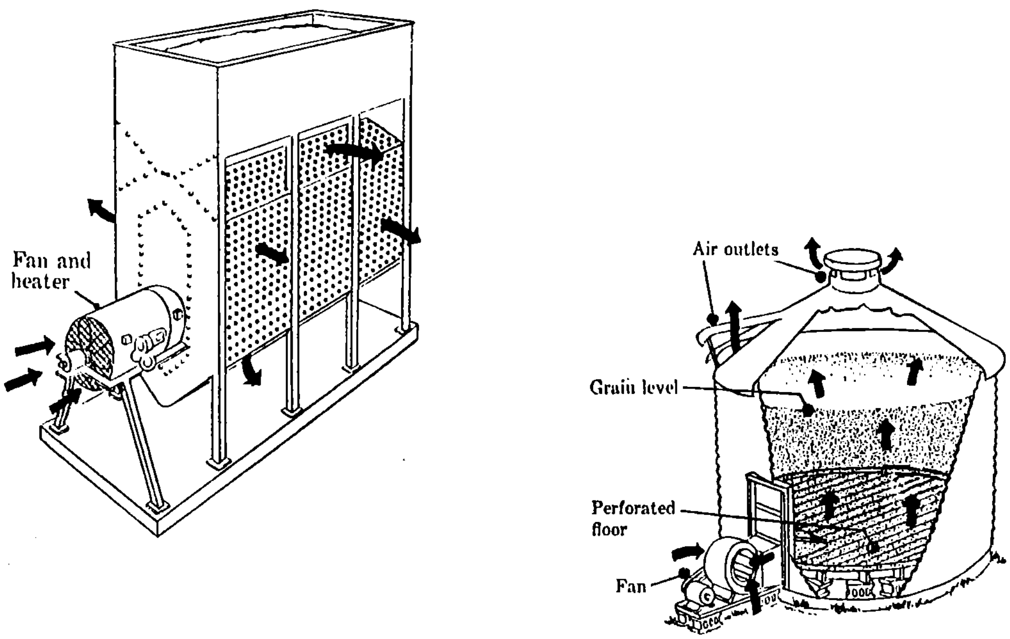

Figure 8-9. Two kinds of grain dryers: heated air (left) and ambient air (right). Both employ fans for air movement. (Source: Yearbook of Agriculture, 1960).

Harvesting occurs by either cutting the grain with a swather which deposits it in windrows to dry before combining, or by "straight-combining," when the grain is cut and combined in one operation. Swathing is done in areas where drying conditions are such that the grain would not dry well on the plant. Swathing is not necessary in areas with low atmosphere humidity, as in the Dakotas, for example.

The combined small grain crop yields both the grain and the straw. The grain is collected in the tank of the combine and then hauled by truck or trailer to grain bins on the farm to be stored or to a grain "elevator" where the grain is sold or stored for later sale. The straw, which is deposited in the field in rows behind the combine, is baled and used for bedding in the barns. It must be dry when baled, of course, so it does not spoil. The good absorbing capabilities of straw results in a manure and straw combination that is good organic fertilizer.

Row crops are harvested with combines and pickers. Combines are used for soybeans, with the crop cut as close to the ground (usually within 3 inches) as possible. Corn is harvested with a corn chopper, corn picker or a combine. A corn chopper cuts the entire corn plant up into short pieces less than an inch long. This can be fed green, but it is usually placed in a silo for silage. Corn silage is made before the moisture content of the plant and corn cob is too low; it must be moist for the ensiling process. Thus corn is cut for silage before or just after frost.

Corn may be picked with a tractor-drawn or self-propelled corn picker. A wagon is drawn behind the picker and the cobs are removed from the stalk by rollers in the picker heads and the ears are elevated back to be dropped into the wagon. When moisture conditions are right, the husks remain on the stalk, with just the cob removed. Cob corn is stored in "corn cribs," which are buildings with slatted walls or wire mesh storage bins. The slatted or mesh walls permit free movement of air, drying the cobs so they store without molding.

The stalks of picked corn left in the field are usually broken down so they are almost flat with the ground. They may contain an occasional corn cob, kernels have been knocked off from the cobs, and there is some spillage from the elevator and wagon, resulting in wastage that is available to wildlife. Deer, pheasants, ducks, and geese will feed in corn fields after harvesting.

Corn may be combined also. Then, the corn cob is removed and run through a sheller in the combine. The sheller removes the kernels, leaving the stalks and the cobs in the field. The shelled corn is collected in the grain tank of the combine, and then augured into a truck or wagon box when it is full. The corn is then brought to the farm for use as feed, stored to be sold later, or brought directly to the grain elevator to be sold.

There is a certain amount of waste in the harvesting process, as kernels are knocked off (shattered) when the grain is cut, and the combines are not 100% efficient in removing the grain, so some if it ends up in the straw and is left in the field. This waste grain is used by wildlife, and is usually present in large enough amounts that wildlife have an abundance of food as a result of harvesting operations, until the fields are plowed or covered with snow.

It is important for the wildlife biologist to realize that the completion of the harvest is a most important farm job, and that its timing is regulated by crop phenology and weather conditions. Crops cannot be harvested too soon to avoid depredation, and it is not desirable to leave them in the field any longer than necessary.

A NEW CONCERN

A recent environmental concern has appeared on the horizon which may affect the yield and the quality of agricultural crops. Acid rain, which has been blamed recently for the disappearance of fish from lakes in the Adirondack Mountains, NY, also falls on farmland in eastern U.S. and elsewhere on the continent. A summary of the influence of rainfall composition on the yield and quality of agricultural crops by Jacobson (1980) provides the following interesting considerations:

1. Acidic precipitation (pH less than 5.6) falls on at least 1 million hectares (2.5 million acres) of farmland and 800,000 ha of forests and woodlands in eastern U.S.

2. The value of all agricultural crops in the 11 states from Maine to Delaware, where the greatest deposition of acidity occurs, is 3 billion dollars annually, the largest single industry in the area.

3. It appears that precipitation has been acidic in northeastern U.S. for at least several decades, but has intensified in recent years.

4. We do not know the extent to which crops are affected, either favorably or unfavorably.

5. Preliminary results indicate that direct contact of acid rain with plant foliage can affect the growth, development, yield, and quality of agricultural crops, but many factors determine the magnitude and direction of these effects.

It is noteworthy that most of the environmental concerns about the effects of acid rain are centered on lakes and fish, while the effects on agricultural production are potentially far greater. Since agricultural production afects the amount and quality of a large segment of wildlife habitat, all of us concerned with the environment as a whole should be aware of crop management practices and the factors affecting crop production.

TOPIC 5. SUMMARY

Crop management is fundamental to agricultural production since it affects both primary and secondary production. Since farmers must remain financially solvent with the expectation of a reasonable profit as well, management practices that result in the attainment of both of these goals must be expected. Some of these practices are detrimental to wildlife living on farmlands. Wildlife nesting habitat changes drastically from one day to the next during the nesting period when hay is harvested. It is unreasonable to expect farmers to alter their operations significantly in favor of wildlife when such alterations result in financial losses to the farmer. A diversity of habitats in close proximity ameliorate the effects of farming operations by providing alternate areas of escape, and an innovative approach to setting aside acres for wildlife, based on the heterogeneity attained rather than simply the number of acres may be worth pursuing.

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