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Weeds

OF CROPS IN SOUTHERN ARIZONA

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Front cover: This is a seedling of watergrass, the most serious annual weed of crops in southern Arizona. The seedlings of watergrass have narrow reddish bands on their leaves; the early growth of watergrass is prostrate. The recognition of weeds in their seedling stage is important, for weed control practices are most effective when weeds are small. Watergrass seedlings are easily recognized.

This bulletin discusses in general the effects of weeds, classification of weed species, cultural and chemical control methods which have been proven, laws governing weed control and contains an understandable description, with illustrations, of the weeds of greatest economic importance in the cultivated areas of southern Arizona. It is planned that this bulletin will be supplemented by two more — one discussing weeds which invade lawns, parks, golf courses and other turf areas, the other bulletin discussing the weeds of Arizona's rangelands which are of economic importance to cattlemen and sheepmen.

Weeds

OF CROPS IN SOUTHERN ARIZONA[1]

by
K. C. HAMILTON[2] AND H. F. ARLE[3]
Drawings by
LUCRETIA B. HAMILTON

This bulletin summarizes current weed control practices in irrigated crops of southern Arizona. It also contains illustrations and descriptions of the most serious weeds. The bulletin was prepared to aid farmers in (1) identifying the common weeds of irrigated fields and (2) selecting the proper methods to control these weeds.

What Is a Weed?

Weeds have been defined as "plants growing where they are not wanted." Definition of a weed may be based on the (1) characteristics of the plant and (2) interests of the person making the definition. Thus, Johnson grass may be a weed to the cotton farmer and a valued forage to the neighboring cattleman. Likewise, pondweeds may be a constant problem to water users' associations, while they are prized by the sportsman as food for waterfowl. Alfalfa, castor beans and sorghums are valuable crop plants, but are weeds when they "volunteer" in cotton.

How Many Different Weeds?

Approximately 100 plants become weedy in the irrigated crops of Arizona. Only one-fourth of these are widespread and become serious problems. The other weeds occur locally, but seldom become serious or widespread.

A unique weed population often occurs immediately after the desert is leveled and irrigated. None of the common weeds are present. A few desert plants, such as *Probascidea arenaria* (devils-claw), *Kallstroemia grandiflora* (desert poppy), and *Palafoxia linearis* (palafoxia) persist, sprouting from seeds in the soil. These desert plants are unable to reproduce because of cultivation or other crop management practices. After a few years of cropping these desert plants disappear when all their seed in the soil has germinated.

The common crop weeds then become established. A few of these are native to America; carelessweed and annual sunflower are examples.

[1] Cooperative contribution from the Arizona Agricultural Experiment Station and the Crops Research Division, ARS, USDA.
[2] Assistant Agronomist, University of Arizona, Tucson.
[3] Plant Physiologist, Crops Research Division, ARS, USDA.

Most of them were introduced from Europe or Asia. Johnson grass, puncture vine, Russian thistle, watergrass and wild oats are examples. Most of these weeds are well adapted to compete with agronomic crops. Their origin and development are similar to the origin and development of the crops they infest. If these newly introduced weeds are able to reproduce under the cultural practices of the area, they become increasingly troublesome.

Spread of Weeds

Few weeds have been introduced intentionally. Most are introduced into an area as impurities in planting seed. Although limited by state seed laws, the number of weed seeds in commercial planting seed is often high. In Arizona, a pound of commercial seed barley can legally contain the following: 100 wild oats, 100 sandbur, 100 curled dock, 100 Russian thistle and 100 puncture vine. Most of this weed seed can be removed from crop seed with cleaning equipment.

In irrigated areas a major means of spreading weeds is irrigation water. Control of weeds on ditchbanks to prevent their spread is extremely important where water is obtained from large reservoirs and the system of irrigation ditches is extensive. Ditchbank weed control programs must have the support of all the farmers in the system to be effective. Control of weeds on ditchbanks is of equal importance in pump areas. However, the pump irrigation system is usually smaller, and individual farmers often control an entire system so ditchbank weed control is simplified.

Farm machinery spreads weeds. Increased mechanization of agriculture has increased the problem of weed spread. Mechanical planters have long been a means of sowing the weed seed in crop seed. Today, harvesting machinery spreads many weeds. Mechanical cotton pickers spread the seed from patches of morning glory over entire fields and into fields not yet infested. Combines spread carelessweed while harvesting sorghum, wild oats while harvesting barley, and silversheath knotweed while harvesting alfalfa. Cultivators, if used improperly, spread rhizomes from patches of Johnson grass and Bermuda grass. Floats, landplanes and other leveling machinery spread weeds.

Weeds are spread by other means. Infested feeds and bedding remain a constant source of weed introduction. Improper management of animals being moved to new pasture can spread weeds. Applying gin trash is a common way to spread many of the weeds which grow in cotton. Some weeds have seeds adapted for spread by wind (sow-thistle) or animals (sandbur, puncture vine).

Highways speed the spread of weeds. Weeds often grow uncontrolled along the roadsides. Weed seeds are scattered along the roadside by trucks carrying livestock, hay, straw, grain and other farm products. A truck carrying Texas cattle to Los Angeles, for example, could scatter weed seed in manure and bedding to roadsides hundreds of miles from where those weeds originated. Spread of weeds in this manner is common and is largely beyond the range of any control methods.

Cost of Weeds

Weeds cause an estimated annual loss to the agriculture of the United States of approximately four billion dollars. The loss attributed to weeds alone equals the combined losses caused by diseases and insects of both plants and animals. Despite control efforts, the monetary loss due to weeds remains relatively constant. Many farmers accept weed losses as being "certain as taxes." Most cotton farmers in Arizona have spent $16

to $20 per acre each year for cultivation and hoeing to control weeds. Control of weeds along irrigation ditches and canals has cost Arizona farmers upwards of $40 per mile each year.

Losses Caused by Weeds

Reducing crop yields is the most direct, although sometimes not the most evident, loss caused by weeds. Dense stands of Johnson grass have reduced the yield of cotton 20 to 25 per cent. Infestations of purslane have caused the abandonment of lettuce fields.

Reduced crop yields are in most part due to direct competition for water, nutrients and light. The water requirements of most weeds equal or exceed the water requirements of our crops. Where water is limited, weeds must be controlled or they will waste water intended for crops.

The nutrient requirements of most weeds are similar to the nutrients required by crops. Applications of sufficient fertilizer to supply both crops and weeds have been attempted. Fertilizer application to supply the needs of both crops and weeds without cultivation has been unsuccessful. When competition for nutrients is eliminated, weeds reduce crop productivity by other means.

Weed competition for light is most important with small-seeded crops. Many plantings of alfalfa and vegetable crops are lost when weeds grow faster than the crop and competition for light becomes severe. Although weed competition for light is removed after only a few weeks, many short-lived vegetables are unable to recover from effects of earlier weed competition.

Another way some weeds reduce crop yield is through the production and release of substances which affect the growth of certain plants.

Weeds sometimes reduce crop yield by mechanical means. A dense growth of morning glory over a cotton field usually reduces yields. In addition, harvest is difficult; sometimes, impossible.

Weeds reduce the quality of crops. The presence of weed seed in planting seed greatly reduces its value. Weed control is extremely important in fields where planting seed is produced. Annual grasses which grow after cotton layby do not reduce total yields, but do reduce the value of the lint because grass fragments cannot be removed with lint cleaners. The value of alfalfa hay will be reduced if it contains sandburs or other weeds which reduce its palatability.

Weeds harbor many insects and diseases which damage crops. Although insects are controlled in a crop, weeds on ditchbanks often serve as a constant source of insects. The lesser stalk borer, which infests Johnson grass on a ditchbank, may damage adjacent sorghum. Lettuce mosaic may be spread to lettuce fields by insects from weed hosts.

Weeds increase the cost of producing crops. Severe weed problems often force a farmer to add a fallow period or a competitive crop of low value to the rotation. Most cultivation and hoeing is for weed control. Special cultivators, sprayers, and burners are needed to control weeds. Seed cleaning equipment must be used to process many crops which contain weed seed. Storage space must be provided for equipment needed to control weeds. The annual dockage due to weed seed in farm produce moving to market is tremendous.

Weeds increase maintenance costs of irrigation, drainage and transportation systems. To maintain efficiency on these systems weeds are controlled by cultivation, spraying, burning and other methods.

Weeds cause losses in other ways. Certain weeds, being poisonous or

harmful to livestock, are a problem in pastures. Weeds affect human health; many people are allergic to the pollen of specific weeds. Lastly, weeds are usually unsightly; their presence is usually considered the sign of a careless farmer.

Benefits From Weeds

Despite great losses caused by weeds, one must point out that weedy plants sometimes are of benefit to man. Weeds reduce wind and water erosion while land is "idle." Usually they need not be seeded. Weeds volunteer this service. On idle land, weeds add organic matter to the soil and retard the leaching of nutrients. Limited plant growth is often desired on unlined canals to reduce erosion; again, weeds usually volunteer. Weeds are often grazed by cattle; during times of drought they have been a major source of forage. Some weeds are prized as food by humans. Weeds are utilized for food and cover by certain types of wildlife. A few weedy plants are a source of drugs.

Classification of Weeds

Plants can be classified by their form and habit of growth. Knowledge of a weed's form and growth habit is necessary to determine how it can best be controlled.

Most weeds are classified as either:

Grassy weeds: Examples are Johnson grass, watergrass and wild oats. They have narrow, parallel-veined leaves which are usually held vertically. The outer floral parts are scalelike; inner floral parts are in multiples of three. Grassy weeds are, in general, susceptible to dalapon, but resistant to 2,4-D.

Broadleaved weeds: Examples are carelessweed, groundcherry and London rocket. They usually have wide leaves which are held horizontally. Floral parts are in multiples of 2, 4 or 5 and often conspicuous and colored. Broadleaved weeds are usually susceptible to 2,4-D.

Weeds are also classified as annual, biennial or perennial. This classification is somewhat confused in the lower valleys of Arizona. Certain weeds, such as sandbur, which usually have an annual growth habit, become perennial when winters are mild. Plants which normally are biennial grow as winter annuals. Annual weeds, such as purslane, which germinate at moderate temperatures may grow in spring and fall.

Annual weeds: Examples are puncture vine and watergrass. They complete their life cycle in a single season. Annual weeds reproduce by seed. In crop land annual weeds are best controlled by preventing seed from being introduced and by destroying existing weeds before seed is produced.

Most annual weeds can produce tremendous numbers of seed if allowed to mature. Once this seed is in the soil it can survive many years until conditions are favorable for germination. However, even when conditions are optimum for germination, only a portion of the seed will sprout. Many of the seeds remain dormant in the soil. Control methods for serious

infestations of annual weeds must be continued for many years until all seed in the soil has decayed or germinated.

Cultivation is the most common control method for annual weeds. The use of herbicides is becoming increasingly important. Both are most effective on young weeds. As annual weeds mature they become more difficult to control. Annual weeds should be controlled while young, for their competition, if only for a few weeks, can reduce yields of most crops.

Winter annual weeds usually grow during the cooler period from November to April. They are predominantly broadleaved weeds such as London rocket, nettleleaved goosefoot, cheeseweed and sowthistle. Wild oats is one of the few winter grassy weeds. Winter annuals are a problem in small grains, alfalfa, vegetables and citrus.

Summer annual weeds usually grow during the hot period from May to October. They include grassy weeds such as watergrass, stinkgrass, sprangletop and sandbur and broadleaved weeds such as morning glory, carelessweed and groundcherry. Summer annuals are most serious in cotton, sorghum, alfalfa and citrus.

Perennial weeds can live longer than a single season. Our most important perennial weeds are Johnson grass and Bermuda grass. Field bindweed and white horsenettle are serious perennial broadleaved weeds. Perennial weeds, usually dormant during the winter months, are most troublesome in summer crops such as cotton and sorghum. Initial introduction of perennial weeds is usually by seeds. Once established, most perennial weeds develop extensive underground stems or rhizomes. These weeds form patches or clumps. Further spread is by seed and underground stems.

The underground stems also are food storage organs and have numerous buds. When topgrowth is removed these buds sprout and, utilizing the stored foods, establish new topgrowth. Most perennial weeds survive repeated destruction of their topgrowth if adequate food is stored in their underground stems.

Knowledge of the food reserves of perennial weeds is important. The amount of stored food varies during the year. Food reserves are usually lowest during the spring and greatest during the fall. Control measures are most successful if initiated when food reserves in underground stems are lowest. Repeated removal of topgrowth by cultivation, mowing, spraying, burning or grazing will reduce food reserves. As the stored food is used to produce new topgrowth, the weed gradually weakens and dies.

Perennial weeds are controlled by reducing or destroying *both* topgrowth and underground stems. Competitive crops growing over and shading weeds will control some perennial weeds. Repeated destruction of topgrowth has long been a control method. Perennial weeds can be controlled with translocated herbicides which kill the buds on the underground stems. Clumps of perennial weeds are controlled by applications of herbicides which sterilize the soil.

Biennial weeds require two seasons to complete their life cycle. Seeds germinate and the weeds grow vegetatively during the first year. During the second year biennial weeds flower, produce seed, and die. There are no serious biennial weeds in crops grown in southern Arizona.

Eradication vs. Control

Weed eradication is complete elimination of a weed — topgrowth, underground stem and seeds. Eradication is usually achieved by soil sterilization or soil fumigation. Because of high costs, eradication is rarely practical on a large scale. Eradication should be attempted on small patches of serious weeds which can-

not be controlled by good farming practices.

Weed control is reduction of weed infestation to a point where crop production is profitable. Farmers usually attempt to control weeds, not eradicate them. Spot treating Johnson grass with dalapon will control but not eradicate this weed. However, weed infestations can be greatly reduced and even may be eradicated within a few years if effective weed control techniques are employed.

Remember, however, that weed prevention is far more economical than either weed eradication or weed control.

Cultural Weed Control

Weeds can best be controlled by good farming. Most cultural practices which increase a crop's growth and competitive ability will reduce weed problems. Many farm operations intended to increase crop production likewise help control weeds.

Crop rotation is usually the most practical method of controlling weeds. When one crop is planted continuously on the same field certain weeds become increasingly serious. These weeds are adapted for survival despite a crop's management schedule. They are able to mature seed or replenish their food reserves at some period during the growing season. Morning glory in cotton, purslane in lettuce, wild oats in barley, and carelessweed in sorghum are examples of weeds adapted to survive and increase under a one-crop system of farming.

Crop rotations should include crops whose cultivation and management interfere with the growth of most weeds. Most crop rotations include row crops and solid-planted crops, annual crops and perennial crops, winter crops and summer crops. Crops to be included in the rotation frequently are determined by economic consideration. Their order in a rotation depends, in large part, on considerations other than weed control.

Short fallow periods between crops are common in most rotations. Extended periods of summer fallow may be added to control serious, general infestations of Johnson grass or nutgrass.

Crop rotations will help control weeds only if good farming is practiced with each crop in the rotation.

Seedbed preparation: Cultural weed control starts with a well-prepared seedbed. The seedbed, important with all crops, is most critical with small-seeded crops. A uniform vigorous seedling stand reduces weed problems. A good seedbed is prerequisite for a uniform stand. Level fields also are usually a prerequisite for a good seedbed.

When preparing a seedbed for cotton, annual weeds sprouting after the pre-irrigation can be destroyed. However, improper harrowing may produce a poor seedbed and result in poor germination, a poor stand, and then weed problems during the growing season.

Planting method: The method of planting influences weed control. A most effective method of weed control is planting in moist soil under a shallow mulch of dry soil. Large-seeded crops germinate in the moist soil and emerge through the dry mulch. Few annual weeds can emerge through this mulch. Often there are no annual weeds in cotton until after the first post-emergent irrigation. Success of this method depends on the crop, weather conditions, proper pre-irrigation, and correct planting equipment.

Crops not planted in moist soil must be "irrigated up." This planting method may make early weed control difficult and expensive. After the germination irrigation, weeds usually germinate before the crop. Purslane often emerges before lettuce. When crops are irrigated up, special cultivation, hoeing, herbicides and mowing are sometimes needed for early season weed control.

The method of planting is influenced by weed problems. It, in turn, influences weed control. Soybeans may be row planted to facilitate cultivation, yet due to row planting the early season weed problems increase.

Plant spacing: In most crops an increase in the rate of seeding influences yields and reduces weeds. Cotton at a 4-inch spacing has fewer annual weeds than cotton at a 15-inch spacing. However, high plant populations are not always desirable. They may contribute to increased boll rots in cotton, lodging in small grains and poor quality in lettuce.

Close row spacing helps control weeds. When a non-tillering crop is planted, or if the growing season is short, a row spacing closer than normal may increase weed control.

