Crop Management Competency Area:
Identification of Seed and Vegetative States

1. Be able to identify the seed and mature plant of each crop	**Alfalfa** Seed: color - light and dark brown to greenish yellow. shape - predominately kidney bean, but few mitten-shaped 2 - 5 mm Mature plant: leaflets generally long and narrow, serrated at tips to approximately 1/3 of entire margin; palmately compound; small, pointed stipules; flower color variable but mostly purple; modified raceme flower; perennial **Red clover** Seed: color - yellow, brown, red, purple (multiple colors); few seeds are 1/2 dark-colored (purple) and 1/2 light colored (yellow). shape - both heart and mitten-shaped. 2-5 mm (larger than white clover) Mature plant: palmately compound; leaves and stems are pubescent; older leaflets are ovate (tips somewhat pointed as opposed to rounded) and with white, V-shaped, marks; large, pointed stipules; flowers are red borne terminally on spherical head; biennial to short-lived perennial. Each head contains 15000 flowers. **Soybean** Seed: color - light yellow; shiny. shape - nearly spherical. large hilum (where seed was once attached to pod), dark-colored with white slit in center; many show conspicuous micropylar scar. 5 - 10 mm Mature plant: palmately compound; netted veins; white or purple flowers at nodes on racemes. Annual. Stems hairy **Barley** Seed: color - yellowish; shape - broad in center, but narrower and blunt at apex with some seeds showing short awn points; most lemmas distinctly veined. > 9 mm chaffy Mature plant: **spike** type inflorescence; short, club-shaped; 3-row effect in front and back; awned; glaborous; clasping auricles. **Canola** Looks like wild mustard. Yellow flower. Smells like broccoli. **Corn** Seed:yellow Mature plant - average hybrid develops about 20-21 total leaves, silks about 65 days after emergence, and matures about 125 days after emergence

1. Cont'd	**Kentucky bluegrass** Seed: color - light brown. shape - straight and boat-shaped; lemma on dorsal side sharply angled or ridged. < 5 mm chaffy Mature plant: leaf tips are shaped like the bow of a boat. inflorescence: **panicle type** - open, long pedicles; lower pedicles usually in whorls of 3 to 5; small, but many spikelets; sometimes purplish color apparent; awnless perennial **Oats** Seed: color - pale yellow to light brown (color depends on degree of weathering or conditions prior to harvest). shape - prominent veins on lemma from middle or upper 1/3 of seed apex. > 9 mm chaffy Mature plant: **panicle type -** open long pedicles; all branches terminate in a single apical spikelet; small, but many spikelets; sometimes purplish color apparent; awnless. annual; veins twisted counter clockwise. Seedling bluish in color. **Orchardgrass** Seed: color - light yellow in color. shape - many seeds show curved-form; some florets in clusters; short awns or awn points visible on many seeds. 5 to 9 mm. chaffy Mature plant: (flat stem) widest blade species, > 10 mm, with leaves folded in a bud shoot. Sheaths are distinctly flat and each blade shows a prominent midrib and a boat-shaped tip. Panicle type inflorescence - compact, upright spikelets on short and long pedicles; spikelets occur in groups appearing as one-sided clusters, sometimes having a purplish color; short awns or awn points; similar in general appearance to reed canarygrass. perennial. **panicle type;** bunch type growth habit **Smooth bromegrass** Seed: very flat and papery-like in appearance; blunt apex; lemma distinctly veined. > 9 mm chaffy Mature plant: (united sheath) inflorescence - **panicle type**; open, but upright short and long pedicles; membraneous; rhizomes; dense stands; M or W on leaf about 1/2 way up. **Sorghum** Seed: color – red, bronze, or cream colored, spherical, BB sized mature plant: White film on plant; Loose to dense panicle; saw tooth margin on sorghum leaves.

1. Cont'd	**Tall fescue** Seed: color - light brown; rachilla (axis of spikelet) is rounded or knob-shaped (baseball bat handle); most seeds awnless, but few have short awns or awn points. 5 -9 mm chaffy inflorescence: open, long pedicels; many pedicles do not re-branch; generally awnless, but a few short awns may be present; **panicle type;** head looks similar to quackgrass **Timothy** Has corms. **Wheat (hard)** Seed: color - dark reddish brown; sometimes nearly translucent.. 5 - 9 mm; naked; **spike type** **Wheat (soft)** Seed: color - light reddish brown; most seeds uniform in size and shape (plump) 5 - 9 mm; naked; deep creased Inflorescence **- spike type -** 2-row effect in front and back on zig-zag rachis; many awned lemmas; short awn points on tip of glumes; blades have veins twisted clockwise; leaves thinner and narrower than barley.

Crop Management Competency Area:
Crop Adaptation

2. Describe how crops respond to these factors:	**Soil Fertility** Leibig's Law: Yield depends basically on the growth factor that is available to the plant in the smallest relative amounts. Refinement of law by Mitscherlick: The increase in any crop produced by a unit increment of a deficient factor is proportional to the decrement of that factor from the maximum. Thus, the greatest response to fertilizer comes when fertilizer is applied and levels are low. At high fertility levels a lesser response is achieved with the addition of fertilizer. Excessive rates of nitrogen applied to small grain crops will stimulate excessive tillering, thus increasing disease severity and lodging.

