

Pest Management Competency Area:

Basic Pest Management Practices

<p>1. Recognize examples of cultural, chemical, mechanical or physical, and biological pest management. Also identify advantages and disadvantages</p>	<p>Cultural management - crop rotation, optimum soil fertility, variety selection, planting date, narrow row widths, optimum plant population, altering harvest date, using smother or cover crops - anything making the crop more competitive. <u>Advantages:</u> part of routine crop production practices; may be less expensive <u>Disadvantages:</u> often does not adequately manage moderate-to-high pest levels, requires more management.</p>
	<p>Chemical - application of pesticides to control insects, weeds or diseases. <u>Advantages:</u> can be quickly applied to a given site according to need. <u>Disadvantages:</u> may be toxic to humans and other animals, may be harmful to beneficial insects, usually reduce pest populations only temporarily, resistant strains of pests frequently develop, some persist in environment (further endangering many types of organisms), may stunt crop temporarily.</p>
	<p>Mechanical or physical – includes the use of tillage, mowing, hand pulling, excavating, hoeing, etc. These tactics can kill or suppress emerged weeds, reduce successful weed seed production, and help bury weed seed beneath the depth of emergence. <u>Advantages:</u> produces immediate results, can be broad spectrum and very effective and is relatively inexpensive. <u>Disadvantages:</u> Intensive tillage can cause soil erosion and reduce soil quality by the increasing the degradation of soil organic matter. Tillage can increase soil compaction problems and reduce water infiltration, it can require specialized equipment, and increase energy consumption (fuel).</p>
	<p>Biological - the use of other living organisms to manage pests: parasitic wasps, fungal pathogens, lady bird beetles, green lacewing, seed head weevils, weed eating herbivores (goats), etc. <u>Advantages:</u> usually relatively safe, economical, and long-term. <u>Disadvantages:</u> often slow in showing results and lag behind pest outbreaks, high degree of management required.</p>

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<p>2. Recognize economic and environmental factors involved in making a pest management recommendation</p>	<p>Different tactics have different costs associated with them. A number of factors should be considered when making a pest management decision such as benefits and risks, economic thresholds, potential for other pests or problems, etc. For example herbicide products may differ in price considerably. The less expensive product may not control the appropriate weeds or it may potentially injure the crop. Cultivation may appear to be a less expensive tool in some situations, but the potential for soil erosion is an environmental factor that also carries a cost.</p>
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**Pest Management Competency Area:
Management of Weeds**

	<p align="center">Annual grasses</p>
<p>3. Identify the following weeds by common name at any stage of growth, and classify each by life cycle:</p> <p><i>Read more: Weeds of the Northeast, Ova, Neal, and Ditomaso</i></p>	<p>BARNYARDGRASS (Summer annual) A common weed of many crops. It is generally found on moist, rich soils and is common in cultivated areas, ditches, and waste areas. Grows 1 - 4 feet tall. Stems are smooth and flattened at base; leaves green with reddish cast are smooth on both sides but may be slightly rough toward tip; distinctive chicken-foot pattern of seed head. Seedling - first shoot usually reddish; first true leaf smooth and green; seedling leaf sheath distinctly flat; narrow leaf blade, smooth on both surfaces; smooth collar and no ligule or auricles.</p> <p>DOWNY BROME (Winter annual) – A weed of winter grains, forages, roadsides, and waste places. Often found in dry or well drained environments. Grows 1 to 2 feet tall. Leaves are tolled in the bud, lack auricles, and have a membranous ligule that is fringed at the top. Young leaf blades are twisted and appear to be spiraling upward. Blades have soft, short dense hairs on both surfaces. Sheath is rounded. Flowers in May and June and the seed head is a drooping purplish panicle. Cheat and Chess are similar <i>Bromus</i> species.</p>

<p>Identify the following weeds by common name at any stage of growth, and classify each by life cycle (cont.):</p>	<p>FALL PANICUM (Summer annual) – A weed of cultivated agronomic, vegetable, and nursery, and noncrop environments. Grows up to 3 ft. tall. Stem often has a zigzag appearance because it bends at nodes; leaves alternate; roots grow from enlarged nodes that touch the ground; leaf blades are dull on top and glossy underneath; upper surface may be sparsely hairy, but both sides are usually smooth. Seed head is a large freely branched, spreading panicle. Seeding - smooth, erect, slightly oval stem, that is white, pale green, or purplish; leaf blade margins rough to touch; ligule is dense row of short, white hairs fused together for about half their length; auricles absent; smooth swollen nodes.</p>
	<p>GIANT FOXTAIL (Summer annual) - A weed of most cultivated crops as well as turf, landscapes, and nurseries. Grows 3 - 5 ft. tall; nodes are large; stems root at lower nodes; leaves flat, up to 12" long and 1 " wide; upper leaf surface densely covered with short straight hairs; ligule is row of short hairs; no auricle; large fuzzy seed head. Seedling - leaf is slender green shoot; true leaves rolled in the bud and have a pale green midvein on lower surface; sheaths and stems smooth and slightly flattened. Green foxtail - upper margins of leaf sheath are smooth. Yellow foxtail - long hairs only in the collar region and flat sheath.</p>
	<p>SHATTERCANE (Summer annual) – Grows in cultivated areas and is a weed of agronomic crops and corn in particular. Grows up to 12 feet in height. Leaves are rolled in the bud, auricles are absent, and the ligule is membranous and fringed on top. Hairs can be present or absent on sheaths. Shattercane has erect corn-like stems can be purple spotted. Tillers are produced at the crown. The seed head is a large open panicle and the seed are egg-shaped, round to flattened, shiny, and black to red at maturity. Johnsongrass is similar, but is a perennial.</p>
	<p><i>Perennial grasses</i></p>
	<p>JOHNSONGRASS – A weed of cultivated, reduced-till, and perennial crops as well as roadsides and waste areas. grows 7 - 9 ft. tall, forming thick dense patches; legules are membranous with hairy upper edge; unbranched erect stems; panicle seed head is loosely arranged, hairy, purple and forms a pyramid; fibrous root system; leaves alternate Seedling - emerging sheath is maroon and green with over lapping margins. One of 10 most troublesome weeds in world. Roots are allelopathic (rhizomes release chemicals). Shattercane is similar, but is an annual.</p>