Planting date: Crops should be planted when conditions are optimum. Major weed problems are created when crops are not planted at the proper time. In Arizona alfalfa should be planted in mid-fall. Earlier alfalfa plantings have summer annual weeds; later plantings have winter annual weeds. Arizona's intensive use of cropland sometimes makes planting at the optimum date impossible. However, from a weed control aspect, planting at the proper time is desirable.

Competitive crops and adapted varieties: Crops differ in ability to compete with weeds. Winter drill-planted crops listed in order of *decreasing* ability to compete with weeds are barley, wheat, oats and flax. Selection of a crop is influenced by the weed problem, competitiveness of these crops and cultural practices used in these crops.

If adapted varieties are grown, weed control is simplified. Crop varieties differ in ability to compete with weeds. Winter dormancy of northern alfalfas allows winter annual weeds to become serious. Growth of southern alfalfas during the winter greatly reduces these annual weeds.

Clean planting seed: Only weed-free crop seed should be planted. Clean planting seed usually can be obtained if certified seed is purchased. The only way to be certain that planting seed contains no weed seed is to *look at what is in the sack* and what is on the label. Reject any planting seed containing weed seed or unknown seed. Inexpensive planting seed is no bargain if it contains weed seed.

Cultivation: Mechanical cultivation is an effective, inexpensive, widely-used method to control weeds in crop lands. Cultivation schedules should insure that weeds are never allowed to produce seed.

Cultivation practices vary with the crop and grower. In most row-planted field crops, 4-row cultivators with various arrangements of sweeps, disks and furrow openers are used. In vegetable crops, 3-bed cultivators with knives, sweeps and openers are commonly used. There are usually one or two cultivations between irrigations until layby. Cultivation is most effective when weeds are small. Rotary harrows are sometimes used in field crops to control annual weed seedlings.

Hoes are the oldest, most numerous, most expensive cultivation implement used in Arizona. Until crop production is more mechanized, hoes will be used to space and weed cotton and vegetable crops and to remove weedy plants from seed fields.

Flame cultivation is an effective, although not widely accepted, method for controlling annual weeds in the drill row of some crops. To control annual grasses in cotton, flame cultivation should begin soon after weeds emerge following the first irrigation. Do not use flame cultivation until cotton is 8 inches high. Until layby, cotton should be flame cultivated once or twice between each irrigation.

Clean cultivation is used in orchards, vineyards and skip-planted cotton. Generally, disk harrows are used whenever weeds grow after an irrigation or rain.

A summer fallow is sometimes necessary to control general infestations of Johnson grass. Starting in April, the field should be cultivated every five weeks to expose and destroy rhizomes.

Irrigation and fertilization: Irrigation and fertilization practices influence weed problems. These operations should be scheduled to maintain a vigorous crop that is able to compete with weeds. If water or nutrients are inadequate for crop development, certain weeds may increase.

In cotton production, the pre-irrigation schedule should allow a minimum of time between irrigation and planting. If this interval is prolonged, additional weed control may be necessary. Proper pre-irrigation and planting reduces annual weeds until the first postplanting irrigation. The first irrigation should be delayed, to extend this relatively weed free period as long as possible without stressing cotton.

During July and August, alfalfa usually is not irrigated in the lower valleys of Arizona. During this hot period, when growth of alfalfa is slow, watergrass and sandbur grow if regular irrigation continues. Improper irrigation during the summer often floods and scalds portions of the alfalfa field. Where alfalfa is scalded, weeds become established.

Irrigation water should be free of weed seed and debris. Weed control on irrigation canals and ditches is the proper method of obtaining clean water. The best program for controlling ditchbank weeds begins with the lining of all canals and ditches. If weeds on canals are not controlled, weed seed traps and screens can be constructed on farm ditches.

Insect and disease control: When crop insects and disease are controlled, weed control is also simplified. Where an insect such as the spotted alfalfa aphid weakens and thins alfalfa stands, control of weeds becomes difficult. Annual weeds are impossible to control economically where Texas root rot destroys stands of alfalfa and cotton.

Harvest: The method of crop harvesting has an influence on future weed problems. When a crop has a severe weed infestation it might best serve as green manure. From the weed control aspect, a barley crop infested with wild oats should be cut for hay. If this barley is harvested for grain the wild oats will produce seed. Likewise, a sorghum field infested by Johnson grass and carelessweed should best be harvested for silage.

Harvest management of perennial crops influences weed problems. Cutting alfalfa before the proper stage reduces its vigor and ability to compete with weeds. Stubbing of cotton introduces a serious problem in controlling perennial weeds.

Harvesting machines should be cleaned when moved from one field to another and should be operated in a manner that does not spread weeds from isolated patches into uninfested portions of a field.

Farm sanitation: Control and elimination of weed growth on ditchbanks, fence rows, field ends, road-

ways and waste areas is termed farm sanitation. These weeds do not compete directly with crops. Farm sanitation is important because these weeds harbor insects, diseases and rodents. These weeds spread into adjacent fields. Farm sanitation and control of weeds growing in crops are of equal importance. In farm sanitation, nonselective control methods are most effective.

On most farms, weed control on border ridges is lacking. Weeds on the ridges can be controlled by using a border disk after each irrigation. In alfalfa and small grain, planting on the ridges controls many weeds.

Biological Weed Control

Biological weed control may be defined as the introduction of animals, insects or diseases which reduce weed populations. Introduction of these organisms for weed control in crops has not proved successful. Our crops are so closely related to the major weeds that no selective organisms have been discovered.

The closest approach to biological weed control in Arizona crops is use of cattle to graze grassy weeds in cotton. This practice is usually restricted to early season grass control. From a crop production viewpoint the disadvantages of grazing grassy weeds in cotton are often greater than the advantages.

Chemical Weed Control

Herbicides can be used to supplement other good farming practices. Widespread acceptance of selective herbicides during the past decade is evidence of their effectiveness and economy. Today selective herbicides are used in the major agronomic and vegetable crops. When used properly *selective* herbicides kill or stunt most weeds without injuring treated crops. Three types of selective herbicides are used in Arizona crops; foliage translocated, pre-emergence and foliage contact.

Foliage Translocated Herbicides

Foliage translocated herbicides are chemicals applied to the leaves of weeds. These herbicides are absorbed, moved (translocated) in the plant and kill topgrowth, underground stems and roots. Movement of foliage translocated herbicides from leaves to growing points is one reason they are effective weed killers. Application of most translocated herbicides results in definite patterns of abnormal leaf development. The methods by which the translocated and other selective herbicides actually affect and kill plants are not completely understood.

The effectiveness of a foliage translocated herbicide applied to a given weed is influenced by many factors. Effectiveness is influenced by species, variety and stage of growth *of the treated plant;* by amount of the herbicide, its formulation, and the amount and type of water or oil or other additives (wetting agents) *in the spray solution.* Temperature, light, humidity and soil moisture as parts *of the plant's environment* affect efficiency of the herbicide.

2,4-D (2,4-dichlorophenoxyacetic acid) is commercially available as liquid formulations of various esters and amine salts. *Only* 2,4-D *amines should be used* for weed control in

Arizona crops. Most 2,4-D amines contain four pounds of the acid equivalent of 2,4-D per gallon.

2,4-D is used to control broadleaved weeds in sorghum, small grains and flax. It is applied to the foliage at rates of ½ to 1¼ pounds in 20 to 30 gallons of water per acre. 2,4-D is usually applied with tractor or trailer-mounted sprayers. Extreme care is necessary when applying 2,4-D near sensitive crops. It should never be applied when the wind is blowing toward cotton, tomatoes or grapes.

MCPA (2-methyl-4-chlorophenoxyacetic acid) is a chemical closely related to 2,4-D. Their formulations, properties and uses are similar. MCPA amines are sometimes used to control broadleaved weeds in sorghums, small grain and flax fields adjacent to crops sensitive to 2,4-D. The rate of MCPA is higher than the rate of 2,4-D required to affect most plants.

DALAPON (2,2-dichloropropionic acid) is commercially available as the sodium salt containing 74% dalapon. This formulation is a whitish, water-soluble powder. Dalapon is very effective for grass control. It is applied in cotton fields and vineyards as a spot treatment to control established Johnson grass. *Spot treating with dalapon in other crops cannot be recommended* until its use is approved. Clumps of Johnson grass are sprayed until wet with a solution containing one pound of dalapon per five gallons of water whenever topgrowth is 8 to 10 inches high. Two or three applications are required to control Johnson grass.

Pre-emergence Herbicides

Pre-emergence herbicides are chemicals applied to the soil before weeds emerge. They cause a temporary "sterilization" of the surface layer of soil which prevents growth of most weeds. Pre-emergence herbicides destroy weed seeds as they germinate, or weed seedlings shortly after emergence. Pre-emergence herbicides are applied at planting, at emergence, or after emergence of the crop. Many herbicides which damage crops if applied as a post-emergence spray can be applied safely, using granular formulations.

Much selectivity of herbicides first used for pre-emergence weed control was due to unequal exposure of crop and weed seed. Crop seeds, planted deeply, were not exposed to as high herbicide concentrations as weed seed near the soil surface. Selectivity of many of the newer pre-emergence herbicides is due to differential tolerance of weeds and crops. Lettuce tolerates higher levels of CDEC than purslane. Melons tolerate higher levels of NPA than watergrass.

Effectiveness of pre-emergence herbicides is influenced by the inherent susceptibility of crops and weeds to the herbicide, its formulation, the amount of herbicide applied, methods of planting, irrigation and cultivation, weather conditions, soil type, pH and salt content.

Pre-emergence herbicides used in Arizona are active only when in the soil solution. *To be effective their application must be followed by irrigation or rainfall.* Proper irrigation following application of pre-emergence herbicides is essential to their success. The period of weed control is usually three weeks or more. During this time cultivation, which mixes untreated soil into the treated layer, decreases the herbicide's effectiveness.

MONURON (3-(p-chlorophenyl)-1,1-dimethylurea) is formulated as a wettable powder containing 80% monuron. Monuron is only slightly soluble in water. When monuron is applied as a spray, mechanical agitation should be used to keep it in suspension. Monuron is used to control annual weeds in cotton. It is applied

to the soil at layby. The rate applied varies with soil type from one pound per acre on sandy loams to about 1¾ pounds per acre on soils with high clay or silt content. Cotton foliage sometimes develops a temporary monuron chlorosis following application of monuron to the soil.

DIURON (3-(3,4-dichlorophenyl)-1,1-dimethylurea) is closely related to monuron. Their formulation, properties and application are similar. Diuron is less soluble than monuron. Diuron is applied to the soil at cotton layby for control of annual weeds. For annual grass control, diuron appears more effective than monuron; for morning glory control diuron appears less effective.

CDEC (2-chloroallyl diethyldithiocarbamate) is formulated as a liquid containing four pounds of CDEC per gallon. Applications of five pounds of CDEC per acre have given excellent control of purslane. CDEC is applied to the soil after planting but prior to the germination irrigation in lettuce, cabbage, and broccoli and prior to the transplant irrigation in celery. Usually the entire tops of vegetable beds are sprayed. Humans should avoid contact with CDEC or its fumes, for they can be extremely irritating.

NPA (N-1 - naphthylphthalamic acid) is available as a liquid formulation containing two pounds of the sodium salt of NPA per gallon. NPA is used to control watergrass in melons. After planting, a band of soil over the drill row is sprayed with 4 to 6 pounds of NPA per acre. Treatment is followed with the germination irrigation which moves the herbicide into the soil.

IPC (isopropyl N - phenylcarbamate) is formulated as a wettable powder containing 50% IPC and as an emulsifiable liquid containing two or three pounds of IPC per gallon. IPC can be used to control annual grasses such as wild oats in flax, with 2½ to 3 pounds of IPC per acre applied to the soil when flax is two inches high. The field is then irrigated.

SIMAZIN (2-chloro-4,6-bis(ethylamino)-*s*-triazine) is formulated as a wettable powder containing 50% simazin. It is a very effective soil sterilant. Soil applications of low rates of simazin have shown promise for selective weed control in corn. Further testing is necessary before simazin can be recommended for use in crop lands in Arizona.

Foliage Contact Herbicides

Foliage contact herbicides are chemicals applied to the leaves of weeds. These herbicides destroy any plant organs contacted by the spray. Foliage contact herbicides are used to control annual weeds in many crops. They are most effective when applied to weed seedlings. Retreatment is sometimes necessary if new weed seedlings emerge. Effectiveness of a foliage contact herbicide is influenced by the inherent tolerance of weeds, amount of herbicide applied, type and amount of additives and carrier (water or oil) in the spray, and environmental conditions.

DNBP (4,6-dinitro *o* secondary butylphenol) is formulated as a foliage selective herbicide containing one pound of the ammonium salt of DNBP per gallon. One to 1¼ pounds of DNBP per acre, applied to the foliage, controls many winter broadleaved weeds. It is usually applied in 40 to 60 gallons of water per acre. In seedling alfalfa, DNBP is applied when weed competition becomes severe. In onions, DNBP is applied when onions are in the crook to first true-leaf stage. When DNBP is used in onions one pound of ammonium sulfate per acre is sometimes added to the spray solution to increase its effectiveness.

High temperatures increase the toxicity and decrease the selectivity of DNBP. It should not be applied when temperatures are 85° F. or higher. Contact with DNBP sprays should be avoided by the applicator.

DNBP can be used to control weeds in established alfalfa. After alfalfa is cut, 1¼ pounds of DNBP per acre, usually in a water-oil emulsion, is applied.

SULFURIC ACID is available commercially as the concentrated acid. For the control of seedling broadleaved weeds in onions and garlic, 80 gallons of 5% (by volume) sulfuric acid is applied per acre. One or two retreatments are needed when weed seedlings emerge. Sulfuric acid is dangerous to handle. The acid should be mixed into water. *Never add water to acid.* When spraying with sulfuric acid, goggles should be worn by the operator. Sulfuric acid is corrosive to sprayers. Use of (1) a venturi to mix acid into water immediately before the solution enters the boom and (2) stainless steel booms and spray nozzles can reduce sprayer corrosion.

SELECTIVE PETROLEUM OILS are selected fractions of petroleum that are similar to cleaning solvents and paint thinners. Selective oils are applied at rates of 50 to 75 gallons per acre to control broadleaved weeds in carrots. Retreatment is sometimes needed. These oils usually are applied when carrots are in the 2 to 4 true-leaf stage. Selective oils should not be applied when the temperature is 80° F. or higher. Other similar petroleum fractions such as stove oil, kerosene and gasoline *should not* be used for weed control in carrots.

Petroleum oils containing high portions of aromatic fractions, can be used as a nonselective foliage contact herbicide in citrus. Several applications are needed each growing season to control most weeds.

KOCN (potassium cyanate) is formulated as a powder containing 91 per cent KOCN. KOCN is used to control seedling broadleaved weeds in onions. It is applied at the rate of 10 pounds in 40 gallons of water per acre. Retreatment is sometimes needed to control weeds. KOCN is ineffective if weed growth is retarded. It should not be used if the temperautre is less than 80° F.

Laws Relating to Weed Control

There are several types of legislation related to weeds and weed control. These laws are concerned with noxious weeds, planting seed, pesticide residues, herbicide use, and weed infested materials. At present only the first three are enforced in Arizona.

Noxious Weed Law

The Arizona Code, Title 3, Chapter 2, Article 4, Sections 301-320, provides that landowners shall have power to establish weed districts and declare which plants are noxious on all lands within the district. Powers of officials and employees of a weed district include: (1) inspection of all lands for noxious weeds; (2) serving notice that noxious weeds must be destroyed; (3) enforcing the quarantine against lands on which noxious weeds are not controlled; (4) removal and eradication of noxious weeds; and (5) assessing landowners the costs of removing noxious weeds. Noxious weed laws are enacted and weed districts have been established. Inspection, quarantine and weed removal could be enforced.

The Arizona Seed Law

The Arizona Code, Title 3, Chapter 2, Article 2, Sections 231-242, provides for labeling, inspecting, sampling, and testing of agricultural, vegetable and ornamental plant seed. Enforcement of this law enables buyers to determine seed quality from the analysis on the label. The seed law and regulations under this law (1) define "prohibited noxious-weed seed" and "restricted noxious-weed seed;" (2) list these weeds; and (3) limit the amount of noxious weed seed allowed in commercial planting seed. The quality and success of state seed laws is, in most part, dependent on support of individual farmers.

The Miller Bill

Public Law 518, the Miller bill, amends the Federal Food, Drug and Cosmetic Act. The Miller amendment allows the Food and Drug Administration to establish limits on how much pesticide can be on or in a crop at harvest. It assures farmers that, if herbicides are used as recommended, excessive amounts of herbicide residues will not occur in crops. This is *important to all farmers using herbicides* or other pesticides on crops intended for interstate shipment. Crops containing more than the legal limit of any herbicide residue can be seized and condemned when shipped outside the state of origin.