2. Cont'd	**pH** Crops vary in their ability to tolerate an acid (low pH) soil. However, for most crops, the general goal of liming agricultural soils continues to be a soil of pH 6.0 to 7.0. For barley and alfalfa, optimum pH levels are 6.5 to 7.0. The greater the soil acidity the greater the activity or solubility of Al, Fe and Mn. Both of these ions in anything other than very low concentrations are toxic to most plants. Also, at low pH levels, phosphates are rendered less available because of their reaction with Al and Fe compounds. At high pH solubility of P decreases again, making it unavailable for plants. When limestone is first applied to soils below pH 5.0, they appear to take on new life. A temporary surge of plant nutrients is released due to increased mineralization of organic matter caused by an increase in the growth of soil organisms. Also, the availability of soil phosphorus and some micronutrients is improved. **Soil Drainage** Poorly drained soils have poor structure, poor aeration, require more energy to raise the soil temperature and are likely to have nitrogen losses from denitrification. Thus, conditions for crop growth are often poor under poorly drained conditions. Some crops are more adaptable to poorly drained soils than others. In general, legume forages are particularly susceptible to poor drainage.
3. List the recommended soil pH ranges for agronomically important crops	For most crops, the general goal of liming agricultural soils, especially with a legume in the crop rotation, or for maximum herbicide activity, continues to be a soil of pH of 6.5 to 7.0. For most crops, corn, soybeans, wheat, oats the optimum pH is 6.0 to 7.0. For alfalfa and barley the recommended range is 6.5 to 7.0. pH for continuous corn fields should be maintained between 6.2 and 7.0.

4. Describe how extremes of temperature generally affect the growth and development of a crop	Temperature. is one environmental factor that exerts an influence on photosynthesis and thus on growth. If temperature is below a basic minimum, physiological processes (respiration, growth, photosynthesis, etc.) will not occur. Once temperatures are above the basic minimum, physiological processes begin and will increase as temperature increases up to the optimum at which the activity proceeds at the highest rate. Above the optimum temperature, growth rate is reduced and then stops once a maximum temperature has been exceeded. Crops may be divided into those which are tender (killed by frost or low temp) and those which are hardy.)
5. Describe how the water needs of a crop typically change during growth and development	The growth of many plants is proportional to the amounts of water present, for growth is restricted both at very low and very high levels of soil moisture. Water is required by plants for the manufacture of carbohydrates, to maintain hydration of protoplasm, and as a vehicle for the translocation of foods and mineral elements. At rates of low physiological processes (low growth rate) less water is required than at high growth rates. Thus, water needs in early plant development are less than needs at later stages of plant development. Total amount of water used by high yielding crops is only slightly more than that used to produce low yields. Thus, improving cropping methods enables more crop to be produced with a given amount of water.
6. Describe the adaptation of agronomically important crops to extremes of precipitation	Root extension is the main way corn plants survive long periods of inadequate rainfall. Some crops (sorghum) can become dormant and then initiate rapid regrowth following a period of drought. Drought affects photosynthesis by inducing stomatal closure. For most plant species, water stress will reduce translocation and nutrient uptake. Some crops such as soybeans have an indeterminate growth habit and flowering continues over several weeks providing a mechanism to avoid drought. Other crops, such as winter wheat and barley grow during cooler parts of the year and avoid drought. Crops such as corn and alfalfa develop deep root systems that allow them to tolerate short term droughts.

7. Recognize the affects of daylength (photoperiod) and temperature (vernalization) on flowering	Photoperiod is a specific day or night length required to initiate flowering. For example soybeans require a certain length of darkness for flowering to occur. Vernalization is a chilling period needed before the reproductive stage can occur. For example, winter wheat and barley have a vernalization requirement. Before stem extension and heading can occur, plants must be exposed to a period of chilling.
8. Define the term growing degree day (GDD) and describe how it is used in crop production systems	GDD is a daily accumulation of heat for crop growth. Corn hybrid GDD ratings are determined from planting to black layer formation. GDD are calculated for each 24-hour day and accumulated from the time the hybrid is planted until it reaches physiological maturity. $GDD = \frac{\text{Temp Max} + \text{Temp Min}}{2} - 50.$ When Temp Min falls below 50 degrees, 50 is substituted; when Temp Max rises above 86 degrees, 86 is substituted. By knowing GDD for a given site the grower can determine which corn hybrids would reach maturity for that given site. Growing degree days can also be used to predict the development of insect pests by using the respective base temperature for each specific insect pest.

Crop Management Competency Area:

Crop Staging, Growth and Development

9. Use staging systems of corn, soybeans, and small grains to identify stage of growth at any time between emergence and physiological maturity	**Corn (System Developed at Iowa State University)** *Vegetative (V) Stages* VE emergence V1 first leaf (each leaf stage is defined according to the uppermost leaf whose leaf collar is visible) V2 second leaf V3 third leaf V6 6th leaf **Growing point above ground making it susceptible to frost** V(n) nth leaf VT tasseling *Reproductive (R) Stages* R1 silking ** the crop is most susceptible to moisture and heat stress** R2 blister R3 milk R4 dough R5 dent R6 physiological maturity **<u>Soybeans</u> (System Developed at Iowa State University)** *Vegetative (V) Stages* VE - emergence with cotyledons above soil surface. VC - cotyledons fully unfolded, and unifoliate leaves unrolled V1 - first trifoliolate leaf, emerging from the next node above the unifoliate node, is fully developed (unrolled). V5- five trifoliolate leaves fully expanded (unrolled) V(n) - n is the number of fully developed trifoliate leaves *Reproductive (R) Stages* R1 - First bloom - an open flower at any node on the main stem. R2 - Full bloom - an open flower at one of the two uppermost nodes on the main stem with a fully developed leaf. R3 - Beginning pod growth - pod 5mm(3/16") long at one of the four uppermost nodes on the main stem with a fully developed leaf.

