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Weeds in Sacramento County of California

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Weeds
in
Sacramento County of California

By
Ross Clover
May 15, 1937

A Thesis
Submitted to the Department of
Botany
College of the Pacific

In partial fulfillment
of the
Requirements for the
Degree of Master of Arts

APPROVED: *E. E. Stanford*

Chairman of the Thesis Committee

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The writer also received a great deal of information about weeds from many Sacramento county farmers.

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INTRODUCTION

Sacramento County has many types of Agriculture and many weed pests which compete with the crops. Stock may be poisoned by certain weeds and weeds may also act as hosts for fungus diseases, virus diseases and insect pests of cultivated crops. Many plants may be weeds in one locality and harmless or beneficial in other parts. The author has made a thorough study of the county's agriculture and its weeds. Latest control practices were also studied.

The State Department of Agriculture lists the following as "primary noxious weeds"; Johnson grass, Lolcus halepensis; camel's thorn, Alhagi camelorum, hoary cress, Lepidum draba; morning glory, Convolvulus arvensis; Canada thistle, Cirsium arvense; and Russian knapweed, Centaurea repens. A list of weeds which are not as harmful as the above list is known as "secondary noxious weeds." The following come in this category: Yellow star thistle, Centaurea solstitialis; poverty weed, Iva axillaris; goat grass, Aegilops triuncialis; coast dandelion, Hypochaeris radicata; Russian thistle, Salsola kali; silver leaf nightshade, Solanum elaeagnifolium; creeping sow thistle, Sonchus arvensis; St. Johnswort, Hypericum perforatum; nut grass, Cyperus spp.; alkali mallow, Sida hederacea; the dodders, Guscuta spp.; and puncture vine, Tribulus terrestris.

The writer found some of the above mentioned weeds in the county and a number of lesser troublesome weeds.

CHAPTER I

GENERAL FACTS ABOUT SACRAMENTO COUNTY

Geographical Location

Sacramento County is located in the heart of the great central valley. From longitude $121^{\circ}-60''$, it extends to longitude $121^{\circ}-50''$, and latitude $38^{\circ}-00''$, to latitude $38^{\circ}-45''$. Its area is approximately 987 square miles. This county reaches from the junction of the Sacramento and San Joaquin rivers at the extreme western end of Sherman Island, to the Sutter and Placer County lines approximately one hundred and twenty-five miles north. It is bounded on the west by Solano and Yolo Counties, on the south by Contra Costa and San Joaquin Counties, and on the east by Amador and El Dorado Counties.

Climate

Sacramento County is noted for its mildness of climate. The summers are dry with warm days and pleasant nights. The winter, or so-called rainy season, resembles springtime in the Eastern states. Even in the rainy season there is a great preponderance of bright weather, rain in measurable amounts occurring only on about nine days monthly during the three winter months of December, January, and February. The average rainfall is about eighteen inches, and occurs between October and April.

Singularly, the rainless summers in the valley are contrasted in winter, 6,500 feet above on the Sierra Nevada slope, by the region of the greatest known depths of snowfall in the United States, resulting in a plentiful supply

of water in valley streams during the dry season.

Lying well south of the main North Pacific storm track, and north of the southern storm course, and because of the protecting influence of the high mountain ranges that skirt the valley, only an occasional heavy winter rain storm invades the valley region, although copious rains and heavy snows frequently visit the western slope of the Sierra Nevada, the southern Siskiyou and to a lesser extent the Coast Range, causing flood conditions occasionally in the Sacramento River and its larger tributaries. This sheltered location also accounts for the rare occurrence of excessive rainfall and almost complete absence of damaging storms.

There are practically no thunderstorms in this locality. Snow falls so rarely and in such small quantities that its occurrence may be disregarded as a climatic feature.

In a normal year at Sacramento, dense fog occurs on 18 days, mostly in midwinter, never in summer, and seldom in spring and autumn. Fogs are of the radiational cooling type and are usually confined to the early morning hours, although an occasional winter fog, under stagnant atmospheric conditions, may persist for several days.

Owing to the north-south trend of the valley and the deflecting and directing effect of the Sierra Nevada Range on oceanic winds flowing eastward through the Golden Gate break in the Coast Range, the prevailing surface winds are southerly for all months of the year, the mountain barriers

preventing the free flow of air into the valley from other directions.

However, with a steep northerly barometric pressure, gradient air forced over the interposing mountain ranges, warming dynamically with descent, reaches the valley floor as warm, drying north winds known as "northers". This condition or modifications thereof is productive of the hot waves in summer, but is often followed by cool southerly breezes. The north winds scorch unshaded vegetation.

The average annual temperature is about 60°F. The average range of temperature is about 88°F. During the summer, the temperature may range between 85°F. to 110°F. Frosts are quite frequent and they often kill the vegetation. The average date of the first killing frost in Autumn is December 7, while the average date for the last killing frost in the Spring is February 14. However, killing frosts have been recorded as early as the first part of November and as late as the first part of May.

The relative humidity is low in this locality. It may possibly increase toward the river vicinities.

The average length of the growing season is 300 days.

Topography

The elevation in Sacramento County varies from a few feet above sea level in the Delta region to approximately two hundred and fifty feet in the foothill region. The elevation of Walnut Grove is eight feet while that of the Hood and Courtland area is about fifteen. The figures at

Elk Grove and Mills are fifty feet. Sacramento and Elk Horn have an elevation of about thirty. A steady rise toward the eastern part of the county gives Folsom an elevation of about two hundred and twenty feet.

The county lies in the region drained by the Sacramento river and its tributaries, the American and Cosumnes rivers.

The western part of the county is fairly level.. Small mounds called "hog backs" are found in this region. Along with these physiographic characteristics are found small dips called "hog wallows".

The eastern part of Sacramento County is made up of numerous rolling hills. The citrus belt of Fair Oaks is a good example of this.

Sacramento County Soils

The soils of this county fall into two natural groups, the soils of the foothill areas and the soils of the valley plain. A study of the soil variation in the county makes it easier to understand why there is such a great variation in types of agriculture.

The soils of the valley plain which occupy the western part of the county are also divided into three groups, the San Joaquin series, the Sacramento series and the group of miscellaneous soils.

San Joaquin loam which is very important in the western part of the county consists of a loam or light-red sandy loam of medium to fine texture, but often carrying small quantities of coarser sharp fragments, the main body of the

soil being fine, silty and somewhat smooth in character. The average depth of this soil is three feet, although it is subject to great variation. This material is underlain by a dense refractory red hardpan of very much the same texture as the overlying soil. Iron compounds are the principal cementing materials. A layer of heavier textured subsoil generally of deeper red color usually intervenes between the soil and hardpan. Sand, clay and gravel are included in varying proportions in these indurated layers.

The soil of this series often becomes boggy in the wet season due to the "hog wallow" depressions. In the summer these soils may become compact and baked when not cultivated.

Alkali salts are not frequently found in this series.

Grain farming is carried out in the San Joaquin series. Under irrigation this soil may raise various fruits and grapes. Alfalfa is raised best on the deeper phases of this series.

The Sacramento clay loams and Sacramento clays make up the Sacramento series. These soils generally occur as flat or depressed areas or basins bordering the Sacramento River, or islands along its lower course. Alkali affects the margins of some of the basins. The Sacramento clay loams consist of a dark-gray drab or black, smooth textured, rather friable silty clay loam. It often extends to a depth of six feet. The chief crops grown in this soil

include tomatoes, alfalfa, melons, asparagus, celery, onions, potatoes and many other truck crops. The better drained phases are especially adapted to pears, cherries, peaches, prunes, hops and many other highly specialized crops.

The Sacramento clay typically consists of a dark-gray, bluish-gray, drab, or black clay of smooth waxy structure when wet, but is rather well granulated and friable when well drained and aerated. The major portion of this type of soil lies in the northwestern part of the county. The chief crops found in this soil are grains, beans and alfalfa.

Soils classified under the Columbia series are found mainly in the western portion of the county. These sandy loams and sand range in color from light brownish gray to light grayish brown or buff and are usually free from gravel. The lighter members are usually micaceous. These soils may reach a depth of six feet or more. They are alluvial in origin, being composed of material derived from igneous, metamorphic and sedimentary rock. This soil is a producer of truck crops and fruits. It is found in the region of the Sacramento, American and Cosumnes rivers.

Stockton and Alamo clay adobes are found near Franklin, Meadow View and Elk Grove in isolated areas. The Stockton clay adobe consists of a dark gray to black clay which is very sticky and waxy when wet, and filled with cracks and checks when dry. The humus content is fairly high. Gravel

and boulders are rarely present in appreciable quantities.

Grains and grapes are grown in the Stockton clay adobe.

The alamo clay adobe closely resembles the Stockton clay adobe and grows the same crops. The average depth of the hardpan in this soil is about one yard.

Muck and peat soil is found in the "Island" region of the county and is adapted to vegetable raising. Asparagus, spinach, potatoes, onions, and celery are examples. Muck and peat is rich in organic matter in various stages of decomposition. The soil is mixed with varying quantities of alluvial silt. The muck is very sticky when wet as the water holding capacity is very high. The water table is usually encountered within twenty-four inches of the surface and for this reason the soil is not fitted for deep rooted crops.

A large portion of the eastern part of the county is made up of the Redding series of soils. These are soils from old valley filling material and are gravelly loam and gravelly sandy loam. This series of soil ranges in color from red to deep red with small areas of yellowish red. Redding gravelly loam contains large quantities of gravel, mainly well rounded to sub-angular, and ranging in size from small gravel to fragments three or four inches in diameter. Nearly all of this gravel is quartzose rock. Hardpan is found under this type of soil at varying depths. This iron-clay hardpan has to be blasted in many cases where trees are planted. Fruits and grains occupy a large portion

of this area and there is also some grazing.

Tailings of hydraulic mining processes are found in the regions of Folsom, Natoma and Fair Oaks in the eastern part of the county. These areas are useless as far as agriculture is concerned.

The soils in the extreme eastern part of the county are classed as residual soils. This is the foothill area of the county. Large rocks are exposed at the soil's surface and stony and sandy loams are common. There is a great deal of grazing in this portion of Sacramento county. Scattered diversified farms are also found in this area.

Sacramento County Agriculture

Sacramento County, due to its topography and soil types, is a diversified farming area.

Of the 629,120 acres, agriculture utilizes the huge portion of 573,025, of which vegetables cover 40,000; grain, 73,000; hay crops, 31,000; trees and vines, 40,000; pasture land, 287,000; sugar beets for sugar, 665; and potatoes, 156.

Latest available information reveals that Sacramento County produces 90 per cent of the world's asparagus, 25 per cent of California's celery crop, leads all counties of the state in Bartlett pear production, grows one-fifth of the spinach crop canned in California, and produces one-third of the state's crop of canning tomatoes.

Peaches, plums, prunes and apricots follow pears as the leading deciduous fruits, but apples, cherries and figs are grown extensively. English walnuts and almonds also cover

a large acreage. Olive production for oil and pickles is also important.

In the neighborhood of 17,775 acres are in grapes, mostly of the Tokay, a table variety. There are several kinds of berries raised in Sacramento County. The strawberry is the leader.

The orange district includes Fair Oaks, Folsom, Orangevale, Citrus Heights, Carmichael and Arcade in the northeastern part of the county. Sacramento County ranks high in the production of oranges among the counties.

The delta region is known as "Netherlands of America." Soil, water and climate have combined to make it an excellent place in which to raise vegetables. The delta soil is composed principally of peat and has a high capillary attraction, thus the common practice followed for irrigating is to fill the drainage ditches with water and subirrigate rather than surface irrigate. During the winter months these ditches are used for drainage, the smaller drain to the larger ditches and thence to canals where electric pumps return the water to the river. This region is noted for its vegetable production. Asparagus is the leader with an annual valuation of approximately \$4,000,000. At no other place in the nation can it be grown so successfully, as its requirements are exacting. Large crops of potatoes, tomatoes, celery, spinach, lettuce, sugar beets, melons and onions are also grown in the delta lands. Of the large vegetable acreage of the county, approximately four-fifths lie in the Sacramento River delta, composed of tracts,

districts and numerous islands.

Weed pests are found related to all types of agriculture. The author visited many farms to make a thorough study of them.

CHAPTER II

AGRICULTURAL RELATIONSHIPS OF LOCAL WEEDS

Chapter two is devoted to a study of weeds, with the emphasis on agricultural relationships and present control practices.

Polypodiaceae

Bracken fern, Pteris aquilina var. lanuginosa is injurious to stock in California. It may be found along the rivers. This perennial herb has a creeping, woody and almost black rootstock. The part above the ground is a much divided frond, with a central stock. The frond is one to four feet high and one to three feet across. The sori are rust colored.

Cattle, sheep and horses are affected by the poison produced by bracken fern. If the stock eat this and are exposed to the sunlight, death often occurs.

Stock should not be allowed to graze where this plant is found in abundance. Where it is present it should be cut down before it reaches maturity.

Typhaceae

The common cat-tail, Typha latifolia, is a pest in rice fields and in irrigation ditches. It is an erect unjointed perennial with stout pithy stems, from four to seven feet high. The stems arise from creeping scaly rootstocks. Long grass-like leaves come from these rootstocks also. This plant is monoecious with the pistillate portion below and the staminate part at the top of the spike. The minute fruits are enveloped in the cotton of the cat-tail

portion.

Cat-tail may be controlled by draining an infested area. If the tops are kept down, this will deplete the reserve food in the root system.

The grass family, Graminae, has a number of common pests of this county. They will be discussed in several genera.

The genus Bromus is composed of annuals or perennials with closed sheaths, flat blades and open or contracted panicles of large spikelets. These spikelets may be several to many flowered. The glumes are unequal and the lemmas are convex or keeled. The palea is usually shorter than the lemma.

