Crop Harvest and Storage Module

Certified Crop Advisor

State Performance Objectives

General New Mexico Crop Growth and Management Competency Areas:

1. Crop harvest and storage goals
2. Crop maturity concepts
3. Harvesting and storing grain and fiber crops
4. Harvesting and storing forage crops
5. Managing seasonal information

Learning Objectives

The objectives for the New Mexico Crop Growth and Management Module are:
· To examine when to harvest and the methods of harvesting specific crops
· To learn the difference between physiological maturity and harvest maturity in crops
· To learn the importance of seed or forage moisture content in the storage of crops
· To learn the role and use of growth regulators, desiccants and defoliants to improve crop quality
· To learn to utilize harvest information within whole farm management planning

Pre-Study Questions for Review

1. Grain crops used for animal feed should have the following uses and harvest goals in order to maximize the quality: maximum grain yield with high energy, _____, and nutrient balance.
   a. nitrogen
   b. stability
   c. protein
   d. ash
2. The optimum maturity date for harvesting and for the subsequent storing of crops depends on the _____ of the final product.
   a. utilization
   b. quality
   c. moisture
   d. rotation
3. No matter how good the quality and the yield on grain or forage or fiber, correctly harvesting at the proper _____ and moisture and storing or baling the product at a moisture level in which the product can be maintained for use is just as important as your production strategies for growing the crop.
   a. height
   b. stem thickness
   c. time of year
   d. stage
4. A defoliant when applied to plants causes the leaves to _____ from the plant.
   a. sprout
   b. twist
   c. separate
   d. branch out
5. Silage can be made from many crops although _____ and sorghum are often thought of when this system is considered.
   a. birdsfoot trefoil
   b. timothy

c. corn
d. canola

Check your answers before proceeding into the unit to find out how much you already know about the basic concepts on planting factors. Each correct answer is worth 20 points, based on a total of 100 points for the five questions. Answers: 1. c .; 2. a.; 3. d.; 4. c.; 5. c.

Crop Harvest and Storage Goals

Different crops are harvested and stored by various means depending on the end utilization. Whether the seed will be used for new plantings the following year, for forage being processed into livestock feed, or even for crops to be developed for a special use, the grower must be aware of harvesting and storage requirements toward a quality product. After determining the prescribed use for the crop, timing on harvest and storage is an important consideration. Along with an assessment of when to harvest, the farmer next needs to determine the method of harvesting the crop. Both of these last two decisions are important in confirming that the planned use of the crop can be implemented. Below are a few of the considerations for harvest-storage goals when working with different crops.

Harvesting and Storage Goals Based on Crop Utilization

Crop	Use	Harvest-Storage Goals
Seed crops	new stand establishment	Maximum seed yield with high vigor and germination percentage
Grain crops	livestock feed	Maximum grain yield with high Energy, protein, nutrient balance
Forage and pasture	ruminant livestock feed	Maximum vegetative yield with high Protein and digestibility
Special purpose crops		
(Hard) wheat	breadmaking	High yield and high gluten protein
(Soft) wheat	cakes, cookies	High yield and lower protein
Durum	pasta	High yield and high protein but weaker gluten than bread wheat
Barley	brewing	High yield, high germinability, high starch but low protein content
Sweet corn	human consumption	High sugar, higher moisture than corn used for feed
Sugarbeets and sugarcane	sugar	Maximum sugar per unit area (yield in tons and percent sugar)
Cotton	fiber	Maximum yield, long fibers
GMO modified crops	many different uses	Maximum yield, quality traits for use

The optimum maturity date for harvesting and for the subsequent storing of crops depends on the utilization of the final product. Maturity dates and storage requirements will vary among crops and even within a crop if it is being used for different purposes. In order to fully explore crop needs for harvesting and storing, the concepts of plant physiological maturity and crop harvest maturity must be more fully understood.

Crop Maturity Concepts

There is a relationship of moisture to maturity in crops that determines the most optimum time for harvest and the best conditions for storage.

Plants reach maximum dry weight at physiological maturity. This maturity usually refers to the maximum dry weight of the total plant, but in grain crops this term is often associated with the maximum dry weight of the seed. At as high a moisture content as 40 percent, most grains have already accumulated their maximum dry weight although this moisture percentage may vary by 5 to 10 percent depending on crop species and variety. If one harvests before physiological maturity is reached, the effect is lower yield, lower quality, lower starch/sugar content, shriveled kernels and lower test weight.