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	<p>QUACKGRASS – A weed of agronomic and horticultural crops as well as turf, nurseries, and landscapes. It grows in cultivated fertile soils and is common in reduced-tillage environments. Grows 2 to 5 ft. tall. Cool season perennial grass. Leaves are rolled in the bud; auricles are present and the ligule is membranous and very short. Sheath can be hairy or smooth, but hairs are short. Fibrous roots arise at the nodes of long sharp-tipped rhizomes. The seed head is a long spike.</p>
<p>Identify the following weeds by common name at any stage of growth, and classify each by life cycle (cont):</p>	<p><i>Perennial grass-like plants</i></p>
	<p>YELLOW NUTSEDGE - A weed of most agricultural areas including nurseries and turfgrass. Grows on many soil types including well-drained to sandy soils as well as damp or wet sites. A sedge; grass like; triangular stem; yellow, flat-topped flower cluster called an umbel (an umbrella turned inside out); Reproduces via nutlets (tubers), rhizomes, and seed. Seedling - emerges as pale green seedling; no collar region, ligule or auricle; triangular stem and v-shaped leaf blades. One of 5 worst weeds in world.</p>
	<p><i>Annual broadleaves</i></p>
	<p>COMMON COCKLEBUR (Summer annual) – A weed of cultivated and nursery crops, as well as waste areas. A particularly competitive weed in soybeans. Tap rooted; grows from 8" to 6" high; dull green leaves alternate along stem, are coarsely toothed with leaf stalks about as long as the leaves; distinct burs. Seedling - Stem below seed leaves is stout, purple at base and green on upper portion; seed leaves are thick and tapered to dull point; leaf stalks are short and broad; first true leaves are opposite each other, egg shaped and slightly toothed; subsequent leaves are alternate and distinctly toothed; newly emerging leaves are erect, flat, and densely covered on both sides with hair; stem is covered with stiff short hairs. Male and female flowers form separate clusters on same plant. Seeds and small seedlings are toxic to humans and livestock.</p>
<p>COMMON LAMBSQUARTERS (Summer annual) - A common weed of agricultural crops. Well adapted to disturbed sites and tolerant of most conditions. Common triazine resistant in the Northeast. Grows 1 to 4 ft. in height. Cotyledons are narrow and elliptic, while young leaves are initially opposite and then alternate, lanceolate, and have a gray-mealy coating, especially on the undersides and emerging leaves. Flowers are produced from June to September on spikes grouped into panicles. Seeds are small and numerous (>50,000 plant) and can persist for years in the soil.</p>	

<p>Identify the following weeds by common name at any stage of growth, and classify each by life cycle (cont'd):</p>	<p>GIANT RAGWEED (Summer annual) – A weed of cultivated crops, forest edges, and waste areas. A very competitive weed of soybeans and corn. Stems vary from unbranched to bushy and are usually covered with velvety hairs; mature leaves are large, three-lobed and opposite (common are alternately arranged); flowers are green and inconspicuous. Seedling - true leaves are deeply indented with distinctive ragweed shape; short, whitish hairs cover leaves and stem, hairs being more dense on lower leaf surface. Male and female flowers are in separate flower heads on same plant.</p>
	<p>IVYLEAF MORINGGLORY (Summer annual) – A weed of agronomic, horticultural, nursery crops, as well as landscapes, fence rows, and noncrop areas. Prefers moist nutrient rich soils. Long climbing vine. Butterfly shaped cotyledons and deeply lobed heart-shaped true leaves. Erect hairs on stems and leaves. Flowers from July to September and flowers are petals are pale blue to white and fused into a funnel. Tall morningglory is similar but does not have lobed leaves. Annual morningglories are very competitive and difficult to control in most crops.</p>
	<p>PENNSYLVANIA SMARTWEED (Summer annual) - An important weed of horticultural, agronomic, and nursery crops. It tolerates a range of soil types and conditions but prefers moist areas. Grows 1 to 4 ft. tall. Cotyledons are elliptic to oblong while true leaves are alternate, lanceolate, and tinged purple on both surfaces. A conspicuous membranous sheath (ocrea) surrounds the stem at the base of the leaves. Stems are smooth and reddish purple. The center of both leaf surfaces are sometimes marked with a purple blotch. Flowers are bright pink to white and bloom from July to October. Ladysthumb is similar in appearance.</p>
	<p>REDROOT OR SMOOTH PIGWEED – Common weed of agronomic and horticultural crops, landscapes and nursery crops. Grows on a wide variety of soil types. Grows about 2 - 3 ft tall, but may grow to 6 ft; reddish tap root; erect stem have many branches; lower stems are relatively smooth and upper are very hairy; leaves are alternate; small green flowers. Seedling - narrow seed leaves, pointed with short stalks joined at stem; stem below is smooth, reddish purple and erect; true leaves alternate along stem, are oval with upper surfaces green and lower red; lateral leaf veins. Smooth pigweed is generally less hairy than redroot, but the two are difficult to distinguish from one another.</p>

<p>Identify the following weeds by common name at any stage of growth, and classify each by life cycle (cont'd):</p>	<p>VELVETLEAF (Summer annual) – An important weed in corn and soybean as well as other cultivated crops. Grows 1 to 5 ft high; Generally unbranched, with strong taproot; leaf stalks half as long as leaves; yellow flower; distinctive butterprint seed capsule. Seedling - stem green with purple near soil; seed leaves on both surfaces covered with short hairs, velvety hairs; true leaves heart-shaped and covered with velvety hairs; leaf veins appear as slight depressions on upper surface and as ridges on lower surface; leaf stalks are flattened on upper surface and densely hairy.</p>
	<p>WILD MUSTARD (Winter or summer annual) – Common weed of nursery, horticultural, and agricultural crops, particularly small grains and fall-seeded forage crops. Grows 1 to 3 ft. tall. As seedlings, cotyledons are kidney-shaped or heart shaped. Young leaves are elliptically oblong with wavy-toothed margins. Hairs are present on the leaves and stem. Leaves are alternate. Flowers are produced from May to August in dense clusters of racemes. Flowers have yellow petals and fruit is a silique with a flattened quadrangular conical beak. Seeds are smooth, round, and black to purplish brown.</p>
	<p><i>Biennials</i></p>
	<p>WILD CARROT – A weed of low-maintenance turfgrass, pastures, landscapes, nursery crop, and other perennial crops. Not common in cultivated soils, except under no-till practices. Flower stalks grow 1 - 5 ft tall; flat umbrella shaped heads; biennial - 1st year produces low rosette of delicate leaves; has strong taproot; 2nd year sends up tall flower stalks and more leaves; stalks are hairy, hollow and ridged. Seedling - stem below seed leaves is smooth and pinkish brown; 2 seed leaves are smooth, narrow and long; true leaves are delicate, deeply lobed and fernlike.</p>
	<p><i>Perennial broadleaves</i></p>
<p>CANADA THISTLE – A weed of many crops, but is most troublesome in perennial crops, rangeland, roadsides, and where reduced tillage is practiced. Grows 2 - 5 ft. high; stem gets hairier with age; leaves are alternate and oblong; upper leaf surface dark green and lower is light green and slightly hairy; leaves are stalk less; flowers are flask-shaped, and contain many small tubular flowers; spineless bracts surround each flower head; color white to pale blue to purple (most rose purple). Seedling - seed leaves dull green and thick; first true leaves are thick and covered with short, bristly hairs; margins are wavy and irregular lobed; each lobe ends in a sharp prickle. Male and female heads on separate plants.</p>	