Bromus rigidus is an annual known as "Ripgut". The long rough awns cause mechanical injuries to animals when the plant reaches maturity. These awns penetrate the eyes, nose and mouth-parts causing irritation and blindness. The open panicle is rather few flowered. "Ripgut" should be cut before it reaches maturity.

Bromus hordeaceus or "soft cheat" came from Europe and is found in waste and cultivated places. The blades are usually pubescent and the erect panicle is contracted. The awn is rather stout.

Bromus hordeaceus should be controlled in the same way as Bromus rigidus.

Salt grass, Distichilis spicata is a low dioecious perennial grass with creeping rhizomes which give rise to erect glaucous culms which grow four to twelve inches in height. These culms bear numerous flat or rolled leaves,

one half to four inches long. The flattened spikelets are clustered at the tops of the culms. This plant is found in salty and alkaline soils.

The best means of eradicating salt grass is clean cultivation in the summer time.

Hordeum murinum or foxtail is a very common member of the wild grasses. It is found in waste places, along fence lines, in grain fields and alfalfa patches. This annual has bushy branched culms which spread. The sheaths and blades are smooth. The spike is five to eight centimeters long and the uppermost inflated sheath often partly incloses it. The glumes of the central spikelet are narrowly spindle-formed. The broad lemmas are eight to ten millimeters long.

Control of foxtail centers around checking the plant from maturing. The first mowing of alfalfa usually checks this weed.

Wild oats is another weed member of the Grass Family. It is known botanically as Avena fatua. The author has found this plant in many waste places. It causes most of its trouble as a grain field pest. It is noticeable that wild oats border along roadside fences and farmers usually cut down the "outside row" before harvesting the grain. This annual was introduced from Europe. The stout culms may reach a height of three and a half feet. The leaf sheaths loosely surround the culms. The long and broad leaf blades have stiff hairs. The flowers are found in spikelets which are grouped in an open panicle. The spikelets hang from a

thread-like stalk. The spikelets usually have two or three flowers. The glumes are about an inch in length. The lemma possesses stiff, long brown hairs. The awn is usually twisted below.

Cynodon dactylon, is another weed pest of Graminae. It is known in this locality as Bermuda grass. It was introduced from Europe and is found in semi-arid and subtropical places where the winters do not become cold enough to freeze the rhizomes. It is found in greater abundance in moist places. This weed is a perennial which produces rhizomes or underground stems. It also has runners which trail along the surface of the ground. Both upper and underground stems are many jointed and root readily at the nodes. They may run out several feet from the parent crown. The wiry stems are flat and smooth. The leaves of the runners are short, broad, thick and scale-like; those of the erect stems are longer, the sheaths being short, the blades one to four inches long, smooth on the lower surface and rough above. There is a conspicuous ring of white hairs at the juncture of the leaf blade and leaf sheath. The flower-bearing culms vary from four to eighteen inches in height and the flowers are grouped in threes or fives. The individual spikelets of each group are arranged in two alternate rows on spikes that are characteristically one-sided. Each spikelet is flattened closely attached to the axis of the spike. The seeds are light in weight and may be carried by wind and water.

Bermuda grass will crowd out other more desirable lawn

grasses. If it gets a strong hold in orchards and vineyards, it makes it very difficult or almost impossible to cultivate the trees and vines. It is spread by farm implements, water, wind and hay.

Bermuda grass is intolerant to dense shading. Crops such as grains, cowpeas, Sudan grass and alfalfa shade this weed enough to weaken it greatly. The author has placed waste tar paper roofing over small patches of this weed and the results were satisfactory.

Fall plowing that exposes the rhizomes to winter frosts has been tried and found successful in many cases. This should be followed with a "shade" crop in the following spring. Rhizomes plowed up in the summer and exposed to sunlight is also satisfactory provided no moisture is around the exposed parts.

Sodium chlorate, at a rate of four pounds per square rod has been effective on experimental plots when applied in the winter time. If an application of this chemical is made after the rainy season, enough irrigation water should be used to carry the salt to the underground parts.

Bermuda grass is used for playground turfs and embankment retainers. If a lawn is over-infested with this weed, it should be plowed up in the early summer. The depth should be about six inches. All rhizomes should be exposed to the sunlight in order to kill them. The plowed part should remain fallow for the remainder of the season and examined frequently for any underground stems that have escaped. When the lawn is ready to be replanted, a new dressing of Bermuda-free soil

should be made. After the lawn seed is planted, a careful watch should be made to check any new infestations.

Crab grass, Digitaria sanguinalis, is an annual weed that infests gardens and alfalfa fields. It is a native of Europe and is suited to Sacramento County conditions. The herbage is pale green. The culms are stout and are usually from one to three feet in length. The leaves are two to five inches long and from one-quarter to one-third inches in width. They possess stiff hairs. The flowers are in spikelets, with the latter in pairs on two sides of the angled branches of the inflorescence. The spikelet has one perfect flower. The lemma is starchy and the glumes are very unequal. The seeds are spread by hay which the weed has infested. Stock sometimes fail to eat crab grass in California due to its bitter taste. In the Southern States, it is a forage grass.

Hoes and cultivators are used in its control in gardens.

Echinochloa crusgalli, which is commonly known as water grass or barnyard grass, is an annual with stout culms which reach a height of two to four feet. The smooth leaf sheaths are flattened and glabrous. The blades are four to twenty inches long and a quarter to three quarters of an inch wide. The flowers are in spikelets each containing a single fertile flower. The flowers are arranged in a loosely branched panicle. The oval spikelets are green or purple and densely crowded in two to four rows on one side of the stem.

This weed should be hoed or cultivated before it reaches

maturity. This pest gets in rice fields. If waterways are kept free from weeds, this plant would not be much of a pest. A waterway weed control program as a community project would check the spread of many of our weeds.

Johnson-grass, Holcus halepensis, is a perennial grass of coarse habit with pithy culms two to six feet in height. It possesses rhizomes which mat underground and cause trouble. The herbage is smooth and glabrous. The flat leaf varies from ten to eighteen inches in length and may become an inch wide. The midrib is white. The leaf sheaths are much shorter. The flowers in spikelets are grouped in threes at the ends of spreading branches of a panicle six to eighteen inches long. The lateral spikes are borne on hairy stalks and contain stamens only. The glumes of the perfect spikelets are purple.

Johnson grass is a native of the Mediterranean region. It was introduced in California from the Southern states where it was given consideration as a forage plant. The author has observed isolated spots of Johnson grass in vineyards and orchards.

The first step toward control is to prevent spread by seeds. To do this, cultivation, mowing, hand-cutting or oil may be employed. If cultivating is practised, care should be taken not to scatter the rhizomes as they start new infestations. Diesel oil has been used to some extent and is successful. The oil which is sprayed on the herbage, kills the latter. In warm temperature it has been known to penetrate to the underground parts and kill a large portion

of the rhizomes. Calcium chlorate has also been employed. A solution containing one pound of chlorate to one gallon of water may be applied as a fine spray to the plants in full bloom or soft seed stage. Sodium chlorate may be used in solution, or dry as a soil treatment in early winter. Three pounds per square yard is a good average treatment. It is best to allow Johnson grass treated with chlorates to stand in a dried condition until the following spring. Then this dry material should be burned.

Red rice, Oryza sativa var. rufipogon, is a rice pest of this county as elsewhere. This plant resembles the white rice only the stems tend to stool and not stand erect. The kernel has a red coat and if it gets in with the white rice, the red coat has to be milled off. The public will not buy rice with the red coat on it.

Seed should be sown that is free from red rice.

Cyperaceae

The nut grasses, Cyperus esculentus and C. rotundus are two local weedy sedges. These plants have triangular stems and closed leaf sheathes. The inflorescence is subtended by a leafy involucre which resembles an umbrella. These two species are the only members of this group that bear nutlets on the root stocks. The underground food storage reserve makes it difficult to eradicate the weed. The nutlets of Cyperus esculentus are roughened-globose or slightly flattened transversely while those of C. rotundus are oblong and covered with a dark fibrous coat. The fruits of nut grasses are achenes.

The author has found these weeds in moist low places. Drainage of certain places may help check nut grasses. The nutlets should not be carried from place to place if mechanical control is used. Oil, carbon bisulphide and sodium chlorate have been used with varying results. These plants are nuisances in rice fields, gardens, vineyards and orchards.

Liliaceae

The Lily family weed members here are Zygodenus venenosus and Z. venenosus var. micranthus. They are stock poisoning plants of the delta area known as death camas. These plants are slender grass-like herbs with smooth and mostly basal leaves which are a sixth of an inch wide and six to twenty-four inches long. The stems arise from an oblong bulb which is dark or black and has a paper-like covering. These bulbs are two to eight inches in the ground. The greenish-white flowers are grouped in a raceme at the top of the stem. The raceme is five to ten inches long. Each flower has three sepals and three petals, similar in size, and appearance.

A green glandular dot appears at the base of each segment. This group possesses six stamens. The ovary ripens into a deeply three lobed capsule containing eighteen to twenty-four seeds in the three parts. The variety micranthus has more open and broader flower clusters than the species. The flowers are larger and the glands are more prominent. The poisonous substances of death camas are alkaloids. This plant has caused death to sheep and

cattle.

Hay that is badly infested with this weed should not be cut. The plant should be cut off at the ground.

Polygonaceae

The Buckwheat family is made up of herbs or low bushes with simple leaves. This family is represented by several Sacramento County weeds. The flowers are small, regular, mostly perfect, and without a corolla. The flowers are rarely solitary. The calyx is five to six-cleft or -parted. The stamens which number from four to nine are more or less attached to the calyx. The superior ovary is one-celled, one-ovuled and bears two or three styles or stigmas. The fruit is an achene, mostly triangular, but sometimes lenticular.

The Knotweed, genus Polygonum, is common here and its weed members will be listed. These plants are herbs. Some live in the water. The leaves are entire and alternate with scarious sheathing stipules, which are entire, ciliate, or lacerate. The flowers are found on jointed pedicels. The calyx which may be red, white, or sometimes greenish is five-cleft or -parted and the divisions are erect in fruit. The stamens number from four to nine while the styles are two or three. The lenticular or triangular achene is enclosed in the fruiting calyx.

Polygonum aviculare is known commonly as wire grass or yard grass and is scattered throughout this county. It is an annual plant with wire-like creeping stems. The

plant is often several feet long and either prostrate or ascending. The herbage is bluish-green in color and glabrous. The flowers are on very short pedicels, two lines broad when expanded. The calyx is cleft and the oblong lobes are white with a greenish center. This plant possesses eight stamens with the three inner ones possessing dilated bases. Yard Grass possesses three very short styles and a brown, ovoid, minutely granular achene. This plant is a native of Europe and is found most commonly on paths and in yards. It may become a serious pest in gardens where it competes with the vegetables for water, light, and soil nutrients.

The logical control method would be to hoe off the crown before the seeds mature. In large onion patches, dilute sulphuric has been applied with the knapsack sprayer with much success. The acid in ten per cent readily kills the tissues of P. aviculare and only scorches the onions. The latter recover in about two weeks. It is advisable to use the acid when both the weeds and onions are young.

Polygonum aviculare is a host plant for virus diseases which attack economic plants.

Polygonum persicaria which is commonly known as lady's thumb is another native of Europe. It is found widely distributed throughout the county in moist sandy soils. The calyx is red or white. The sheaths are strigose and the upper sheaths and truncatish bracts are ciliate. The leaves are sessile. This plant is a garden weed and may be controlled by the use of a hoe or a weed cutter before



In the foreground of the above photograph is shown Polygonum aviculare in an onion patch. The back ground shows where the patch was sprayed with dilute sulphuric acid which killed this weed. (Courtesy of Mr. W. S. Ball)

the fruit matures. The seeds of P. persicaria are spread mostly with seeds of grains and legumes. It is a native of Europe.

Polygonum coccineum is the "kelp" or swamp knotweed" of the county's delta area. The stems of the plant are usually from one to three feet in length. The plant often reaches a height of six feet in moist peat soil. The root system is highly developed with tough root stocks which interfere with cultivation operations. The stems are roughish with hair and also jointed. In swampy places the plant is usually glabrous and smooth. In the aquatic situation, the leaf bases are somewhat heartshaped. In the drier habitat, the leaves are hairy and quite narrow. Sheathing stipules embrace the petioles and both may reach a length of from one to three and a half inches. The spikes are often paired and are from one to four inches in length. The calyx is rose color or pink and is five-parted to the middle. There are five stamens and a two-cleft style. The achene is lens-shaped.

This weed infests banks of drainage canals and laterals and is in a position to spread to the vegetable lands. The plant spreads both by seeds and rootstocks. Where the garden land is thoroughly cultivated, the weed is held back. The rootstocks should be exposed to the sun and the plant should be cut before the seed reaches maturity. Carbon bisulphide may be used as a chemical control measure. It is applied to the soil. The application of sodium chlorate to the soil infested with this weed has been of some success.

"Dotted smartweed", Polygonum acre was found in moist and shady creek soils. This perennial may grow five feet high. The loose and slender spikes vary from one to three inches in length. The greenish calyx is conspicuously glandular-dotted. The achene is triangular or lenticular.

The plant may become a garden pest in the same way as some of the other Polygonum species.

Members or Rumex are known as the "docks". These plants are perennial except one. The flowers are mostly greenish but are sometimes reddish or yellowish. They are pediceled and borne in usually crowded whorls along the branches of the panicle. The calyx is composed of six sepals. The three outer are reflexed. The three inner sepals are larger and cling to the achene. There are six stamens and three short styles. The leaves are mostly basal, with those on the stem alternate. The petioles possess sheathing stipules.

