Resource Unit

On

WEEDS

For

Core Curriculum

Resource Unit Number Eight

Agricultural Education Section
Department of Vocational Education
Phoenix

and

Department of Agricultural Education
The University of Arizona, Tucson

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AREA: PLANT SCIENCE

Unit: Weeds

Concepts to be Taught:

1. A weed is any plant growing out of place.

2. Weeds cause economic losses due to decreased yield, lowered quality of product and increased production costs.

3. Weeds are classified according to their growth habits.

4. Weeds are disseminated in the form of seed and/or vegetative parts.

5. Good management in the form of cultural practices is essential in the prevention and control of weeds.

6. Weed identification is essential to effective control.

7. There are recommended herbicides for the control of specific kinds of weeds.
Unit Objectives

1. To identify how weeds cause economic losses.
2. To list the economic uses of weeds.
3. To identify and describe the methods of classification of weeds based upon growth characteristics.
4. To classify common weeds relative to life cycle, type of leaf, growth habits, and method of propagation.
5. To list and describe the methods of dissemination of weeds.
6. To list and describe the cultural practices used for controlling weeds.
7. To describe the biological practices used for controlling weeds.
8. To list and describe the types of herbicide used in weed control.
9. To classify herbicides according to chemical structure.
10. To describe the approved method of applying herbicides.

References


Teaching Aids

1. Slide series on Weeds of Arizona (Color Classics of Tucson)
2. Transparencies (U. of A. and Nasco)
3. Plant mounts
4. Film - "No Room for Weeds" (Supervisor of Agricultural Development, Union Pacific Railroad, Omaha, Nebraska, 68102)
5.
6.
Student Activities

1. Have students prepare plant mounts of local weeds.
2. On a field trip, identify common weeds growing in the community.
3. Collect weed seed and place in sample bottles.
4. Have students bring in various live specimens for identification.
5. Have students bring in specimens of weeds for comparing growth types.
Questions and Problems for Discussion

1. How do weeds cause economic losses in agriculture?
   a. Reduction in crop yield
   b. Reduction in quality of agricultural products
   c. Reduction of land values
   d. Harbor insect pests and diseases
   e. Impair health of humans and animals
   f. Increase production costs

2. How do weeds reduce crop yields?
   Weeds cause a reduction in crop yields by the removal of moisture and nutrients needed by crop plants and also by competing for the available light. The water requirements of most weeds equal or exceed the water requirements of most commonly grown crops while the nutrient needs are about equal. The shading of crop plants by weeds results in stunted and unhealthy plants.

3. How do weeds reduce quality of agricultural products?
   Weeds reduce the quality of agricultural products by their presence in the harvested crop. Debris (trash) from weeds becomes entangled in fiber crops and tend to stain the crop. Weeds in forage crops lower the feeding value and palatability of the forage. Also, the presence of weed seed greatly reduces the quality and value of crop seed which is to be used for planting. It is interesting to note that with only 2 percent weed seed in a bag, two pounds of weed seed are spread every time a 100 pound bag of crop seed is planted.

   The price of wool is reduced by the presence of burs and awns. Odors in milk are caused by some weeds and may cause its rejection as a marketable product.

4. How do weeds reduce land value?
   Weeds reduce land value by their presence. The real deduction in value is due to noxious weed infestations which are harder to kill than the nuisance weeds. Thus, the cost of controlling the noxious weed is a factor involved in deciding whether or not to buy a parcel of land which is infested with weeds.

5. How do weeds cause economic losses by harboring insects and diseases?
   Many weeds serve as intermediate hosts for numerous insects and diseases. Also, many disease spores and insects overwinter in weed trash.
Insects and pathogens which are often harbored by weeds cause excessive amounts of damage to crop plants each year. The weeds provide a place for the insect or pathogen to reproduce and thus increase in numbers to a point where they become detrimental to the local cultivated crops.

Although insects are controlled in a cultivated crop, weeds on ditchbanks often serve as a constant source of infestation of new insects. Also, pathogens may be spread from their alternate hosts (weeds) to the crop being grown by wind, water, and/or insects.