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	<p>HEMP DOGBANE – Frequent weed of reduced and no-till crops, meadows, roadsides, and other agricultural settings. Bushy plant reaching 1 to 5 ft in height. Stems are smooth, erect and red to green; when broken a milky sap is released; leaves are opposite pairs, are slightly pointed at tips with a narrow oval shape; Margins and upper surfaces are smooth; lower may be slightly downy or smooth. Urn-shaped flower consists of 5 greenish white petals. (Milkweed flowers are pink. Also milkweed stems are single stalk, occasionally divided once or twice at top. Young milkweed leaves are downy soft on under surface.) Fertilized flowers develop into pairs of long slender green pods called follicles. Seedling - stem is smooth, green and often red at the base; erect and sturdy; seed leaves are oval and green with a white mid-rib; true leaves are bright green above and pale below; leaf margins are smooth and leaves are thick for their size; short or no leaf stalk.</p>
<p>4. Recognize how each of the following factors may contribute to the success of weeds:</p>	<p>High growth rate - if weeds have a higher growth rate than crop plants, they will grow more quickly, thus compete more vigorously for water, sunlight and nutrients. They will also produce seeds more quickly resulting in seed maturation and dispersal before crop harvest.</p> <p>Early emergence - weeds emerging prior to crop plants may reduce yields more than weeds that emerge later due to increased competition for water and nutrients.</p> <p>High seed production (fecundity) - Many weedy plants are capable of producing high numbers of seed. High numbers of seed help ensure that some of the seed will survive, germinate, and produce new plants.</p> <p>Seed dormancy - weed seeds display dormancy which may allow them to germinate after a long period of time. This ensures germination when conditions are favorable for seedling survival. It tends to regulate germination of seed populations, ensuring a reservoir of ungerminated, but viable, seed for later seasons.</p> <p>Vegetative reproduction - (asexual reproduction) is achieved naturally via adventitious buds (buds occurring anywhere on a plant other than at its apices and leaf axils) on underground stems (rhizomes) and roots, and by bulbs, corms, tubers, and stolons (above ground stems).</p> <p>Allelopathy (biochemical interaction between plants - Some plants can produce allelopathic substances that are toxic to other plants. Quackgrass and johnsongrass are two examples of plants believed to be allelopathic.</p>

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	<p>Shade tolerance - Some weeds can tolerate shade and will compete more successfully with plants less tolerant to shade. Eastern black nightshade is a good example.</p>
	<p>Seed longevity – Many weed seeds can persist for many years under cool moist conditions that are typically found when buried in soil. Weed seeds exposed to the soil surface are less persistent, but can still survive for several years.</p>

**Pest Management Competency Area:
Herbicide Application**

<p>5. Define preplant incorporate, preemergence, and postemergence herbicide applications</p>	<p>Preplant incorporate - applied directly to soil and incorporated with tillage equipment before the crop is planted. Two passes with a field cultivator or finishing disk is generally required. This application kills germinating seedlings.</p>
	<p>Preemergence - applied directly to soil, after the crop and is planted but before the crop or weeds emerge. The herbicide requires rainfall or irrigation to mobilize and distribute it. This application kills germinating seedlings.</p>
	<p>Postemergence - applied after the crop and/or weeds emerge. This application is generally absorbed through the foliage and moved the site of action.</p>
<p>6. Define herbicide persistence</p>	<p>The length of time that an herbicide remains active in soils is called soil persistence or soil residual life. The persistence of an herbicide in soil after its mission is accomplished is referred to as herbicide residue or carryover.</p>
<p>7. Distinguish between contact and translocated type herbicides</p>	<p>Contact herbicides are generally not systemic meaning they do not readily translocate throughout the plant. They are generally absorbed through the roots or foliage and are toxic near the site of absorption (root and/or leaves). Even distribution is important with foliar-applied contact type herbicides. Herbicides that are translocated are often systemic. They are translocated from the site of entry to other parts of the plant where they disrupt one or more physiological processes. They may be translocated via the transpiration stream (root to shoot) and or via photosynthate (symplast) from leaves to root.</p>

<p>8. Recognize how adjuvants affect herbicide performance</p>	<p>Adjuvants are added to the herbicide solution to enhance the primary active ingredient. Common adjuvants for herbicides include surfactants, petroleum-based oils, plant-based oils, and nitrogen fertilizer solutions. Surfactants reduce surface tension and facilitate and enhance the emulsifying, dispersing, wetting, spreading, sticking, penetrating, or other surface-modifying properties of liquids. They are chemicals that produce physical changes at the surface of liquids, and such changes occur at the interface between two liquids or between a liquid and a gas or solid. All have the common feature of a water-soluble group attached to a long, oil-soluble hydrocarbon chain.</p>
<p>9. Recognize the importance of timing in herbicide application</p>	<p>Herbicide application timing is key for effective control. For soil applied herbicides, most herbicides are absorbed by germinating seedlings prior to emergence. They must be present in the soil solution for the seed or developing seedling to absorb the herbicide. Foliar applied herbicides are most active on small seedling annual weeds. As weeds mature, the herbicides are generally less effective. Systemic foliar-applied herbicides are most effective on perennials at the bud to bloom stage or in late summer. This allows the systemic herbicide to translocate to vegetative structures potentially killing the entire plant. Foliar applied herbicides require a rain-free period for absorption by the leaf surface.</p>
<p>10. Recognize relationship between plant vigor and herbicide effectiveness in postemergence applications</p>	<p>Postemergence or foliar applications are made after the weed and/or crop emerges and are applied to the leaves. Weeds should be growing vigorously for contact or systemic herbicides to be effective. Factors such as waxiness of the cuticle and the hairiness of the leaf structure affect foliar retention of herbicides. Weather conditions at the time of application can also be important. Drought and/or cool temperatures will reduce activity. Also, crop plants should be growing vigorously for the plants to tolerate the herbicides.</p>

<p>11. Identify general plant symptoms caused by the following herbicide mode of actions groups</p> <p>Read More:</p> <p><i>Introduction to Weeds and Herbicides, Penn State</i></p>	<p>Photosynthetic inhibitors - This class includes the triazines (atrazine), phenyl ureas (Linuron), uracils (Terbacil), nitriles (Buctril), and bentazon (Basagran). They are used widely for the selective control of annual grass and broadleaved weeds in crops. They are activated by light, causing chlorosis and desiccation of green tissues. They move apoplastically only (transpiration), whether taken in through roots or shoots. When soil applied, triazines are taken up by roots of seedlings and move into emerging foliage. Seedlings broadleaves typically emerge from the soil and grow until they exhaust food stored in the cotyledons. They then become chlorotic, necrotic, and die. Roots are not killed directly, but indirectly due to destruction of shoot growth. The most severe triazine symptoms develop on lower, mature leaves and new growth is least affected. On individual leaves, triazine symptoms tend to be most evident at the leaf tips and margins.</p>
	<p>Cell membrane disruptors - Includes the bipyridyliums (paraquat) which are photosystem I electron diverters, and the protoporphyrinogen oxidase (PPO) inhibitors including the diphenyl ethers (acifluorfen or Blazer and lactofen or Cobra), aryl triazolinones (sulfentrazone or Authority/Spartan and carfentrazone or Aim), and a phenylphthalimide called flumiclorac (Resource). Contact herbicides that are cell membrane disruptors cause plants to wilt, turn brown and desiccate within hours or a day or two.</p>
	<p>Growth regulators - Includes the phenoxy's (2,4-D), benzoic acids (dicamba or Banvel), and pyridines (clopyralid or Stinger). They are auxin-like growth regulators. Effective for controlling numerous annual broadleaves and for suppressing several perennial broadleaves. Symplastically translocated (phoyosynthate). The most obvious effects on susceptible plants are the twisting and downward curvature (epinasty) of the stems and leaves. Although death may not occur for several weeks, curling can be seen within a day after treatment. Tissues undergoing active meristematic activity are particularly susceptible to injury.</p>
	<p>Pigment inhibitors - Pigment inhibitors include the isoxaxolidinones (clomazone or Command) isoxazole (isoxaflutole or Balance) and the triketone called mesotrione (Callisto). Isoxaflutole and mesotrione are also known as HPPD inhibitors. Herbicides that cause the loss of pigments cause leaves and shoots to take on an albino appearance. Tissue present prior to treatment remains green. Death occurs slowly and apparently is due to an exhaustion of food reserves.</p>