Rume acetosella or "sheep sorrel" is a native of Europe. It is a weed of gardens, orchards and vineyards. The tufted stems arise from running root stocks. The lower leaves are hastate and the upper are reduced or the branches are leafless and ending in reddish pistillate or yellowish staminate panicles.

In controlling sheep sorrel the root system should be dug up so it will be unable to send up new shoots. It will do that if the tops are just cut. Salt may be sprinkled on cut surfaces of the weed if it is in dooryards.

Curly dock, Rumex crispus is quite troublesome in many places. It grows from a foot and a half to four feet. The wavy margined leaves are bluish-green in color. The flowers are greenish, yellowish or reddish and are borne in crowded whorls along the branches of the panicle. The achene is triangular. Curly dock came from Europe and is abundant in orchards, vineyards, gardens and waste places. Hoes, cultivators and weed cutters should be used in the control of this weed.

Chenopodiaceae

The Saltbrush family includes herbs or shrubs. The leaves are mostly alternate or rarely opposite, or leafless. The flowers are apetalous. The calyx is herbaceous with five or fewer sepals. In the pistillate flower, the calyx is sometimes absent. The stamens are as many as the sepals or fewer. The superior ovary is one-celled and contains a single ovule. The styles or stigmas number two or three. The fruit may be an achene or utricle.

Chenopodium possesses members that are frequently mealy or glandular. The leaves are alternate and petioled. The flowers are perfect, bractless and sessile. They are arranged in simple or paniced spikes. The fruit in this genus is an achene.

Chenopodium album (lamb's quarter or white goosefoot) is a weed which may reach a height of four feet and usually is paniculately branched. The herbage is light green or whitish. The leaves are one-half to four inches long, the lower being wedge-shaped and the upper narrower.

The bractless flowers are densely clustered in spikes that compose a narrow or widely branching terminal panicle or solitary in the axils of the leaves. The utricle contains a single black shining seed.

This weed is common in orchards, vineyards and vacant lots. It also invades garden lands. Lamb's quarter acts as a host for many of the injurious aphids which attack cultivated crops. The cottony cushion scale, Icerya purchasi of citrus fruit has been found on this weed. Other injurious insects which the weed harbors include the beet and spinach leaf miner, Pegomyia hyoscyami; the banded flea beetle, Systema taeniata which attacks vegetable and vine crops; and the apple skin worm, Tortrix franciscana.

The control implements include cultivators, hoes, and weed cutters.

Chenopodium murale is commonly known as sowbane or nettleleaf goosefoot. This weed came from Europe and is found in orchards and waste places. This annual is rather stout and succulent with dark green herbage. The growing parts are finely mealy. The flowers are found in dense axillary or terminal panicles. The achene is acutely marginal.

This weed may be controlled by mechanical means.

Salsola kali var. tenuifolia is the only member of that genus in the locality. This bushy annual reaches a height of from one to four feet. The leaves of the young plant are very narrow and thread-like and may reach an inch or more in length. The early foliage drops off as

the stems become woody. The foliage of the mature plant consists of short bracts attached to the stem by broadened bases. The bracts are spiny and give the plant its thistle-like characteristics. The flowers are perfect and are found in the axils of the bracts. The calyx divisions are five in number and converge over the mature fruit (utricle) forming a sort of beaked envelope. There is one seed in the fruit.

The seeds of the russian thistle were brought to this country from Russia in impure flax seed last century. It first became a nuisance in the grain fields of the Dakotas and Minnesota. Specimens of this plant were collected in Antelope valley, Los Angeles County some forty years ago. The author found this weed scattered near the Sacramento River region.

This pest should be cut before maturity as it spreads in the "tumbleweed" manner. Flooding the young plants found in alfalfa has been carried out successfully as the Russian thistle does not need much water. If grain becomes greatly infested with this weed, it is advisable for the farmer to rotate crops with a tilled crop such as corn or beans.

Amaranthaceae

The Amaranth family is made up of coarse herbs with simple outer leaves. The small inconspicuous flowers are usually greenish and may be perfect or unisexual. They are also congested in spikes or clusters. The flowers do not possess a corolla. The calyx is made up of three to

five sepals, or sometimes only one, which is persistent and more or less scarious. There are five or fewer stamens. The superior ovary is one-celled with two or three stigmas. The fruit in this family is an indehiscent utricle.

The genus Amaranthus includes a group of annual weeds with alternate leaves and small green or sometimes purplish glabrous flowers. The flowers are bracteate, disposed in axillary or terminal spikes, or in axillary clusters, usually monoecious and rarely dioecious. The staminate and pistillate flowers occur commonly in the same cluster. The seed usually is a shiny black.

Amaranthus retroflexus is often found in orchards, gardens and waste places during summer and is known as "rough pigweed". It is a stoutish plant that branches from the base and may reach a height of four feet. The leaves are oval and the lower are blunt while the upper are usually pointed. The leaf-stalks are about half the length of the blade. The stems are more or less reddish. The green flowers are densely crowded in axillary and terminal spikes. These spikes are erect or spreading, one to four inches long. The bracts are lanceolate-subulate, except the green carinate midrib. This species possesses five unequal sepals which surpass the wrinkled utricle. The utricle splits around at the middle, exposing the single black shining seed. These seeds may be spread with economic seeds.

This pest may be controlled properly if it is cut with a hoe or weed cutter before the seeds mature.

Amaranthus retroflexus was introduced from tropical

America.

Amaranthus graecizans is the "tumbleweed" and was naturalized from tropical America. The plant is found in the same places as A. retroflexus L. The writer photographed an excellent example of tumbleweed along a fence in one of the rural districts of Sacramento County. (Page 85) The plant may reach a height of four feet. The stems branch freely and rigidly and gives it a bush-like appearance.

The yellowish-green herbage is nearly glabrous. The leaves are oblong-spatulate or obovate and from four to eight lines long. The flowers are found in clusters in short axillary spikes. The utricle is very wrinkled and when it ripens the top comes off like a lid.

Tumbleweeds may be cut before maturity with a hoe or weed cutter. If they reach maturity, the seeds may be spread by the wind, farm implements, or with the weed.

Portulacaceae

The Purslane family includes low herbs with succulent entire leaves. The flowers are perfect. The calyx is chorisepalous (synsepalous and superior in Portulaca). The petals may number from three to sixteen and the stamens three to twenty. The one-celled ovary is commonly superior with two to eight styles. The fruit is a capsule. This family as a whole is not of major importance as far as weeds are concerned, but some members should be mentioned.

The genus Calandrina has one representative Calandrina caulescens var. menziesii known as "Red Maids" which may become a garden pest. It is a slightly fleshy annual herb

blooming in early spring. The stems are one to many from the base and vary from one-half to two feet in length. The leaves are alternate and entire. They taper at the base. Each flower is borne on an erect flower stalk and composed of persistent sepals and have red petals. The latter are notched at the top. The capsule contains numerous black and shiny seeds.

This plant may be considered as a good cover crop in some places. If it infests gardens, it has to be hoed out of the vegetables.

"Miner's lettuce" Montia perfoliata. is a common weed to nearly everyone. It is also a good covercrop plant, but may become a garden weed. The herb is succulent and glabrous and ranges in height from one-third to one foot. The plant possesses narrow basal leaves with the paired upper ones completely united into a round and entire or angulately two lobed disk. The flowers are small and grouped in terminal racemes with two sepals and five white petals. The capsule contains several shiny black seeds.

"Miner's lettuce" may be hoed or cultivated out if it gets into gardens.

Caryophyllaceae

The pink family includes herbs with white, red or pink corollas. The simple and entire leaves are always opposite. The sepals and petals number four or five. There are usually as many or twice as many stamens as petals and alternate with the latter. The superior ovary is one-celled with one to five styles. The fruit is a

capsule.

The common chickweed Stellaria media is another garden pest which must be kept down with the cultivator and hoe. It is somewhat succulent with weak procumbent stems which root at the lower nodes. The lower leaves are ovate and petioled, while the upper are narrow and sessile. The small white flowers are composed of five free sepals and as many smaller petals. This plant possesses from three to seven stamens and a three-styled single oblong ovary. The fruit is a capsule and contains many round flattened brown seeds. This plant is a native of Europe.

Silene gallica or "windmill pink" is a common annual weed of fields and gardens. It is a native of Europe. The stems are erect and unbranched or bearing one to two small lateral branches. There are about four or five pairs of opposite leaves to a stem. The flowers are grouped in one-sided terminal racemes. The tubular calyx is formed of five united sepals. It is hairy and ten nerved. The corolla of five petals is white or pale pink. The petals are twisted and resemble the vanes of a windmill.

This weed should be hoed or cultivated out before the capsule ripens.

Ranunculaceae

The members of this family are herbs with alternate or basal leaves (with the exception of Clematis). All parts of the flower are free and distinct. The flowers are solitary or grouped in terminal racemes or panicles. There are usually five sepals and often these parts are

petal like. There are five or more petals and the stamens are usually numerous. The superior pistils are one-celled. The fruit is a follicle or achene.

The genus Delphinium possess the only weed members of the Buttercup family. They are stock poisoning plants. California members of Delphinium are perennials. They have palmately divided leaves and flowers in terminal racemes. The five sepals are irregular. The upper one is spurred at the base. The petals number four. The three pistils develop into many seeded follicles.

Cattle are poisoned by the larkspurs more than any other animals. Horses have been poisoned by these weeds when taken in large quantities, but sheep and goats are not affected by the poison to any great degree.

The alkaloid poison acts on the nervous system of the animal. It has a gradual paralyzing effect on reflex power, respiration and coordination of movement.

Larkspurs are often referred to as "low" or "tall" larkspurs. Height is taken into consideration in that case.

The coast larkspur, Delphinium californicum is found in the delta region. It is a tall larkspur. This species, which is known as coast larkspur is the tallest one here. It varies in height from two and a half to seven feet. The numerous leaves are very large, being four to six inches long. The dense racemes are nine to eighteen inches long.

The two low larkspurs in this county are Delphinium

hesperium var. recurvatum and D. hesperium.

Delphinium hesperium is found mostly in the delta area. It ranges in height from one and a half to three feet. The flowers are commonly blue and rarely white, pink or intermediate shades. The variety recurvatum has recurving sepals and pink-lavender or lavender-white flowers. They are rarely blue. The leaves of the variety usually have narrower and more acute divisions.

Larkspurs should be grubbed out and burned.

Cruciferae

The mustard family includes several weed pests that are of major importance. These herbs have alternate leaves with no stipules. Sepals and petals number four and both are regular and distinct. There are six stamens. In many cases, two of these are shorter than the other four. The superior ovary is two celled and has one style. On ripening it forms a capsule.

Raphanus sativus or wild radish which was introduced from Europe is a garden and grainfield weed. It has some value as a covercrop plant. This plant branches widely and may reach a height of five feet. The flowers are large and may be purple, or white. The petals are long clawed. The pod, which is thick and filled with corky tissue, is from one to three inches long and three to four lines broad. The pod may be one, two or three seeded. The basal and lower leaves are long-stalked and large while the upper leaves are small, short-stalked, and toothed. This plant has a biennial tendency.

Hoes and weed cutters may be employed to cut down wild radish in gardens. If this weed gets in grain fields it may be killed with dilute sulphuric acid. This chemical will not hurt the grain plant. Sulphuric acid is spread on when the grain and radish are comparatively young. The spraying units and method of application will be discussed under chemical control of weeds.

The mustards of genus Brassica are common in this locality and are found in about the same places as wild radish. They are annuals, either glabrous or sparsely hispid with coarse hairs. The flowers are large and yellow. The lateral sepals are more or less gibbous at the base. There are four green glands alternating with the claws of the petals. The terete pods terminate in a stout beak. The globose seeds are in one row.

Brassica campestris blooms in the early Spring. The herbage is succulent, glaucous and glabrous with the exception of the lower leaves. The cauline leaves are all sessile and clasping by an auricled base. The lower leaves are irregularly serrate or denticulate.

This weed is controlled in the same manner as wild radish. The author found this weed in grain fields where it may become a major pest. The other species of Brassica are harmful in the same way. They all have some cover crop value. B. campestris was introduced from Europe. It is a common practice for some grain farmers to hire laborers to pull out young radish and mustard from grain fields.

Brassica arvensis is known commonly as charlock. This



The above picture shows the grain that has been treated with sulfuric acid on the right and the untreated on the left with a mustard infestation.

(Courtesy of Mr. W. E. Ball)

plant is also a native of Europe. The light green herbage is hispid with scattered hairs. The pinnatifid leaves are lobed or toothed. The upper rhombic leaves are petioled or sessile by a narrow base. They are not clasping. The petals are four to six lines long. The glabrous pods are ascending or erect and vary in length from one to one and a half inches. There are three to eight seeds in each cell.

Black mustard, Brassica nigra is another noxious grainfield pest. It appears later than the other two species mentioned. It often reaches a height of three to six feet. The dark green herbage is not glaucous. It may be glabrous or it may possess some stiff scattered hairs. The deep lobed basal leaves are three to eight inches long. The terminal lobe is much the largest. The upper stem leaves are smaller than the lower. The upper leaves are all pointed and are often pendulous. The petals are about three and a half lines long and much longer than the sepals. The pods are closely appressed to the axis of the raceme. They bear black seeds.

Lepidum draba or "hoary cress" is a major noxious weed of Sacramento County. It is chiefly a vegetable and alfalfa weed. This weed is a perennial and has a cord-like root system. The herbage is grayish and the plant is leafy below. The plant may reach a height of sixteen inches. The lower leaves are very short stalked while the upper leaves clasp the stems. The upper leaves are auricled. The flowers are white and borne in panicles of racemes. The stamens usually number six. The ovary develops into a cordate pod containing



The above is a photo of Lepidium draba. Its strong perennial root system makes it one of the primary noxious weeds. It is found scattered in the garden lands of the Sacramento river region.