9. Cont'd	R4 - Full pod elongation - pod 2cm (3/4") long at one of the four uppermost nodes on the main stem with a fully developed leaf. R5 - Beginning seed growth - seed 3mm (1/8") log in a pod at one of the four uppermost nodes on the main stem with a fully developed leaf. (period of rapid seed development) R6 - Full seed - pod containing green seed that fill the pod cavity at one of the four uppermost nodes on the main stem with a fully developed leaf. R7 - Beginning maturity - seed in one or more pods are physiologically mature. R8 - Full maturity - 95% of pods have reached mature pod color (e.g. tan) **Small grains** *Seedling* – Stage 1: Coleoptile emerges and first leaf emerges through the coleoptile. *Tillering* - Stages 2 and 3: Tillers (shoots) emerge on opposite sides of the plant from buds of the 1st and 2nd leaves. Stages 4 and 5: Leaf sheaths lengthen; main shoot and tillers are short and hidden within the leaf sheaths. *Stem Extension* *Jointing* - Stage 6-8: first node, second node of stem visible, last leaf (flag leaf) just visible *Boot* – Stages 9 and 10 - ligule of last leaf visible, the head swells in the "boot" and then emerges *Heading* - Stage 10.1 - 10.5: flowering *Ripening* - Stage 11
10. Use staging system to identify growth stages of forage legumes	*Vegetative (pre-bud stage)* - Plants have leaves and stems but no flowerbuds. More specific description includes plant height. *Bud stage* - Flowerbuds are present, but not flowers; full bud refers to all plants with at least 1 flowerbud *Bloom (flower) stage* - Plants are flowering 1 st bloomFlowers first appear 1/10 bloom10% of plants have at least 1 flower half bloom50% have at least 1 flower full bloomall plants have at least a flower *Pod stage* - Green seedpods are developed

11. Describe how frequency of harvest is related to forage yield and quality	Grass plants store carbohydrates temporarily in all parts of the plant. For longer-term storage, the stolons, corms, rhizomes and stem bases are the principal storage organs in grasses. Severe defoliation of grasses will remove not only a substantial amount of dry matter, but also much of the carbohydrate reserve material stored in the stem base. Thus, regrowth following severe defoliation is slow and productivity (yield) decreases. If plants are cut just after flowering, the buds which form the regrowth are in a suitable physiological condition to initiate new vegetative growth. (flowering releases apical dominance) If cut before flowering, there is a delay in the initiation of regrowth, while the auxin mechanism is reversed. Then overall production in time is reduced. Most forage crops decline in nutritive value as they mature, and a short delay in harvest can often result in forage with much reduced quality. Thus, harvesting early can increase forage quality. However, cutting too early in order to improve quality often causes a reduction in yield, and continuous early harvests can reduce stand life. As plants mature, crude protein values fall, while crude fiber values rise. (In grasses there is an increase in the stem-to-leaf ration and an increase in structural carbohydrate material as the plant matures. In legumes there is also a decline in the crude protein and digestibility of alfalfa leaves as the plant matures.)
12. Describe how frequency and timing of harvest affects stand longevity, food reserves, and stand persistence	The base of the stem and crown of alfalfa is the source for a large number of dormant buds. The height of cut will consequently determine the number of buds available for regrowth. Height of remaining stubble determines the proportion of the plant's bud left behind after cutting. For high quality forage, cutting early results in greater crude protein and less crude fiber. However, cutting early reduces the amount of carbohydrates stored by the plant. Thus, cutting early and too many times can reduce stand vigor. If the goal is to have a long-lived stand, then a longer cutting interval should be considered. If the crop is being grown under a short rotation (4 yrs or less) then more cuttings to maximize quality may be desired.

13. Describe the locations and functions of meristems used for regrowth in forage legumes and forage grasses	In forage grasses the apical dome (main growing point) and axillary buds initiate growth. The apical and axillary buds remain close to the soil until floral development takes place, at which time the apical dome may be carried up inside the column of leaf sheaths to a greater height. In legumes the growing point is at the top of the stem which is elevated as the stem elongates. The top of the tap root (crown), however, carries a large number of dormant buds. The use of the root as a storage area contrasts with the grasses, in which reserve material is held in stem bases.
14. Relate anatomical features of major crops to developmental stages	**Forage legume crops:** Small-seeded perennial forage species require more care in seedbed preparation and cultivation than larger-seeded row crops. Small seeds require soil contact for moisture uptake and germination. Inoculation with rhizobia bacteria is important for encouraging development of nodules for fixing nitrogen. Legumes develop a fleshy taproot which stores carbohydrates. As the young shoot grows, it becomes sensitive to photoperiod. At a certain day length, floral rather than vegetative buds are produced. The onset of flowering initiates the release of apical dominance, resulting in additional buds on the crown and vegetative growth from buds on lower parts of shoot. **Forage grass crops:** *Tillering* at this stage the apical and axillary buds remain close to the soil surface. Once *Stem Extension* begins the apical dome is carried up into the column of leaf sheaths .During cool weather in early spring, root and tiller growth rates will be at a maximum. This below ground activity decreases as the season advances, reaching a minimum at about the time flowering takes place. With the onset of shorter days and cooler temps in fall, the growth rates for underground organs will again increase. These are organs in which carbohydrates are stored for winter survival. **Corn:** Early in growing season (VE - V4) corn plants increase in weight slowly. As more leaves are exposed to sunlight, the rate of dry matter accumulation gradually increases.The leaves are produced first, followed by the leaf sheaths, stalk, husks, earshank, silks, cob and grain.