6. How do weeds impair the health of humans and animals?

Some weeds impair the health of humans and animals by being poisonous or by producing pollen to which humans are allergic.

Poisonous weeds can cause serious gastric disturbances and sometimes death in animals as is the case with halogegeton.

7. How do weeds increase production costs?

Weeds increase production costs through the cost of control. The primary reason for cultivating row crops is to control weeds. Special cultivators, sprayers, and burners are needed to control weeds and these machines must be purchased by the farmer.

Seed used for planting usually have to go through a cleaning process to eliminate weed seed, thus increasing the price of the seed.

Also labor must be hired to operate the weed control equipment and space must be provided to store the equipment.

8. What is the dollar loss due to weeds annually in the United States?

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<tbody>
<tr>
<td>Crop losses</td>
<td>$2,459,000,000</td>
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<tr>
<td>Cost of control</td>
<td>2,551,000,000</td>
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<td>$5,010,000,000</td>
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</table>

9. What are some of the economic uses of weeds?

a. Add organic matter to soil
b. Prevent erosion
c. Provide livestock forage
d. Source of wildlife feed
e. Food for man (dandelions)
f. Medicinal properties (plantago)
g. Improve soil tilth
10. What is a weed?

A weed is a plant growing where it is not desired. For example, Bermuda grass is a weed in a cotton field and corn would be considered as a weed if it was growing in a field of oats.

11. Relative to growth characteristics, how are weeds classified?

Relative to growth characteristics, weeds are classified as to (a) life cycle, (b) type of growth, and (c) type of propagation.

a. Life cycle

The life cycle of a weed is the history of its development from germination to a mature plant that produces seed and then finally dies.

b. Type of growth

The type of growth refers (1) to whether the plant produces broad or narrow leaves and (2) to its growth habits such as standing erect, lying prostrate, becoming bushy, or developing as a vine.

c. Type of propagation

The type of propagation is based on whether the plant is reproduced sexually or asexually. Sexual propagation is accomplished with seed whereas asexual propagation usually utilizes the vegetative parts of the plant.

12. Why is a knowledge of the classification of weeds important?

The first step in effective control of weeds is the identification of weeds and their growth characteristics.

Annuals are controlled primarily by preventing the production of seed while perennials are controlled by preventing the production of seed and also by destroying below ground vegetative parts. For effective control of perennials, the below ground parts may be depleted of their stored food so that no further growth will take place.

Narrow and broadleaf weeds provide a basis by which selective herbicides may be used to kill only one type of weed while leaving the cultivated crop unharmed.

The type of growth is also important. Prostrate weeds are harder to kill because they are so close to the ground while erect weeds can often be killed simply by mowing as is the case with sunflower. However, erect perennial weeds such as Johnsongrass, require repeated mowings to deplete the underground food supply of the perennial.
13. How are weeds classified as to life cycle?

Relative to life cycles, weeds are classified as annual, biennial, and perennial.

a. Annual

Annual plants complete their life cycle in one year or less. Annuals are normally easy to control, but they are very persistent due to their fast growth and abundant production of seed. Obviously, all methods of controlling annuals have one principal purpose -- the prevention of the seeding. Most common field weeds are in this group.

Annuals are further classified into two types: (1) Summer annuals, and (2) Winter annuals.

1) Summer annuals

Seed of summer annuals germinate in the spring, make most of their growth during the summer, produce seed, and usually mature and die in the fall. Seed produced by summer annuals lie dormant in the soil until the following spring. Then they begin another life cycle. Cocklebur, morning glory, and carelessweed are examples of this group.

2) Winter annuals

Seed of winter annuals germinate in the fall and winter, and usually mature seed in the spring or early summer before dying. London rocket, sour clover, and wild oat are examples.

b. Biennial

Biennial weeds have a life span of 2 years. The first year's growth is mainly vegetative which results in the storage of food in the roots for the next year's growth; while seed is produced during the second year. Examples of biennial weeds are bull thistle and mullein.