Lepidium draba in a small patch in Fair Oaks.

two flattened seeds.

A practice increasingly popular in California for controlling perennial weeds in flooding. This is accomplished by surrounding the areas with dikes and covering them with six to ten inches of water for several weeks in the summer. The infested area should be plowed before immersing, and no growth should be allowed to appear above the water. Flooding "hoary cress" is common in this state.

The author found several isolated spots of the weed in the garden lands between Freeport and the delta. Farmers are gradually controlling this weed by keeping the seeds from maturing. In this case mechanical means is proving successful where a constant watch for the weed is kept.

Hedge mustard, Sisymbrium officinale is a very common roadside weed of the mid-summer. This annual, which is a native of Europe possesses an erect stem and grows to a height of upwards to four feet. The leaves are nearly lobed to the midrib. The lateral lobes appear somewhat as separate leaflets below the large blunt terminal lobes. The lower leaves are long stalked while the upper leaves are short stalked. The yellow flowers are grouped in spike-like racemes disposed in a panicle. The terete pods are six lines long, tapering from base to summit. They (the pods) are nearly sessile and closely appressed to the axis in a long slender raceme.

The immature plant should be hoed off at the ground if it is a nuisance.

Shepherd's purse, Capsella bursa-pastoris is an abundant

local annual cruciferous weed. It is commonly found in orchards, vineyards and gardens. It is more of a garden pest, as it has some value as an orchard and vineyard covercrop. The erect stems are simple or branching and may reach a height of a foot and a half. The stems are sparsely hispid. The basal leaves form a rosette. They are from two to five inches long and are more or less lobed. The upper leaves are dentate and sessile-auriculate.

The white petals are three-quarters to one and one-half lines long. The fruit is a flattened and wedge-shaped silique which is notched at the free end. There are about two dozen seeds in the pod. The seeds possess a pair of lengthwise grooves on each side.

Shepherd's purse has been found to harbor the beet leaf hopper, Eutettix tenellus. This insect carries the virus disease causing the curly top disease of sugar beets from the wild hosts to the cultivated hosts. Spinach and tomatoes are also affected by this virus disease.

Shepherd's purse may be hoed or cultivated out before the seeds reach maturity. This plant is a native of Europe.

Geraniaceae

This family is represented in this state with herbs. The complete flowers are regular, symmetrical and five-merous. The petals are deciduous but the sepals are persistent. The stamens are twice as many in numbers as the petals. The five-celled ovary is superior and deeply lobed. The five styles are united around the prolongation of the receptacle. The fruit is made up of five one-seeded carpels bearing

twisted or coiled styles as tails.

Red stem filaree, Erodium cicutarium is found in abundance here. The leaves are compound with deeply lobed leaflets and the petals are a rose-purple color. The beak of the fruit usually does not exceed two inches in length. This plant is of Mediterranean origin, being introduced by the Mission Padres. It has some forage and covercrop value. It should be spaded, hoed or cultivated out of vegetable and flower gardens.

Euphorbiaceae

The Spurge family is made up of herbs or shrubs with simple leaves. The flowers of this group are monoecious or dioecious and with only one exception or apetalous. The flowers are small and often do not possess a calyx. A calyx-like involucre is often present in this family. The stamens number from one to many. The superior ovary is four or one-celled, with one or two pendulous ovules in each cell. The styles or stigmas number twice as many as the cells of the ovary. The capsule is commonly three-lobed and three-valved. The embryo is straight and the flat cotyledons are almost as wide as the fleshy or oily endosperm.

There is only one member of genus Eremocarpus in California and that is Eremocarpus setigerus, which farmers commonly term turkey mullein. This weed is a low spreading annual herb with forking stems. The spread may be from one to three feet and the plant reaches a height of one to eight inches or slightly more. The leaves are thick and three-nerved from the base and oval-pointed to nearly round in outline. They range from one-third to one and one-half

inches in length, with the lower leaves alternate and the upper opposite. The herbage is covered with a bristly gray dense coat of hair. The flowers are small and the staminate are composed of a calyx of five or six sepals enclosing six or seven stamens. The pistillate flowers are without sepals and are formed of a solitary, densely hairy ovary and style. The ovary ripens into a dry capsule containing a smooth, shining, mottled seed about one-tenth of an inch long. The staminate flowers are grouped in flat-topped clusters at the end of stem branches and are usually solitary or in twos or threes in the axils of lower leaves.

Turkey mullein is scattered throughout Sacramento County in dry fields, stubble and summer fallow land. It has been reported that this plant is harmful to hogs and sheep which occasionally eat it. Solid indigestible balls formed in the digestive tract of the animals as a result of the hairs of the herbage clinging together is the cause of the trouble.

Since the plant is shallow rooted, it may be controlled by early summer harrowing before it attains much size or becomes woody.

Zygophyllaceae

The Calthrops family has one weed representative in Sacramento County and that is the highly publicized puncture vine. This weed spreads along the ground with its decumbent stems which vary from one-half to three feet in length. The compound leaves are numerous and are formed of five to seven pairs of leaflets, each leaflet being about one quarter of an inch in length. The leaf stalks are short with a pair of short stipules at the base. The flowers have five yellow

petals and are found solitary in leaf axils. The calyx is composed of five persistent, jointed and hairy sepals. The ten stamens are placed in a manner where a longer one alternates with a shorter one. The ovary is five-celled and covered with erect hairs. The ovary ripens into a spiny fruit about one-half of an inch broad which at maturity splits into five carpels, each containing three to five seeds and armed with two rigid spines.

Puncture vine has been known in California since 1903, and probably was introduced some years earlier. This weed is a native of the Mediterranean region. It first appeared in California along railroad stations. The writer has observed this pest in small patches in yards and orchards in Sacramento County. Although automobile tires have been the principal means of dissemination, it is also carried by animals, alfalfa and other hay.

Puncture vine becomes a pest in hays, grains, melons, orchards and vineyards. Persons and animals may become injured by the burs. The burs also puncture bicycle and automobile tires.

For the control of puncture vine, cultivation and cutting are satisfactory methods if done often enough to prevent the formation of seeds. Diesel oil is the best chemical to use in control work. It possesses the property of penetrating the burs and killing the seed as well as the plant even in emulsion with water, provided the oil is in the external phase of the emulsion. Crank case oil has also been used with success.

Malvaceae

The Mallow weed representatives of the county are: alkali mallow, the cheesweeds and Modiola caroliniana. The family in general is composed of herbs or soft woody shrubs with mucilaginous juice. The inner bark is tough and fibrous. The simple leaves are alternate and palmately veined. They are also commonly lobed and stipulate. The flowers are commonly perfect, although sometimes polygamous or dioecious. The calyx has five lobes. The five petals are twisted in the bud. The stamens are indefinite and hypogynous. They are arranged in a column or tube around the pistils. The petals are inserted on the base of the tube. The fruit is a loculocidal capsule with the carpels separating at maturity.

Malva parviflora is a very common weed of this locality. Cheeseweed, which is a native of Europe, is a coarse, widely branching biennial herb. It may reach a height of three feet. The petioles and upper branches of the stem possess forking white hairs on the upper side, but are glabrous below. The flowers are found in rather dense clusters in the leaf axils. Each flower is on a short stalk. There are five united sepals in the calyx. They (the sepals) are joined for about one-half their length and bear three small linear bractlets near the base. The pinkish corolla has five notched petals. The fruit is circular and flattish and splits when ripe into about a dozen carpels, each bearing a single seed.

Bull mallow, Malva borealis has a corolla of pinkish

petals which surpass the sepals much more than the petals of M. parviflora surpass their sepals. M. borealis possesses seven to nine carpels.

Malva spp. are found in orchards, vineyards and gardens. A hoe or weedcutter should be used before the seeds reach maturity.

The worst pest of the Mallow family is alkali mallow, Sida hederacea. The writer has found specimens of this weed around Sacramento garden lands along the river. It also occurs in orchards and waste places. The plants are low, scurfy, whitish perennial herbs. The scurfiness is due to scale-like hairs and to forked yellow hairs which cover both stems and leaves. The stems are from one-half to a foot in length. They are more or less decumbent and the tips rise. The roundish or kidney shaped leaves are three-fourths to two inches wide and possess toothed edges. Their petioles are from one-half to an inch long. The flowers are cream colored and each is about one-half inch in length. There are numerous stamens in this plant. The superior ovary ripens into six to ten dry one-seeded triangular fruits.

The planting of grain followed by dry plowing after harvest tends to keep alkali mallow in check. In some cases alfalfa planted after the plowing has proven successful.

Modiola caroliniana has been reported locally as a weed which is the cause of pink whites of poultry eggs when eaten by these fowls. The Malva spp. have been reported to do the same. Eastern markets have rejected eggs on this account.

Modiola caroliniana is a low perennial herb with rounded leaves which are one to one-half inches broad. They are palmately lobed or incised. The small flowers are solitary on axillary peduncles subtended by two or three narrow bractlets. The corolla is dark red. This plant possesses fifteen to thirty two-seeded carpels. The underground root system of this weed presents a control problem. Although it is not abundant here, it should be watched in order to check further spread. Mechanical control methods were the only ones reported to the author.

Hypericaceae

St. Johnswort, Hypericum perforatum is found in the eastern half of Sacramento County. It was first recorded at Folsom. This plant is one of the worst weeds of the range lands of the state. It is a smooth freely branching, erect perennial herb, with stems one to five feet high. The plant is woody at the base, but herbaceous above. It possesses a dense cyme of showy yellow flowers. The root system is extensively branched. Many sterile shoots arise from it. The opposite sessile leaves are narrow and from a half to an inch long and an eighth of an inch wide. The individual flowers are from two-thirds to an inch broad. The five petals are three-eighths to an inch long and pointed. The petals, like the leaves have conspicuous black glandular dots near the margins. This weed has five green sepals and they are shorter than the petals. There are numerous stamens, and three styles. The fruit is a three parted capsule bearing numerous, small, pitted dark brown seeds.

The toxic substance, known as hypericin is found in the glandular areas of the plant. However, the whole plant is said to be poisonous.

Mechanical control methods include digging and cutting. Other methods are covering, flooding and burning, but chemical methods are now used extensively.

Sodium chlorate applied at the rate of three pounds per square yard has given good results. Rainfall brings this chemical to the root system. Borax and sodium chlorate applied dry show good results. Sodium arsenite has been used to completely eradicate certain stands of St. Johnswort. The main drawback of the use of chemicals is the cost.

Reinfestation from seed disseminated by grazing animals always presents a problem. Stock should not be moved from an infested range to a clean range.

Onagraceae

Epilobium paniculatum is known as one of the willow herbs. This plant is a dry ground weed pest of the Summer and Fall seasons. The author has found this weed in orchards and vineyards. It is especially troublesome around grape vines during the cutting season as it tends to grow in between the runners. The plant may reach a height of six feet but it is more commonly three feet. The stems are simple below, but paniculately branched above. The glabrous herbage is sometimes glandular puberulent on the inflorescence. The leaves, which are lanceolate to linear are mostly alternate with smaller ones fascicled in the axils. The four rose-purple petals are deeply two-cleft into linear-oblong

lobes. The petals are three to five lines long. The four-celled inferior ovary is long and narrow. The fruit is a capsule which bears numerous seeds. The seed bears long tufts of hairs on the summits which aid in dissemination.

The weed cutter should be used frequently to check this weed in its earlier stages.

Umbelliferae

There are two members of the Parsley family in Sacramento County with weed significance. Both are stock poisoning plants. Conium maculatum or poison hemlock is found in the region of the Sacramento river. This plant is a tall branching biennial with hollow stems. The stems are dotted with purple marks. The white flowers are found in compound umbels. Each flower has five petals, five stamens, and a two-celled inferior ovary with two styles. The leaves are one to two feet or more long with finely cleft leaflets.

The plant contains alkaloids which give the plant its burning taste and probably accounts for its low palatability. Losses from poison hemlock are few because the stock eat the other plants around it. Badly infested areas should be fenced off.

Salt marsh hemlock, Cicuta bolanderi is found in the delta region. It is the largest of the water hemlocks and grows only in salty places. It varies in height from five to ten feet. The white flowers are found in compound umbels also. There are five petals, five stamens, and a two-celled ovary. The rootstocks are hollow with cross partitions.

Oil tubes are found in the seed. The large basal and cauline leaves are bipinnate and from three quarters to two feet long.

The alkaloid poison of this plant is known as cicutoxin and affects the nervous system of the animals that eat it.

The hemlock may be grubbed out or if an area is heavily infested it should be fenced off.

Asclepiadaceae

The Milkweed family possesses a group of stock poisoning plants. Its members are perennial herbs with milky juice and opposite or whorled leaves. The flowers are regular with a five-lobed corolla and a five parted calyx. There are two pistils in a flower. The styles are distinct below, but united above. The five stamens are united into a tube and inserted on the base of the corolla. This family possesses fruit of two follicles. The seeds have a tuft of silky hairs which aid in wind dissemination.

The genus Asclepias is represented by two species here. They are found mostly in the eastern section of the county. The genus as a whole is made up of herbs with stems arising from a thick horizontal root system. The calyx and corolla divisions are deciduous. The follicles are ovate or lanceolate.