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	<p>Grass specifics - These include the cyclohexanediones (sethoxydim or Poast and clethodim or Select) and the aryloxyphenoxypropionates (fluazifop or Fusilade and quizalofop or Assure II). They are also called the Lipid synthesis or ACCase inhibitors. These are herbicides developed for the selective postemergence control of grass weeds in broadleaved crops.</p>
	<p>Root and shoot inhibitors - These include root meristematic inhibitors such as the dinitroanilines (Prowl and Treflan), and general shoot inhibitors such as the chloroacetamides (Dual, Harness, etc.) and the thiocarbamate herbicides (EPTC). They kill susceptible germinating seedlings prior to emergence. They are generally effective on annual grasses and small-seeded broadleaves.</p>
	<p>Amino acid biosynthesis inhibitors - These products inhibit amino acids biosynthesis, which form the building blocks for proteins. This group includes the ALS inhibitors (imidazolinones, sulfonyleureas, and sulfonamides) and the amino acid derivative glyphosate. The ALS inhibitors inhibit the ALS enzyme and include products such as Pursuit, Raptor, Accent, Beacon, and other herbicides used in corn, soybean, alfalfa, and small grains. ALS inhibitors often have both soil and foliar activity depending on the active ingredient. Susceptible plants slowly turn chlorotic to necrotic. Other symptoms can include vein reddening, stunting, and inhibited root growth.</p> <p>Glyphosate inhibits the EPSP enzyme and is nonselective meaning it kills or injures most plants. Glyphosate is foliar applied and does not have any soil activity. Injury symptoms include stunting, chlorosis, and necrosis of plant tissue and symptoms often require several days or weeks to develop.</p>
	<p>Nitrogen metabolism inhibitors – This includes the glutamine synthetase inhibitor glufosinate (Liberty). Glufosinate inhibits the activity of the glutamine synthetase enzyme that is necessary for the plant to convert ammonia into other nitrogen compounds. Ammonia accumulates causing a toxic reaction as well as a deficiency of amino acids required for other metabolic processes. Glufosinate has limited translocation and injury symptoms appear as a foliar burn with several hours after application.</p>

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<p>12. List soil and climatic factors that affect the performance of herbicides</p>	<p>Soil pH - most herbicides work optimally at a near neutral pH. Soil pH can affect the availability and persistence of some herbicides. The triazines are degraded more quickly at low pH and persist longer at soil pH greater than 7.2. The sulfonyleurea herbicides also persist longer at pH greater than 6.8 and are degraded more quickly at lower soil pH (less than 5.5)</p>
	<p>Organic matter - herbicides bind to soil organic matter making them unavailable to the soil solution. Soils higher in soil organic matter often require a higher soil application rates to achieve equivalent weed control.</p>
	<p>Soil fertility - herbicides generally work best in soils with optimum soil fertility. Good plant growth generally ensures herbicide absorption and translocation to the active site. Plant growth that is limited by low or excessive plant nutrients may not be controlled as well.</p>
	<p>Soil texture - Like organic matter, clay content in soil impacts soil applied herbicide availability. Soils higher in clay bind herbicides making them less available to the soil solution. Clays and clay loams often require a higher herbicide rate than soils with lower clay content.</p>
	<p>Temperature, wind, humidity, and precipitation - climate can influence both soil and foliar applied herbicide performance. Herbicides are less active under cool temperature conditions and become more active at higher temperature. Rainfall or irrigation is necessary to mobilize soil applied herbicides. Foliar applied herbicides require 1 to 4 hours without rainfall following application. Foliar applied herbicides are more active under high humidity, which generally improves absorption into the foliage.</p>

Pest Management Competency Area:

Management of Infectious Plant Diseases

<p>13. List the types of disease causing organisms</p>	<p>fungi, bacteria, viruses, and nematodes</p>
<p>14. Describe basic principles of disease development</p>	<p>There may be 4 components to disease development: environmental factors, disease-causing agent (pathogen), vector (insect or other agents necessary to spread disease), and crop plant (host). The most critical environmental factors are air and soil temperature, dew, relative humidity, rainfall, soil type, pH, and fertility.</p>
<p>15. Corn diseases</p> <p>Identify corn diseases by symptoms, study biology of the pathogen and be able to discuss management options.</p> <p>See Appendix 1</p>	<p>Stalk rot – causes deterioration of inner stalk tissue such that one or more of the lower internodes can be easily compressed when squeezed between thumb and fingers. Stalk rot is caused by several different fungi that become active several weeks after silking, when stalk and root tissue are senescing. These fungi survive in the soil in association with organic matter or in crop residue. Management of stalk rots are difficult and the focus should be on minimizing the potential for disease through crop rotation, selection of less susceptible varieties, and control of wound causing insects.</p> <p>Northern corn leaf blight – appears as long, grayish-green elliptical (cigar-shaped) areas on leaf blades. Later, areas become tan, and under humid conditions may turn grayish-black due to spore production of the fungus. Fungi causing this disease survive in crop residue, including leaf and stalk tissue. This disease is managed through crop rotation and hybrid selection. Disease pressure may also be reduced by removal of crop for silage or destruction of crop residues.</p> <p>Gray leaf spot – early symptoms include moderate size yellow- to tan-colored lesions that are limited by leaf veins. Under favorable conditions, the lesions are often brown then gray in color with characteristic rectangular shape. The disease is caused by a residue-borne fungus and is often managed by selecting resistant hybrids, crop rotation, and reducing the amount of crop residue remaining on the soil surface.</p> <p>Stewart's bacterial leaf blight – causes long, thin yellow to white colored lesions on leaf blades. When severe, the lesions may run the entire length of the leaf. As the disease progresses, the lesions appear grayish-brown in color and often have a wavy margin. The disease is caused by a bacterium that is</p>