There is some confusion between the biennials and the winter annuals. This is because the winter annuals normally live during 2 calendar years and during at least 2 seasons, but they do not live for 2 complete years.

c. Perennial

Perennials live more than 2 years. Perennial weeds are more difficult to control because they reproduce by seed as well as vegetatively. Seed is usually produced each year.
14. How are weeds classified as to type of growth?

Relative to type of growth, weeds are classified as (a) narrow-leaf and broadleaf and (b) prostrate, erect, bushy, and vines.

a. Narrowleaf vs. broadleaf

Narrowleaf weeds have parallel veined leaves which are usually held vertically. The outer floral parts are scale-like; inner floral parts are in multiples of three. Also called grassy weeds, they are susceptible to dalapon, but resistant to 2,4-D. Examples of narrowleaf weeds are Johnsongrass, wild oat, and barnyardgrass.

Broadleaf weeds usually have wide leaves which are held horizontally. Floral parts are in multiples of 2, 4, or 5 and often conspicuous and colored. Broadleaf weeds are usually susceptible to 2,4-D. Carelessweed, groundcherry, and London rocket are examples of broadleaf weeds.

b. Prostrate, erect, bushy, or vines

Prostrate plants grow quite close to the ground and have the habit of spreading out horizontally. Examples of prostrate weeds are bur clover, crabgrass, horse purslane, and puncturevine.

Many weeds grow erect, sometimes to a height of 3 or 4 feet. Examples of erect narrowleaf weeds are barnyardgrass, Johnsongrass, and sprangletop. Broadleaf weeds such as curly dock, prickly lettuce, shepherdspurse, and sour clover also grow erect.

Some weeds grow tall while forming many side branches, giving the weed a bushy appearance as is the case with carelessweed, cocklebur, sunflower, and Russian thistle.

The fourth type of growth exhibited by weeds is that of vines. Field bindweed, morningglory, and dodder are examples of vine-type weeds.

15. How are weeds classified as to type of propagation?

Relative to types of propagation, weeds are classified as seed propagators (sexual) and vegetative propagators (asexual).

a. Seed

Most weeds reproduce by seed. All annuals and biennials reproduce by seed. Also both the simple perennials and creeping perennials reproduce by seed.

b. Vegetative

Perennials reproduce vegetatively as well as by seed. They reproduce by roots, stolons (aboveground stems), and rhizomes (belowground
Plants that reproduce vegetatively are harder to control. If any part of the plant remains alive, there is the possibility of regrowth and spreading of the weed. Examples are Johnsongrass and Bermudagrass. Nutsedge leaves small tubers (nuts) in the ground which later develop into new plants.

16. What are parasitic weeds?

Parasitic weeds, such as dodder, are weeds which live off of other plants. The weed seed germinates in the soil and the plant forms a temporary root-like system. When a host plant is found, the parasitic weed will send out haustoria (food absorbing cells) into the stem or leaf of the host plant. If a host plant is unavailable, the parasitic weed will die when its stored food reserve is depleted.