Asclepias mexicana is the narrow leaf milkweed. The slender stem is two to five feet high. The herbage is glabrous and the linear, to linear-lanceolate leaves are found in whorls of three to six. The lower and the uppermost leaves may be opposite. They are two and a half to six inches long and two to six lines broad. The plant is many flowered. They

are greenish-white or tinged with purple and found in umbels. The follicles are three or four inches long and four lines thick at the widest part. The seeds are three and a half lines long. This weed is found along roadsides, ditch-banks stream beds and slopes.

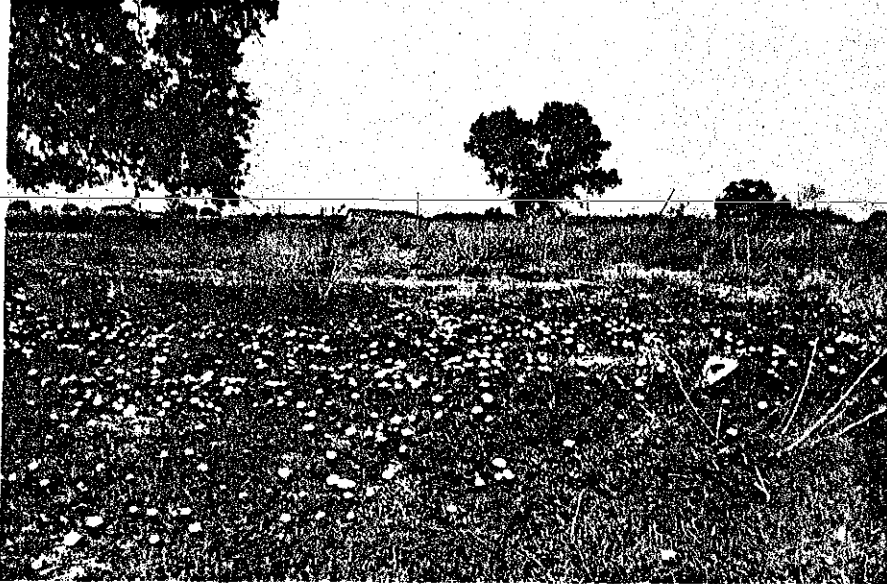
Carbon disulphide and chlorate have proven effective in chemical control. The plant could be hoed or cultivated out, if the root stocks are not spread about.

Asclepias speciosa or creek milkweed has oval to ovate or oblong leaves. The pink or reddish-purple flowers are found in umbels.

This plant may be controlled in the same way as A. mexicana.

Convolvulaceae

Orchard morning glory Convolvulus arvensis, is a major noxious weed of this locality, found in gardens, vineyards, orchards and other cultivated places. This herbaceous perennial has spreading smooth prostrate stems from one to several feet in length. These stems are simple or branched and arise from a very strong underground system. The herbage is glabrous to villous-pubescent. The blue-green leaves have squarish or flaring bases which narrow into blunt or rounded tips. The leaves vary from a half to two inches in length and are twice as long as the petioles. The flowers are borne on slender stalks in leaf axils. These stalks are one to four flowered. The funnel shaped corolla is pale pink or white inside and purplish outside. It is about an inch long and an inch broad. This plant has five stamens and a



Convulvulus arvensis thriving on uncultivated land.

two-celled ovary which develops into a capsule. There are four dark brown seeds to a capsule.

A great deal of study has been given to the control of morning glory. Favorable results have been gained by the use of carbon disulfide, chlorate, and acid arsenical as chemical control measures. The weed cutter, cultivator and "farmall" are the best mechanical devices for the control of this weed. Cropping with alfalfa reduces the vigor of the weed but does not eradicate it entirely. Small patches may be smothered with pieces of tar paper. Flooding certain plots of morning glory from sixty to ninety days has given variable results.

Boraginaceae

The borage family is made up of herbs which are usually rough with coarse hairs. The simple leaves are commonly entire and alternate. The complete flowers of this family are found in one-sided spikes or racemes coiled spirally. The calyx is commonly composed of five divisions or teeth and the five-lobed corolla has the five stamens inserted on its tube alternating with the divisions. The ovary is superior and deeply lobed, except in Heliotropium. The fruit is made up of somewhat roughened or prickly nutlets.

An alkaline weed of Sacramento County is Chinese pusley or Heliotropium curassavicum. This plant is a fleshy smooth prostrate perennial. It is grayish-green in color and branches from one-half to three feet or more. The leaves are obovate to broadly oblanceolate. The spikes occur mostly in pairs. The small white flowers turn to lavender with age.

The author found this weed scattered in places along the Sacramento river.

Grubbing is one of the best control practices with this weed. Renewal is checked if the crown is cut about an inch below the ground.

Amsinckia douglasiana was found in abundance in garden lands (especially in spinach), orchards, vineyards and grain-fields. It is a rough hairy annual with a sticky secretion. The yellow flowers are found in elongated spikes. The plant is from one and a half to four feet high. The roughened nutlets are carinate on the back. They are gray or pale.

This weed may be controlled with the hoe and cultivator in gardens. Dilute sulphuric acid kills this weed in grain-fields along with the mustards and radish.

Labiatae

The Mint family is represented by several weeds of this county. These aromatic plants possess simple opposite leaves. The stems are usually square. However, the writer has observed that mints do not always show the square stem characteristics. The perfect flowers are solitary in axils or more commonly in small cymes, which are usually sessile in the axils of the opposite leaves. The calyx is synsepalous, either two lipped or five toothed. The corolla is tube like and lipped with four stamens inserted on it. The superior ovary is four lobed and develops on ripening into small one-seeded nutlets. The style is single and cleft at the apex.

Trichostema lanceolatum is a common Sacramento County annual weed of the late Summer and Fall. It is commonly



Amsinckia douglasiana in a spinach patch.



Trichostema lanceolatum and Centromadia pungens in
a grain stubble field.

known as the vinegar weed, camphor weed or blue curls. It is a gray glandular strong scented annual herb usually less than a foot in height. The calyx is of five sepals united for about half their length. The lipped corolla is blue and quite showy with its four protruding stamens. The nutlets are wrinkled. This species can hardly be considered a major weed as it appears usually after harvest on grain stubble lands. It affects dry soil and it is seen throughout the county on such lands. The best control measure for its eradication where it is not wanted (principally in orchards and vineyards) is a weed cutter or other farm implements used before it reaches maturity. This plant, however, is a valued bee plant in this locality.

Marrubium vulgare which is commonly known as horehound is widely distributed here around farms and waste places. It is a perennial half woody evergreen herb with a large system of tough fibrous roots, from which arise tufts of white wooly stems, which are generally unbranched. Horehound may reach two and one-half feet in height. The wrinkled leaves are dark green and cottony below. The white flowers are small and grouped in dense, half rounded clusters in leaf axils. The ovary is four-lobed, each lobe developing into a one-seeded nutlet. Common horehound, despite the dark, ill-tasting honey, is proving a blessing to Sacramento Valley beekeepers since its blossoms occur during the dearth period from May to July. Bees appear to prefer this plant to many others perhaps on account of the rich easily available nectar.

Horehound is not considered as a major weed pest as far as crop infestation is concerned. It should be hoed or cultivated out if it is a pest.

Solanaceae

The Nightshade family is very interesting from the standpoint of its cultivated members, but this family is also represented by stock-poisoning plants and plant hosts for insect pests. The Nightshade members are herbs or shrubs with alternate leaves and the flowers are complete and regular. They bear a five-lobed sympetalous corolla and a calyx that is five-cleft or toothed. Flowers are either single or in umbels, cymes or panicles. The five stamens are inserted on the corolla. The fruit may be a berry as in the case of Solanum nigrum or a capsule as exemplified by the genus Datura. The superior ovary which is two celled, possesses one style. The stigma may either be entire or sometimes two-lobed.

The genus Datura is represented in Sacramento County and although it is not an abundant weed group here, it is nevertheless harmful.

Datura meteloides which is commonly known as Tolguacha is not the true Jimson weed. This weed was found in the dry sandy river bottom lands. It was found in larger numbers in the Cosumnes River area and was flowering in September. The herbage of the plant is grayish and stands from two to three feet high. The fruit of this species is very spiny and when ripe it breaks open and releases the numerous black seeds. Seeds are scattered by means of water usually. The flowers

of D. meteloides are large and white with some traces of purple. The author has found most specimens examined to have a corolla limb of about three inches.

Datura stramonium was found scattered in Sacramento County but was not always associated with sandy creek and river bottom land. The writer observed several specimens in summer fallow land away from any stream beds. This species is the true Jimson Weed and differs from D. meteloides in that the flower of the latter is much larger. D. stramonium possesses a fruit with fewer but longer prickles than D. meteloides.

Datura stramonium is a native of America and may be spread by water or farm implements. It also has been reported to be spread by the wind. In this case the fruit or whole plant may be blown.

The two Datura species mentioned before are poisonous to stock. All parts of the plant are poisonous, the seeds being the most dangerous, and next the young leaves. Toxicity diminishes as the plant dries.

Mowing the plants before seed maturity and burning them, followed by revegetation of the lands with wholesome forage is the best known means of prevention of the Datura species. Care should be taken not to include these plants in hay.

A third member of this genus, the purple thornapple, Datura tatula was found blooming in October in the low garden lands of the American river near Sacramento. This plant possesses a purple corolla and a purple stem to distinguish it from the other species. The prickles are numerous, very



Datura tatula in the garden lands near Sacramento

stout and sub-equal. The economic importance, methods of spreading and control methods are the same as the other two Datura species. Datura tatula was introduced from tropical America.

The genus Nicotiana is represented in Sacramento County also. The tobaccos are stock-poisoning plants and are usually heavy scented, viscid-pubescent herbs with entire leaves. The flowers come in panicles or racemes. The calyx is persistent and is either 5-toothed or -lobed. The corolla is funnelform or salverform. The ovary is 2-celled with large and thick placentae. The fruit is a smooth 2-celled capsule. The seeds are small and very numerous.

Nicotiana glauca is the tree tobacco. This plant is usually found in river beds. The author found many good examples of it along the American river at Folsom. This soft-woody evergreen shrub may reach a height of 10 feet. Its glabrous and glaucous herbage does not seem to be scented. The flowers, which are yellow, occur in terminal panicles. The corolla is about $1\frac{1}{2}$ inches long. The calyx is usually 5-toothed and 5 to 6 lines long. The oblong capsule is about $\frac{1}{2}$ inch long. When mature, it merely has to be touched slightly to release the seeds. This plant was introduced from South America.

That tree tobacco is poisonous is not doubted. Serious losses of cattle from feeding on the leaves and young stems have been reported from San Luis Obispo County.

Tree tobacco is a host plant of one or more virus diseases which attack agricultural crops.

Since tree tobacco is found mostly in isolated groups, it is not hard to keep in check. It is a perennial plant and the roots should be grubbed out. In many cases, stock do not range in the thicket areas of river bottoms where tree tobacco is found and that also lessens its danger.

Nicotiana attenuata appears in this region scattered along sandy river and creek soils. The flowering period is from April to November. This plant, which is commonly known as coyote tobacco is from two to four feet in height. The herbage is glandular-pubescent and ill-smelling. The lower leaves are broadly ovate while the upper are lanceolate. All leaves are petioled. The flowers are numerous, growing along leafy racemes. The white corolla varies from one to one and a half inches in length. The calyx teeth are one third as long as the flower tube.

The seeds of this plant are spread by means of water. Nicotiana attenuata which is poisonous to stock is easily recognized by its resemblance in form and odor to cultivated tobacco. They ordinarily grow in small, thick patches, and under such conditions can readily be destroyed, as they are annuals and only need to be cut down before the seeds are formed.

The genus Solanum is the true Nightshade and is represented in this locality. The plant is a herb and may sometimes be woody at the base. The flowers are found in umbels on short lateral or terminal peduncles. The calyx is 5-parted and the rotate corolla is 5-lobed. The fruit in this genus is a berry as was mentioned before.

Solanum nigrum or black nightshade is widely distributed in this area and it is usually found in moist, sandy places that are shaded. This plant is a low, much branched annual with a spread of one to three feet. The leaves are pointed-ovate, and the herbage in general is dark green and glabrous. The corolla is white and turns purple with age and the berries are green at first and then change to a blue-black. The flowering period is from June to November.

Black nightshade contains the narcotic poisonous principle solanin, which is found in small amounts in all its parts. The berries, which are somewhat edible, are not especially poisonous but should be avoided in all stages, especially when green. Agriculturists of this district have reported cases where young turkeys and poultry have been poisoned by this plant. It should be cut before it reaches maturity.

Plantaginaceae

The Plantago family possesses several weed pests in this locality. They are low herbs with only basal leaves. The leaves are one to several-ribbed or -nerved. The flowers, which are borne on scapes are complete, regular and 4-merous. The flowers persist in a dried condition for some time. The superior ovary is 2 to 4-celled. This family is represented by the genus Plantago.

Plantago major is a common lawn and pasture weed of this county and is widely distributed. It is a native of Europe. This is also the case with P. lanceolata. Plantago major possesses an ovate leaf and the herbage is glabrous.



Plantago lanceolata (left) and Plantago major are shown after they were uprooted from a lawn by the weed puller shown in the middle.

Plantains seed well and their spread is rapid, when cut with hay and clover. The thickened root stocks of these perennials must be cut in order to check their spread. It will pay stockmen to plow infested land as late as possible and give the summer sun a chance to dry out the rootstocks. The hand weed puller is a good tool to use around lawns. The fork is inserted around the crown of the plant root and with a little effort, the pest may be pulled out. This method is slow but practical.

Plantago lanceolata is a higher plant than P. major usually, and is found in moist agricultural lands and lawns. P. lanceolata possesses two hollow faced seeds to a capsule, while in P. major the capsules contain from four to sixteen seeds, which do not have this hollow faced characteristic. P. lanceolata has sword-like and not spatulate leaves. This species is said to be a good bee plant, as these insects obtain much pollen and some nectar from the blossoms.