14. Cont'd	Cell division in the leaves occurs at the growing point of the stem. Leaves enlarge, become green, and increase in dry weight as they emerge from the whorl and are exposed to light, but no cell division or enlargement occurs after they are exposed. All leaves are full size by V12, but only about half the leaves are exposed to sunlight. By V17 the upper ear shoots may have grown enough that their tips are visible at the top of the leaf sheaths that surround them. The tip of the tassel may also be visible. At V18 brace roots are now growing from the nodes above the soil surface. They help support the plant and scavenge the upper soil layers for water and nutrients during the reproductive stages. R1 begins when any silks are visible outside the husks. Pollination occurs when falling pollen grains are caught by new moist silks. A captured pollen grain takes about 24 hours to grow down silk to the ovule where fertilization occurs and the ovule becomes a kernel. (Generally 2-3 days required for pollination of all silks) Blister R2 (10-14 days after silking), Milk R3 (18-20 days after silking), Dough R4 (24-28 days after silking), Dent R5 (35-42 days after silking), Maturity R6 (55 to 65 days after silking).
15. Recognize relationships between the growth and development of major crops and management factors	**Corn:** Choose regionally adapted hybrid. Choose planting densities to match hybrid's and soil's potential. Use starter fertilizer. Early planting, plant shallower (1 ½ in.). (soil temp. warmer near surface and moisture usually not limited). Late planting, plant deeper if necessary. Ideally, it is suggested that corn and soybean planting starts when soil temperature in the top 2 inches reaches 50 degrees. Generally cold soil restricts root growth and nutrient absorption. To offset slow root growth, starter fertilizer, which contains no more than 60 to 70 pounds of nitrogen plus potash, is placed strategically near seed. The standard placement is 2 inches beside and 2 inches below the seed. If fertilizer is placed directly with the seed, make sure the application rate supplies no more than 10 pounds of total nitrogen plus potash. Sidedress N up to about

15. Cont'd	V8. V10 - R1 moisture and nutrient needs are great. R1, K uptake complete and N and P uptake are rapid; adequate moisture is critical. R2, N and P still accumulating, but relocation from vegetative to reproductive parts begins. R3, stress now can still have profound effect on yield. As kernels mature, stress becomes less an issue. R5, stress will reduce yields by reducing kernel weight, not kernel number. A hard frost will halt dry matter accumulation and cause premature black layer. **Soybeans:** Ideal planting depth is 1 - 1.5 inches. Row width ranges from 7 to 30 inches. As planting date is delayed past mid-May, the yield advantage for narrow rows increases. Thus, row spacing should be less than 15 inches when planting in June. Optimum plant population for full-season soybeans is 150,000 plants per acre. This is increased to 200,000 when planting double-crop in late June and early July. Plant is highly affected by photoperiod and day-night temp. Most varieties have a critical threshold night length requirement for floral initiation and development. A variety with a short night length requirement flowers and matures earlier than varieties with long night length requirements. There are 13 recognized maturity classes: groups 000,00,0 and I through X. Those varieties with the lowest number designation 000 to IV have a shorter night length requirement for flower initiation. Varieties adapted to northern regions will normally be shorter and mature earlier than normal when planted in southern latitudes. Amount of vegetative growth after flowering depends on environment and growth habit which may be determinate, semideterminate or indeterminate. Determinates are grown in south. On determine soybeans, vegetative growth on the main stem stops once the terminal bud becomes a flower. Flowers are borne on both axillary and terminal flower racemes. Indeterminates are grown in north (generally group 4 and lower). They have overlapping vegetative and reproductive growth periods. Flowers are borne in clusters at nodes.

15. Cont'd	**Small grain crops:** In PA winter wheat is sown at 1.5 inches, between middle of Sept. to middle of Oct. Seeding rate is 1.2 to 1.5 million ppa or 90 to 120 lbs/a. (28 - 34 ppsqft). When the seeding date for winter wheat is delayed past the suggested date, the seeding rate should be increased 30%. If fall pasture is desired plant 1 to 2 weeks earlier than normal. Harvest usually early to mid July when moisture is 14% or less. Winter barley is planted a little earlier than wheat. Seeded at same rate as wheat, about 1.5 to 2" deep. Spring oats should be planted between mid-March and mid-April. Same 1.2 to 1.5 million ppa (34 ppsqft). If small grains are harvested for forage they should be cut between boot and head emergence. Up to 15 lbs. N and all P and K may be broadcast prior to planting or a portion can be applied with the drill.

Crop Management Competency Area:
Tillage systems

16. Recognize how environmental and management factors influence the selection of a tillage system	The slope of a field may require a reduced tillage system to prevent erosion. Some farm conservation plans require a certain level of crop residue be maintained on the surface. Reduced tillage systems usually delay spring soil warm-up and drying, especially on less than well drained soils. It also minimizes soil moisture and wind erosion losses, however. Generally no-till or minimum tillage establishment of all crops can be successful on most soils, but this will require additional management, especially with equipment, herbicides and insect control. Reduced tillage usually requiring less labor and may result in more timely crop establishment.
17. Identify the following implements and describe their functions in a tillage system	*Primary tillage* **moldboard plow -** cuts, lifts, shears and turns the furrow slice; it is superior to any other tool for breaking up tough sod and for turning under green-manure crops, heavy straw, cornstalks and other trash. Furrow slice is usually 8". Requires another type of tillage to smooth surface. **chisel plow** - rigid-tined harrows capable of penetrating to plow depth. It loosens and shatters the plow layer. Leaves residue on surface.