17. How do individual weeds compare as to life cycle, type of leaves, growth habit, and method of propagation?

<table>
<thead>
<tr>
<th>Weed</th>
<th>Life Cycle</th>
<th>Leaf</th>
<th>Growth</th>
<th>Propagation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barnyardgrass</td>
<td>Annual (S)*</td>
<td>Narrow</td>
<td>Erect</td>
<td>Seed</td>
</tr>
<tr>
<td>Bermudagrass</td>
<td>Perennial</td>
<td>Narrow</td>
<td>Prostrate</td>
<td>Seed, rhizome runner</td>
</tr>
<tr>
<td>Bur clover</td>
<td>Annual (W)</td>
<td>Broad</td>
<td>Prostrate</td>
<td>Seed</td>
</tr>
<tr>
<td>Carelessweed</td>
<td>Annual (S)</td>
<td>Broad</td>
<td>Erect</td>
<td>Seed</td>
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<tr>
<td>Cheeseweed</td>
<td>Annual (W)</td>
<td>Broad</td>
<td>Bushy</td>
<td>Seed</td>
</tr>
<tr>
<td>Cocklebur</td>
<td>Annual (S)</td>
<td>Broad</td>
<td>Bushy</td>
<td>Seed</td>
</tr>
<tr>
<td>Common sunflower</td>
<td>Annual (S)</td>
<td>Broad</td>
<td>Bushy</td>
<td>Seed</td>
</tr>
<tr>
<td>Crabgrass</td>
<td>Annual (S)</td>
<td>Narrow</td>
<td>Prostrate</td>
<td>Seed, stems rooting at joints</td>
</tr>
<tr>
<td>Curly dock</td>
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<td>Broad</td>
<td>Erect</td>
<td>Seed</td>
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<tr>
<td>Dodder</td>
<td>Annual (S)</td>
<td>-</td>
<td>Vine</td>
<td>Seed</td>
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<td>Field bindweed</td>
<td>Perennial</td>
<td>Broad</td>
<td>Prostrate</td>
<td>Seed, underground stems</td>
</tr>
<tr>
<td>Green foxtail</td>
<td>Annual (S)</td>
<td>Narrow</td>
<td>Erect</td>
<td>Seed</td>
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<td>Horseweed</td>
<td>Annual (S)</td>
<td>Broad</td>
<td>Erect</td>
<td>Seed</td>
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<td>Horse purslane</td>
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<td>Prostrate</td>
<td>Seed</td>
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<tr>
<td>Hyssop spurge</td>
<td>Annual (S)</td>
<td>Broad</td>
<td>Erect</td>
<td>Seed</td>
</tr>
<tr>
<td>Johnsongrass</td>
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<td>Prostrate</td>
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<td>Knotweed</td>
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<td>Broad</td>
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<td>Seed</td>
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<td>Lambquarter</td>
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<td>London rocket</td>
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<td>Broad</td>
<td>Bushy</td>
<td>Seed</td>
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<td>Morningglory</td>
<td>Annual (S)</td>
<td>Broad</td>
<td>Vine</td>
<td>Seed</td>
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<tr>
<td>Nettleleaf goosefoot</td>
<td>Annual (W)</td>
<td>Broad</td>
<td>Bushy</td>
<td>Seed</td>
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<tr>
<td>Nutsedge</td>
<td>Perennial</td>
<td>Narrow</td>
<td>Erect</td>
<td>Seed, tuber</td>
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<tr>
<td>Prickly lettuce</td>
<td>Annual (W)</td>
<td>Broad</td>
<td>Erect</td>
<td>Seed</td>
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<tr>
<td>Prostrate spurge</td>
<td>Annual (S)</td>
<td>Broad</td>
<td>Prostrate</td>
<td>Seed</td>
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<tr>
<td>Puncturevine</td>
<td>Annual (S)</td>
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<td>Prostrate</td>
<td>Seed</td>
</tr>
<tr>
<td>Purslane</td>
<td>Annual (S)</td>
<td>Broad</td>
<td>Prostrate</td>
<td>Seed</td>
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<tr>
<td>Russian thistle</td>
<td>Annual (S)</td>
<td>Broad</td>
<td>Bushy</td>
<td>Seed</td>
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<tr>
<td>Sandbur</td>
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<td>Erect</td>
<td>Seed</td>
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<tr>
<td>Plant</td>
<td>Life Cycle</td>
<td>Habit</td>
<td>Seed Characteristics</td>
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<td>Shepherdspurse</td>
<td>Annual (W)</td>
<td>Broad Erect</td>
<td>Seed</td>
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<tr>
<td>Silversheath knotweed</td>
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<td>Broad Erect</td>
<td>Seed</td>
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<td>Sour clover</td>
<td>Annual (W)</td>
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<td>Seed</td>
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<tr>
<td>Spiny sovthistle</td>
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<td>Broad Bushy</td>
<td>Seed</td>
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<td>Spangletop</td>
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<td>Seed</td>
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<tr>
<td>Tansy mustard</td>
<td>Annual (W)</td>
<td>Broad Bushy</td>
<td>Seed</td>
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<td>Watergrass</td>
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<tr>
<td>White horsenettle</td>
<td>Perennial</td>
<td>Broad Bushy</td>
<td>Seed, underground stems</td>
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<tr>
<td>Wild oat</td>
<td>Annual (W)</td>
<td>Narrow Erect</td>
<td>Seed</td>
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<tr>
<td>Wrights groundcherry</td>
<td>Annual (S)</td>
<td>Broad Bushy</td>
<td>Seed</td>
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* (S) - Summer
(W) - Winter