Compositae

The great sunflower family has a number of major and minor weed members in Sacramento County. The family as a whole possesses annual or perennial herbs or shrubs with alternate or opposite leaves. The perfect flowers are unisexual or sterile, in heads, borne on the receptacle. The receptacle may have bracts subtending the flowers or may have bristles among the flowers. In some cases there are no bristles or bracts. Ray and disc flowers are common in Compositae. The one-celled ovary develops into an achene.

Cichorium intybus or chicory is a composite weed of the wastelands, roadsides and lawns. This native of Europe is a perennial herb with branched stem and mainly basal leaves. The flowers are blue and rarely white. The basal leaves spread and become three to seven inches in length and about an inch wide. These basal leaves are irregularly toothed, while the upper entire stem leaves clasp by broadened bases. The flowers, which are about an inch broad are are grouped in clusters of one to four along nearly naked stem branches. The heads are enclosed at the base by an involucre of green bracts arranged in two series.

Chicory may be pulled out by the hand weed puller if it is found in lawns. The tap root should be grasped firmly. The weed cutter may be used if this weed gets in orchards and vineyards.

Prickly lettuce, Lactuca scariola is a tall annual or biennial weed of bluish-green color. The simple stem is erect and paniculately branched above. It is glabrous throughout or hirsute or prickly below. The leaves are oblong or oblong-lanceolate, spinose, denticulate, pinnatifid, sessile or sagittate clasping. They vary from one and one-half to seven inches in length and possess a row of soft prickles on the lower side of the midrib. The open panicles of this weed are nine to fourteen flowered. The cylindrical involucre are five to six lines long. The ligules are a cream-yellow color. The achene is carried by the wind.

Prickly lettuce is commonly found in orchards and vineyards in Sacramento County. The weed should be cut a little below the crown in immature stages to assure proper control.

White-stemmed gum plant or Grindelia camporum is a roadside weed flowering in the fall. It may infest cultivated areas and should be cultivated or hoed out before reaching maturity. This herbaceous perennial has several smooth, white, shining stems reaching a height of one or two feet. These stems arise from a stout root and are not leafy at the base. The leaves are oblong to oblanceolate, serrate and clasping. The heads are either solitary or loosely corymbose. The heads are composed of green broad-pointed bracts, surrounding the many bright yellow ray and disc florets. The bracts secrete a gum substance.

Western golden rod, which is known botanically as Solidago occidentalis is found in stream beds in the Fall season. It is a perennial herb with alternate leaves. It may become five feet high. Corymbose clusters of small heads branch at the top. The entire leaves are linear or nearly so with minute clear or dark dots. This plant has sixteen to twenty ray flowers and eight to fourteen disc-flowers.

Western golden rod is not a major weed pest, but occasionally may infest garden lands of the river bottom. A cultivator is the best implement to use to keep this plant in check.

Telegraph plant, Heterotheca grandiflora is an annual fall weed found chiefly along roadsides. It has one to several erect stems and varies in height from two to six feet. The herbage is hairy. The yellow flowers are found

in heads in terminal corymbose panicles. It possesses about thirty ray flowers surrounding numerous disc flowers. The numerous alternate leaves are gray-green in color and oval in shape.

If this weed is abundant it should be mowed or burned down before the fruit matures. Hand pulling is practical if this annual is scattered.

~~The author found one weed member of the genus Aster.~~

This plant, which has only minor weed significance is commonly known as purple aster or Aster menziesii. It is an autumnal weed found in low dry ground. It occasionally infests vegetable crops. There are several simple stems from the woody root. It may reach a height of two feet. The herbage is cinereous or almost glabrous and the foliage is rough-pubescent. The leaves, which are purple-veined beneath are linear to lanceolate. They are sessile and serrate or entire and vary in length from one to two and one-half inches. The heads, which are three to five lines high, are found on rigid erect branchlets. The rays may be violet or purple. The linear-spatulate bracts are arranged in several closely imbricated ranks.

This plant may be controlled in the same way as the telegraph plant, Heterotheca.

Erigeron canadensis or horseweed was found in waste places, orchards and vineyards during the fall season.

This weed, which came from the eastern part of the United States reaches a height from two to five feet. The erect stem is simple below and paniculately branched above. The

herbage is hispid or nearly glabrous and the leaves are linear to lanceolate. The small heads are very numerous in a dense panicle. The heads vary from only one and a half to two lines in height. The white rays are very short and inconspicuous. The fruit is an achene and is spread by the wind. The pappus is responsible for its dissemination.

Horseweed is an orchard and vineyard pest and should be cut down with a weed cutter in its earlier stages of growth.

The genus Helianthus is found in Sacramento County. These are stout, coarse herbs with petioled simple leaves. The rays are yellow and the disc-flowers are purplish or brownish. The leaves are alternate, with the exception of the lower or lowest. The large heads are found solitary on the ends of branches or in terminal corymbs. The bracts of the involucre are imbricated and the receptacle is flat or convex.

Helianthus annuus is the common sunflower. The author found this in moist lands of the creek and river regions. The plant varies in height from two to five feet. The herbage is rough-hispid. The serrate leaves are deltoid-ovate. The disc is one to one and a half inches broad.

Helianthus californicus is a larger species than H. annuus. The former varies in height from four to eleven feet. H. californicus has stems which come from tuber-like roots and oblong to narrowly lanceolate leaves. The heads, which are two or three inches broad, are found in terminal corymbose panicles.



Helianthus californicus along the Cosumnes river
near the Elk Grove-Galt highway

The sunflowers should be cultivated out in the earlier stages if they are pests.

The common dandelion, Taraxacum vulgare is a common lawn pest. This plant is stemless with basal leaves. The heads are found solitary and terminal on naked hollow scapes. The flowers are yellow and the achenes possesses a pappus. This plant has a deep tap root which makes it hard to pull. In many lawns, this weed completely crowds out the grass. The weed puller should be used before this herb produces mature achenes.

Centromadia pungens is known locally as common spikeweed. This plant is a rigidly branching annual with alternate spinescent leaves. The herbage is more or less glandular and scented. There are twenty five to forty small yellow bifid rays on this plant. The fruit is an achene. Spikeweed is found in alkaline soils which are not cultivated much. The author found this weed in grain stubble lands after harvest. It did not do any harm there. The weed has some forage value in range lands if the stock eat it before the parts get too woody.

Hemizonia virgata is one of the local tarweeds. It usually is a foot or a foot and a half in height. It commonly branches at the middle into several virgate branches bearing numerous heads on short branches. The herbage is viscid-glandular and nearly glabrous. The leaves are serrate to toothed or entire and are from one to two and a quarter inches long. This plant has four or five yellow ray flowers and seven to ten disc flowers. The ray achenes are a shiny

black. This plant which is an annual is usually found in waste places. It should be cut before reaching maturity, if it is not desired. The tarweeds have some value as a bee plant.

Western ragweed, Ambrosia psilostachya is a hay fever plant of this region. The writer found it in abundance along the Sacramento River bank. It is a coarse perennial herb with simple stems from two to four feet high. The stems grow erect from rootstocks. The deeply lobed leaves are two to five inches long. The harsh gray-green herbage is somewhat aromatic. There are two sorts of greenish flowers, which are borne on the same plant. The numerous staminate heads are clustered in erect spike-like racemes while the pistillate flowers are found in heads in the axils of the upper leaves at the base of the staminate racemes.

Ragweed should be hoed or cultivated out before it reaches maturity.

The genus Xanthium has two weed members in Sacramento County.

Common cocklebur, Xanthium canadense is a coarse annual with a stout central stem rising about two feet high. It branches freely. The leaves are deltoid-ovate or somewhat cordate, irregularly serrate or somewhat incised. They are often distinctly three-lobed, rough and hispidulous. These green leaves are three to four inches long and their petioles nearly reach that length. This plant possesses both staminate and pistillate flowers. They are greenish in color. The small, inconspicuous and subglobose staminate heads are found

in terminal clusters. There are many tubular corollas in the staminate groups, and the stamens are attached to these. The axillary pistillate heads are situated below the staminate heads. Each pistillate head contains two flowers only, inclosed in a spiny cylindrical bur. The glandular bur is one-half to an inch in length and possesses hooked spines. There are two black achenes in each bur. The whole plant may be spread by means of farm implements or the burs may attach themselves to animals and become disseminated in this manner.

This weed which came from eastern United States is found in moist sandy soils. The Xanthium species are stock poisoning plants. The toxic substance of the cockleburs is a glucoside. These plants are relished by stock, especially hogs. The stage when the cotyledons have just emerged from the ground, and before the true leaves have formed, is the time when it is most poisonous. The seeds are more poisonous than the herbage. Cockleburs are troublesome in sheep wool in some areas. The burs may also cause mechanical injury when eaten.

The Xanthium species should not be allowed to mature. Weed cutters in orchards should be used frequently. One pound of copper sulphate (blue vitriol) to ten gallons of water sprayed on the herbage when the plant is six inches to a foot high is a good chemical control method.

Xanthium spinosum may cause trouble in the same way as X. canadense but is not as troublesome in this state. X. spinosum is commonly known as spiny clotbur. The author

found this weed in waste lands near the river regions. It is an annual with erect branching stems. This species gets from one to three feet in height. The alternate leaves which are two to five inches long are green above and white-pubescent beneath. They are lanceolate or ovate-lanceolate, acute or acuminate and two or three lobed or cut. In each leaf axil there is a three-pronged yellow spine. The middle spine is about an inch long. There are also separate staminate and pistillate flowers on this plant.

This weed came from Europe. It should be controlled in the same way as K. canadense.

Pineapple weed, Matricaria suaveolens is a common plant of minor weed significance. It is a low annual glabrous herb which is found in dry places around farm yards. Sometimes it gets in gardens, orchards and vineyards. The leaves are pinnately divided. The heads are solitary or somewhat corymbose. The herbage is sweet scented suggesting the pineapple odor. There are no rays on this plant. M. suaveolens varies in height from two to ten inches.

Control methods should center around cutting down this weed before it matures. Cultivators, hoes and weed cutters should be used.

Common groundsel, Senecio vulgaris is another composite plant of minor weed significance. This annual was introduced from Europe. It is from six to fifteen inches high and possesses simple or branching fleshy stems. The leaves are deeply lobed with jagged margins. The upper leaves are clasping while the lower taper into petioles. The heads

are found in terminal corymbs. There are from fifteen to twenty-five yellow tubular flowers in each head. There are no rays. The heads are only a quarter of an inch high. The green bracts are black-tipped. The fruit is spread by the wind as the achene has a silky pappus.

Groundsel should be hoed or cultivated out.

The thistle tribe has a number of major weed pests here. A brief summary of the structural characteristics of this group is in order. Thistles possess alternate prickly leaves. The large heads have imbricated bracts which are usually prolonged into a bristle or spine or have membranous edges. The receptacle of thistles is bristly or hairy. There are no rays in this group. The perfect flowers have corollas cleft in long narrow lobes.

There are a few infestations of Canada thistle, Cirsium arvense in this county. The slender stems which are from one to three feet high, arise from creeping perennial rootstocks. The spiny leaves are lanceolate to oblong in outline and vary in length from one to five inches. The numerous heads are six to eleven lines high and the staminate and pistillate heads are usually on different plants. The staminate heads are ovate-globular, with the flowers well exerted, while the pistillate heads are oblong-campanulate with flowers less exerted. The corollas are rose-purple and the involueral bracts are appressed with small weak prickles. Canada thistle came from Europe.

This thistle has been controlled by plowing in order to waste the food reserve in the rootstocks.

The Star thistle genus, Centaurea has several representatives here. They are usually erect herbs. The alternate leaves are not prickly. The heads are medium sized. The imbricated bracts end in needle-like prickles.

Napa thistle, Centaurea melitensis reaches a height of one or two feet. The decurrent leaves give the stem a winged appearance. The lowest leaves are pinnatifid and the upper are narrow and mostly entire. The heads are mostly solitary. The bracts are rigid with the outer bearing palmatifid spines. The inner and intermediate bracts bear rigid spines two to four lines long. The flowers of Napa thistle are yellow and the achene bristles are in three rows of unequal lengths. This pest came from Europe and was first introduced to Napa. It is a pest of grainfields, pasture and other agricultural lands.

Centaurea solstitialis is known as yellow star thistle. This annual grows to a height of one to two and a half feet. The rigid stems branch from the base. The stems and leaves are covered with a white cottony wool. The deeply lobed basal leaves are two to three inches long; the upper leaves are from one-half to one inch long, entire, narrow, sharply pointed and extend down the stem at the base to form wings. The flowers are bright yellow and the achene possesses a pappus. The ovoid-globular heads are solitary at the ends of branches. The heads are about one inch long. The uppermost bracts are spineless, while the lowest bracts possess three pronged spines. The yellow spines of the middle bracts are simple and stout and reach a length of one-quarter to one

inch.

This species came from Europe and is the most widely distributed star thistle. It is found along road sides, in cultivated fields and in waste lands.

The purple star thistle, Centaurea calcitrapa also came from Europe. This plant is a coarse rigid perennial found along roads and in uncultivated lands. It is nearly glabrous and varies in height from two to four feet. The leaves are pinnately divided into a few linear or lanceolate lobes. The uppermost leaves are narrow, undivided and not decurrent. The large heads are nine to ten lines high and possess purple flowers. The bracts of the head possess rigid straw colored spines from a half to one inch in length.