Other Laws

Herbicide use laws, regulating use of herbicides, exist in several states. Such laws are designed to (1) prevent damage to crops susceptible to herbicides, and (2) help determine responsibility if damage occurs. Some use laws prohibit use of certain herbicides in a given area at certain seasons. Other use laws merely require registration of the sale and/or use of certain herbicides.

Infested materials laws, where enacted, allow the state to stop the sale of grain, feed, or bedding containing seeds of noxious weeds.

Weed Species

The following illustrations and descriptions can be used to identify the important crop weeds. Compare unknown weeds to the drawings. If a weed looks like one of the drawings, read the description and habits. If the weed checks with the drawing and description your identification is probably correct.

If weeds are picked at random from the crops in southern Arizona, 90 per cent can be identified by using this bulletin. If you cannot identify a weed, take it to your county agent. He will identify it or send it to the Agricultural Experiment Station of the University of Arizona to be identified.

The controls recommended for each weed are only outlined. Refer to the control methods described in the preceding sections and the following publications. These are current Arizona publications containing information related to chemical weed control.

1. *Kill Weeds in Small Grains* — Agricultural Extension Service Circular 217; April, 1954.
2. *Johnson Grass Control* — Agricultural Experiment Station Bulletin 265; Sept., 1955.
3. *Growing Cantaloupes in Arizona* —Agricultural Experiment Station Bulletin 275; May, 1956.
4. *A Field Sprayer* — Agricultural Extension Service Circular 249; February, 1957.
5. *Chemical Control of Annual Weeds in Cotton* — Agricultural Experiment Station Bulletin 283; April, 1957.
6. *Carrots in Arizona* — Agricultural Experiment Station Bulletin 285; June, 1957.
7. *Growing Onions in Arizona* — Agricultural Experiment Station Bulletin 280; March, 1958.
8. *Johnson Grass Control With Dalapon and Liquified Petroleum Burners* — Agricultural Experiment Station Bulletin 293; April, 1958.

NOTE: New herbicides are constantly being formulated, tested, and some of them approved. Publications report such testing and methods of application for specific crops. Check with your county agent, and read new listings of available publications from your College of Agriculture to keep informed about new herbicides approved and applicable for the crops in your area.

Glossary

Alternate — one leaf attached at each node.

Awn — a spine or bristle.

Axil — the angle between the base of a leaf and the stem.

Bract — a much reduced scale-like leaf.

Sepals — the outer whorl of flower parts, usually green.

Fruit — any berry, capsule, nut, pod, or structure containing seed.

Floret — a small flower.

Inflorescence — arrangement of flowers, flower heads, or spikelets on a stem.

Node — a point on a stem where a leaf or leaves are attached.

Opposite — two leaves attached at the same node.

Panicle — a branched and re-branched inflorescence.

Petals — the whorl of flower parts inside the sepals, often bright colored.

Rhizome — an underground stem.

Sheath — the lower portion of a leaf which encloses the stem.

Spike — flowers attached directly to an unbranched main stem.

Spikelet — one or more florets enclosed by two bracts.

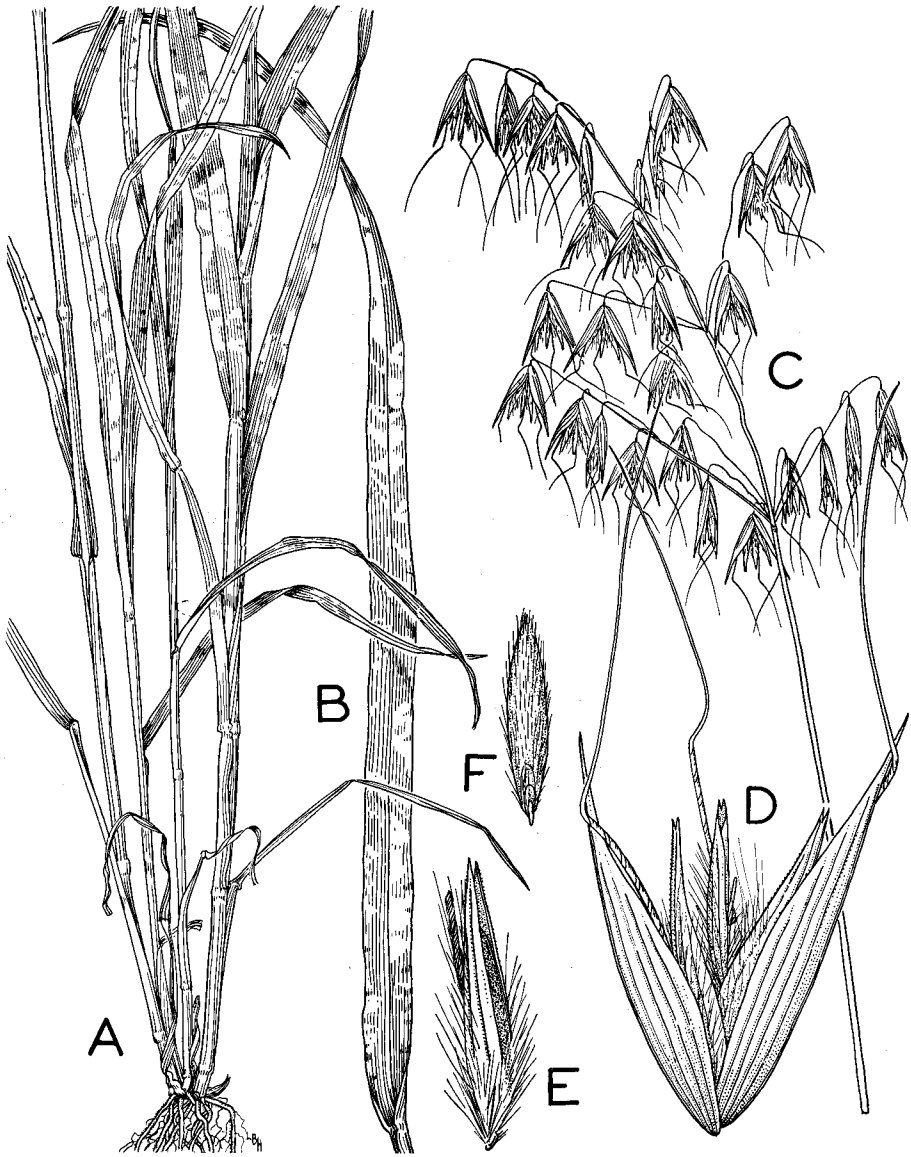
GRASS FAMILY

WILD OATS *(Avena fatua)*

DESCRIPTION — *Annual,* reproduces by seed. *Roots* fibrous. *Stems* smooth, thick, erect, 2 to 4 feet high, one to many per plant. *Leaves* alternate, smooth, wide, 4 to 12 inches long. *Flowers* arrangement a panicle similar to tame oats. *Spikelets* 2 to 3 florets enclosed loosely by 2 large, papery outer flower parts about 1 inch long. *Florets* have a dark awn with basal portion twisted and upper portion sharply angled from the basal portion, sucker-like collar at base. *Seeds* large, ⅛ inch long, hairy, color varies from light to dark brown.

HABITS — Our most serious winter annual grassy weed, especially in the Salt River Valley. Grows from November to May. Common in non-cultivated crops such as barley, alfalfa, wheat, oats, citrus and flax. Ability to emerge from deep (3 to 4 inches) in the soil makes control difficult. Matures earlier than small grains and shatters its seed before small grains are combined. Also common on ditchbanks, fence rows and roadways.

CONTROL — Proper crop management and crop rotation are the best ways to control wild oats. Where this weed is serious, non-cultivated winter crops should not be grown. Summer crops should be planted. Small grain fields containing excessive amounts of wild oats should be cut for hay, grazed or plowed under. If small grains or alfalfa are planted, the border ridges should be seeded. Apply IPC to control wild oats in flax.



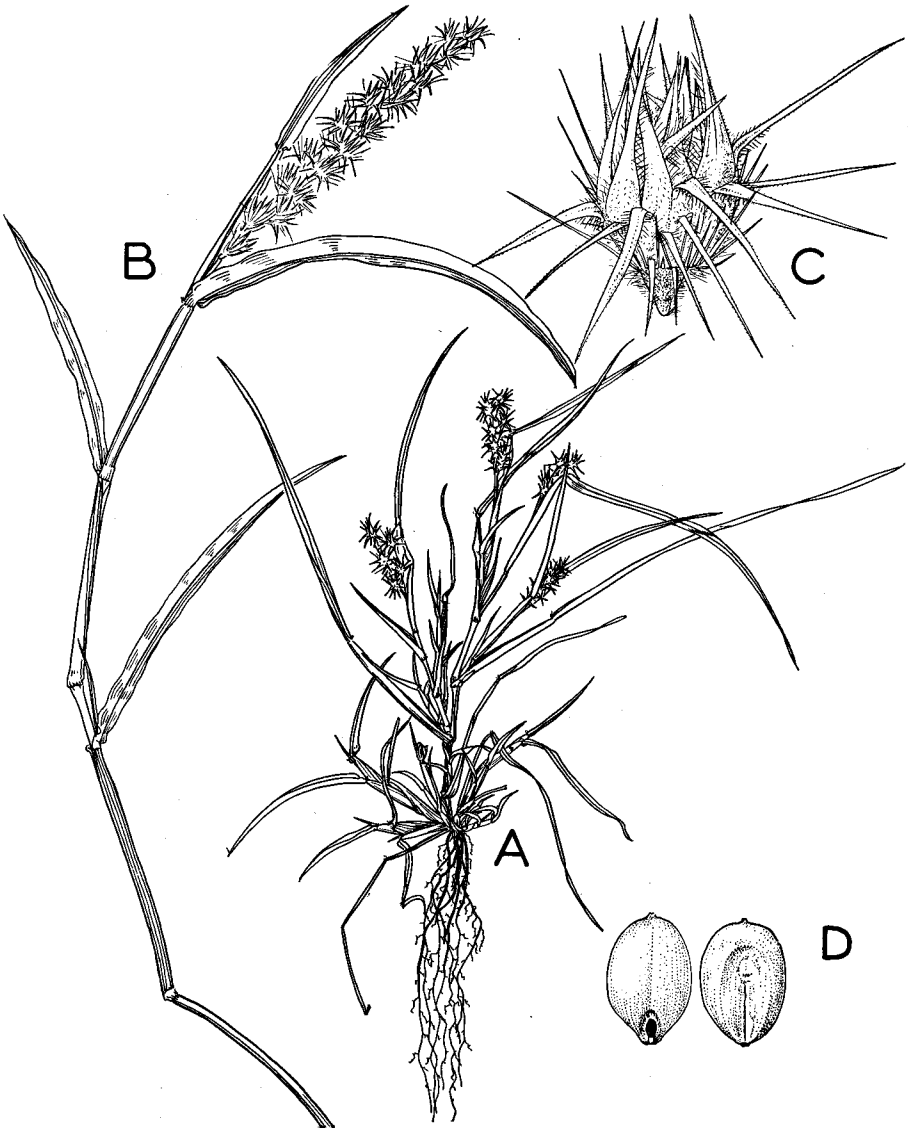
WILD OATS *(Avena fatua)* — A, Lower portion of stems; B, Leaf; C, Panicle; D, Spikelet; E, Floret; F, Seed.

SANDBUR, Burgrass *(Cenchrus echinatus)*

DESCRIPTION — *Annual,* reproduces by seed; sometimes *perennial,* crown survives if winters are mild. *Roots* fibrous. *Stems* smooth, often reddish, erect or spreading, 6 to 30 inches long, sometimes rooting at nodes, 1 to many stems per plant. *Leaves* smooth, 4 to 6 inches long. *Flowers* inflorescence compact, spike-like, composed of reddish *burs* with numerous sharp spines, contains 4 spikelets. *Seeds* tan, egg-shaped, 1/12 inch long, 2 to 4 in each bur.

HABITS — The summer "annual" grass most difficult to control. Grows from March until fall frost. Most common in non-cultivated summer crops. Found in citrus, cotton, alfalfa during the summer cuttings, and in other crops. Very serious on sandy soil. Ability to germinate from deep (2 to 3 inches) in the soil makes control difficult. Presence of mature sandburs in citrus and cotton makes harvest difficult and painful.

CONTROL — Proper crop management and crop rotation are the best ways to control sandburs. If possible, non-cultivated summer crops should not be grown. Plant summer row crops and cultivate or hoe as needed. Sandburs in citrus should be controlled with disk harrows or aromatic petroleum oils. Do not irrigate alfalfa if it is dormant during the late summer. Spotty stands of alfalfa should be plowed under and new stands established. Plant competitive winter crops such as small grain.



SANDBUR, Burgrass *(Cenchrus echinatus)* — A, Whole plant; B, Stem and spike-like inflorescence; C, Bur; D, Seed.

BERMUDA GRASS *(Cynodon dactylon)*

DESCRIPTION — *Perennial,* reproduces by seed, rhizome, and runner. *Roots* fibrous. *Rhizomes* hard, scaled, 1/16 to 1/8 inch in diameter; extensive, forming a dense sod. *Stems, runners* (stolons) prostrate, flattened, several feet long, bladeless or short-bladed leaves at nodes, rooting at nodes; branching to form *aerial stems* erect, 6 to 18 inches high. *Leaves* narrow, 1/8 inch wide, short, 1 to 3 inches long, fringe of hairs at the base of leaves. *Flowers* in 3 to 7 spikes arising from one point of the flower stem, spikes 1 to 3 inches long. *Spikelets* in two rows on one side of spike, flattened against spike. *Seeds* small, reddish-brown.

HABITS — Grows from March until frost. Serious in noncultivated crops such as alfalfa, citrus and grapes. Often a problem in row crops until row middles are shaded. Common on ditchbanks, field ends and border ridges from where it spreads into fields. Often spread when rhizomes are scattered by cultivation equipment.

CONTROL — Proper crop management and crop rotation control Bermuda grass. Where Bermuda grass is serious, summer fallow can be used. Where only patches of Bermuda grass are present, plant summer row crops and cultivate as needed. Plant winter crops such as barley, wheat or winter vegetables. Cultivate citrus and grapes with disk harrows. Spot treat Bermuda grass with aromatic petroleum oils in citrus and dalapon in grapes. In cotton, spot treat Bermuda grass with dalapon. Re-establish alfalfa as stands thin. Do not irrigate alfalfa if it is dormant during the late summer.

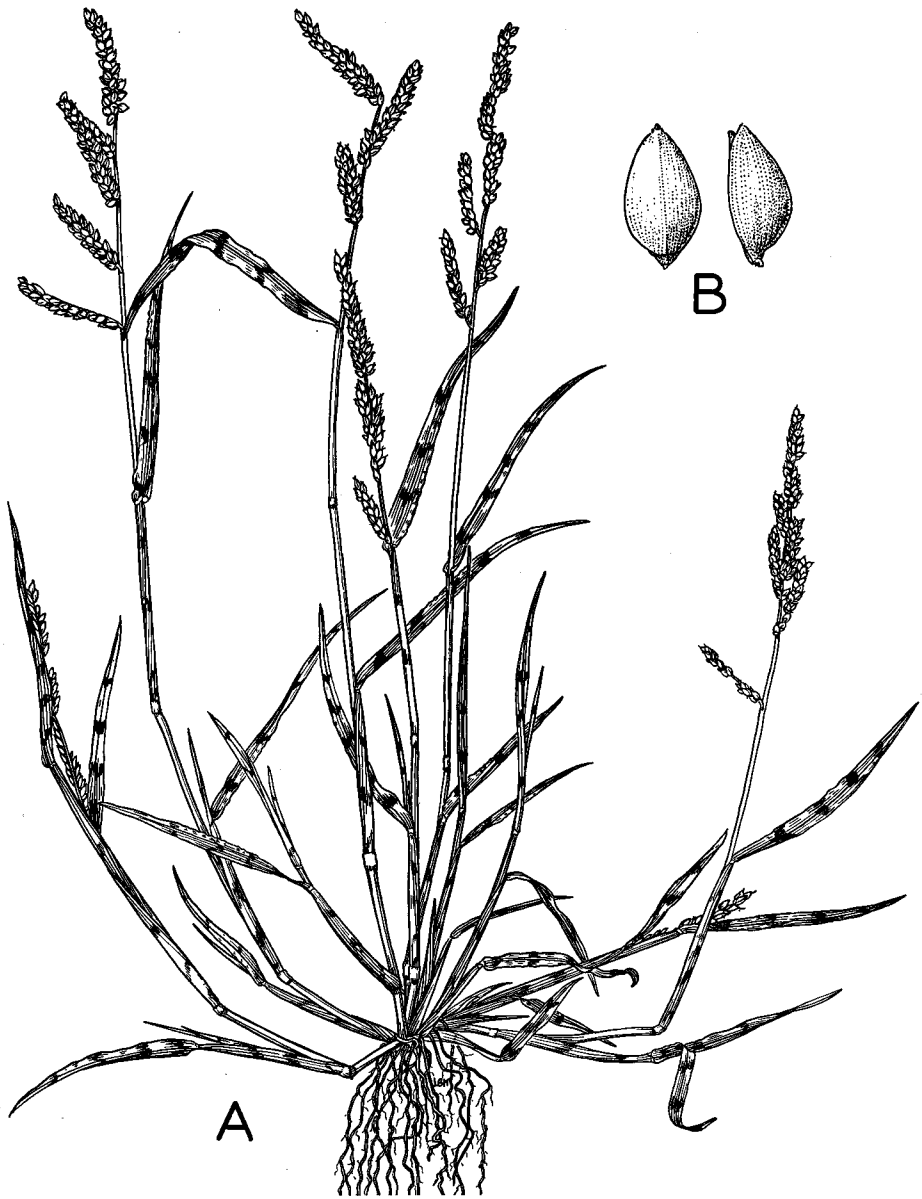
BERMUDA GRASS *(Cynodon dactylon)* — A, Whole plant showing the roots, rhizomes, and aerial stems; B, Inflorescence; C, Spikelet; D, Seed.