18. **How are weed seed disseminated?**

Weed seed is disseminated by wind and water, crop seed, machinery, and man and animals.

a. Wind and water

Some seed is equipped with devices which aid in their distribution by wind. The dandelion, wild lettuce, thistles, and milkweed have tufts attached to the seed which help them stay airborne. Russian thistles (tumbleweed) are rolled along the ground by the wind to disseminate the seed. Other seed is so light that the slightest gust of wind will move them.

Other seed is carried by water in surface runoff, natural streams, drainage canals, and irrigation canals. Some of these seed have specially adapted seed coats which allow them to float in water. Examples of weeds disseminated by water are smartweed and curly dock.

b. Crop seed

About 75 per cent of the most harmful weeds in the United States were imported in crop seed from foreign countries. By this same method, weed seed have been scattered widely throughout the United States. Today, most states require that seed for sale be labeled to show such information as kind, purity, weed-seed content, and germination. Crop seed which contain seed of noxious weeds cannot be sold in most states. Noxious weeds are those weeds declared illegal.

c. Machinery

Crop harvesting equipment which is used on several farms may carry weed seed from farm to farm unless these machines are cleaned carefully before leaving each farm. Other machinery also carries weed seed from place to place when they become stuck to the tires or other parts.
Cultivation equipment often disseminates weeds by carrying vegetative parts of weeds from field to field.

d. Man and animals

Man and animals carry weed seed from place to place when they become attached to man's clothing or an animal's hair, wool, or fur. Seed of weeds such as puncturevine, sandbur, bur clover, and cocklebur are enclosed in coverings which have spines or hooks to aid in their dissemination by this means.

Also the seed of many weeds are passed through the digestive tracts of animals and are found in a viable condition in the droppings. When the droppings are moved to another area, there is a ready source of weed infestation.

19. In what other ways have weed seed adapted to ensure the survival of their species?

Most species of weeds produce vast amounts of seed that are scattered easily by the methods mentioned in the previous question. Some tumbleweeds have as many as 24,000 seed in each mature plant; and a single lambsquarter plant may produce up to 72,000 seed in one season.

Also not all the seed from a plant will sprout the first year. Some will remain dormant for years before they begin growing. This means that each year some of the seed will continue to sprout from weed seed disseminated in previous years, even though every weed in this year's crop was killed before the production of seed.

20. What methods are used for controlling weeds?

   a. Cultural control
   b. Biological control
   c. Chemical control

21. Why is the identification of weeds important in planning a control program?

   Weed control treatments vary in their ability to control different species of weeds; therefore a weed must be identified before an effective control measure can be selected. Cultural control, biological control, chemical control, or a combination of control methods can be selected after the weed is identified.

   Herbicides are available that are capable of killing most species of weeds. For example, 2,4-D is very effective, when properly used, against many species of broadleaf annuals, biennials, and perennials; however it is ineffective against some broadleaf within these groups, and is totally ineffective against a narrowleaf weed such as Johnson-grass. Consequently, it is absolutely necessary that the weed or weeds be identified before an effective herbicide can be selected for control of the weed(s).
22. How are weeds controlled by cultural practices?

Cultural practices involved in the control of weeds include the use of weed-free seed, crop rotation, cultivation, mowing, mulching, burning, and use of competitive crops. Good cultural practices are essential in the prevention of weed infestations and also in controlling weeds.

a. Weed-free seed

All seed purchased for use in planting should come from reliable sources and carry labels which show freedom from seed of any serious weeds.

b. Crop rotation

Rotation of crops is an efficient way of reducing weed infestations. Some species of weeds are more prevalent in some crops than in others. Usually a good rotation for weed control includes both (a) summer row crops, and (b) winter or early spring grain crops, plus strong competitive crops grown in each part of the rotation.

c. Cultivation

Cultivation involves the use of tillage tools that physically lift weeds from the soil, cut them off, or bury them. These tools include hoes, cultivators, discs, plows, etc.