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	<p>vectored by flea beetles. Disease management includes control of flea beetles through insecticides and selection of less susceptible hybrids. Note that sweet corn is often more susceptible to the disease, possibly resulting in severe blight which may cause wilt symptoms. Stewart's bacterial leaf blight can be distinguished from gray leaf spot by flea beetle presence and wavy margins not limited by leaf veins.</p>
<p>16. Soybean diseases</p> <p>Identify soybean diseases by symptoms, study biology of the pathogen and be able to discuss management options</p> <p><i>See Appendix 1</i></p>	<p>Sclerotinia stem rot (white mold) – symptoms include stems with fluffy white mold growth, possibly causing wilt if lesions girdle the stems. Small black structures called sclerotia are often produced both within and outside the infected tissues. Sclerotia serve as survival structures for this fungus, and may survive in the soil for many years. Management includes crop rotation with small grains, corn, or other grasses. Cultural practices that reduce canopy density and increase air movement, including reduced planting density and increased row spacing, may help reduce the impact of this disease.</p> <p>Septoria brown spot – produces small, irregular shaped brown spots often found on the lower leaves of the canopy. Lesions often have yellow margins, with heavily infected leaves becoming yellow and dropping prematurely. This disease is common in the lower canopy of soybeans in PA, but in most years not thought to result in serious yield loss. Management includes crop rotation and tillage to reduce the amount of residue on the soil surface.</p> <p>Purple seed stain – seeds affected by this disease develop a purple, irregular shaped lesion or blotch. The fungus that causes purple stain is residue-borne. The discoloration of soybeans may result in price reductions when grain is marketed or rejection of food-grade soybeans. The fungus may also impact germination and cause seedling death when infected seed is used to establish a stand of soybeans. Control of this disease includes harvesting the soybeans as soon as possible to reduce disease development and spread.</p> <p>Seedling damping-off – causes young seedlings to fall over because of decay at the soil surface. This disease may be caused by a number of different fungi or fungi-like organisms caused Oomycetes. Damping-off is common when soybeans are planted in cool, wet soils and is best managed with systemic fungicide seed treatments.</p> <p>Soybean cyst nematode – causes irregular patches of stunted and/or yellowed soybeans often following the direction of planting or tillage. This disease is caused by a small round worm known as a nematode. Currently, this nematode is not wide spread in PA but is found in many surrounding states.</p>

<p>16. Cont'd</p>	<p>The nematode feeds on the roots throughout the season and the nematode population reaches peak density late in the season. The female nematodes swell as their bodies fill with eggs, and may be visible if plants are carefully removed from the soil. Soybean cyst nematode management includes crop rotation to non-host crops, appropriate use of resistant varieties, soil sampling to monitor the nematode population, and control of weeds that may also serve as hosts.</p>
<p>17. Wheat diseases</p> <p>Identify wheat diseases by symptoms, study biology of the pathogen and be able to discuss management options</p> <p><i>See Appendix 1</i></p>	<p>Head Scab (Fusarium head blight) – a residue borne fungus that infects wheat and barley causing tan or brown lesions encompassing a single spikelet or a large section of the developing head. Infected grain is often shriveled and white in appearance. The disease is often associated with the mycotoxin DON, and may result in significant reductions in yield and grain quality. Note that a mycotoxin is a toxin produced by a fungus that may cause animals or humans to become sick when contaminated grain is consumed. Wheat is most susceptible to infection during anthesis (flowering) but some infections may also occur during grain filling stages of growth. Management includes crop rotation with broad leaf crops (alfalfa, soybean) and selection of less susceptible varieties. This disease also infects corn causing gibberella stalk and ear rot.</p> <p>Powdery Mildew – appears as small white tufts of mold growth on the surfaces of leaves. This fungus survives as mycelium in association with volunteer wheat or fall seeded crop. The disease can be effectively managed with resistant varieties. Fungicides may also be used but add cost to production.</p> <p>Stagonospora leaf blotch – produces lesions which are chocolate brown to tan and often have a yellow margin. Lesions may expand and merge resulting in a large section of necrotic leaf tissue. The fungus survives in crop residues but may also be seed borne. The disease may also affect the glumes resulting in a disease known as glume blotch. Management includes the selection of cultivars less susceptible to the disease, crop rotation, and tillage to remove crop residue. Seed treatment fungicides can be used to effectively limit seed borne Stagonospora. Leaf and glume blotch can be managed with foliar fungicides if necessary.</p>

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	<p>Barley yellow dwarf virus – symptoms in wheat include yellow and red discoloration of leaf tips. This viral disease of wheat, oats, and barley is common in PA.. When infection occurs early in the growing season, the virus may also result in significant stunting and greatly reduced grain production. The virus is spread by at least four aphid species and may survive in association with volunteer wheat or barley. Management of barley yellow dwarf virus depends on controlling or avoiding virus carrying aphids. Planting winter seeded small grains should occur after the “fly free date” to avoid aphid feeding in seedlings. Seed treatment insecticides may also be used, but economics are often questionable in PA. Many wheat and barley varieties are resistant to barley yellow dwarf virus and can be used to effectively manage the disease.</p>
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<p>18. Alfalfa diseases</p> <p>Identify alfalfa diseases by symptoms, study biology of the pathogen and be able to discuss management options</p> <p>See Appendix 1</p>	<p>Crown Rot – symptoms include a brown discoloration of the crown and root tissue. This disease can be caused by a number of different fungi and several disease causing organisms may be present on the same plant. The fungi survive in association with soil organic matter and often enter the plants through wounds created by insect feeding or mechanical damage that occurs during harvest. The disease is often managed with crop rotation and selection of less susceptible varieties.</p> <p>Spring Black Stem – symptoms include numerous small black spots on leaves, stems, and seed pods. Lesions may enlarge on stems resulting in extensive black discoloration. The fungus that causes black stem survives on alfalfa residues. Disease may result in premature leaf drop and reduced forage quality. Management includes early harvest prior to leaf drop and the use of less susceptible varieties.</p>
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<p>19. Distinguish between systemic and non-systemic fungicides</p>	<p>Systemic fungicides, often termed curatives, have the ability to move into plant tissue and extend the coverage of the fungicide by moving from the point of application toward the leaf tip. Since the fungicide is in the plant tissue, not just on the surface, the intervals between applications can be extended. Systemic fungicides are also important in the control of internal diseases such as stagonospora leaf blotch. Systemic fungicides include Triazoles (Tilt® and Laredo®) and Strobilurins (Quadris® and Headline®). Non-systemic fungicides, also known as protectants, only protect the areas of the plant that are covered by the fungicide.</p>
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Pest Management Competency Area:

Management of Arthropods and Mollusks

<p>20. Recognize complete and gradual metamorphosis</p>	<p>Complete (feed in different places) - 4 life forms are present: egg, larvae, pupa (resting stage) and adult. Gradual (Feed in same place) - 3 basic life forms: egg, nymph and adult. Also called incomplete metamorphosis.</p>
<p>21. Identify following pests and classify each by feeding habits, crops attacked and type of metamorphosis:</p> <p><i>See Appendices 2 – 5</i></p>	<p>grasshopper (chewing) - gradual; corn, soybeans, alfalfa, small grains. Damage appears as irregular chunks consumed from leaf edges.</p> <p>bean leaf beetle larva (chewing) - complete; soybeans; adult beetle chew rounded shot holes out of leaves; larvae girdle stems and feed on root nodules.</p> <p>alfalfa weevil larva and adult (chewing) - complete; alfalfa; in early spring larvae hatch from eggs deposited in plant stems and begin feeding within folded leaves at growing tips. Early damage appears as tiny pinholes. As larvae grow they chew larger holes (skeletonizing plants). Adult is a light brown snout beetle.</p> <p>Aphids (piercing/sucking) - small grains; gradual; injure small grains by sucking plant juices from the leaves, stems or heads. They also serve as vector for barley yellow dwarf, a virus disease. Aphids tend to have both the immature and mature stages feeding on the same host.</p> <p>leafhoppers (piercing/sucking) - gradual; alfalfa; Use piercing-sucking mouthparts to remove plant juices. Most serious damage caused by nymphs. Damage first appears as wedge shaped yellow areas on leaf tips.</p> <p>european corn borer larva (chewing) - complete; corn: first generation tunnel into midrib of leaves, causing leaves to break and then tunnel into stalk, causing breakage. Second generation bore into ear shanks.</p> <p>corn earworm larva (chewing) - complete; corn; chew tip of ear allowing moths to enter.</p> <p>wireworm larva (chewing) - complete; corn; feed on germ of corn seeds, hollowing out seeds.</p> <p>northern/western/southern corn rootworm (chewing) - complete; corn; larva feed on roots; adults feed on silks and leaves. Spotted cucumber beetle and southern corn rootworm are same. On belly SCRW is black, WCRW is green yellow.</p>