WATERGRASS *(Echinochloa colonum)*

DESCRIPTION — *Annual,* reproduces by seed. *Roots* fibrous. *Stems* smooth, thick, usually erect, 2 to 4 feet high, 1 to many stems per plant. *Leaves,* seedlings have red bars about ¼ inch wide perpendicular to the veins. *Flowers* inflorescence of several compact spikes on a common flower stem. *Spikelets* awnless, arranged on one side of spike. *Seeds* medium sized, shiny, yellow, convex side opposite flattened side.

HABITS — Grows from February until fall frost. Usually most serious after summer irrigations. Common in all summer crops if stands are thin, growth is slow or cultivation is neglected. Found in cotton, alfalfa, sorghum, melons, lettuce, citrus and Bermuda grass seed fields. Also common on ditchbanks.

CONTROL — For summer row crops, proper preplanting irrigation and planting in moist soil under a mulch of dry soil is an excellent way to control watergrass. Cotton and sorghum should receive careful mechanical cultivation, supplemented with flame cultivation if necessary. In cotton, monuron or diuron should be used to control watergrass after layby. Good stands of vigorous alfalfa control watergrass. It is not a problem in small grains. Apply NPA to control watergrass in melons. CDEC sometimes controls it in early planted lettuce, although hand hoeing is usually necessary.



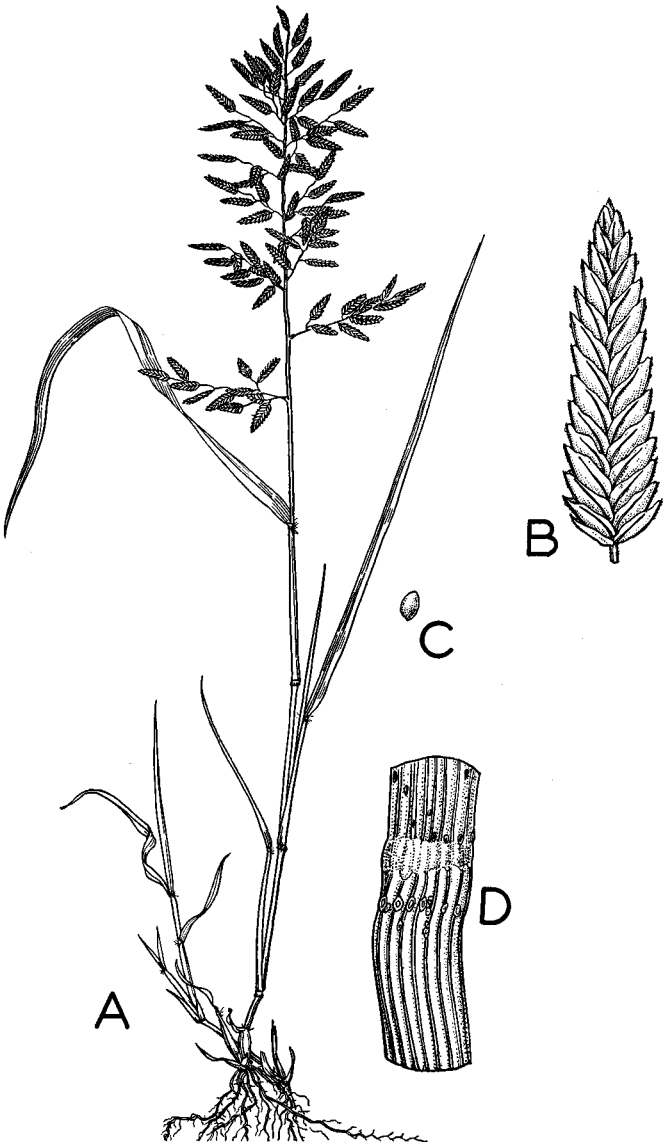
WATERGRASS *(Echinochloa colonum)* — A, Whole plant showing inflorescence and bars on leaves; B, Seed.

STINKGRASS *(Eragrostis cilianensis)*

DESCRIPTION — *Annual,* reproduces by seeds. *Roots* fibrous. *Stems* smooth, slender, erect, 2 to 3 feet high, small glands at each node, 1 to many stems per plant. *Leaves* flat, smooth, hairs at base of blade. *Flowers* inflorescence an open branching panicle, with many spikelets. *Spikelets* flattened ¼ to ½ inch long, composed of many small overlapping florets. *Seed* very small, reddish, egg-shaped. Some people find the *odor* of this plant disagreeable.

HABITS — Grows from April until fall frost. A pest in cotton, sorghum, alfalfa and citrus. Most serious after the summer irrigations. If crop stands are thin, growth is slow or cultivation is neglected, this weed can become serious.

CONTROL — Proper crop management and crop rotation are the best methods to control stinkgrass. Include winter crops in the rotation. Cotton should have pre-irrigation and the seed should be planted in moist soil. Use mechanical cultivation to control stinkgrass early in the growing season. Apply monuron or diuron at cotton layby for late season control. Re-establish alfalfa when stands thin and stinkgrass increases. In citrus, control this weed with disk harrows.



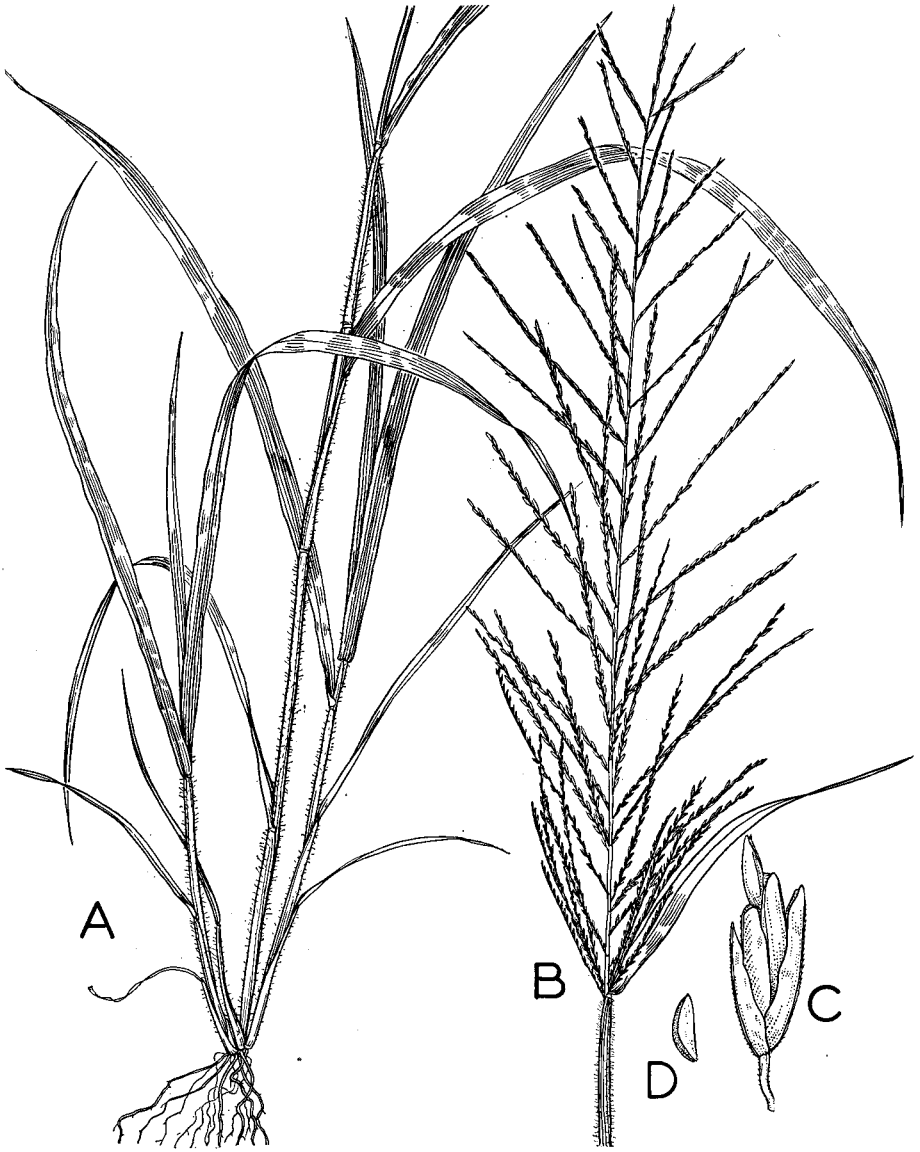
STINKGRASS *(Eragrostis cilianensis)* — A, Whole plant; B, Spikelet; C, Seed; D, Glands at nodes.

SPRANGLETOP *(Leptochloa filiformis)*

DESCRIPTION — *Annual*, reproduces by seed. *Roots* fibrous. *Stems* smooth, slender, erect, 2 to 4 feet high, 1 to many per plant. *Leaves* up to ½ inch wide, 6 to 10 inches long, sheaths are hairy. *Flowers*, at several points on the center flower stem. 1 to 4 slender spikes are attached, center flower stem often bending. *Spikelets* very small, lying against the stem of the spike. *Seed* very small, reddish.

HABITS — Grows from April until fall frost. Serious weed in cotton and sorghum, emerging after the first irrigation. Increases if crop stands are thin, growth is slow or cultivation neglected. Also found in alfalfa and citrus; on ditchbanks and border ridges. Sprangletop seldom reduces cotton yield but pieces of dry seed heads in lint reduce quality.

CONTROL — Proper crop management and crop rotation are the best ways to control sprangletop. Small grains should be included in the rotation. In cotton, seedbeds should be pre-irrigated and the seed planted in moist soil. Early season control of sprangletop by mechanical cultivation can be supplemented with flame cultivation. Apply monuron or diuron at layby for late season control of sprangletop. In alfalfa, thin stands should be re-established to control this weed. Do not irrigate alfalfa if it is dormant during late summer. In sorghum, a close row spacing helps control sprangletop.



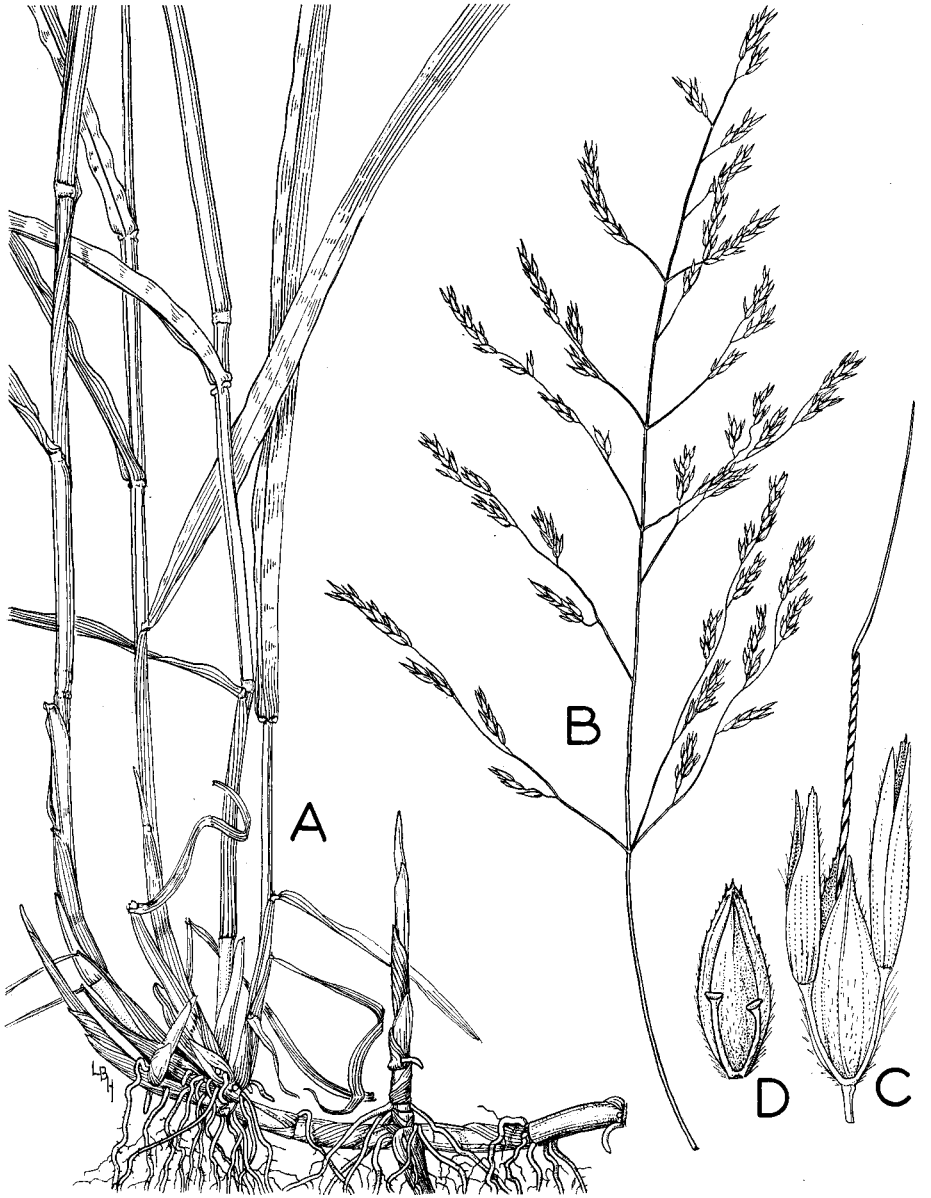
SPRANGLETOP *(Leptochloa filiformis)* — A, Lower stem showing hairs on sheaths of leaves; B, Flower stem; C, Spikelet; D, Seed.

JOHNSON GRASS *(Sorghum halepense)*

DESCRIPTION — *Perennial,* reproduces by seed and rhizome. *Roots* fibrous. *Rhizomes* thick, sometimes more than ½ inch in diameter, spreading, scales at nodes. *Stems* smooth, very thick, erect, 2 to 7 feet tall, not branching, leafy. *Leaves* alternate, flat, smooth, ½ to 2 feet long, up to 1 inch wide. *Flowers* purplish, hairy, in a large, open panicle. *Spikelets* with a twisted awn about ½ inch long. *Seed* large, oval, brown, often with awn and small pieces of flower stalks attached.

HABITS — Grows from March until fall frost. Serious in all summer crops, including cotton, sorghum, alfalfa, citrus and grapes. Sometimes serious in small grain where green topgrowth makes harvest difficult. Widespread on ditchbanks and waste areas. Usually introduced as seed, then forming clumps, and spread by rhizomes.

CONTROL — Proper crop management and crop rotation are the best ways to control Johnson grass. If an infestation of this weed is general, include a summer fallow in the rotation. Small grains and winter row crops should be included also. In cotton, early cultivation and spot treatment with dalapon of established Johnson grass in the row are the best control methods. Apply monuron or diuron at layby to control Johnson grass seedlings late in the season. Sorghum with severe infestations of Johnson grass should be cut for silage; scattered clumps can be hoed. Johnson grass in grapes should be spot treated with dalapon; in citrus, aromatic petroleum oils should be used.



JOHNSON GRASS *(Sorghum halepense)* — A, Base of stem showing rhizomes and roots; B, Flower stems; C, Spikelets, center one fertile and awned; D, Seed with two segments of flower stalk attached.