Just because physiological maturity has been reached, however, this point may not be the optimum moisture content to store the crop. Harvest maturity is the point at which the crop is at the best combination of yield and quality and at or close to a moisture content at which the forage or seed may be stored. As you might guess, the optimum moisture content for different harvested grains varies depending on the crop use and the harvesting equipment available as well as any environmental conditions that allow harvest to proceed. Harvesting at physiological maturity but before proper harvest maturity can result in crop damage due to mechanical damage to kernels, spoilage in storage, and even field losses due to harvesting equipment not properly picking up all of the crop or grain.

Problems with High-Moisture Grain or Silage

1. storage time for the crop is reduced (spoilage can accelerate)
2. fines may be numerous when excessive grain damage during harvest occurs which then interferes with grade, quality and storage life
3. fractures to grain during harvest to high moisture seed exposes the grain to mold and insect attack in storage, again lessening storage life
4. visual appearance of the grain or silage can be poor, lessening grade and quality as well as possibly increasing the risk toward spoilage

Harvest maturity for most forages ranges from 70 to 85 percent moisture concentration on a fresh weight basis and depending on the forage species, fertility regime the crop was grown under, the weather conditions and other production factors.

Delaying harvest until after the grain or forage has reached proper harvest maturity can also result in yield loss. Seed or ear losses as well as stalk lodging in the crop may lower yield. Crop quality may also be compromised as lower bushel weight, lower seed germ and even deteriorated grain due to field weathering and losses. In forages such as alfalfa, digestibility decreases about 0.5 percent a day beyond the early flowering stage of alfalfa, intake decreases about 0.5 percent or more per day beyond the early flowering stage of alfalfa, and thus the feeding value decreases about one percent (0.5 + 0.5) per day when harvest is delayed beyond the early flowering stage. Each quality factor loss is an expensive penalty to the producer for poor timeliness in harvesting. Especially with forages, there exists the common misconception that higher yields may be obtained if harvest is delayed. Indeed, in some cases, dry matter may increase but forage quality may be decreasing making the harvested feed nutrients less than a crop harvested in a timely manner. In crops that have multiple cuttings within the season such as alfalfa, a late first cutting gives less of a growing season for subsequent harvests, resulting in lower dry matter yields for the entire growing season. In hay crops, color, leafiness, protein content and digestibility are all affected by the stage of maturity when the crop is cut. Digestible dry matter (DDM), intake and crude protein also decrease with delays in harvest.

Silages vary greatly when cutting is recommended. For grain crop silages, the following general stages for cutting are suggested.

Grain Crop Silages

Crop	Stages for harvest

Sorghum	medium to hard dough seed
Oats	soft dough seed
Barley, wheat	milk stage of seed
Corn	dent seed

Indeed, for any given species or mixture of hay or silage, the growth stage when cut influences the DDM intake and the meat or milk output of the animal on feed. Herbaceous forages may drop in crude protein, digestibility and intake as harvest is extended due to the plants becoming stemmy. In general, leafy pastures give higher gains per head than hay.

General Uses of Forage Based on Moisture Content

Moisture percent	Use	Harvest management operation
70-80	wet silage	direct cut
60-70	regular silage	cut and wilted
40-60	haylage	cut and wilted
25 or lower	hay	cut and allowed to dry

Even after the harvest maturity in crops has been reached, the crop may yet require additional dry down, conditioning or the use of preservatives (in the case of some forages and silages) to best set the storage maturity needs. In storage, the crops must be able to retain as much quality and quantity as possible over the time interval needed to utilize or sell the crop. In some crops in more northern regions, grain drying is a common practice and must be part of the economical assessment of costs incurred with growing the grain. In areas such as New Mexico, it is rare that grain crops are caught by freeze or environmental conditions where the crop must be harvested before a harvest and storage maturity condition can be reached. However, forages that are stressed from very dry, very wet or by a freeze can be affected.