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<p>21. Cont'd</p>	<p>black cutworm (chewing) - complete; corn; larva feed on young corn plants, leaving small irregular holes.</p> <p>two-spotted spider mites (piercing/sucking) - soybeans; eight legged arthropods with piercing mouthparts that feed by sucking out plant juices. Feed on underside of leaves.</p>
<p>22. Identify the following beneficial organisms, classify them as a parasite, predator, or pathogen, and be able to discuss their importance in pest population regulation</p> <p><i>See Appendix 6</i></p>	<p>a.spiders b.minute priate bug c.lady-bird beetle d.nabids (Damsel bug) e.stinkbug f.predator mite g.ground beetles h.lacewings i.big-eyed bug j.parasitic wasps (represents several families) k.parasitic flies (represents several families) l.preying mantids m.nematodes n.<i>Bauvaria bassiana</i> o.syrphids</p>
<p>23. Understand the relationship between field characteristics and pest occurrence</p>	<p>Black cutworm moths are attracted by winter annuals such as chickweed.</p>
<p>24. Distinguish between contact insecticides, stomach poisons, and systemic insecticides</p>	<p>Contact insecticides kill insects on contact; systemic requires that the insecticide be absorbed by the plant, making plant poisonous and offering long term protection; stomach poisons work after the insect has injected the insecticide.</p> <p>Furadan is contact and systemic. Most contact are non-polar and slip through skin of insect.</p>

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<p>25. Recognize importance of timing</p>	<p>Timing is important in relation to the pest's life cycle. For example, if first cut alfalfa was heavily infested with alfalfa weevil and the majority of the alfalfa weevil have entered the pupal stage, even though there may still be 1.5 large larvae per alfalfa crown, it would not pay to treat the field, since the remaining larvae will pupate shortly.</p> <p>Timing is also important in relation to the crop stage of growth. For example, if an alfalfa field is in the second cutting, 13 inches tall, and has just exceeded the economic injury threshold for potato leafhopper, the best management strategy would be to cut the field 5 to 7 days earlier than normal if possible.</p>
<p>26. Recognize how the factors of tank, pH, weather, new plant growth, inherent molecule stability and spray coverage affect longevity and effectiveness of an insecticide application</p>	<p>With a pH of 7.5 or higher, pesticides may become inactive -- a buffer must be added to correct problem.</p> <p>Weather - Some insecticides do not work well at low temperatures while others perform OK at low temp. Sunlight may result in photodecomposition</p> <p>New plant growth - most insects prefer new plant growth.</p> <p>Inherent molecule stability - less stable materials may need to apply more often but may be safer for the environment.</p> <p>Spray coverage - contact - need complete coverage; systemic - complete coverage not critical.</p>

Pest Management Competency Area: Pesticide Formulations and Labels

<p>27. Recognize physical characteristics of the following pesticide formulations:</p> <p><i>Read More: Pest Management Section of the Agronomy Guide</i></p>	<p>water soluble liquids - (S or SL) mix completely in water with minimum agitation and once dissolved require no additional agitation. Clear spray solution.</p> <p>water soluble powders - (SP) dry finely divided solids that dissolve completely in water. Considerable agitation may be required but once in suspension remain so. Clear spray solution. May be a breathing hazard.</p> <p>wettable powders - (W or WP) finely ground solids consisting of a dry carrier plus herbicide and dispersing agents. Many can be directly dispersed in water, but usually mix paste first. Continuous or moderate agitation required to keep in suspension. Mixture is milky or opaque.</p>
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<p>27. Cont'd</p>	<p>emulsifiable concentrates - (E or EC) nonpolar (oily) liquids containing emulsifiers. These liquids disperse to form emulsions (droplets of oil surrounded by water). Spray tank emulsions are milky and require some agitation to prevent components from separating. Easy to handle, but may be flammable.</p> <p>water dispersible granules - also called dry flowables and water soluble granules (WDG or DF) Granules made up of finely ground solids combined with suspending and dispersing agents. They disperse without clumping.</p> <p>dusts - ready to use, but not usually economical.</p> <p>pellets - (P) dry formulations of herbicides and other components in discrete particles that usually are larger than 10 mm³. Frequently used for spot applications.</p> <p>granules - (G) dry formulations of herbicides and other components in discrete particles that usually are less than 10 mm³. granule components include clay minerals, dry fertilizers and ground plant residues. Require more rainfall to leach into soils. The safest pesticide formulation when using chemicals near foraging bees.</p>
<p>28. Recognize the types of information found on a label</p>	<ul style="list-style-type: none"> a. Brand name – every manufacturer has a brand or trade name for its products (Sevin 50WP) b. common name – many chemical names are given a common name, only the common names officially accepted by EPA may be used (carbaryl) c. chemical name – the complex name that identifies the chemical components and chemical structure (1- naphthyl N-methyl carbamate) d. active ingredient – the chemical or chemicals in the product that controls the pest e. inert ingredient – has no pesticidal activity, helps the active ingredient do its job f. EPA registration number – indicates the pesticide product has been registered and its label approved by the EPA g. EPA establishment number – identifies the facility that produced the product

<p>28. Cont'd</p>	<p>h. Signal words: DANGER-POISON, skull and cross bones - highly toxic WARNING - moderately toxic CAUTION - slightly toxic DANGER – can cause severe eye damage or skin irritation, tells nothing about toxicity</p> <p>i. Restricted Entry Interval (REI) – how much time must pass between the last application of a pesticide and when workers can reenter a treated area.</p> <p>j. Preharvest interval – the minimum number of days which must pass between the last application of a pesticide and the harvest of the crops</p>
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**Pest Management Competency Area:
Pesticide Application Equipment**

<p>29. Identify and describe the function of the following granular applicator components:</p>	<p>metering opening - regulates flow rotating agitator - prevents materials from jamming or bridging over. drop tubes - place granules on soil surface hopper - holds granules</p>
<p>30. Identify and describe the function of the following sprayer components:</p>	<p>tank - holds spray material agitator - stirs spray material to keep dispersed boom - delivers spray to target area pump - delivers material through system and maintains pressure; drives agitator line strainer - keeps large particles such as rust or grit from clogging system pressure gauge - provides constant pressure readings; estimates rates and duplicates results nozzle - help determine amount of spray delivered, the spray pattern and the distribution of herbicide on the target nozzle screen - keeps large particles such as rust or grit from clogging the nozzle orifice</p>