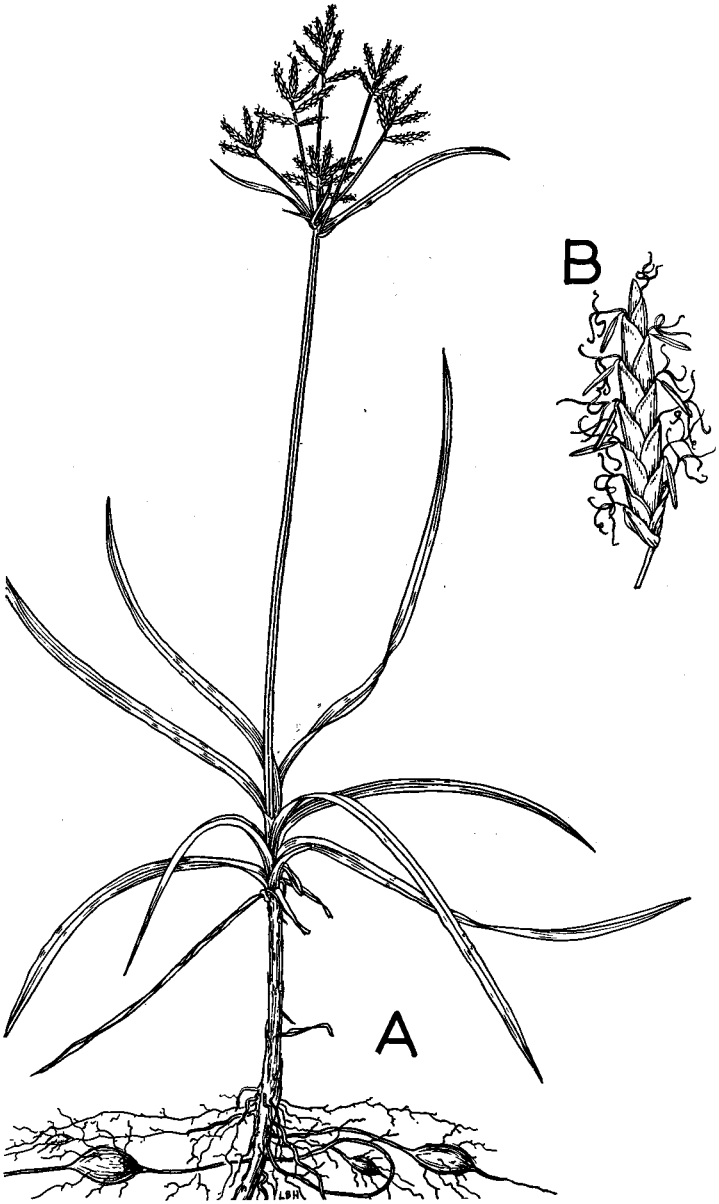
SEDGE FAMILY

NUTGRASS *(Cyperus rotundus)*

DESCRIPTION — *Perennial,* reproduces by seed and tuber. *Roots* fibrous. *Rhizomes* long, narrow, with scale-like leaves. *Tubers* reddish, oval, nut-like, ⅛ inch long. *Stems* smooth, triangular, leafless except at base and just below inflorescence, erect, 1 to 2 feet high, not branching. *Leaves* narrow, grass-like, clustered at the base of the stem, arranged in 3 rows. *Flowers* dark brown, arranged in clusters of flattened spikes. *Spikes* ½ inch long, with scales of individual flowers overlapping. *Seeds* small, brown, beaked.

HABITS — The perennial weed most difficult to control. Grows from March until fall frost. Infestations start as small patches which spread vegetatively (by rhizomes and tubers), in time covering entire fields. In all summer crops, especially non-cultivated crops. Found in alfalfa, cotton, sorghum, citrus and grapes. Also common on ditchbanks, field ends and border ridges from where it spreads into fields.

CONTROL — Proper crop management and crop rotation are the best ways to control nutgrass. If only a few patches are present nutgrass can be hoed. If the infestation is serious and general, inclusion of a summer fallow in the rotation is often the best control. Small grains and winter row crops should be grown. Summer row crops such as cotton, sorghum and castor beans should be grown. Early cultivation is essential. Alfalfa should be re-established as the stand thins. Nutgrass in citrus should be cultivated with a disk harrow or treated with an aromatic petroleum oil whenever necessary for control.



NUTGRASS *(Cyperus rotundus)* — A, Whole plant showing tubers and leaf and flower arrangement; B, Individual flower spike.

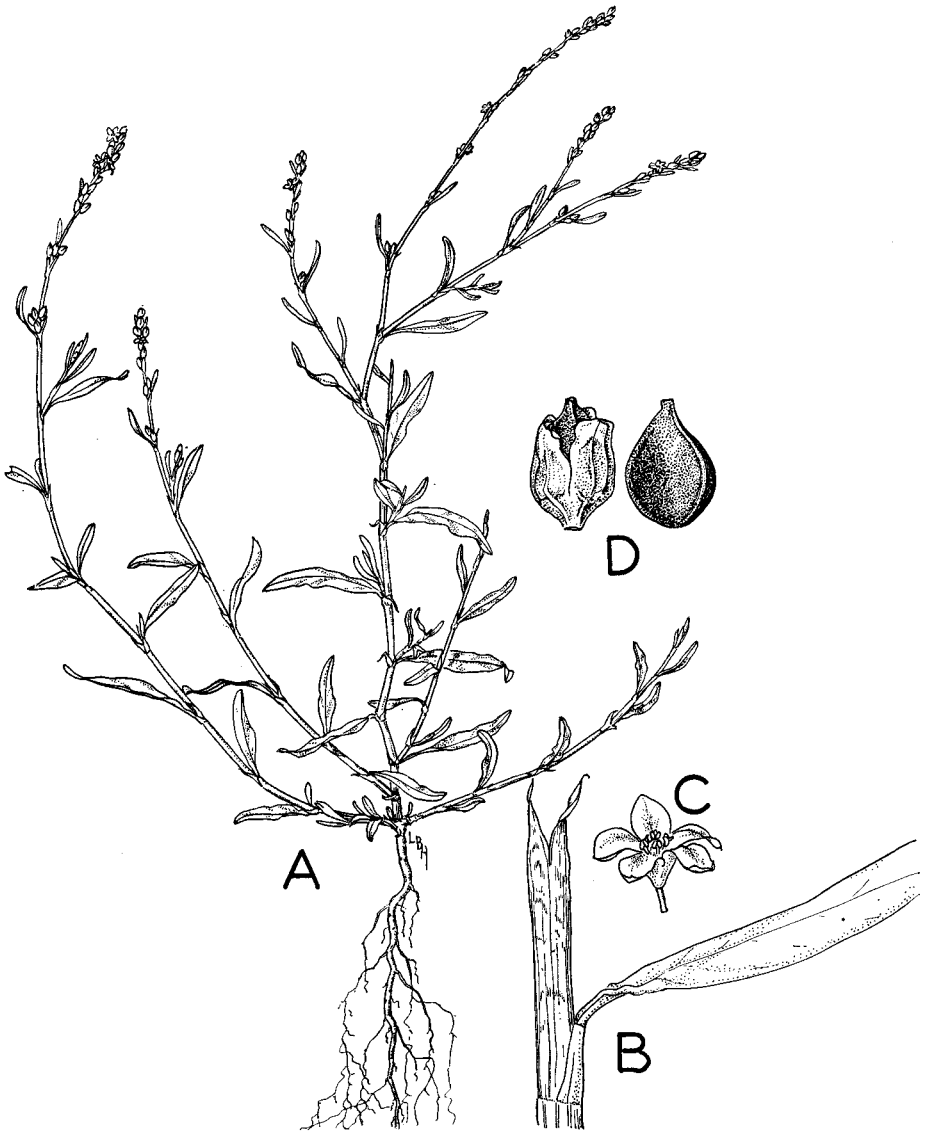
BUCKWHEAT FAMILY

SILVERSHEATH KNOTWEED *(Polygonum argyrocoleon)*

DESCRIPTION — *Annual,* reproduces by seed. *Roots* shallow, branching taproot. *Stems* smooth, branching, spreading to erect, 2 to 3 feet long. *Leaves* narrow, 1 to 2 inches long, much reduced at upper end of stem; a silvery sheath ¼ inch long around stem at base of leaves. *Flowers* small, pink, on a slender leafless terminal spike. *Seeds* 3-sided, brown, smooth, shiny, ⅛ inch long.

HABITS — Grows from November until July. Most serious in winter noncultivated crops such as alfalfa, flax and small grains. Also found in winter vegetables, citrus, ditchbanks, border ridges and waste areas. Its seed is very difficult to remove from alfalfa seed. A very serious weed in alfalfa seed fields.

CONTROL — Proper crop management and crop rotation are the best ways to control silversheath knotweed. Summer crops and row-planted winter crops should be included in the rotation. 2,4-D can be used to control this weed in small grains. Sulfuric acid, selective petroleum oils and DNBP can be used to control silversheath knotweed in vegetable crops which tolerate these herbicides. In alfalfa seed plantings, the seed for establishing the field must be free of weed seed, the crop should be row planted and cultivated, the field may be hand hoed. In citrus, silversheath knotweed should be controlled with disk harrows.



SILVERSHEATH KNOTWEED *(Polygonum argyrocoleon)* — A, Whole plant showing terminal inflorescence; B, Sheath at base of leaf; C, Flower; D, Seed.

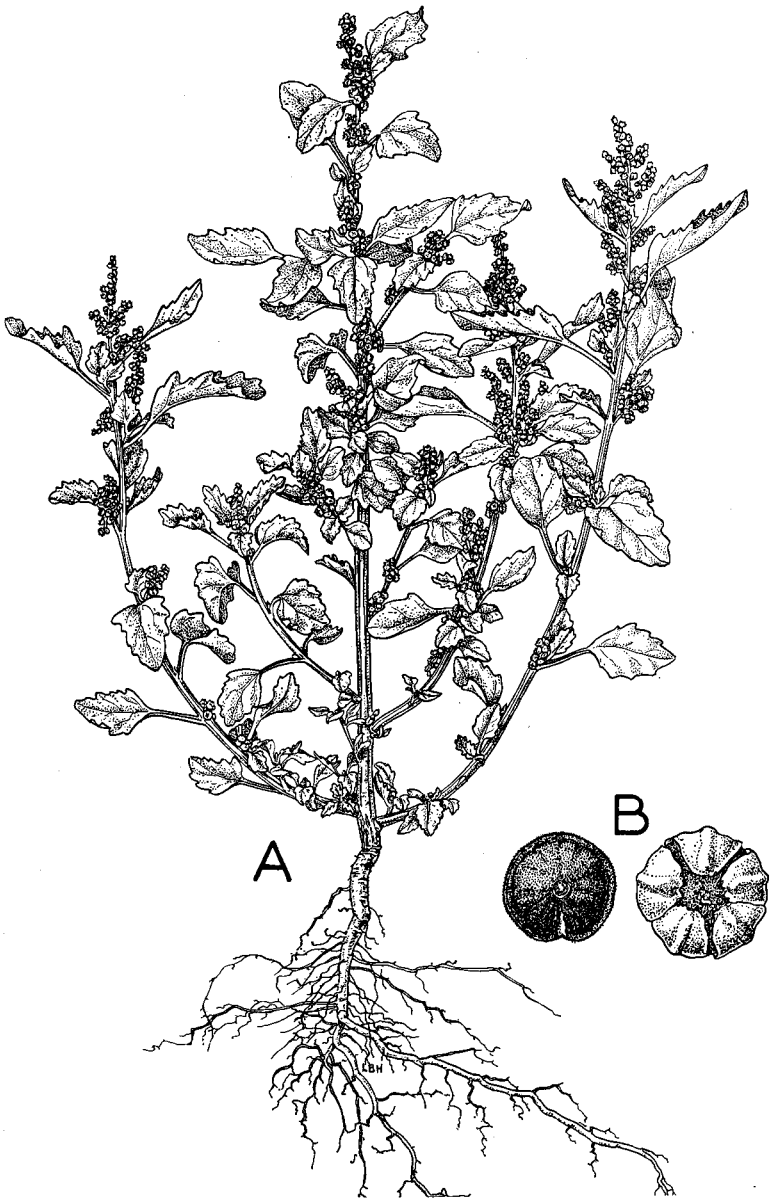
GOOSEFOOT FAMILY

NETTLELEAF GOOSEFOOT *(Chenopodium murale)*

DESCRIPTION — *Annual,* reproducing by seed. *Roots* branching taproot. *Stems* smooth, thick, angular, reddish, erect, much branched when growing without competition. *Leaves* alternate, thick, dark green, shallow toothed on margin, young leaves have a white meal-like coating. *Flowers* small, green, sometimes reddish, in dense terminal clusters and in axils of upper leaves. *Seed* black, lens-shaped, 1/16 inch in diameter.

HABITS — Grows from October to June. Common in all winter crops including vegetables, citrus, small grains, alfalfa and flax and on ditchbanks and waste areas.

CONTROL — Proper crop management and crop rotation are the best control methods. Summer crops should be included in the rotation. Small grains should be pre-irrigated and planted in moist soil; the border ridges should be seeded; 2,4-D should be applied if needed. In vegetables, cultivation should be supplemented by applications of sulfuric acid, selective petroleum oils, DNBP, or KOCN in crops which tolerate these herbicides. In alfalfa, mowing destroys topgrowth of nettleleaf goosefoot; unless border ridges are disked they should be seeded. Use disk harrows to control this weed in citrus.



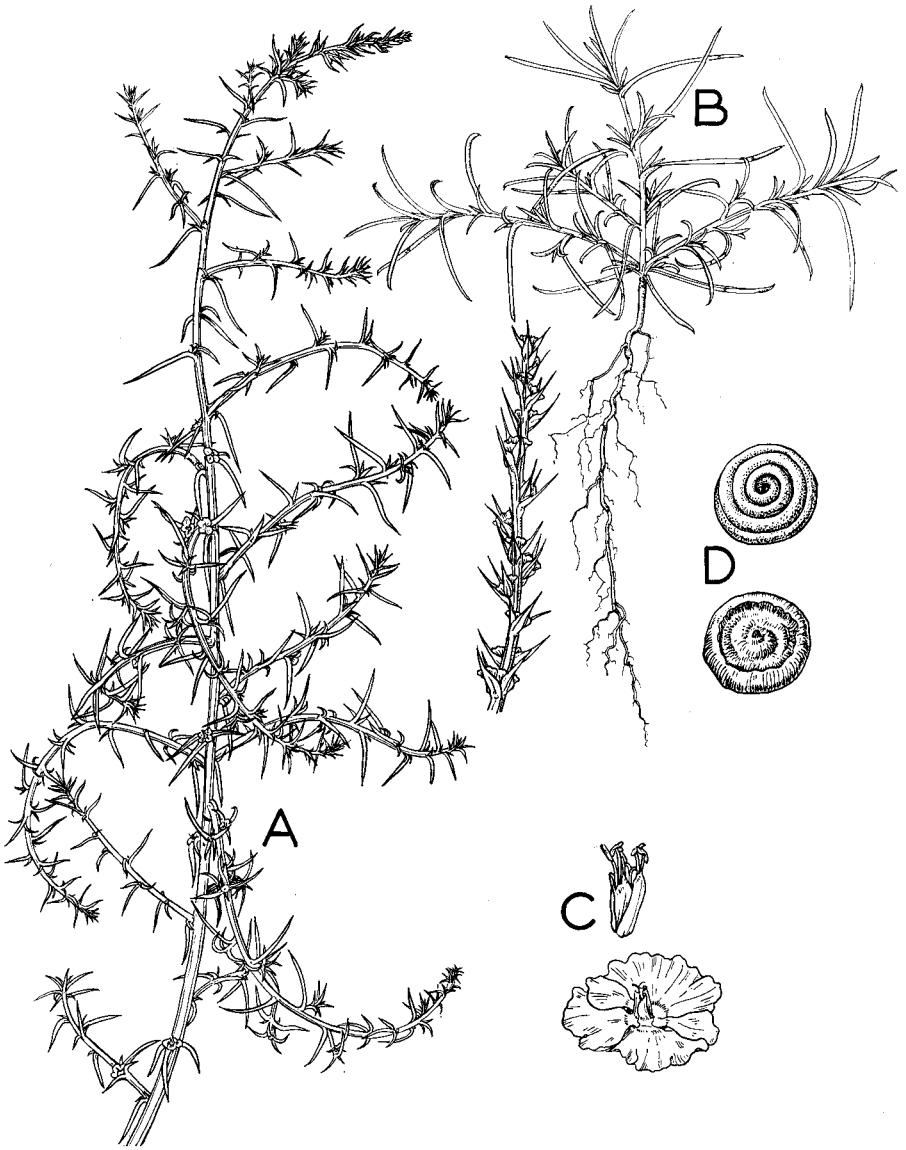
NETTLELEAF GOOSEFOOT *(Chenopodium murale)* — A, Whole plant; B, Seed.