	disk-chisel - combination of plow and disk. Under proper conditions it nearly completes seedbed preparation in one step. Leaves residue on surface. **heavy disk** - it cuts, throws and loosens the surface 3 to 6 inches, but packs the lower furrow slice. Leaves residue on surface. *Secondary tillage* (refers to all soil working between plowing, or other primary tillage, and planting) **One-pass tool** - usually a series of tools that will in the end provide a smooth firm surface. Leaves residue on top. **light disk** – loosens soil surface, breaks small clods, incorporates some residue. Leaves residue on surface. **field cultivator** - digs, lifts, and loosens soil; cuts roots below surfaces; leaves residue on surface. **harrows** - mainly used to smooth seedbed and break clods. **culti-packer** - used to pulverize clods and level freshly plowed soil.
18. Describe the timing and sequence of tillage operations in an intensive tillage system	The field is disked or the residues are chopped, it is fall or spring plowed with a moldboard plow, worked with a disk harrow once or twice, and finally harrowed with a spike-tooth harrow.
19. Compare and contrast fall and spring tillage	Fall plowing will usually allow earlier planting than spring plowing. Also, fall plowing is the easiest for managing heavy soils. If you plow when the soil is too wet or too dry, the winter weather will largely correct your mistake. Fall plowing, however, is likely to cause erosion. It is also a disadvantage on dairy farms because the fields are too rough to spread manure on after they freeze. It has the same drawback for farmers who want to spread fertilizer or limestone in the winter.

20. Describe the advantages and limitations of an intensive tillage system	**Advantages**: Soil warms up faster in spring; finer seedbed promotes better seed soil contact; herbicides may be more effective; weed seeds are turned under; mineralization will occur earlier; insects and diseases are easier to control; thoroughly mixed soil may promote deep root formation; can incorporate manure; less perennial weed problems. **Disadvantage**: If drought occurs after seeding, more water may be lost from an uncovered surface than a surface covered with mulch or plants; erosion is a strong possibility; compaction and a hardpan may occur beneath the plow zone; the surface may be susceptible to rapid dealing; water infiltration may be reduced and runoff and erosion may occur; may decrease speed and timeliness of planting; takes a lot of energy; equipment wear and tear.
21. Describe the timing and sequence of tillage operations in a reduced tillage system	The field is worked with one or a combination of tillage tools, leaving residues and a rough surface. Fall or spring tillage may occur.
22. Describe the advantages and limitations of a reduced tillage system	**advantage:** reduces soil and wind erosion; increases speed and timeliness of planting; less soil compaction; better water infiltration; less energy and labor. **disadvantage:** cooler soils at planting; less weed, insect and disease control; roots are encouraged to develop near the surface.
23. Identify the following implements and describe their function in a ridge-till system:	**ridge-till planter:** planter maintains ridge **ridge-till cultivator:** Cultivator digs, lifts, and loosens soil, while it helps to build a ridge by turning a 14" furrow slice on top of a 28-inch ridge top.
24. Describe the timing and sequence of tillage operations in a ridge-till system	Corn is planted two or more years on the same ridge. Plant and then follow with 2 cultivations to form a ridge.

25. Describe the advantages and limitations of a ridge-till system	**Advantages**: fewer trips over field; reduced water runoff and erosion; less drowning of corn in flat areas; furrows between ridges hold water, allowing more of it to soak in; can band herbicide on ridge; ridge warms up faster. **Limitations**: Needs more equipment and time
26. Describe the functions and operation of a no-till planter	This planter uses a fluted coulter mounted directly in front of each planter unit. Its purpose is to leave all residue on the surface. It must be able to cut through residue and provide good seed to soil contact.
27. Describe the timing and sequence of operations in a no-till system	No tillage is done before planting. For best success, existing vegetation should be killed before planting.
28. List the advantages and limitations of a no-till system	Advantages: Soil loss from wind and erosion is reduced or eliminated. Reduced labor as a result of elimination of tillage; water infiltration is better; more water is available to crop. Disadvantages: takes soil longer to warm up; may require slightly more pesticides; can't incorporate manure; requires increased level of management

Crop Management Competency Area:
Hybrid vs. Cultivar and Crop Seed

29. Distinguish between a hybrid and a cultivar	A cultivar is a cultivated variety. The variety may be self-pollinating as in wheat or oats where the cultivar is a pure line of plants that breeds true to type, generation after generation; it may also be a cross-pollinated crop such as alfalfa, orchardgrass or rye where a population or group of plants can be distinguished on some morphological or physiological basis. The term hybrid cultivar is applied to corn, a cross-pollinated crop, and refers to a population developed from a specific combination of inbred lines.
30. List the characteristics used in selecting a hybrid or cultivar	Selection should be based on maturity, yield, standability, disease resistance, and adaptability (vigor, height, protein or oil content, etc.)

31. Recognize how storage time, handling, and storage conditions may affect seed quality	Seed quality is the composite term used to reflect germination, genetic purity and freedom from foreign material, including inert matter, other crops and weeds. handling - physical damage may occur during threshing, conditioning, treating, bagging and transport, resulting in microscopic breaks in the seed coat or injury to the growing points if the impacts are in the embryo region. storage - insects, mites, fungi and rodents can reduce the quality of seeds in storage. In addition, quality is affected by moisture and temperature conditions. On-farm storage of seeds in uncontrolled temperature, humidity and oxygen conditions requires initially dry seeds (approx. 10% moisture content) for long-term storage. However, moisture of seed fluctuates with the relative humidity of the surrounding air. For long-term storage the sum of the percentage RH and the mean temp in Fahrenheit should total 100 or less. Rate of aging is strongly influenced by temperature and humidity during storage and further modified by species, variety, stage of harvest and mechanical damage.
32. Define seed dormancy and hard seed	The failure of seeds to germinate owing to factors associated with their seed coat or embryo is termed seed dormancy. Dormancy is due to the following factors: seed coat impermeable to water; mechanical resistance of embryo to growth (hard seed coat); low permeability of seed coat to gases; endogenous chemical germination inhibitors. Hard seed coats are impermeable to water. Seed dormancy due to hard seed coat may be overcome by removing or puncturing the seed coats or by damaging the seed coats by abrasion