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31. Describe pattern form, relative droplet size, proper pattern, overlap, and primary uses of the following nozzle types See TeeJet catalogue	nozzle	pattern form	relative droplet size	overlap	primary uses
	standard flat fan	tapers off at edge	med	40 - 50%	broadcast spraying
	even flat fan	retains full vol.	med	none	banding/directed
	full cone	retains full vol.	fine	none	contact pesticides
	hollow cone	uneven	fine		contact pesticides
	flood tip	tapered	coarse	100% overlap	broadcast
32. Describe how to determine nozzle wear	Worn nozzles increase application rates and change distribution patterns. Collect in mason jars to determine if nozzles have same output. If more than 10% variation need to replace.				
33. List physical factors affecting output during granular spraying of pesticides	size of feeder gate opening, ground speed of applicator, speed of hopper agitator, nature and size of granules, roughness of ground, relative humidity, carrier viscosity.				
34. List physical factors affecting output during spraying of pesticides, and define when conditions are favorable for spray drift	Nozzle size, pressure and speed. Spray drift is greatest when spray droplet size is small and wind speed is high.				
35. Describe method to estimate ground speed during pesticide application	set 2 markers in field 88 ft apart (88 is 1/60 of a mile) select gear and throttle setting on tractor. Check time from running start in seconds to drive 88 ft. Divide 60 by the time in seconds. This equals field speed in M.P.H.				
36. Recognize relationship between spray boom ht. and nozzle spacing	Increasing boom height increases area covered and decreases concentration. The lower the boom height, the closer the nozzles need to be.				
37. Describe procedure used to adjust output of a granular applicator or sprayer	Adjust - speed of auger, release, ground speed If you increase pressure and nozzle size and decrease speed, you increase rate of application.				

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<p>38. Use calibration factors of gallons per acre, gallons per minute, width of nozzle spacing, and ground speed to demonstrate how to set up and calibrate a sprayer</p>	<p>Can mix and match. Measure distance, measure nozzle spacing, time distance, turn on at pressure and catch liquid to determine rate.</p>
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Pest Management Competency Area:

Resistance to Pesticides

<p>39. List factors influencing development of resistance to pesticides and define cross resistance</p>	<p>Monculture, using the same pesticide or family of pesticides and pests with multiple generations per year influence resistance. Pests become resistant through natural selection. Cross resistance occurs when a pest population is resistant to one pesticide and to other chemically-related pesticides.</p>
<p>40. List ways to prevent the occurrence of pesticide resistant insects and weeds</p>	<p>Alternate pesticides; rotate crops, use pesticide at recommended rates</p>
<p>41. List ways to manage pesticide resistant insects and weeds once they have occurred</p>	<p>Mow or graze before weeds go to seed; rotate crops, change tillage practices, keep equipment clean; be careful of spreading weed seeds through manure; vary methods of control; keep soil fertility levels high; be timely with practices (some targets have narrow window for control).</p>

Pest Management Competency Area:

Using Pesticides in an Environmentally Sound Way

<p>42. Recognize how movement of a pesticide in soil or into water may be affected by:</p>	<p>soil texture - adsorption will be high if high organic matter or clay content. leaching - solubility influences losses through leaching erosion - pesticides bound to particles are lost through runoff pesticide adsorption - when pesticide is adsorbed by soil it becomes unavailable for uptake by plants and microorganisms pesticide degradation - chemical, microbial and photochemical degradation result in decreased pesticide activity pesticide persistence - described in terms of 1/2 life. Length of time it is active. precipitation runoff - occurs when pesticides bound to soil particles are lost through erosion pesticide solubility - the more soluble the more movement source of entry into the environment - 90% applied as spray to surface of soil. depth of water table - if high, more likely to result in pesticides in water</p>
<p>43. Know which soil property or pesticide characteristic would most likely retard or restrict the movement or leaching of a pesticide</p>	<p>A highly insoluble pesticide A highly absorptive soil</p>
<p>44. Be able to identify conditions that affect pesticide volatilization</p>	<p>High air temperatures and strong winds will help increase pesticide volatilization. Incorporating pesticides will help reduce volatilization.</p>
<p>45. Describe how pesticide degradation is affected by soil moisture and soil temperature</p>	<p>Degradation increases with increasing soil temperature and soil moisture.</p>

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<p>46. Describe the purpose of FIFRA</p>	<p>In order to protect the public health and welfare and to prevent adverse effects on the environment it is essential that pesticides be regulated. The purpose of federal and state pesticide acts is to regulate in the best public interest, the labeling, sale and distribution, storage, transportation, use and application, and disposal of pesticides.</p>
<p>47. Recognize general provisions of FIFRA</p>	<p>EPA can stop the sale or use of any hazardous pesticide. State restrictions on pesticides cannot be more liberal than those of FIFRA The applicator is not permitted to use any pesticide for any use other than that stated on the label. All pesticides are classified according to their potential hazard to humans and the environment. General use – generally lower toxicity, may be purchased by the general public. Restricted use – often quite hazardous to humans and /or the environment and can only be purchased by certified applicator.</p>
<p>48. List penalties for violation of FIFRA provisions</p>	<p>License revoked, fines levied.</p>
<p>49. Know which types of records must be kept by private pesticide applicators in Pennsylvania</p>	<p>Restricted use pesticide applications for three years.</p>
<p>50. Know to whom restricted use pesticides can be sold</p>	<p>Certified commercial, public, or private applicators.</p>
<p>51. Be able to explain the restricted entry interval (REI) associated with the Worker Protection Standard</p>	<p>It is the time immediately after a pesticide application, when entry into the treated area is limited.</p>

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<p>52. List SARA regulations that pertain to pesticide dealers</p>	<p>Dealers must notify PA State Emergency Response Commission and local emergency planning committee that SARA applies to their facility if have more than specified quantity of extremely hazardous substances.</p> <p>Must notify proper authorities if there is an accidental release into environment.</p> <p>Must submit inventory list and copies of MSDS for hazardous substances stored or used in greater than specified amounts.</p> <p>If they have a manufacturing operation must submit annual inventory of toxic chemical releases that have occurred during the year.</p>
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Pest Management Competency Area:

Protecting Humans Against Pesticide Exposure

<p>53. List pesticide modes of entry into the human system</p>	<p>Dermal, inhalation, oral, eyes</p> <p>The most common route of entry into the body is by dermal exposure.</p>
<p>54. Distinguish between chronic and acute poisoning effects</p>	<p>acute - poisoning from a single short term exposure</p> <p>chronic - poisoning from small repeated exposure over long periods of time.</p>
<p>55. Recognize general symptoms of acute poisoning</p>	<p>Dermatitis, headache, flu like symptoms, dizziness, pin-point pupils</p>
<p>56. List possible chronic effects of poisoning</p>	<p>birth defects, blood and nerve disorders, kidney problems</p>