RUSSIAN THISTLE, Tumbleweed *(Salsola kali)*

DESCRIPTION — *Annual,* reproduces by seed. *Roots* extensive, branching, taproot. *Stems* much branched, usually forming a ball-shaped tumbleweed 1 to 5 feet in diameter. *Leaves* alternate, green; on *seedlings,* soft, cylindrical, about one inch long; on *established plants* short, stiff, awl-shaped, spine-tipped, sometimes reddish at maturity. *Flowers* small, light green, inconspicuous, in axils of upper leaves. *Seed* small, conical, snail-shaped, gray to brown.

HABITS — Grows from March until fall frost. Serious weed on ditchbanks, border ridges, roadsides, and waste areas. Common in small grains. Very common in small grain fields after harvest if land is not cultivated. When mature, stem breaks from root and plants are blown into fence rows, ditches and holding ponds.

CONTROL — Crop rotation is the best control. Plant summer row crops, for mechanical cultivation controls this weed. In small grains, 2,4-D should be applied to control Russian thistle. Apply 2,4-D while the weed is small; its resistance increases rapidly after the seedling stage.



RUSSIAN THISTLE, Tumbleweed *(Salsola kali)* — A, Portion of plant showing flower in leaf axil; B, Seedling; C, Flower; D, Seed with hull removed.

AMARANTH FAMILY

CARELESSWEED, Pigweed *(Amaranthus palmeri)*

DESCRIPTION —*Annual*, reproduces by seed. *Roots*, taproot. *Stems* thick, lower portions reddish, not branching if growing in competition, erect, 2 to 10 feet tall. *Leaves* alternate, smooth, margin not toothed, white V-shaped bar on leaves of young plants. *Flowers* small, green, clustered in very long, terminal spikes, some in small spikes from axils of leaves, male and female flowers on different plants, female flowers concealed by rough bracts. *Seeds* shiny, black, flattened, egg-shaped, 1/16 inch long.

HABITS — Grows from March until fall frost. Common in all summer crops. Most serious in cotton and sorghum. Grows rapidly in midsummer and is a vigorous competitor in both crops. Common in alfalfa, citrus and grapes and on ditchbanks, roadways and waste areas.

CONTROL — Proper crop management and crop rotation, supplemented with applications of herbicides, are the best control. Winter crops should be included in the rotation. Cotton should be pre-irrigated and receive careful early season mechanical and flame cultivation. Monuron should be applied at layby for late season control of carelessweed. In sorghum, apply 2,4-D to control this weed. Mowing destroys carelessweed topgrowth in alfalfa. In grapes, use disk harrows, French plows, and hoes to control this weed.

CARELESSWEED, Pigweed *(Amaranthus palmeri)* — A, Whole plant; B, Flower heads; C, Male flower; D, Female flower; E, Seed.

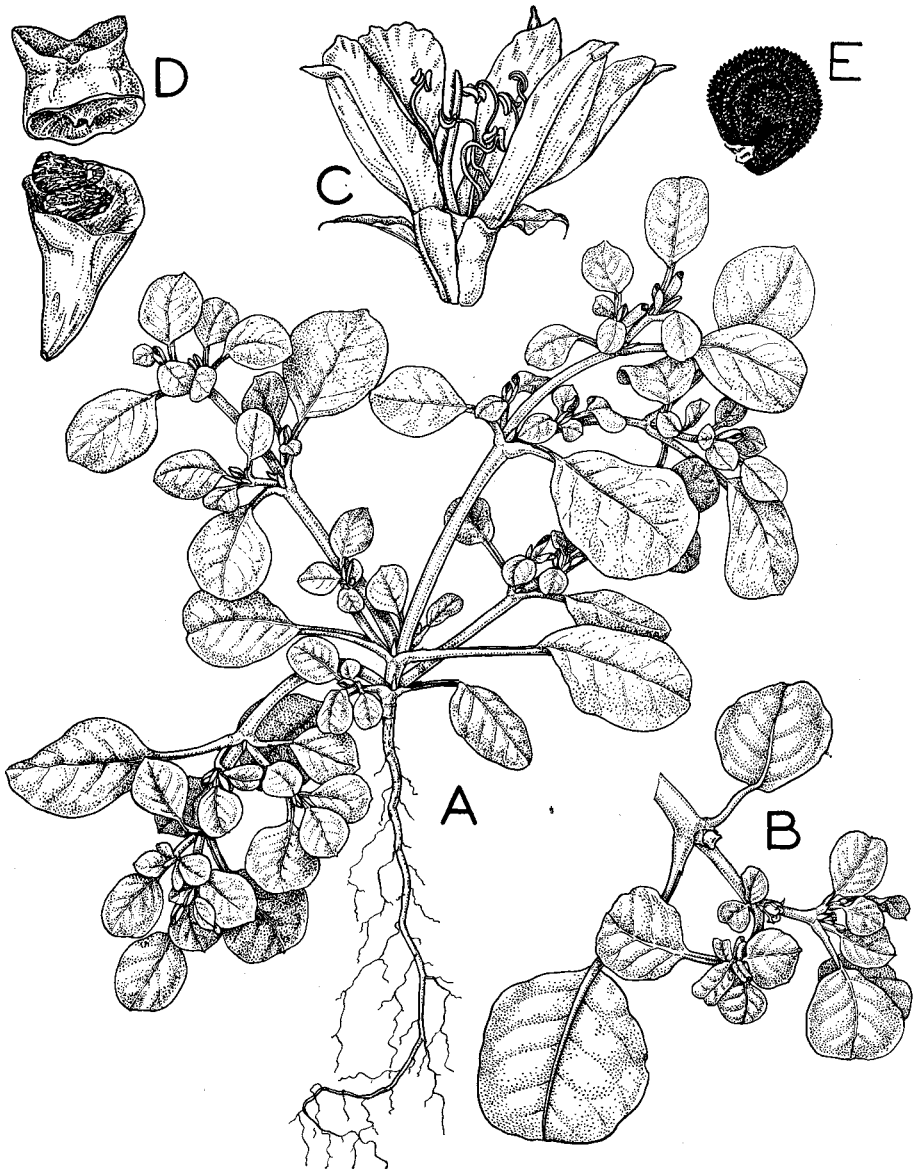
CARPETWEED FAMILY

HORSE PURSLANE *(Trianthema portulacastrum)*

DESCRIPTION — *Annual,* reproduces by seed. *Roots,* taproot. *Stems* smooth, fleshy, often purplish, prostrate, freely branching, forming a mat, 1 to 3 feet long, stems ascending when growing in competition. *Leaves* smooth, opposite, pair unequal in size, thick, round to oval, green, tinged with purple. *Flowers* small, purple, borne singly in axils of upper leaves. *Fruit* a few-seeded capsule that splits around the middle. *Seeds* small, black, round.

HABITS — Grows from April until fall frost. Common in cotton, citrus, and sorghum; also on ditchbanks and border ridges.

CONTROL — Proper crop management and crop rotation control horse purslane. Include winter crops in rotation. Cotton should be pre-irrigated and the seed planted in moist soil. Mechanical cultivation will control horse purslane. In citrus, use disk harrows.



HORSE PURSLANE *(Trianthema portulacastrum)* — A, Whole plant; B, Branch showing flower in axil of leaves; C, Flower; D, Capsule; E, Seed.

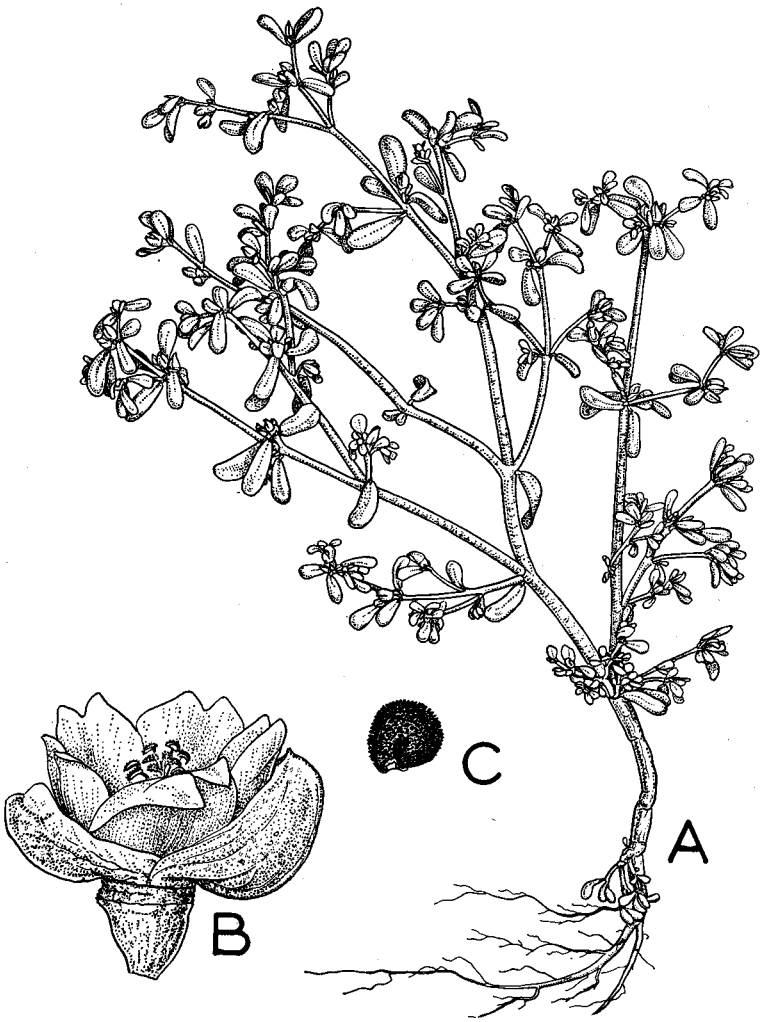
PURSLANE FAMILY

PURSLANE, Pusley *(Portulaca oleracea)*

DESCRIPTION — *Annual,* reproducing by seed. *Roots* shallow, branching taproot. *Stems* smooth, fleshy, reddish, freely branching, usually prostrate, forming mats on ground, stems 1 to 2 feet long. *Leaves* alternate or clustered; smooth, fleshy, narrow, wedge-shaped, up to 1 inch long. *Flowers* small, yellow, 5 petals, in axils of terminal leaves. *Fruit* a capsule that splits around the middle, containing many seeds. *Seeds* very small, black, round, flattened.

HABITS — Grows from April to June and August until frost. Grows only when temperatures are moderate. Most serious in lettuce, carrots, sugar beets and citrus. Severe infestations have caused lettuce fields to be abandoned. Can become increasingly troublesome if lettuce is grown several years continuously on the same field.

CONTROL — Crop rotation is the best method to control purslane. Cotton, sorghum, alfalfa or small grains should be included in the rotation. In lettuce, CDEC should be applied after planting for early season control. Cultivation and hoeing control purslane after thinning. Purslane in citrus and grapes can be controlled with disk harrows. In carrots, apply selective petroleum oils to control purslane.



PURSLANE, Pusley *(Portulaca oleracea)* — A, Whole plant; B, Flower; C, Seed.

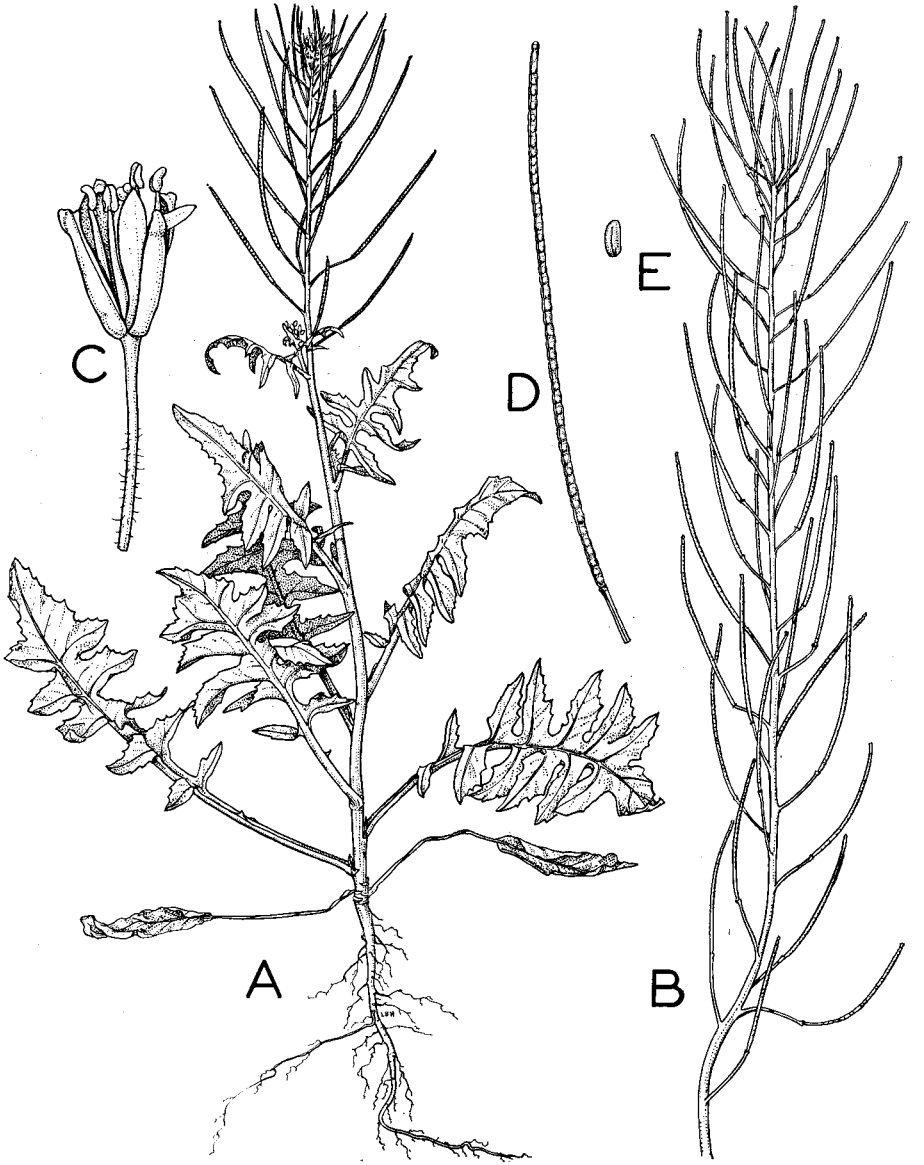
MUSTARD FAMILY

LONDON ROCKET, Mustard *(Sisymbrium irio)*

DESCRIPTION — *Annual,* reproduces by seed. *Roots,* taproot. *Stems* smooth, erect, reddish, branching when growing without competition, 1 to 3 feet high. *Leaves* dark green, deeply lobed, 4 to 6 major lobes on each side of leaf. *Flowers* small, yellow, borne in terminal clusters. *Fruit* long, 1 to 2 inches, narrow pod; pods borne on a long terminal stem; pods spread from this stem. *Seed* very small, tan, oval.

HABITS — Grows from October to May. Our most common winter broadleaved weed. Found in alfalfa, small grains, winter vegetables and citrus. Also on ditchbanks, border ridges, roadsides and waste areas. Produces great numbers of seed. In small grains it matures and shatters seed before grains are combined.

CONTROL — Proper crop management and crop rotation are the best methods to control London rocket. Include summer crops in the rotation. In alfalfa, mowing destroys topgrowth of London rocket. It is not a problem after the second spring cutting. In seedling alfalfa, apply DNBP if competition of London rocket is severe. Small grains should be preirrigated; the border ridges seeded; 2,4-D applied if infestations are severe. In vegetables, supplement cultivation with applications of sulfuric acid, selective petroleum oils, DNBP or KOCN in crops which tolerate these herbicides. In citrus, London rocket should be controlled with disk harrows.



LONDON ROCKET, Mustard *(Sisymbrium irio)* — A, Whole plant; B, Inflorescence; C, Flower; D, Pod; E, Seed.

CLOVER FAMILY

SOUR CLOVER *(Melilotus indica)*

DESCRIPTION — *Annual,* reproduces by seed. *Roots,* taproot. *Stems* smooth, branching, usually erect, 2 to 3 feet high. *Leaves* trifoliate, *leaflets* wedge-shaped, toothed; leaflets of seedlings have a narrow red bar along midrib. *Flowers* small, yellow, in dense terminal clusters about 1 inch long, also in axils of leaves. *Fruit* small, one-seeded pods on narrow flower spikes. *Seed* green, rough, round, medium sized.

HABITS — Grows from November to June. Serious in citrus, winter vegetables and small grains. Common on ditchbanks, roadsides and waste areas. Often in alfalfa hay but seldom in alfalfa seed.

CONTROL — Proper crop management and crop rotation are best. In citrus, a disk harrow should be used. Summer crops should be included in rotations. In vegetables, supplement mechanical cultivation with applications of sulfuric acid or selective petroleum oils in crops which tolerate these herbicides. In small grains, use 2,4-D to control sour clover.