33. Describe seed tests used to determine seed viability (germination) and vigor	**Warm** germination test - Represents the germination potential of seed under ideal conditions. Germination assessed under warm conditions (77 degrees F) for seven days. **Accelerated** aging of seed at high RH (nearly 100%) and high temp (40-45 Celsius) for a few weeks. High vigor seed lots should show less loss in germination than low vigor lots, indicating greater tolerance to adverse conditions. **Cold** germination testing is commonly used to estimate low temp. tolerance of cotton seeds. Seeds are germinated on blotters at a constant 18 Celsius rather than the standard 30 Celsius with germination counts made 6 or 7 days after planting. Tetrazolium chloride tests the internal integrity of the embryo by staining those tissues exhibiting dehydrogenase enzyme activity. Since dead tissues do not stain, staining pattern and intensity of coloration indicate respiration rate. However, the test is usually used as a quick test of viability rather than a test of vigor.
34. Define PLS	Pure, live seed. It is the ratio of the weight of viable seeds of the desirable seed stock to the total weight of the seed stock, which may include nonviable seeds, weeds seeds, and inert material along with the viable seeds.
35. Calculate % PLS values for seedlots when given percentage purity and percentage germination	Alfalfa : Purity = 99%, Germination = 90% %PLS = .99 x .90 = .89
36. Calculate the amount of seed needed for a field when given the seeding rate and the %PLS value of a seedlot	Alfalfa PLS = 89%; seeding rate = 16 lbs recommended; amount seed needed = 16/.89 = 18 lbs.

Crop Management Competency Area:
Seeding Date Factors

37. Describe factors which determine when to seed corn, soybeans, small grains and forages	**Corn**: Normally corn can be safely planted 10 to 14 days before the average date of the last killing frost. Ideally soil temp should be 50 degrees or above and the 5-day extended forecast should indicate continued warm or warmer conditions. .Planting date delays can reduce yields and grain quality. **Soybeans:** "if the soil is dry, don't try". Besides good soil moisture need good seed to soil contact. Planted in spring when soil temp has reached 50-55 degrees. Often planting begins in early May. **Small grains**: Spring Oats - Mid-March to mid-April; Winter Wheat and Barley - Mid-Sept to Late-Oct. **Forages**: small grain forages for pasture - mid-Aug. to early Sept. Alfalfa seedings - prepare in spring as soon as good seedbed can be prepared or early- to mid-August.
38. Recognize consequences of seeding too early or too late	Too early: slower germination and seeds may rot because of cold soil temp. Too late: seeds may germinate unevenly because of poor soil moisture.

Crop Management Competency Area:
Seeding Rates and Pattern Factors

39. List factors that influence the seeding rate of major crops	Seeding machinery Seedbed Planting depth Purity of Live Seed ratio Crop purpose (silage/forage vs. grain) Water availability (irrigated vs. non-irrigated) Yield potential of field Price of seed Time of year

40. List factors that influence the planting pattern of major crops and understand characteristics that make them adapted to high or low density	Leaf area and whether leaves are upright or horizontal. Big tall leafy cultivars (corn) are grown in wider rows than small grains which can be grown in narrower rows. Size of seed, planting and harvest equipment, moisture. **Corn**: Rows are planted from 15 to 40 inches apart, with a range of 30 to 36 inches being most common. Narrower rows are used for silage production and tend to support slightly higher seeding rates. **Soybeans** can be seeded in any row spacing from 7 to 30 inches. Wider rows are generally preferred when diseases are anticipated or where soil crusting may be a problem. **Alfalfa**: branching affects pattern; Pattern may be broadcast or drilled in rows; row spacing is determined by equipment; seeding rates vary according to row spacing. **Small grains**: Tillering influences pattern. Row width is from 6 to 10".
41. List methods to seed small grains and forage crops	grain drills (till and no-till) cultipacker seeder fluid seeder (forage legumes) band seeding broadcast
42. Explain why forage crop establishment is more difficult than the establishment of grain crops	Seeds are smaller. Generally, the smaller the seed the more carefully the seedbed must be prepared. % hard seed higher in legumes. Planter adjustments more critical to small seeds. Usually earlier seeding dates for forage.
43. List recommended seeding rates for major crops	**Corn**: 26,000 to 30,000 plants per acre. Pop. for corn silage may exceed grain by 2,000 to 4,000 ppa. **Soybeans**: 150,000 ppa for full-season and 200,000 ppa for double-crop **Legume**: Alf - 15 - 18 lb; alf mix - 10 lb alf + other; Clovers - 10-12 lbs. **Small grains**: 1.3-1.5 million ppa (30 plants/sqft), increase with delayed seeding.

44. List advantages and disadvantages of seeding pure grass or legume stands vs. mixed stands	**Advantages**: Mgmt. easier for pure; yields of mixtures are usually higher than of either component; legumes supply N to the grasses, so they yield more than grasses grown alone and also have a higher protein content; soil in many fields are quite variable and mixing two may provide better adaptation; the presence of grass reduces the likelihood legumes will be heaved out; mixtures usually resist encroachment of weeds better; grass reduces the danger of bloat; the presence of grass roots results in increased aggregation of soil particles and thus aids in resistance to erosion losses. **Disadvantages**: need to manage cutting and fertility for both cultivars. More soil heaving with pure stand and decreased tonnage if pure.