There are a few infestations of Russian knapweed in this county. Its botanical name is Centaurea repens. The stems reach a height of one to three feet from creeping perennial rootstocks. The oblong basal leaves are sinuately lobed or pinnatifid and one and a quarter to three inches long. The entire cauline leaves are shorter. The heads which are solitary on the ends of leafy branchlets are oblong or short cylindric and about a half of an inch high. The flowers are blue and the pappus possesses many bristles. This species does not have spiny bracts.

This species was introduced from Asia.

The sodium chlorate and acid arsenical methods have proven the best in the case of Russian knapweed.

Control practices of the star thistles should center around checking the ripening of the seeds. Mechanical methods

are commonly practiced here.

Bull thistle, Cirsium lanceolatum is a perennial herb with stout, branching striate stems. It ranges from two to four feet in height. The lanceolate leaves are from one and a half to fourteen inches long. The leaf blades are coarsely toothed or deeply lobed nearly to the midrib. The large heads are one and a half to two inches high. The rose-purple corolla is fragrant. The involucral bracts are lanceolate. The fruit is an achene.

Bull thistle came from Europe. It is found in waste places and along fence lines. The plants should be cut or mowed down and burned before reaching maturity.

Silybum marianum or milk thistle is from two to six feet high. The alternate leaves are pointed and the bases clasp the stem. The lower leaves may become one to two feet in length and half that width. The upper leaves are smaller than this. The leaf margins are wavy and often deeply lobed. Other leaf characteristics are the yellow marginal prickles and the shiny upper green surface with its mottled whitish blotches. The purple flowers are all perfect. The heads are two to two and a half inches broad. The spines of the middle involucral bracts are one to one and a half inches long. The fruit is an achene.

Milk thistle was introduced from Europe and is quite common in pasture lands and along roadsides. The stem should be hoed off at the ground.

Common madia, Madia elegans is found along roadsides, in waste places and some cultivated places. It is an annual.



Madia elegans growing along a roadside
in Citrus Heights.

plant commonly, but at times exhibits a perennial tendency. It is one to four feet high with stout stems branching above. The plant has glandular hairs and is heavily scented. The strap-shaped leaves are mostly alternate and from three to five inches long. This plant has about a dozen ray flowers with yellow corollas which are three lobed at the summit and often have a red spot at the base. The disc flowers are few to many and often infertile. The achene does not have a pappus.

This tarweed should be cut down before maturity and burned.

Mayweed, which is botanically known as Anthemis cotula is a garden and orchard weed of minor importance. This annual is erect and much branched. It reaches a foot to two feet in height. The alternate leaves are finely divided. The herbage is ill-scented and gives off a juice that is irritating to the skin. The numerous heads are found at the ends of naked stalks which are one and a half to four inches long. The heads are three quarters to an inch broad. There are ten to twenty white ray flowers and numerous yellow disc flowers. The achene does not have a pappus.

The weedcutter and hoe may be used to keep this weed in check.

CHAPTER III

WEEDS AS HOSTS TO INSECT PESTS AND PLANT DISEASES

Weeds are not only harmful as competitors with the desired plants for light, soil moisture, and soil nutrients or harmful as stock poisoning plants, but also undesirable as hosts to insect pests and plant diseases. Some weeds have been found to be worse than others and the author will only list the weeds that are the most noxious in this phase of the study.

Russian thistle, Salsola kali var. tenuifolia acts as host for the sugar beet leaf hopper, Eutettix tenellus and Monoxia consputa, the western beet leaf beetle. Bean thrips, Hemiothrips fasciatus thrives on Lactuca spp. The Aster spp. are undesirable as hosts of the vegetable weevil, Listroderes obliquus. Although shepherd's purse, Capsella bursa-pastoris is not a major noxious weed otherwise, it is very undesirable in harboring the sugar beet leaf hopper, Eutettix tenellus; clover aphid, Anuraphis bakeri; the leaf curl plum aphid, Anuraphis helichrysi; the cotton or melon aphid, Aphis gossypii; the bean aphid, Aphis rumicis; the cabbage aphid, Brevicoryne brassicae; and the green peach aphid, Myzus persicae. Chenopodium album or lambsquarter is relished by Icerya purchasi, the cottony cushion scale of citrus fruit; the harlequin cabbage bug, Murgantia histrionica; the banded flea beetle, Systema taeniata, which is destructive to vegetable and vine crops; the beet and spinach leaf miner Pegomyia hyoscyami; and the apple skin worm, Tortrix franciscana. The docks, (Rumex spp.) harbor the citrus thrips, Scirtothrips citri; the apple leaf

hopper, Empoasca mali; the grape leaf hopper, Erythroneura comes; the sugar beet wireworm, Pheletes californicus; and the strawberry root weevil, Brachyrhinus ovatus. Insects which feed on the Datura spp. are the red spider, Tetranychus telarius; the cotton or melon aphid, Aphis gossypii; the potato flea beetle, Epitrix cucumeris; the tomato sphinx, Protoparce sexta and the potato tuber moth Gnorimoschema operculella. Pests injurious to cultivated crops which may be found on Plantago spp. are the cotton or melon aphid, Aphis gossypii; the tarnished plant bug, Lygus pratensis; the potato flea beetle, Epitrix cucumeris and the serpentine leaf miner, Agromyza scutellata of beans, cabbage, peas, peppers, spinach and watermelon. The Brassica spp. harbor the sugar beet leaf hopper, Eutettix tenellus; the grape leaf hopper; Erythroneura comes; the harlequin cabbage beetle, Murgantia histrionica; the black grass bug, Irbisca solani of peaches and apricots; the onion thrips, Thrips tabaci; the blossom thrips, Frankliniella tritici; the sugar beet wire worm, Pheletes californicus, the potato flea beetle, Epitrix cucumeris; the western flea beetle, Phyllotreta pusilla; the hop flea beetle, Psylliodes punctulata; and the cabbage butterfly, Pieris rapae. The morning glories, Convolvulus spp. aside from their other harm, harbor the common red spider, Tetranychus telarius; several species of Thrips; the cotton or melon aphid, Aphis gossypii; the soft brown scale, Coccus hesperidum and the apple skin worm, Tortrix franciscana.

If the weed hosts are controlled, the insects will be greatly reduced in numbers because they will not have these

plants as a substitute or a place to hold over on from season to season.

Weeds may become a factor in the spread of plant diseases. Virus diseases, fungus diseases and nematode diseases have caused a great deal of damage in many localities. The curly top disease is caused by a virus which does a large amount of damage to sugar beets, spinach, cucurbits, and tomatoes. This virus is spread from plant to plant by the beat leaf hopper, Eutettix tenellus. The insect spends the winter on native vegetation and migrates to cultivated plants in the spring. The virus has been found on Brassica arvensis, Capsella bursa-pastoris, Chenopodium spp; Malva parviflora, Polygonum spp; Salsola kali and Solanum nigrum.

Spotted wilt of tomatoes, spinach, peas, beans and lettuce is another virus disease. It has been found in some gardens of Sacramento County. "Die-back" is another name for it and the worst damage is done in the Santa Clara valley. The weed hosts of this virus are Datura stramonium, Stellaria media, Capsella bursa-pastoris, Nicotiana glauca, Malva parviflora, Montia perfoliata, Cichorium intybus, Solanum nigrum and Convolvulus arvensis.

A fungus disease known as the club root of cabbage is caused by Plasmodiophora brassicae. This disease has been found on Capsella bursa-pastoris and Sisymbrium officinale. However, club root has not been reported in California. Phytophthora infestans, which causes late blight of potatoes and tomatoes has been known to live on native hosts of Solanaceae. This disease has been reported in the State on

the cultivated plants but not on the weeds. The downy mildew of lettuce, which is caused by the fungus Bremia lactucae has been reported on species of Lactuca and Sonchus elsewhere but not in California.

Southern root rot caused by the fungus, Sclerotium rolfsii damages the sugar beets. Weed hosts include Cynodon dactylon, Convolvulus arvensis, and Chenopodium spp.

The root knot nematode, Heterodera radiculicola, is found on a number of California cultivated plants. Many weeds act as hosts for this nematode in infested areas.

CHAPTER IV

THE SPREADING OF WEEDS

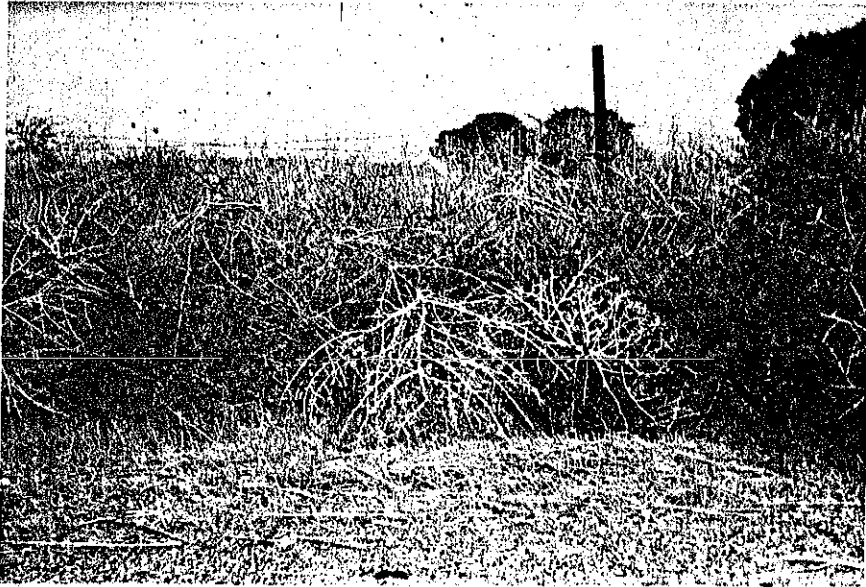
Weed seeds are spread by wind, water, farm implements, animals, crop seeds and underground root systems.

Russian thistle, Salsola kali var. tenuifolia rolls from place to place in the "tumbleweed" manner. This is the case of Amaranthus graecizans. The whole plant breaks off at the lower regions and tumbles along scattering the seeds. Occasionally the Datura group breaks off at the ground and rolls. The seeds drop out of the capsules and scatter.

By far the largest number of weed seeds which spread by the wind are those which possess modified parts on the fruit or on the seed which aid in dispersal. A tuft of hair known as the pappus found on the achenes of many of the composites aid in this way. The seeds in Asclepias and Epilobium have tufts of hair.

The following seeds are spread by the wind due to the fruit or seed hairs that they possess: Epilobium paniculatum, Asclepias spp., Lactuca scariola, Solidago occidentalis, Heterotheca grandiflora, Aster menziesii, Erigeron canadensis, Senecio vulgaris, Cirsium lanceolatum, Silybum marianum, Centaurea melitensis, Centaurea solstitialis and Centaurea repens. Typha latifolia and Taraxacum vulgare do the same.

The author observed that weeds of all kinds were along water ways and irrigation ditches. It is from such places that major infestations get their start. The achenes of some weeds and seeds of others are light and able to float on water and be carried for varying distances.



Amaranthus graecizans is shown above after it had blown and collected along a fence line. The lower photo shows an individual plant of Salsola kali var. tenuifolia which rolls in the same manner.

The following weed achenes or weed seeds are carried by the water: Cynodon dactylon, Rumex spp.; Chenopodium spp., Calandrinia caulescens var. menziesii, Montia perfoliata, Stellaria media, Brassica spp., Holcus halepensis, Amaranthus retroflexus, Capsella bursa-pastoris; Sisymbrium officinale, Raphanus sativus, Malva spp., Polygonum spp., Convolvulus arvensis, Heliotropium curassavicum, Amsinckia spp., Trichostema lanceolatum, Marrubium vulgare, Latura spp., Nicotiana spp., Plantago spp., and Cyperus spp.

Farm implements are responsible for scattering weeds. Threshers, harrows, and cultivators may spread any amount of weeds if the operator is negligent. In some cases the rhizomes may be spread by the implement or without it. Examples of this would be Convolvulus arvensis, Cynodon dactylon, Holcus halepensis, Polygonum coccineum, Asclepias spp., and Cyperus spp.

The upper part of the plant could entangle in the implement and scatter the seeds or achenes. Examples are Polygonum spp., Eremocarpus setigerus, Xanthium spp., Salsola kali var. tenuifolia, Trichostema lanceolatum and Tribulus terrestris (especially automobile tires).