SOUR CLOVER *(Melilotus indica)* — A, Whole plant; B, Seedling showing bar along midrib of leaflets; C, Flower; D, Seed.

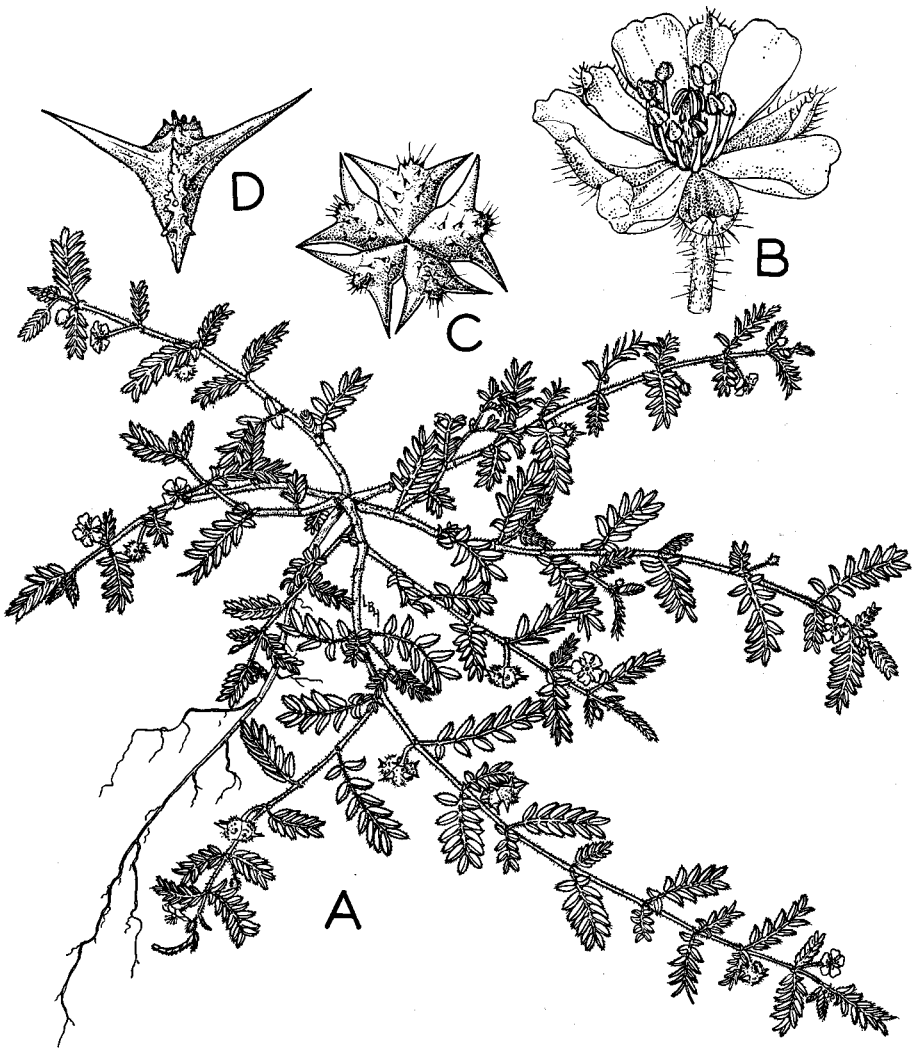
CALTROP FAMILY

PUNCTURE VINE, Goathead, Bullhead *(Tribulus terrestris)*

DESCRIPTION — *Annual*, reproduces by seed. *Roots*, taproot. *Stem* hairy, prostrate, freely branching, runners 2 to 8 feet long, often forming dense mats. *Leaves* opposite, hairy, divided into 4 to 7 pairs of small leaflets. *Flowers* yellow, 5 petals, in axils of leaves. *Fruit* flattened, contains up to 5 nutlets, fruit splitting when mature. *Nutlets* (burs) with 2 spines, contains several seeds.

HABITS — Grows from March until fall frost. Found in citrus, cotton, sorghum, small grain, alfalfa and vegetables. Most common on ditchbanks, border ridges, roadsides and waste areas. Spined nutlet is well adapted for spreading by agricultural implements mounted on rubber tires.

CONTROL — Proper crop management and crop rotation are the best methods of control. Include winter crops in the rotation. Use disk harrow to control this weed in citrus. In cotton, puncture vine can be controlled by mechanical cultivation. Apply 2,4-D to control puncture vine in small grains and sorghum. Reestablish alfalfa when stands thin and this weed becomes a problem.



PUNCTURE VINE, Goathead, Bullhead *(Tribulus terrestris)* — A, Whole plant; B, Flower; C, Mature Fruit; D, Nutlet.

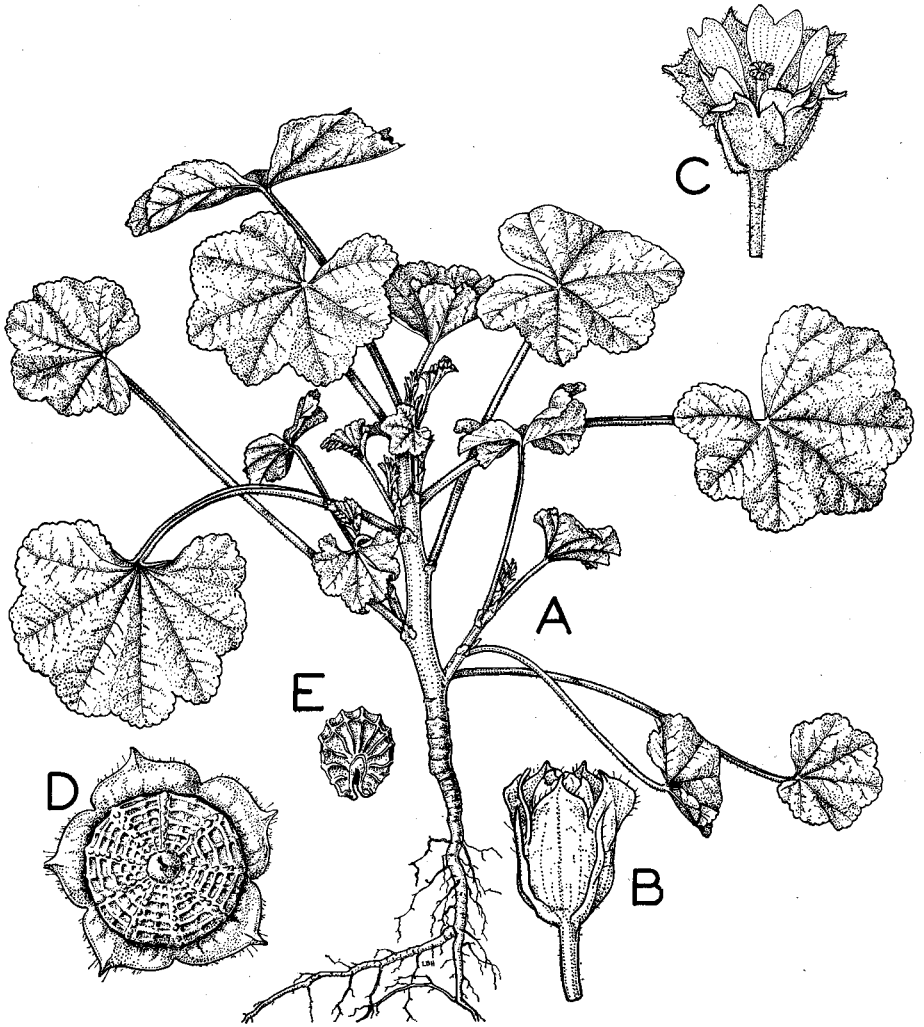
MALLOW FAMILY

CHEESEWEED, Mallow *(Malva parviflora)*

DESCRIPTION — *Annual,* reproduces by seed. *Roots,* taproots. *Stem* slightly hairy, freely branching, reddish, erect or spreading, 1 to 3 feet high. *Leaves* large, up to 5 inches in diameter, finely hairy, circular, 7 large lobes and many small teeth on margin, borne on long slender leaf stem. *Flowers* small, 5 white to purple notched petals, borne in clusters in axils of leaves. In cool weather seed is set although flowers may not open. *Fruit* flattened disk with many seeds arranged around the edge, shattering easily when mature. *Seed* round, with a notch, flattened, 1/16 inch in diameter.

HABITS — Grows from November to June. Most common on ditchbanks, border ridges, roadsides and waste areas. Found in alfalfa, citrus and small grains.

CONTROL — Proper crop rotation and crop management are the best ways to control cheeseweed. Include summer crops in the rotation. In alfalfa, mowing destroys the top growth of cheeseweed. It is not a problem after the second cutting. The border ridges should be seeded. In citrus, use disk harrows to control cheeseweed. In small grains, apply 2,4-D to control this weed.



CHEESEWEED, Mallow *(Malva parviflora)* — A, Whole plant; B, Flower when temperatures are low; C, Normal flower; D, Fruit; E, Seed.

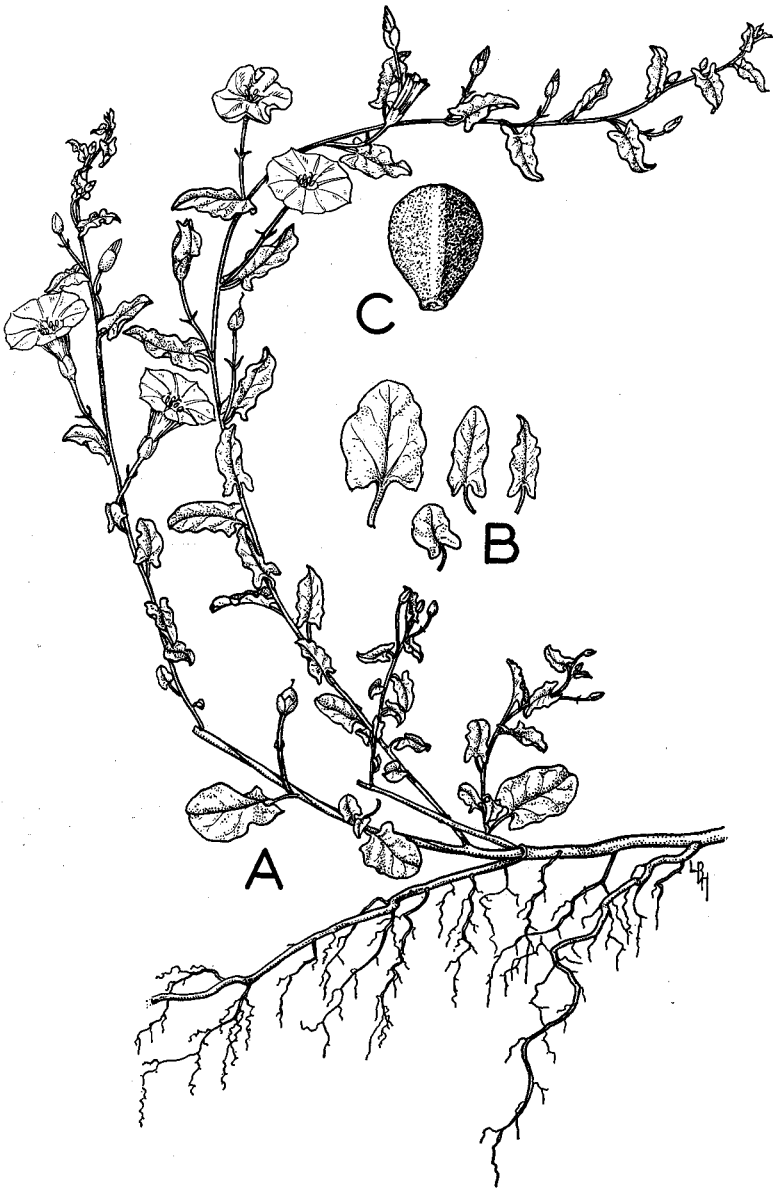
MORNING GLORY FAMILY

FIELD BINDWEED *(Convolvulus arvensis)*

DESCRIPTION — Perennial, reproduces by seeds and underground stems. *Roots* fibrous. *Underground stems* branching, very deep and extensive. *Stems* smooth, slender, prostrate, spreading on surface of ground, or climbing on crop plants, 2 to 6 feet long. *Leaves* alternate, arrow-shaped, with large basal lobes, margins smooth, 1 to 3 inches long. *Flowers* white to purple, 5 united petals, funnel-shaped, 1 inch in diameter, borne singly on stems from axils of leaves. *Fruit* egg-shaped capsule containing 2 to 4 seeds, splitting when mature. *Seeds* large, 1/6 inch long, rough, gray-brown, 3-angled, one side rounded, 2 sides flat.

HABITS — Grows from February until fall frost. Serious in a few locations. Found in cotton, sorghum, small grain and alfalfa. More often found on ditchbanks, roadways and waste areas. Extensive system of underground stems is difficult to destroy. Seed can remain dormant in the soil for many years. Any attempt to destroy bindweed must be based on an extended control program.

CONTROL — Proper crop management and crop rotation are the best ways to control field bindweed. Where infestations of this weed are serious and general, summer fallow cultivating at 2 to 3 week intervals with wide sweeps is the best control method. Winter row crops should be included in the rotation. In small grains and sorghum, apply 2,4-D to control field bindweed. In cotton, mechanical cultivation and hoeing control this weed.



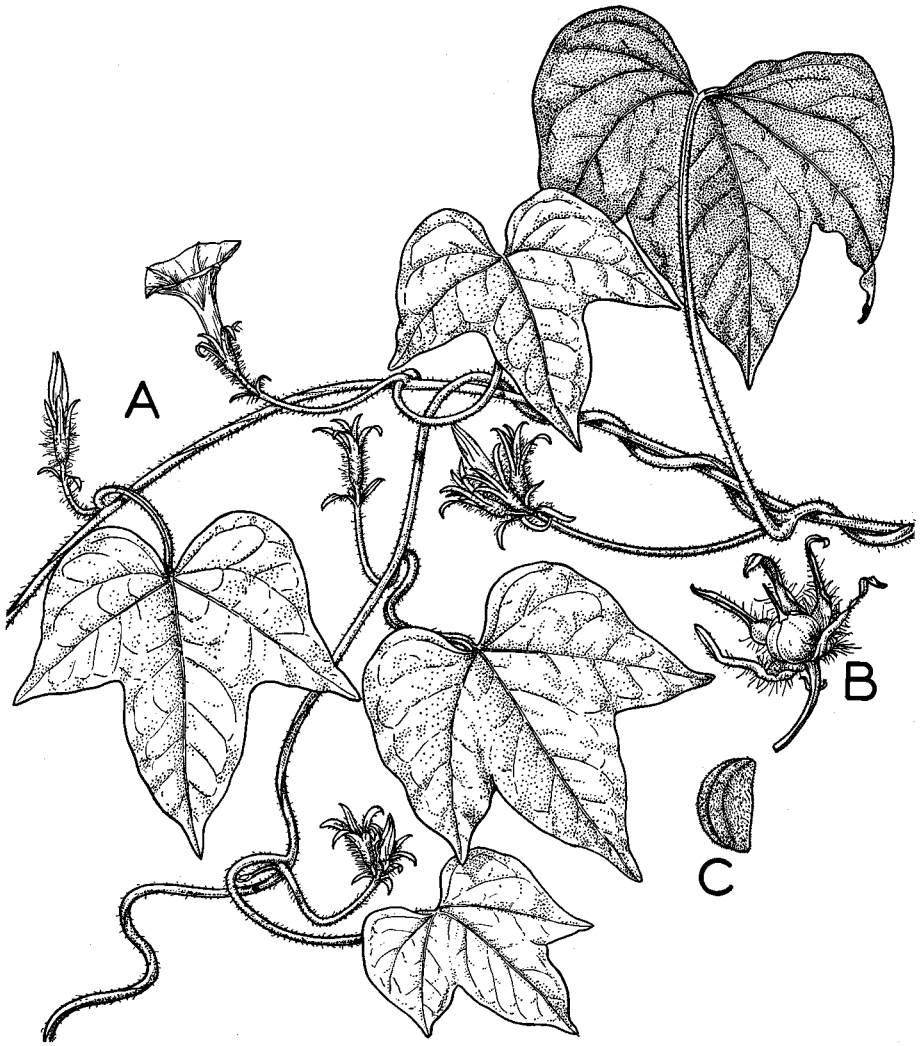
FIELD BINDWEED *(Convolvulus arvensis)* — A, Portion of a plant showing leaves, flowers, and underground stem; B, Leaves; C, Seed.