Tillage operations are effective on most small annual weeds, providing all growing points of the weed are buried or the root system is disturbed. However, burial is only partly effective against weeds with underground stems and roots that are capable of sprouting (Bermudagrass, Johnsongrass, nutsedge). To control such perennials, they must be repeatedly cut-off or buried until the underground parts are killed.

d. Mowing

Mowing is effective in controlling many tall-growing annual weeds; however this practice is not effective against prostrate weeds. Tall annual weeds are mowed primarily to prevent them from producing seed, and to reduce their competition with desirable plants. Repeated mowings may starve underground parts. Tall perennial weeds, to be controlled, must be moved repeatedly for a period of 1 to 3 years and often enough to prevent them from replenishing their stored food supply in underground rhizomes. The best time to start mowing weeds of this type is when their underground root reserves are low. For most species this is in the late spring between full leaf development and first flower appearance.
e. Mulching

Straw, plastics, and other mulching materials are effective in controlling weeds. However, the use of these materials are usually economical primarily in mulching truck crops, home gardens, shrubbery, and flowers.

f. Burning

Flame cultivators are used for destroying weeds in certain crops such as cotton. By proper control of the flames, many of the small weeds are killed without injuring the larger plants of the cultivated crop being treated.

g. Competitive crops

Competition makes use of an old law of nature - survival of the fittest. It means using the best crop production methods - those so favorable to the crop to be grown that weeds are crowded out. Planting crops sufficiently thick to provide strong competition and shading are methods utilized to make crops compete with weeds.

23. How are weeds controlled by biological practices?

Biological control of weeds utilizes the introduction of animals, insects or diseases which reduce weed populations.

The closest approach to biological weed control in Arizona crops is the use of cattle and sheep to graze grassy weeds along ditch banks. In California geese are used to control weeds in cotton and other crops.

24. What is chemical control of weeds?

Chemical control of weeds is the use of herbicides to kill weeds.

25. What is a herbicide?

A herbicide is any chemical that will kill weeds.

26. How are herbicides classified?

Herbicides are classified in two ways: (a) according to type, or the way they kill (contact herbicides, translocated herbicides, and soil sterilants); and (b) according to their chemical structure.

27. How do contact herbicides, translocated herbicides, and soil sterilants work?

a. Contact herbicides

These chemicals kill primarily by contact with plant parts rather than as a result of being translocated within the plant and upsetting
the plant's growth processes. Contact herbicides directly affect only that portion of the plant they contact. Contact herbicides are effective for control of young seedlings of annuals. These plants die soon after coming in contact with the chemical due to disruption of the physiological processes of the plant. Perennials, however, usually recover from uninjured belowground parts; therefore, repeat treatments over long periods of time are required to eliminate these weeds.

Contact herbicides may be (1) selective, or (2) non-selective, in their method of kill:

1) Selective

Those contact herbicides that selectively kill or stunt either broadleaf weeds, or grasses, but not both. They have more toxic action on some species than others. An example of a way in which a contact selective herbicide is used is that of using dinoseb in legumes to kill mustards. It kills the weeds without injury to the crop.

2) Non-selective

Non-selective contact herbicides will kill all kinds of living plant tissue, whether cotton, corn, dock, Johnsongrass or others. Dinoseb can be made to be non-selective if it is mixed with diesel oil.

b. Translocated herbicides

These herbicides are absorbed either by the aboveground parts or by the roots, and then moved or translocated through the vascular system of the plant, upsetting the plant's growth and metabolic processes. They have a chronic effect upon the plant cells. Full effects of these herbicides may not result for some time - a week or more after treatment.

Translocated herbicides are usually effective on certain plants but not on others; thus making it possible to use these herbicides selectively - killing certain plants without appreciably injuring others if used correctly. Herbicides of this type are usually used in post-emergence treatments.