Prussic acid and nitrate poisoning can result in the rare cases when crops are harvested under less than idea conditions. Hydrocyanic acid, or prussic acid, is generally not found in healthy plants but is formed by the enzymatic action on compounds called the cyanogenetic glucosides when growth is checked by adverse environmental conditions. This hydrolysis of the glucosides also occurs by bacterial action in rumen animals with the resulting cyanide rapidly absorbed into the blood. This cyanide combines with hemoglobin to form cyanohemoglobin, which does not carry oxygen. The cyanide-poisoned animal shows an increased rate of respiration, increased pulse rate, gasping, muscular twitching, and convulsions—death can occur from respiratory paralysis. The crops where prussic acid poisoning poses the greatest risk here are forage sorghums and sudangrass, where the cyanogenetic glucoside is dhurrin. The potential for poisoning by the sudangrass-sorghum hybrids varies depending on the cultivar, stage of growth, level of nitrogen fertilization and environmental conditions. Generally, more prussic acid occurs in new growth of the grasses, at high levels of nitrogen applications and under environmental stresses such as drought and frost.

Nitrate poisoning is a different problem that can result when high-nitrate silages are used too soon after ensiling or when cereal hays or corn or sorghum fodder accumulate toxic amounts of nitrates when grown under adverse environmental conditions such as high fertilization, low light intensity and drought conditions. With nitrate poisoning, consumption of the forage by rumen animals such as cattle result in the condition of methemoglobinemia from conversion of nitrate into nitrite in the rumen of the animal. The nitrite is then absorbed into the blood and converts normal blood hemoglobin into methemoglobin, a form incapable of transporting oxygen to the body tissues. The untreated animal can die of anoxia. Sublethal effects are often seen with corn and forage crops and these effects include limitations on growth, reproduction, milk production and the vitamin A and iodine status of the animal. The cereal crops and certain weeds have been considered the best to accumulate nitrate under the adverse environmental conditions; however, some perennial grasses and legumes under high levels of nitrogen fertilization can develop potentially dangerous levels of nitrate. Forages with potentially toxic nitrate levels should be mixed with other feeds before use with provisions for an energy supplement to minimize the possibility that nitrate poisoning will result.

Forage testing services can be used to test suspect feed before use. Moisture meters properly calibrated can be used to test crops for grain moisture to confirm if harvest and/or storage moisture levels have been obtained. Local grain elevators also can test grain for moisture readings. Forage and silage can be tested for moisture content by determining the water weight in a sample through the use of a wet weight, drying in a microwave or oven, determining the dry weight and then figuring the amount of water in the sample. Forage testing services can also make this determination. No matter how good the quality and the yield on grain or forage or fiber, correctly harvesting at the proper stage and moisture and storing or baling the product at a moisture level in which the product can be maintained for use is just as important as your production strategies for growing the crop.

Harvesting and Storing Grain and Fiber Crops

Maximum grain yields occur when the grain reaches physiological maturity. As no additional dry matter will accumulate in the grain after this stage is reached, this is the time when full grain protein, starch or other constituents may be at their peak. However, grain is a perishable commodity that can deteriorate over time if not harvested, handled and stored properly. Thus, storage maturity should be the grain moisture and stage at which the grain is placed into storage. Higher moistures than safe for storage conditions will result in symptoms of deterioration on the grain including decreased feeding value, dry matter or weight loss, insect infestation, mold and possibly a reduction in grade.

Harvesting and Storing Grain and Fiber Crops: Early Harvesting of Grain and Fiber

The longer a crop remains standing in the field after physiological maturity, the longer the grain or fiber product is subject to environmental factors that can result in harvest losses. Both quantity and quality of the grain and fiber can be affected. Several means of accelerating the timing of grain and fiber harvest have been used to try to bring crops to storage. Some of these methods of speeding up harvest include use of plant regulators, use of defoliants, use of desiccants, use of grain dryers or other methods to mechanically, physiologically, chemically or naturally accelerate crops from the field through to harvest maturity and into storage maturity.

The use of plant growth regulators have been implemented to control physiological processes in crops such as flowering and fruiting, partitioning of assimilate, germination, propagation, growth suppression, defoliation and post harvest ripening. Plant growth regulators can include auxins, gibberellins, cytokinins or kinins, growth inhibitors and ethylene. Defoliants and desiccants can also be considered substances that promote, inhibit or modify physiological processes.

Auxins have been used in agricultural not only to stimulate elongation and growth or even to prevent fruit drop or to promote callus and root formation, but also to stop growth of specific plants like weeds. Some of the most valuable and widely used selective herbicides in weed control are auxins (2,4-D and MCPA). Limitations due to harvest intervals or feed use may apply if auxin herbicides are used to stop weed and/or crop growth on a field to prepare for harvesting a broadleaf crop or a weedy grain crop.