Crop Management Competency Area:
Seeding Depth Factors

45. List recommended seeding depths for major crops	Normally about 3 times the size of seed **Corn**: 1.5 - 2.5 inches. (Cold and/or moist – shallower; warn and/or dry – deeper) **Soybeans**: 1-1.5 inches **Legume**: no deeper than .5". (small seeded legumes and grasses are generally planted at depths of .25 ") **Small-grain**: 1.5 – 2"
46. Recognize how crops respond to depth of planting	Seed size, seed type, soil type and soil temp all influence planting depth. As a general rule, small seeds are planted at shallower depths than large seeds. The larger seeded crops may be planted at depths of 1-3". Planting at deeper depths usually results in a longer period before germination.
47. Recognize conditions which would cause recommended seeding depth to be altered	Early spring, cool temps, moisture likely - plant shallower Late spring, warmer temps, moisture not sure - plant deeper

Crop Management Competency Area:

Crop Damage, Mortality and Factors Influencing Replanting Decisions

48. Describe the type of damage hail frost, flooding, drought, and wind can cause corn, soybean, small grain and forage crops	hail - shredded leaves, LODGING flood - roots die from anaerobic conditions frost - leaves die from ice forming in cells; WILTED FIRST, WHITE AND BROWN drought - transpiration ceases because of lack of water and plant shuts down; wilting, corn leaves roll and deficiency symptoms. wind - plant leaf damage can occur; torn leaves and lodging.
49. Recognize when major crops are most susceptible to specific environmental stresses	**Corn** is most sensitive to heat and water stress during the 3-5 day period of pollination. Cannot tolerate frost after growing point emerges from soil. Hail damage is most severe at tasseling. **Soybeans** - after emergence leaves very susceptible to hail damage. Also, very warm midsummer temp. (above 90 degrees) reduce yields and lower quality. Sustained below normal temp. (75 degrees) during this same period delays flowering. The minimum temp. for effective growth is 50 degrees. Soybeans can tolerant frost better than corn. **Small grains** - high humidity increases diseases and flood will cause problems anytime wind and rain can cause lodging and increase harvest losses. **Forages** - legume forages tolerate frost well. Flood probably will cause greatest problems.
50. Describe climatic and plant factors which influence a plant's ability to resume growth after being damaged	Length of time plant is stressed and severity of stress; also, type of plant (sorghum tolerates dry conditions better than corn) If a temperature decline is prolonged (lasting several weeks or more) and is coupled with decreasing day length, most perennial plants adapt by hardening. In addition, many perennial crops become dormant.
51. Determine when crop damage would justify replanting	If the crop is a near-failure, the decision to tear up the stand is usually easy. However, if the stand is spotty or about 75%, the decision is more difficult. If the optimum planting date is past, the lower yield per plant must be balanced against the increased yield from more plants. Refer to replant charts.

Crop Management Competency Area:
Cropping Systems

52. Recognize how fallow is used in crop production	Throughout much of semi-arid region of U.S. and Canada, cereal production is based on crop-fallow systems in which the rotation of crop and fallow follows this pattern: • current yr. wheat in early fall • After harvest cultivate to hasten decomposition of crop stubble. • Next spring, do not plant, but cultivate periodically to control weeds and break sod capillary action; this is the fallow period during which precipitation is stored in soil. • Prepare seedbed and plant after full fallow (11 -13 mos. after harvest) • Repeat cycle The system is suppose to enable 1 year's precipitation to be held in reserve for use by the next year's crop.
53. List advantages and limitations of growing cover crops and companion crops in a cropping system	Much erosion can be prevented through the use of a winter conservation cover crop. This crop will also keep nitrogen from leaching out of the soil. Problems however with insects and the tying up of nitrogen are draw backs. Companion crop such as small grain seeded with a legume • assure a usable crop for cash, feed, pasture or silage during the first year • help to reduce soil erosion • help to control weeds • extra forage • holds nutrients, reduces erosion • increases ORGANIC MATTER Disadvantage - the companion crop, however, does compete with the primary crop for moisture, sunlight, and nutrients; small window for establishment; slow soil warmup; more pest problems; careful about allelopathy (must kill rye at right time to plant N-T corn) better to disk after rye.

54. Compare and contrast single crop systems and crop rotations	**Advantages of rotation** • legumes in rotation can utilize atmospheric N and increase the N content of soil • plant disease, insects and weeds can be more easily controlled • land can be kept more continuously in a soil-holding crop, reducing erosion • labor can be better distributed • as result of above factors, greater yields are obtained **Advantages of single crop system** • farmer can be become specialist at growing just one crop • Can tool up with best equipment • there are more periods for spare time • if farm is generally of one soil type can grow the 1 or 2 crops that best fit that type • yields may be higher • Single crop - not as much equipment
55. Describe double cropping	Two crops are grown in the same calendar year. For example, soybeans are grown as a summer crop followed by a winter small grain.

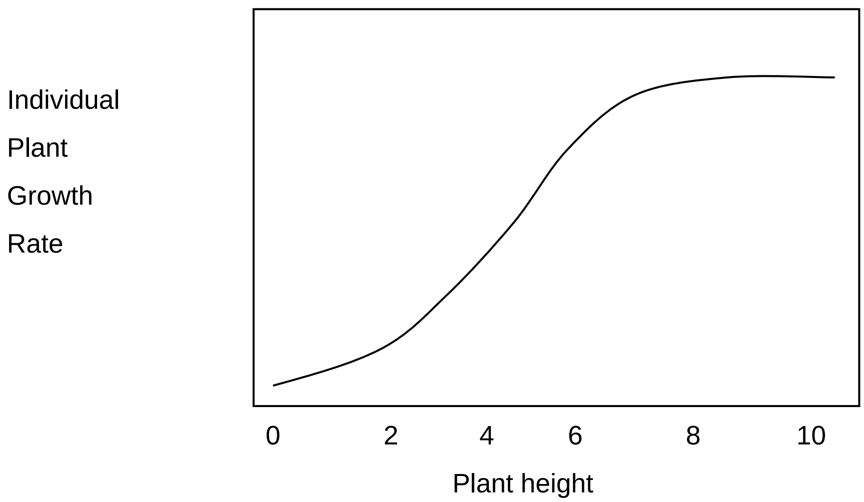
Crop Management Competency Area:
Forage Harvesting Factors - Perennial Crops