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<p>57. Recognize general procedures to follow if pesticide gets on skin, in eyes, in mouth or stomach, or if inhaled</p>	<p>Follow instructions on label/MSDA; remove clothing, rinse, see physician, call poison control center, give label/MSDS to physician.</p>
<p>58. What is the best source of information concerning level of pesticide toxicity, handling precautions, first aid procedures, and other pesticide safety information?</p>	<p>MSDS</p>
<p>59. Describe protective gear used during mixing and application of pesticides</p>	<p>Read the product label. Each pesticide product has specific requirements for personal protective equipment (PPE). Long-sleeved shirt, long pants or coveralls, gloves, proper footwear, goggles, face shield, and a respirator may be necessary.</p>
<p>60. Describe proper cleanup procedures for PPE and application equipment</p>	<p>Follow instructions on label for cleaning PPE and application equipment. Clothing that has become saturated with a product concentrate should be discarded.</p>
<p>61. Recognize proper ways to dispose of pesticides and containers</p>	<p>Triple rinse containers and apply rinsate to area being treated. Dispose of containers according to label instructions. Return unopened pesticides to dealers if possible. Dispose of at hazardous waste collection facility if you have one. Never reuse pesticide containers for any purpose.</p>

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<p>62. Describe safe storage</p>	<p>a. Always store in original container. Never store pesticides in food containers, soft drink bottles or other non-pesticide containers.</p> <p>b. keep the original label attached to the container.</p> <p>c. keep in locked area</p> <p>d. store out of reach of children</p> <p>e. do not expose to extreme temperatures or dampness</p> <p>f. store dry formulations above liquid formulations</p> <p>g. store pesticides separately from fertilizers and seeds</p> <p>h. check for leaks</p>
<p>63. Recognize procedures to follow when spill occurs</p>	<p>The “Three C” program: Control the spill, Contain it, Clean it up.</p> <p>Wear protective clothing before attempting to control the leak. Immediate steps should be taken to CONTROL the flow of the liquid being spilled. Do not leave the site unattended. Have someone get help. Isolate the area. Keep people at least 30 feet away from the spill. CONTAIN the spill in an area as small as possible. Do not let the spill get into any body of water, including storm sewers. For liquid spills use vermiculite, pet litter, or absorbent pillow/tubes to adsorb the chemical; if granular or dry material, lightly mist with water or cover with plastic. CLEAN up spill and use or dispose of the chemical according to label directions. Any porous contaminated material and equipment used in the cleanup must be handled as hazardous waste and disposed of according to label directions.</p>

**Pest Management Competency Area:
Integrated Pest Management**

<p>64. Understand the philosophy of integrated pest management</p>	<p>IPM is a philosophy that stresses the need to use as many non-pesticide based pest management tactics as possible to keep pest populations below the economic injury level. IPM is defined as the use of multiple pest management tactics to efficiently produce crops, while minimizing the risk of undesirable environmental and health effects. IPM is a systematic approach to crop protection that used as much information as possible to make the best management decision. It promotes field collection of information on the pest and field conditions. It does not advocate the elimination of pesticides, but their use only when all other methods of keeping the pest below economic levels fail.</p>
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<p>65. Understand the relation between the economic injury level, economic threshold, and general equilibrium position of an organism's population</p>	<p>The general equilibrium position of an organism's population is the average population density at which the population fluctuates higher and lower. This GEP is the result of counter acting forces that work to cause populations to increase or decrease. The economic injury level is the number of insects per some unit (density) that causes a dollar loss exactly equal to the cost of controlling the population. It is the break-even point expressed as the number of pests. The economic threshold is the number of the pest that if left uncontrolled will increase to or exceed the economic injury level. The economic threshold is the working value that pest management professional use. It is designed to provide a window (time interval) for pest control actions to be initiated before the pest causes economic damage.</p>
<p>66. List steps in carrying out an IPM program</p>	<p>1) planning, 2) monitoring, 3) identifying the cause of the problem, 4) determining the need for management (use of ET), 5) evaluating management alternatives and selecting a the most appropriate, 6) implementing the pest management alternative of choice, 7) assessing performance of the pest management alternative, 8) maintain records of pest management activities for next season's planning.</p>
<p>67. Understand why it is important to sample pest populations and the need for using an adequate sample size to estimate an organism's population level</p>	<p>Sampling is important to estimate the pest's density (numbers per unit) relative to the economic threshold for decision making. It is important the scout collect enough samples in a field to make a statistically valid estimate of the pest population. If the sample size is too small, a scout can easily make an inappropriate management decision that cost the farmer money. If the sample size is too high, it cost too much to scout.</p>

<p>68. List types of pest monitoring methods and the advantages and disadvantages of each of the following:</p>	<p>Visual counts – The advantage is you have a good estimate of the population in the field. The disadvantage is the time needed in some cases to visually scout fields.</p> <p>Pheromone traps – These traps provide a relative measure of the population and do not provide a measure of what is in a specific field. They primarily tell you when the pest is active but not the intensity of a problem in a field. One advantage is that a pheromone is usually specific to one insect species, so only that species is collected in the trap making identification easy.</p> <p>Black light trap – Same as pheromone trap, but many species are collected so identification can be difficult.</p> <p>Sticky traps- Collect specific pests, but can also collect other species. These method also only provides a relative measure of numbers.</p>
<p>69. Understand the types and significance of plant injury/plant response relationship</p>	<p>There are four basic types of plant injury/plant response to insect feeding: 1) linear, 2) tolerance, 3) undercompensation, 4) overcompensation.</p> <p>Linear – In this relationship each insect pest takes away the same amount of yield as all others.</p> <p>Tolerance – In this relationship the plant can tolerate a few insects before it starts losing yield. Tolerance can occur when the plant is under good environmental conditions, such as good moisture.</p> <p>Undercompensation – In this relationship the first few insects cause most of the yield impact. Additional insects take a smaller and smaller fraction of yield away.</p> <p>Overcompensation – In this relationship, the first few insects cause injury that causes the plant to overcompensate and increase yield. When more and more insects feed, the plant can finally no longer deal with the injury and it starts to lose yield.</p>

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<p>70. List the variables used to calculate the economic injury level (EIL) and understand how the EIL varies when any one variable value changes</p>	<p>The economic injury level is calculated using the following equation for a cost to benefit ratio:</p> $EIL = CC / MV * EY * PLPI * NI * PC, \text{ where}$ <p>CC = control cost (material cost, scouting cost, application cost) MV = market value EY = Expected yield PLPI = proportional loss per insect NI = number of insects (when the cost to benefit ratio is one, solving for this value is the economic injury level) PC = proportional control for technology</p> <p>If a value in the numerator increases, the economic injury level increases. If a value in the denominator is increased, the economic injury level decreases.</p>
<p>71. Understand the term pest status, the types of pest status, and how pest status influences the form of an IPM program</p>	<p>Pest status refers to the frequency that a pest is a pest.</p> <p>There are four major pest statuses: non-pest, occasional, perennial, and severe.</p> <p>A pest is categorized as a non-pest if its population fluctuations never exceed the economic threshold.</p> <p>A pest is categorized as occasional if one in five to ten years it reaches pest levels in a given field.</p> <p>A pest is categorized as perennial if it exceeds the economic injury level once every one to three years.</p> <p>A severe pest is one that exceeds the economic injury level every year in every field.</p>
<p>72. Understand the limitations and strengths of the integrated pest management approach</p>	<p>Strengthens – provides sound information to make informed decisions. This helps assure protection of the environment and health (human or wildlife and livestock).</p> <p>Weakness – Can require a lot of time and cost to collect the information needed for informed decision making when time is limited.</p>