Gibberellins have been used in the hybrid seed industry early in the 1950s as the plant growth regulator caused male sterility in maize grown in breeder fields and thus could lead to more consistent seed stock, but results were often inconsistent. One success story is the use of gibberellins on grapes, rice and barley seed. The use of gibberellin on grapes encourages larger grapes with improved table quality. In rice, gibberellins allow quick emergence and growth so that flood water can be used to control weeds. In the malting industry, gibberellins promote alpha-amylase activity and the resultant starch hydrolysis in embryoless barley seeds, however, more modern cultivars have been selected where this process is no longer needed.

Cytokinins can increase fruit-set in grapes and improve size and shape of apples. However, little use for harvest or storage maturity considerations exist.

Growth inhibitors have been used to shorten internode length and plant height as well as to reduce lodging. Also, defoliants are used as harvest aids in both stripper and picker cotton. Ironically, one of the first highly active growth inhibitor isolated in the early 1960s was from cotton fruits and named abscisin II. A similar compound was discovered in sycamore leaves and called dormin. Both were found to be chemically and biologically identical and then were named abscisic acid or ABA. Compounds over the years have been used on sugarbeets, soybeans and peanuts to curtail late vegetative growth. Growth inhibitors have also been used on Christmas trees, grains and tobacco in other regions. Most familiar here in New Mexico in agronomic crops is the use of defoliants as cotton harvest aids.

A defoliant when applied to plants causes the leaves to separate from the plant. The correct use of chemical defoliants on cotton can reduce moisture, lessen objectionable green stains on fibers and limit trash from picked cotton as well as facilitate mechanical harvesting in both stripper and picker cotton by reducing the leaf material on the plant.

A desiccant on the other hand is used in cotton to dry out the plant and allow it to die. Both defoliants and desiccants can be useful and with correct combinations can make harvesting much easier. Both simple as well as complex plans for using these chemicals in cotton have been formulated and tested. Environmental conditions make a big difference on whether either chemical is needed. With a proper, hard freeze, cotton farmers can bypass the use of the chemicals as plants will naturally drop their leaves and die for easy harvest. However, without this condition or in order to harvest before additional weathering takes its toll on cotton quality, defoliants and desiccants may be needed. Combinations of the chemicals or higher levels of desiccants as suggested on the label can also encourage late bolls to open and thus increase potential yield. If a field has cut-out (growth has slowed and possibly plants have begun to die back) due to drought or other stress condition, less chemical may be required to get the crop into shape for picking or stripping. With dense foliage and continued good growing conditions, more chemical or multiple applications may be required to harvest quickly. Narrowing the window between defoliation and harvest can also help growers preserve lint quality and minimize potential losses that could be caused by foul weather. Preventing regrowth is critical to avoid problems with lint staining by leaves. Discounts for stained cotton can be significant, especially in recent years with textile mills.

Agricultural use of ethylene has been limited due to the impracticability of field treatment with a gas. However, ethephon has been used on walnuts to hasten senescence and dehiscence of hulls allowing earlier harvests and improved nut quality and has also been used in tobacco seedlings to suppress growth in starting beds. It has also been used in storage of certain fruits and vegetables to hasten use maturity when these are picked early at a stage less than optimum for food use.

Other processes have also been used to allow early harvest of grains. Some work with topping plants has been done in an attempt to speed up harvest or to facilitate harvesting. Topping plants allows better ventilation in the lower part of the canopy, provides deeper light penetration and often allows earlier harvesting. However, some grains such as corn when topped before physiological maturity may have yields lowered. Grass crops often utilize the flag leaf to optimize the final fill in grain and thus topping is only helpful after physiological maturity has been reached and even then the time of harvest maturity is usually not changed by more than a few days. This practice has even more limited use in arid environments where canopies are not as thick unless irrigation is used.

Curing and storage system may allow earlier harvesting on some crops. Airtight storage has been used for high moisture grain (25-30 percent) to prevent losses from molding of the crop. However, this situation for storage is difficult to maintain. Drying the crop before storage allows the crop to be harvested and then rather than wait for the environment and the variety to regulate moisture loss, grain dryers when used correctly at the proper temperature, rate and grain depth can get grains down to safe storage moistures. Done improperly, grain losses to yield and quality can result.