MORNING GLORY *(Ipomoea hirsutula)*

DESCRIPTION — *Annual,* reproduces by seed. *Roots,* taproot. *Stems* slightly hairy, twining or spreading on ground, often 10 to 20 feet long, freely branching when plant reaches sunlight. *Leaves* alternate, broad, 2 to 4 inches wide, three lobed. *Flowers* 5 united petals, bell-shaped, blue, with white throat, over 1 inch in diameter, borne in clusters on stem from axils of leaves. *Fruit* egg-shaped, splitting when mature, partly enclosed by long hairy sepals, usually contains 3 to 5 seeds. *Seeds* black, rough, large, ¼ inch long, one round side, two flattened sides.

HABITS — Grows from April until fall frost. Well adapted to survive in summer row crops. Most common in cotton and sorghum. Very serious where crop fails to shade the row middles at layby or where stands are thinned by disease. Able to emerge from two inches deep in the soil. Can germinate at layby, grow over cotton and make harvest difficult. Spread by mechanical cotton pickers, sorghum combines and application of gin trash. Seed is difficult to clean from sorghum seed.

CONTROL — Crop rotation is the best control for morning glory. It is not a problem in small grains, winter vegetables or alfalfa. In cotton, preplanting irrigation and planting in moist soil reduces but does not eliminate the early season problem of morning glory. Cotton should receive careful cultivation, which may be supplemented with flame cultivation. Apply monuron at layby for late season control of morning glory. In sorghum, 2,4-D may be needed to control this weed.



MORNING GLORY *(Ipomoea hirsutula)* — A, Portion of the plant showing leaves, flowers, and stem; B, Fruit; C, Seed.

NIGHTSHADE FAMILY

GROUNDCHERRY *(Physalis wrightii)*

DESCRIPTION — *Annual*, reproduces by seed. *Roots*, taproot. *Stem* smooth, thick, succulent, pale green, branching, 1 to 5 feet high. *Leaves* alternate, pale green, succulent, toothed. *Flowers* solitary in axils of leaves, wheel-shaped, 5 united petals, white with yellow center. *Fruit* berry-like, enclosed by papery, inflated, veined sepals; contains many seeds. *Seeds* flattened, yellow, 1/16 inch diameter.

HABITS — Grows from March until fall frost. In cotton, sorghum and citrus. Serious in summer row crops if stands are thin, growth is slow or cultivation is neglected. Common on ditchbanks, border ridges and waste areas.

CONTROL — Proper crop management and crop rotation, supplemented by applications of herbicides, are the best control. Winter crops should be included in the rotation. Summer row crops should be preirrigated and planted in moist soil. In cotton, early season control of groundcherry by mechanical and flame cultivation should be supplemented by a layby application of monuron or diuron. In sorghum, cultivation can be supplemented by an application of 2,4-D. In sorghum, a close row spacing helps control groundcherry.

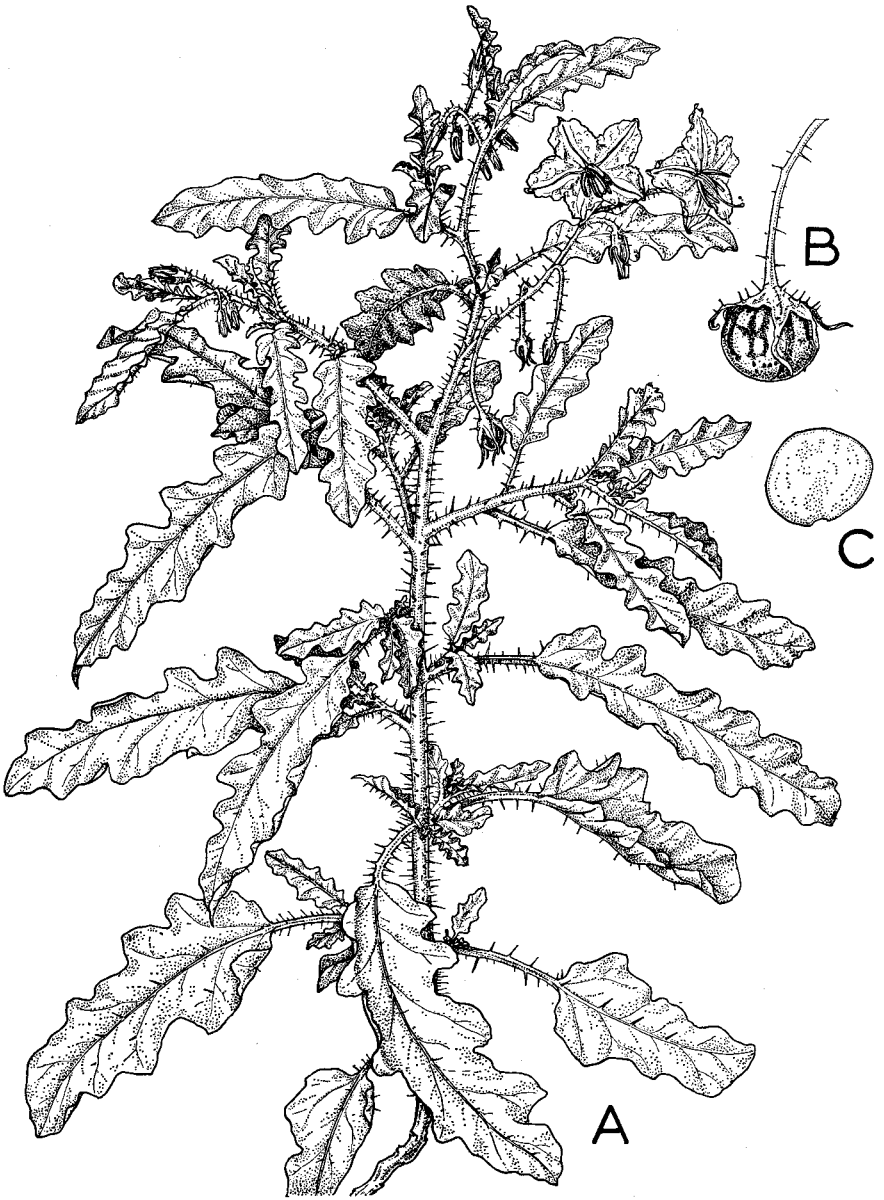
GROUNDCHERRY *(Physalis wrightii)* — A, Whole plant; B, Flower; C, Fruit; D, Seed.

WHITE HORSENETTLE, Blueweed *(Solanum elaeagnifolium)*

DESCRIPTION — *Perennial,* reproduces by seed and underground stems. *Underground stems* long, deep, spreading. *Stems* spiny, slender, branching, small white hairs, 1 to 3 feet high. *Leaves* alternate, rough, wavy-edged, white hairs, spines along midrib on both the upper and lower surface. *Flowers* white to blue, 5 united petals, wheel-shaped, 1 inch in diameter, yellow stamens, few flowers on each stem from axil of leaves. *Fruit* smooth, mottled, green berry, ½ inch in diameter, turns yellow when mature, contains many seeds. *Seeds* yellow to brown, flattened, oval, ⅛ inch long.

HABITS — Grows from March until fall frost. The most widespread perennial broadleaved weed in Arizona. Common in summer crops such as sorghum, cotton and alfalfa. Serious on ditchbanks, field ends, border ridges and waste areas.

CONTROL — Proper crop management and crop rotation are the best methods to control white horsenettle. Include winter crops in the rotation. In sorghum, mechanical cultivation should be supplemented with an application of 2,4-D. In cotton, supplement mechanical cultivation with hoeing until the row middles are shaded.



WHITE HORSENETTLE, Blueweed *(Solanum elaeagnifolium)* — A, Whole plant; B, Fruit; C, Seed.

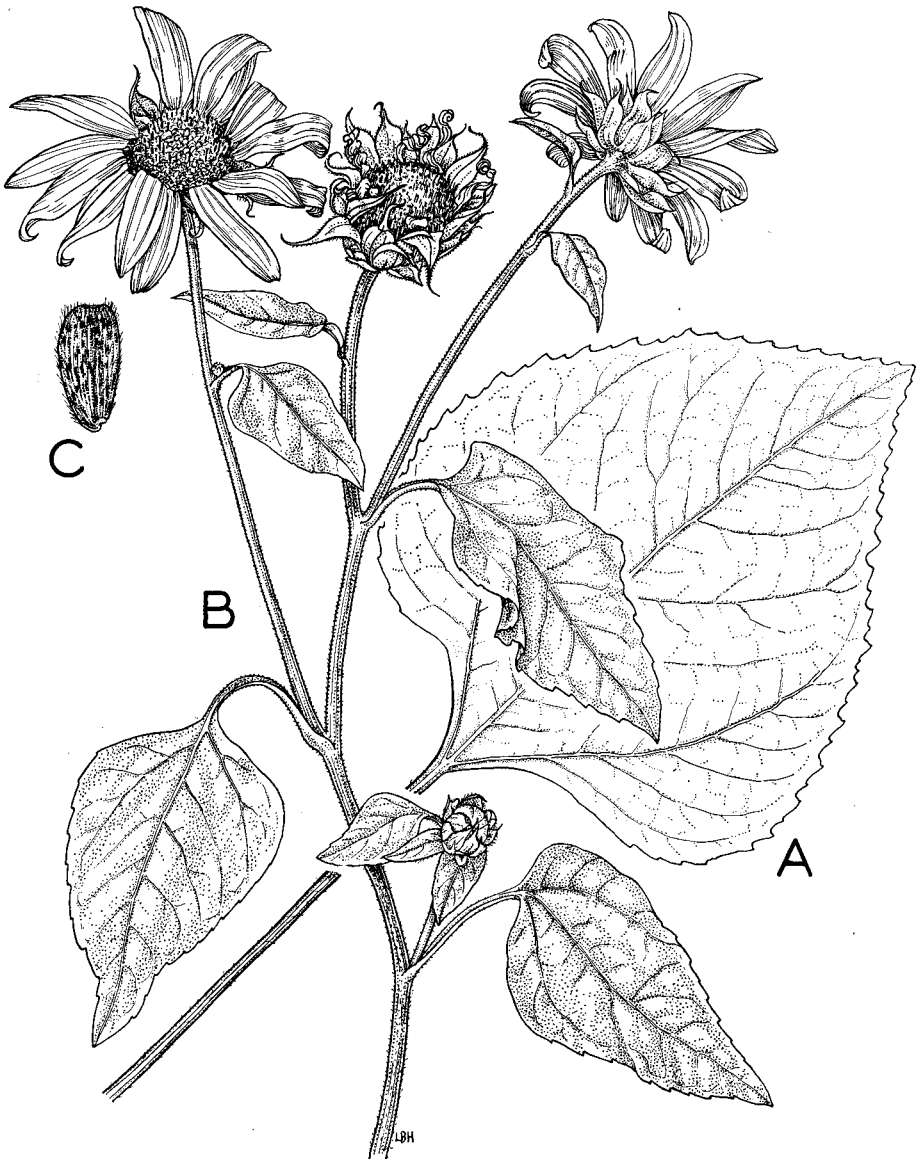
COMPOSITE FAMILY

ANNUAL SUNFLOWER *(Helianthus annuus)*

DESCRIPTION — *Annual,* reproduces by seed. *Roots,* taproot. *Stems* rough, hairy, erect, 2 to 10 feet high. *Leaves* alternate, rough, hairy, margins toothed, long stems on leaves, lower leaves heart-shaped. *Flower heads* 2 to 4 inches in diameter, outer flowers yellow, inner flowers brown, solitary, terminal or on stems from axil of leaves. *Seed* ½ inch long, flattened, angular, egg-shaped, gray with black spots and stripes.

HABITS — Grows from March until fall frost. Most common on ditchbanks, roadsides and waste areas. Found in cotton, sorghum, small grains, citrus and alfalfa. A problem in cotton because of its ability to emerge from relatively deep in the soil. This weed volunteers after small grain harvest if land is left idle.

CONTROL — Proper crop management and crop rotation are the best ways to control annual sunflower. It is not a problem in winter row crops. In small grains, apply 2,4-D to control annual sunflower. In cotton, mechanical cultivation, supplemented with hoeing, controls this weed. In sorghum, mechanical cultivation can be supplemented with an application of 2,4-D. Use a disk harrow to control this weed in citrus.



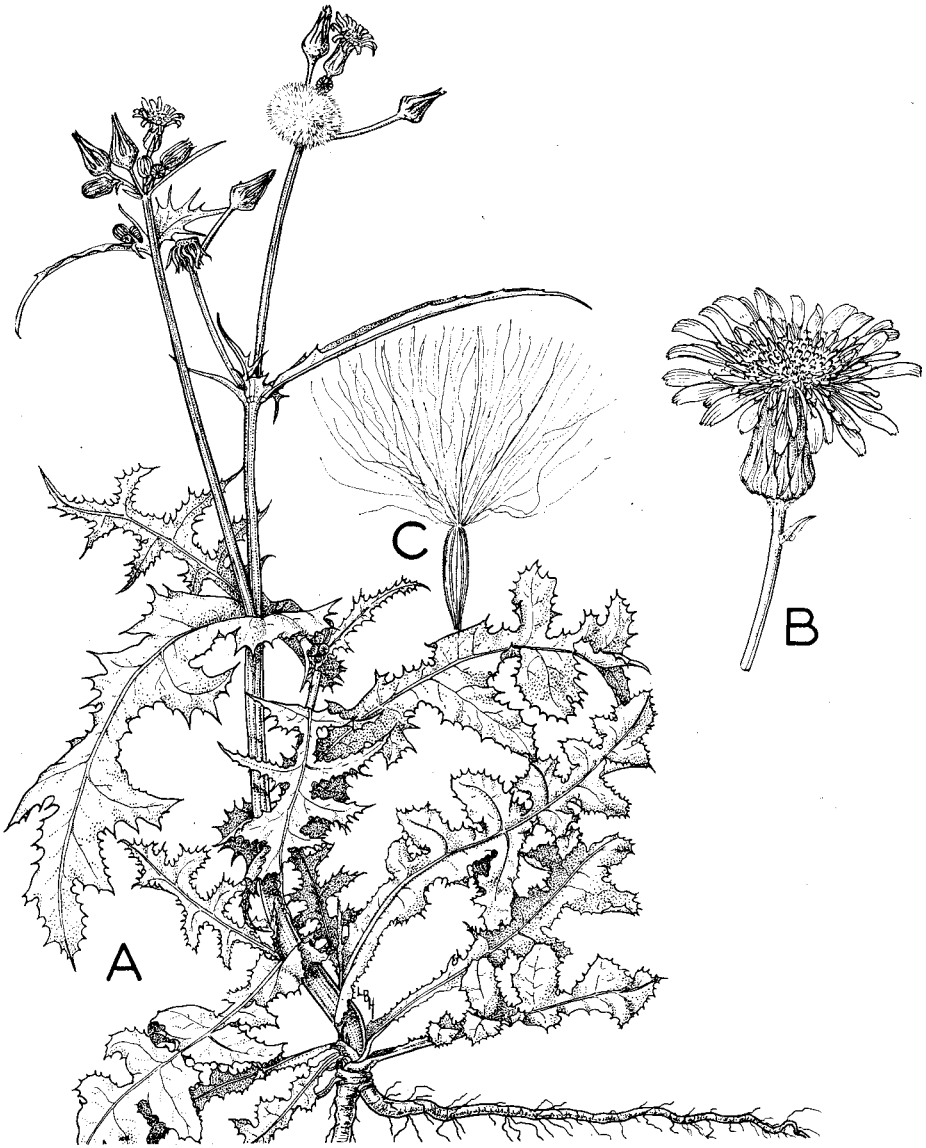
ANNUAL SUNFLOWER *(Helianthus annuus)* — A, Leaf; B, Upper portion of stem with flowers; C, Seed.

SPINY SOWTHISTLE *(Sonchus asper)*

DESCRIPTION — *Annual*, reproduces by seed. *Roots*, taproot. *Stems* smooth, pale green, sometimes reddish, contain a milk-like sap, erect branching above, 1 to 4 feet high. *Leaves* pale green, reddish midribs and veins, lobed, prickly margins, base of leaf clasping stem. *Flower heads* ¾ inch in diameter, yellow, all flowers strap-shaped, several flower heads borne in a terminal cluster. *Seed* brown, ribbed, flattened, 1/10 inch long with white hairs at tip.

HABITS — Grows from November to May. Common in alfalfa, small grain, winter vegetables and citrus. Also found on ditchbanks and waste areas. Hairs on seed facilitate this weed's spread by the wind.

CONTROL — Proper crop management and crop rotation are the best ways to control spiny sowthistle. Summer crops should be included in the rotation. In alfalfa, mowing destroys the topgrowth of spiny sowthistle. It seldom survives the second cutting. The border ridges in alfalfa and small grain fields should be seeded or disked to control this weed. DNBP can be applied to control spiny sowthistle in alfalfa and onions. Use 2,4-D to control this weed in small grains. Spiny sowthistle should be controlled with disk harrows in citrus. In carrots, apply selective petroleum oils.



SPINY SOWTHISTLE *(Sonchus asper)* — A, Whole plant; B, Flower; C, Seed.

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