56. Describe how frequency of harvest is related to forage yield and quality ***Read more:*** *Agronomy Facts 7 "Cutting Management of Alfalfa, Red Clover, and Birdsfoot Trefoil".*	Plants store carbohydrates temporarily in all parts of the plant. For longer-term storage stolons, corms, rhizomes and stem bases are the principal storage organs in grasses while the root and crown are the principal storage organs in legumes. Severe defoliation of grasses will remove not only a substantial amount of dry matter, but also much of the carbohydrate reserve material stored in the stem base. Thus, regrowth following severe defoliation is slow and productivity (yield) decreases. If plants are cut just after flowering, the buds which form the regrowth are in a suitable physiological condition to initiate new vegetative growth. (flowering releases apical dominance) If cut before flowering, there is a delay in the initiation of regrowth, while the auxin mechanism is reversed. Then overall production in time is reduced.

	Most forage crops decline in nutritive value as they mature, and a short delay in harvest can often result in forage with much reduced quality. Thus, harvesting early can increase forage quality. However, cutting too early in order to improve quality often causes a reduction in yield, and continuous early harvests can reduce stand life. As plants mature, crude protein values fall, while crude fiber values rise. (In grasses there is an increase in the stem-to-leaf ration and an increase in structural carbohydrate material as the plant matures. In legumes there is also a decline in the crude protein and digestibility of alfalfa leaves as the plant matures.)
57. Describe how frequency and timing of harvest affects food reserves and stand longevity ***Read more:*** *Agronomy Facts 7 "Cutting Management of Alfalfa, Red Clover, and Birdsfoot Trefoil".*	The base of the stem and crown of alfalfa is the source for a large number of dormant buds. The height of cut will consequently determine the number of buds available for regrowth. Height of remaining stubble determines the proportion of the plant's bud left behind after cutting. For high quality forage, cutting early results in greater crude protein and less crude fiber. However, cutting early reduces the amount of carbohydrates stored by the plant. Thus, cutting early and too many times can reduce stand vigor. If the goal is to have a long-lived stand, then a longer cutting interval should be considered. If the crop is being grown under a short rotation (4 yrs or less) then more cuttings to maximize quality may be desired.

Crop Management Competency Area:
Pasture Systems

58. Recognize the advantages and disadvantages of forage grass and legume species for pasture	**Grass** Advantages: No bloat Fewer disease & insect problems Tolerate frequent grazing better than legumes Disadvantages: Requires N inputs Less drought tolerant than legumes **Legume** Advantages: Require no N inputs Generally higher quality than grasses Disadvantages: Some species cause bloat
59. List factors that influence the selection of grass and legume species for pastures	Yield Pests resistance Seasonal distribution of yield Adaptation to environmental conditions (soil pH, fertility, and moisture, and extremes in temperature) Persistence
60. Recognize the difference between continuous and rotational grazing **Read more:** *Agronomy Guide: Forage Section*	**Continuous Grazing:** Allowing animals continuous access to a pasture area for extended periods of time (months). **Rotational Grazing:** Allowing animals access to a pasture area for a short time (hours or days) and them moving them (rotating) to another pasture.

61. Describe animal unit ***Read more:*** *Agronomy Guide: Forage Section*	1000 lbs of animal (e.g. 1 x 1000 lb cow or 10 x 100 lb sheep)
62. List the management factors that influence the productivity of continuous and rotational grazed pastures	The greatest management factor that influences productive is plant height. Plant growth rate which ultimately determines yield is greatly reduced when plants are grazed very short (can often occur with continuous grazing) or too tall. 

63. Estimate the area required for pasturing various classes of livestock on pastures with varying productivity ***Read more:*** *Agron Facts 43 "Four Steps to Rotational Grazing"*	**<u>STEP 1</u>** **Determine the number of animal units (AU) that will be in the grazing system.** The first step into rotational grazing is to determine the forage requirements of the herd or flock. Dry matter forage intake varies by animal species and class. The concept of animal units gives a much better measure of pasture required, as compared to using animal numbers. One animal unit is based on the daily forage intake of one 1000 lb dry cow (about 25 pounds of dry forage per day. **<u>STEP 2</u>** **Estimate how many acres will be needed throughout the grazing season.** Estimating the number of acres required to pasture a herd or flock depends not only on the feed requirements of the animals but also on the available forage produced. Pasture growth is dependent upon plant species, soil characteristics. **<u>STEP 3</u>** **Estimate how large each paddock should be.** Paddock size depends on the AU in the herd, the amount of available pasture at the beginning of grazing, and the desired grazing period. Available pasture refers to that present in a paddock at the start of grazing minus the amount present when the animals are removed from the paddock. Typical Pennsylvania pastures, depending on density of plants, have about 300 lb of pasture. **<u>STEP 4</u>** **Estimate number of paddocks needed.** The number of paddocks needed for a rotational grazing system will depend on the number of days the animals graze in a paddock and the maximum summer rest period needed. Rest periods should be based on the growth rate of the pasture and will vary depending on the season and weather conditions