Proper grain and fiber storage minimizes losses due to grain respiration, spoilage, molds, heating and insects. The two major factors that must be controlled are temperature and moisture.

Options for Grain Storage

System	Problems Prevented
Air-tight storage	Respiration and spoilage reduced due to the absence of oxygen
Dry grain	Safe moisture level for storage retards molds and disease
Grain for seed	Not drying above 110F will keep seed with good germ
Grain for processing	Starch and flour products do not dry above 135-140F to keep quality
Grain for feed	No significant losses in feeding value with drying up to 190F
Proper ventilation	Used in non-airtight storage helps prevent temperature/moisture build-up

Indeed, high temperatures on grains in storage creates greater respiration of the seed resulting in heating of the grain, loss in test weight and quality and loss in protein content. High moisture can cause mold and disease as well as insect growth to be promoted. This can then lead to spoilage, toxic substances produced and loss in quality and feed value. Grain like forages have established standards that set benchmarks for quality. Less weed seed, foreign material along with excellent quality, whole grain at the right moisture will establish the grain that can be sold at the best price. Grades and grade requirements are also established from all grains. These allow designations for quality which then relate back to expected price. For crops with specialty traits, special grades are also established.

Harvesting and Storing Forage Crops

Hay is one of the top three leading crops in practically every state of the United States and there is no exception in New Mexico. The quality of this crop as with silages, however, varies more with this crop than with any other. This variance is mainly due to the type of crop and the weather risks involved in field curing. High quality hay and silage is a result of proper cutting at the correct stage of maturity and by using the proper harvesting technique in order to produce a product that can provide for good animal performance. Both yield and quality traits are essential in harvesting and storing excellent forage crops.

Quality = Palatability + Digestibility + Nutritive Value

Several terms are used around forage crops, depending on how the crop will be used and put up. Some of the terms include hay, silage, soilage and pasture. Hay is harvested and stored in bales, usually. Very little loose hay is handled and even less is field chopped. Size of bales varies quite a bit since the general “small” bale and “large” bale baling manufacturers have set their own specifications. Often bales are 35 to 2500 pounds for storage. Moisture for bales can be up to 25 percent. Field operations usually include mowing, curing, raking into windrows and baling. Bales may be square or round. Ease of handling large, round bales with equipment and the added ease of mechanization has increased the use of these bales that can be up to 2500 pounds in weight.

Before the development of balers, hay was handled as long, loose hay. It was cut, cured, windrowed and placed in buildings or in stacks in the field. There have been some mechanized stackers developed on the idea similar to the cotton module that has allowed loose hay to be handled mechanically in 1 to 6 ton blocks; however, these have not be very popular down in the southwest where wind can still damage the loose hay block.

Also, the ease with which one person can handle the large round bales with a front-end loader tractor, back loading system or even onto a truck has made this continue in popularity. Also, efficient use of the round bales within a round feeder fence has popularized this system for cattle feeders as has the consistency of the product if properly stacked. Stacking or arranging round bales open face to open face allows each round bale in the line to protect the next round bale from weathering.

Field chopped hay reduces hay to particle sizes that can be moved by air. Chopped hay is often stored at moisture content of 22 percent or lower. Ease of ensiling, feeding directly or even mixing this hay with other feed stuff has made this a popular process. However, the cost of the forage harvester (forage chopper) does add cost to the process.

In order to get hay to a storage moisture content, besides field curing there are other options. Use of a mechanical hay conditioner, artificial hay drying or forage dehydration are possible but add cost. Hay conditioners crush or break the plant stems so that they will dry faster, often by about 50 percent. This allows faster drying, less weathering and higher quality hay in areas with more rainfall. Hay can also be allowed to dry to 35-40 percent moisture in the field and then bales and dried artificially in storage. This can be expensive. Forage can also be chopped and immediately put through a rotary drum drier at 1400-1500F to dehydrate the hay for a few minutes. A high quality product can be produced. This is one way alfalfa is pelleted and sold.