2,4-D is an example of a selective, translocated herbicide. It is used to control broadleaf plants. Dalapon on the other hand is used for the control of narrowleaf weeds.

c. Soil sterilants

Soil sterilants are chemicals which prevent the growth of plants in the soil. They are important for use in greenhouse and potting soils; on ditchbanks, barnyards, and fencerows; for spot treatment of serious weeds from farm lands; and for many industrial uses such
as along railroad right-of-ways, etc. Normally they are uneconomical for use on a large-scale basis on farm lands because of cost.

Sterilants vary in their residual action, according to the nature of the specific chemical, the rate of application, type of soil, rainfall, etc. Examples of soil sterilants are: methyl bromide, sodium chlorate, simazine, atrazine, etc.

28. How are herbicides classified according to their chemical structure?

<table>
<thead>
<tr>
<th>Classification</th>
<th>Way They Kill</th>
<th>Examples of herbicides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenoxy compounds</td>
<td>Selective translocated</td>
<td>2,4-D; 2,4,5-T; MCPA; Sivex; 4(2,4-DB)</td>
</tr>
<tr>
<td>Benzoic acids</td>
<td>Selective translocated</td>
<td>2,3,6-TBA</td>
</tr>
<tr>
<td>Aliphatic acids</td>
<td>Contact, or selective translocated</td>
<td>TCA; dalapon</td>
</tr>
<tr>
<td>Heterocyclic nitrogen derivatives</td>
<td>Selective growth regulator, or soil sterilant</td>
<td>Simazine; atrazine; prometryne</td>
</tr>
<tr>
<td>Substituted ureas</td>
<td>Selective growth regulator, or soil sterilant</td>
<td>Monuron; diuron; Neburon</td>
</tr>
<tr>
<td>Carbamates</td>
<td>Selective growth regulator</td>
<td>Chlorpropham; EPTC</td>
</tr>
<tr>
<td>Metal-Organic</td>
<td>Contact, or selective growth regulator</td>
<td>Ammonium sulfamate; MSMA</td>
</tr>
<tr>
<td>Inorganic salts</td>
<td>Non-selective contact</td>
<td>Arsenic trioxide, sodium arsenite; sodium chlorate</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>Non-selective contact</td>
<td>Herbicidal oils</td>
</tr>
<tr>
<td>Organic halogens</td>
<td>Soil sterilants</td>
<td>Methyl bromide</td>
</tr>
</tbody>
</table>

29. When should chemical treatments be applied?

Chemicals may be applied to control weeds as (a) preplanting treatments, (b) preemergence treatments, and (c) as postemergence treatments.

a. Preplanting treatments

Preplanting treatments are made before the crop is planted. For example, methyl bromide may be used in fumigating gardens to kill most weed seed - and soil diseases - before planting.
b. Preemergence treatment

Preemergence treatments are those made prior to emergence of a specific crop or weed. They are applied soon after the crop is planted, usually immediately behind the planter. Examples of chemicals that are used in preemergence application are: trifluralin in cotton and atrazine in corn.

c. Postemergence treatment

Postemergence treatments are those made after emergence of a crop or specific weed. Examples are: using diuron to kill emerged weeds in cotton; and 2,4-D to kill emerged broadleaf weeds in pasture, corn, small grains, etc.

30. How are herbicides applied?

Relative to application, herbicides are applied in four ways: (a) in bands, (b) broadcast, (c) as direct sprays, and (d) on a spot basis.

a. Banding

Banding is used when herbicide costs are high. It consists of treating strips throughout the field, usually a narrow strip centered on the top of the row, for example, a 12" band on a 40" row. Such preemergence chemicals as diuron used in cotton, simazine used in corn, and benefin used in some truck crops are applied as band treatments in order to control many weeds for at least several weeks until the crop has become established.

b. Broadcasting

Broadcasting is used when herbicide costs are low. It is a blanket application to an entire area. It is more commonly applied to areas such as pastures.

c. Directed sprays

This is the application of spray material to a particular part of the plant, usually to the lower part of the stem or trunk. Such applications are usually directed at or just above the ground line, as in the case of applying DSMA in cotton to kill small annual weeds that have emerged.