Silage can be made from many crops although corn and sorghum are often thought of when this system is considered. Silage is simply forage that has been preserved in a succulent condition by fermentation in the absence of air (anaerobic conditions). This system in New Mexico is usually stored under plastic or in earth bunkers/trench silos/stack silos covered in plastic with tires weighing down the plastic covering. There are few silos used in this area. Even more efficient is the newer plastic tubing that hold silage. From the end, the tubing appears to be about the size of a large, round bale but the tubing can be continuous for many feet. The advantage here is that the silage is completely encased in the tubing so no silage is exposed to the ground or the air and can conceivably remain in excellent condition for much longer. Silage allows feeding operations to be mechanized if arms or augers used reach from the silage source to the feeding area or if the silage can be mechanically loaded onto trucks and likewise unloaded at the feed site. Harvest of silage is also less dependent on weather as drying time is short. Also, silage is usually higher in quality than hay harvested under similar conditions. The actual preservation of silage only takes four to five hours where plant cells and aerobic bacteria deplete the “free oxygen” through respiration, creating the anaerobic conditions needed. Under these anaerobic conditions, another three or four days will allow the lactic acid-forming bacteria to increase throughout the silage and a chemical reaction occurs converting glucose to lactic acid which usually results in around a 3.1 percent loss in mass. The silage preservation process is virtually complete in another 12 to 15 days, hopefully with very little acid production. The actual pH of the silage has now changed from 5.5 (more acid) to 6.5 (almost neutral) in fresh silage and from 3.6 to 4.6 in good silage. You can tell good quality silage by the smell and taste. A good quality silage has a pleasant alcoholic odor and tastes sour. In poorly ensiled forage, the strong odor is high in ammonia, volatile fatty acids (especially butyric acid), hydrogen sulfide, and other smells. Energy losses in poor silage can easily be as high as 20 percent.

Why Silage May Be of Low Quality

1. the original forage used was low in quality (cut at the wrong stage, too much foreign material)

2. the forage was stored at too high a moisture content (freshly cut with 75 percent moisture or above, acids were formed in the preservation process, and a low pH may not have developed)
3. the forage was stored at too low a moisture content (below 60 percent, anaerobic conditions may not be obtained, molds may form)

How to Improve Silage

1. Use of silage additives (acids, usually, that will help in the preservation process)
2. Use of ground grains or molasses (these increase the carbohydrate content and allows the bacteria fermentation process to result in higher quality silage)
3. Fine chop or compact the material (this helps exclude the air, hasten the process)
4. Use wilted forage legumes and grasses (lower moisture allows the pH to be better in the processing and will improve the smell of the silage over high moisture processing)

Steps to Insuring Proper Silage Fermentation

1. fine chop the material (1/4 to 3/8 inch)
2. distribute well and pack firmly in the silo so oxygen is excluded
3. ensile below 70 percent moisture to eliminate seepage
4. have adequate carbohydrates for fermentation by harvesting at the proper stage of maturity

There is continually a need for hay and silage standards to accurately reflect feed value. Three of the most basic methods used today for estimating in vivo digestibility (dry matter digestibility-DMD) and intake are as follows.

1. animal digestion trials (material is consumed, excrement is analyzed—accurate but costly and takes time)
2. in vitro (IV) rumen fermentation technique (measures IVDMD values closely correlated to IV digestibility—low cost, rapid)
3. newer, chemical methods using the acid detergent fiber (ADF) and the neutral detergent fiber (NDF) (uses the cell content fraction and the cell wall fraction—varying costs, rapid)

When using the ADF-NDF system, several generalities can be made on forages across the U.S. In general, alfalfa grown in the southern U.S. has ADF-NDF values comparable to other areas or better. Alfalfa crude protein (CP) is higher in the south—warm temperatures result in fewer days to crop maturity. Alfalfa digestible dry matter (DDM) is fairly constant. ADF and NDF percentages are lower in younger forages and are negatively correlated to animal performance. ADF percentage is similar in legumes and grasses of similar maturity stages. NDF percentage is lower in legumes than grasses and is highly correlated with forage intake (intake is higher for legumes than grasses).

Rather than harvesting and storing forages, pastures may also be used. Advantages include: easy source of green, succulent feed; harvesting costs are minimized or negated; and, livestock do not have to be confined to a small area where the sanitary conditions are more difficult to maintain. The disadvantage is that the amount of dry matter harvested per acre by pasturing is usually less whether using natural grasslands or improved pastures. Grazing under these systems can be zero grazing (green chop or soilage used such as in very large operations); rotation grazing (pasture subdivisions shifted in use); or, continuous grazing (harvesting costs are low but production per acre is too).