Directed spray applications, using dropped nozzles, are also used to control weeds between row crops. Examples of the use of directed sprays between row crops are the use of: diuron at lay-by time in cotton to control annual weeds; and 2,4-D at or after lay-by time in corn and sorghum to control broadleaf weeds.
d. Spot treatment

Spot treatments are made to restricted areas to control an infestation of a species of weed requiring special treatment, such as spot infestations of Johnsongrass in cultivated crops, around buildings, fencerows, etc. Another example is the use of soil sterilants in fields and small areas to prevent the spread of perennial weeds.

31. What is a surfactant?

A surfactant is a material which, when mixed with a herbicide, enables the herbicide to cover the weed more completely.

32. Why should a surfactant sometimes be used?

Water is repelled by the wax-like cuticles on plant surfaces. By adding a wetting agent (surfactant) the effectiveness of a herbicide can be increased. Herbicides, when used as a postemergence spray, should be absorbed readily. The addition of a surfactant to certain herbicides increases "wetting" of the entire surface of plants, by preventing the water droplets from forming a "ball" by causing the droplets to spread, thus covering more leaf area and improving absorption.

Examples of usage of surfactants with some herbicides to increase their effectiveness are: (a) the use of a surfactant with diuron for post-emergence in cotton during early growing season and/or at lay-by time; (b) the use of a surfactant with DSMA or MSMA to control crabgrass and dallisgrass in Bermudagrass lawns; and (c) the use of a surfactant with dalapon to control Johnsongrass.

33. What affect does the age of weeds, soil condition, and climatic condition have upon the method of weed control?

Timing is an important factor in weed control. When herbicides are applied at the right time, more effective weed control is obtained with a smaller amount of chemical applied.

a. Stage of weed growth

Generally, young, active-growing weeds are easier to kill. The efficiency of the herbicide decreases as plants reach maturity due to decreased plant activity and absorption. However, in the case of perennial weeds, applications made at certain later stages of development may be more effective than earlier treatments. This is due partially to the larger amounts of leaf absorbing surface and also to the fact that a considerable amount of root reserve has been expended just prior to blooming. Because of these reasons, Johnsongrass, for example, is easier controlled with dalapon-surfactant mixture when application is made from full leaf development stage to the time flowers first appear in the spring.
b. Soil conditions

Warm, moist soil that favors rapid germination and growth of seedlings is conducive to high effectiveness of applied herbicides. Drouth conditions retard their effectiveness because plant processes are retarded (absorption is decreased). For example, adequate moisture is necessary to activate simazine used in corn.

The type of soil also influences the retention of herbicides used in preemergence treatments - and occasionally postemergence treatments. Leaching of herbicides is greater in light, sandy soils than in soils containing higher amounts of organic matter and clay.

c. Rainfall

Rain occurring immediately following application of a foliage herbicide may decrease its effectiveness by washing the chemical from weed leaves before it can be absorbed. Later, however, rain may actually increase herbicidal action by helping weeds grow faster, thus helping to make them more susceptible to kill. Excessive rainfall after application of preemergence herbicides may prove detrimental to some crops since it causes some herbicides to leach into the crop root zone and cause injury. Light rain after application of preemergence herbicide, on the other hand, is beneficial.

d. Temperature

Higher temperatures, generally, speed up the action of some herbicides, while low temperatures retard their action. Also some herbicides become more volatile under high temperatures.

34. How do the various methods of weed control compare as to cost, effectiveness, etc.?

No single method of control can be considered as best. The useful method or methods depend upon the many factors or conditions prevalent in each case. Often the most effective economic control involves the use of more than one method - a combination of both cultural and chemical treatments.

Experimental data and rapid adoption of chemical practices have advanced chemical control methods. It should be emphasized, however, that herbicides have their limitations. They are not intended to entirely replace cultural management practices; only to supplement them. Sound management including cultural practices still play an important role in weed control programs. Weed control is a year around job. It begins with plowing under the old crop to kill some of the weeds before they mature, and continues with the use of weed-free seed, good seedbed preparation, and the use of mechanical or chemical control methods, or combinations of both.
In selecting the method or methods to be used, one should consider many factors, such as the kind of weed or weeds to be controlled, the effectiveness of the various methods in controlling the weeds, costs, weather conditions, etc.