Managing Seasonal Information

In order to improve your farm management, records and information for individual fields must be maintained. With global positioning systems (GPS) farm records can be micromanaged, but even with only pencil and paper year end records can improve your farming skills. Over time, information on rotation successes, seasonal operations and soil texture/structure factors within each field will help you learn the land to such an extent that you have the sweet spots and poor land mapped out in your head almost like the new GPS maps can color code soil, fertility and yield information. A combination of annual or at least biennial soil samples to check and justify fertility needs and knowledge of potential disease, insect and weed pests that might prevail in fields from year in and year out will help form a basic information source from which to farm. Add to this information, yields, variety information on seed that work well in your soils and farming conditions along with knowledge on limitations to pest controls, environmental conditions and timing of operations and you have formed a second tier knowledge base from which to farm. Add onto this information production techniques that work for you and proper seeding and harvest times under specific conditions and you have a third tier of knowledge that will continually be improved over the years. Tack on the economics of each operation and the knowledge of what crops in what rotation and with what production techniques work best on individual fields and you have graduated up to a mid-career farm manager. Manage your equipment needs along with the farm size and needs and the economics along the way and your looking at an agronomy career. Add to all of this even more in depth knowledge of your farm down to every caliche spot or rock in the way along with an understanding how integrated pest management and scouting directly influence those end results in yield and grain/fiber/forage quality and you can end your career being called a true farmer. Add to this yet more knowledge with continuous education in crops and agriculture and you will be able to begin to understand how seed contains a genetic blueprint for potential yield that then transfers into seedling establishment to rapid plant growth to flower initiation to pollination to assimilate collection to seed filling to physiological maturity to harvest maturity to storage maturity and the decisions, production techniques, input needs, environmental constraints and timing of operations all tie together to produce crop productivity and economics that make being updated and informed as a certified crop consultant that much more essential to your operation and business.

Post-Study Questions for Review

1. _____ dates and storage requirements will vary among crops and even within a crop if it is being used for different purposes.
    a. Seeding
    b. Calendar
    c. Maturity
    d. Appointment
2. Even after the harvest maturity in crops has been reached, the crop may yet require additional _____, conditioning or the use of preservatives (in the case of some forages and silages) to best set the storage maturity needs.
    a. dry down
    b. time
    c. assimilate rerouting
    d. seed fill
3. Harvesting at physiological maturity but before proper harvest maturity can result in crop damage due to mechanical damage to kernels, _____ in storage, and even field losses due to harvesting equipment not properly picking up all of the crop or grain.
    a. turgor
    b. temperature lowering
    c. spoilage
    d. moisture evaporation
4. Seed or ear losses as well as stalk _____ in the crop may lower yield.
    a. growth
    b. hardness
    c. shortness

    d. lodging
5. Generally, more prussic acid occurs in new growth of the grasses, at _____ levels of nitrogen applications and under environmental stresses such as drought and frost.
    a. low
    b. adequate
    c. high
    d. minimal
6. Nitrate poisoning is a different problem that can result when high-nitrate silages are used too soon after _____ or when cereal hays or corn or sorghum fodder accumulate toxic amounts of nitrates when grown under adverse environmental conditions such as high fertilization, low light intensity and drought conditions.
    a. ensiling
    b. cutting
    c. baling
    d. fine chopping
7. The longer a crop remains standing in the field after physiological maturity, the longer the grain or fiber product is subject to _____ factors that can result in harvest losses.
    a. poisoning
    b. hardening
    c. environmental
    d. production
8. Limitations due to harvest intervals or feed use may apply if _____ herbicides are used to stop weed and/or crop growth on a field to prepare for harvesting a broadleaf crop or a weedy grain crop.
    a. psycho
    b. broadleaf
    c. grass
    d. auxin
9. A _____ on the other hand is used in cotton to dry out the plant and allow it to die.
    a. defoliant
    b. desiccant
    c. dehydrant
    d. dezapper
10. The actual preservation of silage only takes four to five _____ where plant cells and aerobic bacteria deplete the “free oxygen” through respiration, creating the anaerobic conditions needed.
    a. days
    b. weeks
    c. hours
    d. seconds

Check your answers before proceeding into the unit to find out how much you already know about the basic concepts on cropping systems. Each correct answer is worth 10 points, based on a total of 100 points for the ten questions. Answers: 1. c.; 2. a.; 3. c.; 4. d.; 5. c.; 6. a.; 7. c.; 8. d.; 9. b.; 10. .