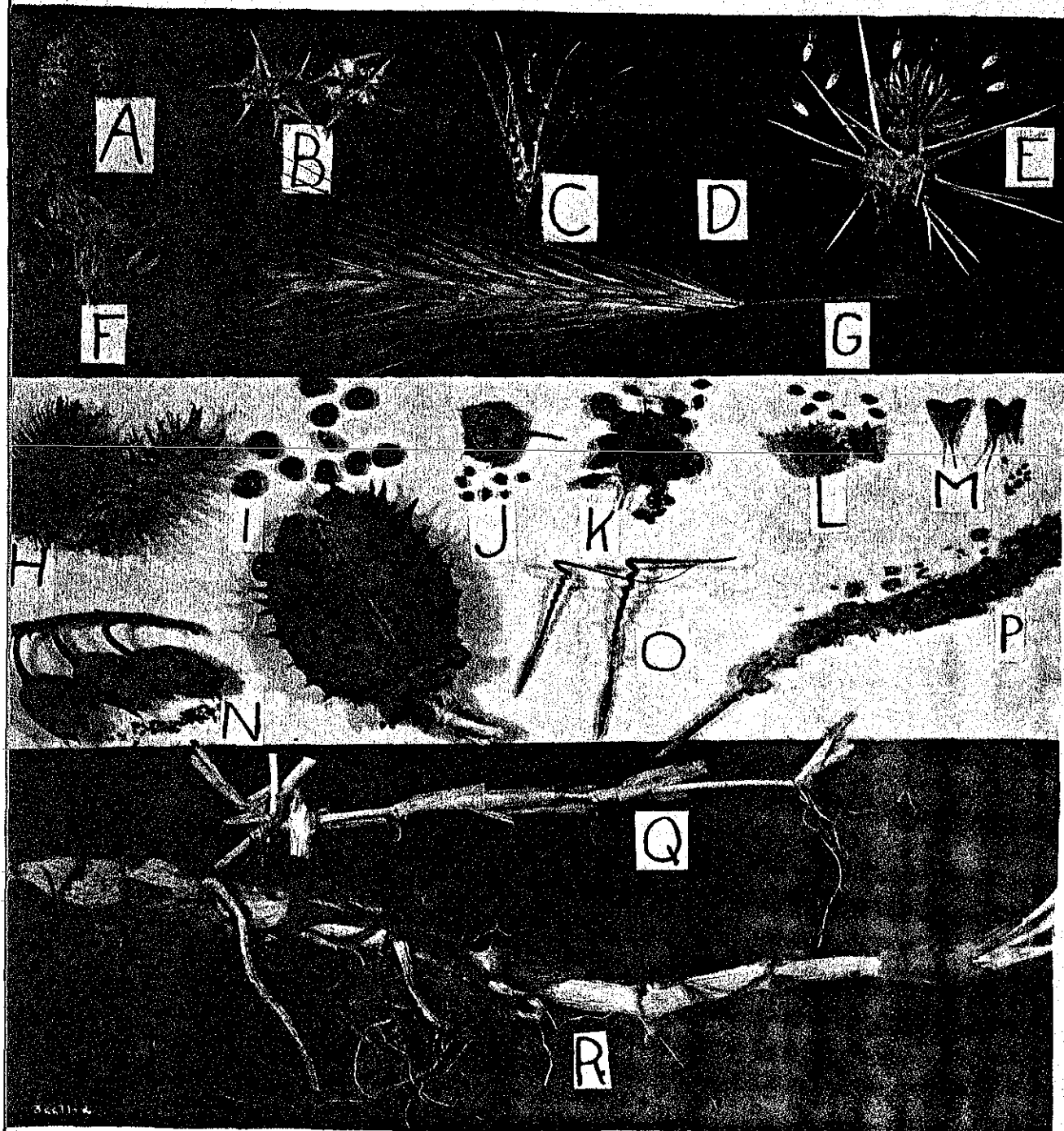
Animals may spread seeds about. The fruits may have barbs to hook on to the fur of the animals. The Xanthium spp. are the best examples of this. The nutlets of Marrubium vulgare hook on farm animals and spread the same way. Erodium cicutarium is also in this group with its very familiar fruit.

The animal may eat the seeds and pass them out the digestive tract unharmed. Holcus halepensis and Hypericum perforatum are examples.

Noxious weed seeds are found in crop seeds in varying amounts. Where no attempt is made to check these weeds from maturing, it will be found that numerous weed seeds are in with the crop seeds. A good example of this would be the seeds of Erassica spp. and Kapbanus sativus in grains.

Studies show that seeds of alfalfa, Sudan grass, oats, barley, wheat and the clovers, have a varying amount of weed seeds with them. The following weed seeds have been found in crop seeds: Avena fatua, Salsola kali var. tenuifolia, Lepidium draba, Sida hederacea, Hypericum perforatum, Convolvulus arvensis, Tribulus terrestris, Centaurea calcitrapa, Centaurea repens, Holcus halepensis, Centaurea solstitialis, Cyperus spp., and Cirsium arvense.

The figure on page 88 illustrates fruits, seeds and rhizomes which are structurally adapted to aid in spreading the weeds about.



The above photo shows anatomical characteristics of fruits, seeds and rhizomes of several weeds. These structures aid the plant in spreading. Specimens A (Xanthium spinosum) H (Xanthium canadense), L (Marrubium vulgare) and O (Erodium cicutarium) are spread by animals. Specimens C (Epilobium paniculatum), E (Centaurea solstitialis) and F (Lactuca scariola) are carried by the wind. The following are carried by water: I (Datura tatula), J (Malva parviflora), K (Rumex crispus), M (Capsella bursa-pastoris), N (Nicotiana glauca) and P (Plantago major). The rhizomes of Q (Gynodon dactylon) and R (Holcus halepensis) may be carried by implements, while B (Tribulus terrestris) may be carried by tires. Hordeum murinum (G) is carried in hay.

CHAPTER V

WEED CONTROL METHODS

Weed control practices may be placed under heads of cultural, mechanical, chemical, and miscellaneous methods. Laws pertaining to weed control will be discussed under a sub-head of cultural control.

Cultural control

Cultural control involves several phases which the farmer should consider. Clean seeds should always be planted, as cheap seeds may prove costly afterwards. Seeds should be bought from established dealers. Birds which eat weed seeds should be protected. Farm machinery such as hay-presses, threshers, and harrows should be thoroughly cleaned before they are moved from one farm to another. Crop rotation is another cultural practice. Wastelands, ditch banks and fence rows should always be kept cleared of objectionable weeds. "Maintenance" as defined in the new Streets and Highways Code includes "weed control" as one of the general utility services thereunder.

The Agricultural Code of the California laws has important regulatory measures which are very important in the attempt to control weeds and to keep new pests from entering. The weed-free area provisions make it unlawful to transport into the district proclaimed by the Director, the seeds of any specific weeds for which the weed-free area has been declared. The following weeds come in this category: Johnson grass, Holcus halepensis; goat grass, Aegilops sp.; sand bur, Cenchrus pauciflorus; nut grass, Cyperus sp.; Russian thistle,

Salsola kali; camel's thorn, Alhagi camelorum; pignut,
Hoffmannseggia falcaria; Scotch broom, Cytisus scoparius;
 puncture vine, Tribulus terrestris; mallow, Malva spp.;
 alkali mallow, Sida hederacea; wavy leaved gaura, Gaura
sinuata; hoary cress, Lepidium draba; black currant, Ribes
nigrum; wild currant, Ribes sp.; water hemlock, Cicuta sp.;
 poison hemlock, Conium maculatum; Mexican whorled milkweed,
Asclepias mexicana; wild morning glory, Convolvulus arvensis;
 cressa weed, Cressa cretica; dodder, Cuscuta sp.; Klamath
 weed, Hypericum sp.; wild heliotrope, Heliotropium curassavicum;
 white horse-nettle, Solanum eleagnifolium; Carolina horse-
 nettle, Solanum carolinense; chicory, Uichorium intybus;
 prickly lettuce, Lactuca scariola; blue lettuce, Lactuca
pulchella; creeping sow thistle, Sonchus arvensis; fleabane,
Erigeron linifolius; sunflower, Helianthus annuus; spikeweed,
Centromadia sp.; tarweed, Hemizonia sp.; tarweed, Ladia sp.;
 poverty weed, Iva axillaris; ragweed, Ambrosia sp.; burweed,
Franseria sp.; cocklebur, Xanthium sp.; spiny clotbur, Xanthium
sp.; spiny clotbur, Xanthium spinosum; corn chrysanthemum,
Chrysanthemum segetum; milk thistle, Silybum marianum; cardoon,
Cynara cardunculus; bull thistle, Cirsium lanceolatum; Canada
 thistle, Cirsium arvense; burdock, Arctium sp.; Russian knap-
 weed, Centaurea repens; Iberian thistle, Centaurea iberica;
 and star thistle, Centaurea sp.

The Director of Agriculture publishes the weed-free
 area boundaries and the names of the weeds in question in
 newspapers, farm journals or on posters. Persons residing
 within this area are compelled by law to cooperate by not

letting any of the weeds spread or mature in this area.

The Director may enter into cooperative agreements with boards of supervisors and other officials, State, and Federal agencies for the purpose of eradicating pests dangerous to the agricultural industry of California. County agricultural commissioners may enter into contracts with landowners for the eradication of "pests." An area of limited infestation of a particularly serious and injurious weed pest can, if necessary, be circumscribed by quarantine lines to aid in eradication or prevention of spread. The seed inspection provisions of the Agricultural Code are directed primarily to the prevention of introduction of certain primary and secondary weeds through planting of impure seeds. "Weed seeds" means any and all noxious weed seeds and any and all seeds not included in the definition of agricultural seeds. "Agricultural seeds" means all domesticated grasses, cereals, legumes such as alfalfa, sweet clover, red clover, crimson clover, alsike clover, white clover, field peas, cowpeas, beans, soybeans, and vetches and the seeds of all other crops that are or may be grown commercially on a field scale in this state, not including flower, sugar beet, and garden vegetable seeds.

Every lot of agricultural seeds of five pounds or more by weight, except as herein otherwise provided, when sold in bulk, packages or other containers must bear a labelling stating the commonly accepted name of such agricultural seed and the approximate percentage, by weight of purity, meaning the freedom of such agricultural seeds from other kinds of

seeds distinguishable by their appearance and from inert matter. The approximate total percentage by weight of weed seeds and the name and number per pound of each kind of seeds of primary noxious weeds which are present must be stated. Also to be included on the label is the name of each kind of seed or bulblet of secondary noxious weeds which are present singly or collectively, as follows: in excess of one seed in five grams of timothy, redtop, tall meadow oat grass, orchard grass, crested dogs' tail, Canada blue grass, Kentucky blue grass, fescues, brome grasses, perennial and Italian rye grass, western rye grass, crimson clover, red clover, white clover, alsike clover, sweet clover, alfalfa and all other grasses and clovers not otherwise classified; in excess of one seed in each twenty-five grams of millets, rape, flax, sudan grass, and other seeds not specified in the first series ("five gram series") or the following series ("one hundred gram series"). If there are more than one weed seed of the secondary group in each one hundred grams of wheat, oats, rye, barley, buckwheat, vetches, or other seeds as large or larger than wheat, a statement must also be made on the label. The approximate germination percentage of such agricultural seeds together with the month and year the seed was tested and the name and address of the vendor of the agricultural seeds is required to be put on the label.

Mixtures of agricultural seed of an amount of five pounds or more by weight, which contain not more than two kinds of such seed in excess of five per cent by weight of each, when sold as mixtures in bulk, packages or other

containers must bear a label stating that such seed is a mixture. The label must state the name and approximate percentage by weight of each kind of agricultural seed present in such mixture in excess of five per cent of weight of the total mixture, the approximate percentage by weight of weed seeds and the name and number per pound of each kind of seeds of the primary noxious weeds which are present in such mixture. ~~The name of each kind of seeds or bulblets~~ of secondary noxious weeds which are present singly or collectively in excess of one seed or bulblet in each fifteen grams of such mixture, the name and address of the vendor of such mixture and the approximate percentage of germination of each kind of agricultural seed present in such mixture in excess of five per cent by weight, together with the month and year said seed was tested must be put on the label.

Special mixtures of agricultural seeds, in an amount of eight ounces or more by weight, except as specified in the above provision just mentioned, when sold as mixtures, in bulk, packages, or other containers must bear labels stating that such seed is a special mixture. The name of each kind of agricultural seed which is present in proportion of five per cent or more of the total mixture, the approximate total percentage by weight of weed seeds and the approximate percentage by weight of inert matter must be stated. Besides the above mentioned data, the following must also be on the label; the name and number per pound of each kind of seeds of primary noxious weeds which are present in such special mixture, the name of each kind of seeds or bulblets of second-

any noxious weeds which are present singly or collectively in excess of one seed or bulblet in each fifteen grams of such special mixture and the name and address of the vendor of the special seed mixture.

Agricultural seeds, mixtures or special mixtures are exempt from the provisions given above when possessed or sold for food or manufacturing purposes only or when sold to merchants to be recleaned before being sold for seeding purposes or when in store for the purpose of recleaning or not possessed or sold for seed purposes within the state. When a lot of wheat, oats, rye or barley, which has been produced within the state, is sold it shall be exempt from the requirements calling for the labelling of the approximate percentage of germination of such agricultural seeds together with the month and year the said seed was tested.

The Director of Agriculture enforces the above article by himself, his agents or through the commissioners acting under his supervision and control. The director also publishes in the agricultural bulletin of the department, rules and regulations for the enforcement of this article and maintains a properly equipped laboratory for making the laboratory weed seed tests. The director has power to inspect, examine, analyze and test any agricultural seed sold within this state for seeding purposes within this state, at such time and place, and to such extent he may determine. The director shall have free access at all reasonable hours to any premises or conveyances, to examine such agricultural seeds, and may, upon notice to the dealer, his agent or the representative



The State seed laboratory at Sacramento where commercial seeds are tested for weed seed content (Courtesy of the Department of Agriculture).

of any warehouse, elevator, or transportation company, if present, take for analysis a composite sample of such agricultural seeds upon payment of a reasonable purchase price for the same when demanded. The sample is thoroughly mixed and two official samples are taken therefrom. Each official sample is thoroughly sealed. One sample is taken by the director for analysis and the other is left with the party in interest. After an analysis is made, provided it falls below the statement on the tag or label, the vendor or consignee of the lot of seed is notified and a copy of the notice is mailed to the person whose tag or label is affixed thereto. Any person who appears to have violated any of the provisions of the above article shall, before the filing of a complaint against said person, be granted opportunity for a hearing before the director under such rules and regulations as may be adopted by the director which shall include the giving of proper written notice. At the hearing the person may be represented by counsel. Any lot of agricultural seeds offered for sale in violation of the provisions of this article must, in accordance with rules and regulations of the director, be removed from sale by the vendor thereof upon his receiving notice from the director of such violation. The vendor must withhold such agricultural seeds from sale until such violation has been corrected.

Any citizen of the State of California may submit to the director samples of agricultural seeds for test and analysis, subject to rules and regulations as adopted by the director. The director may by regulations fix the maxi-

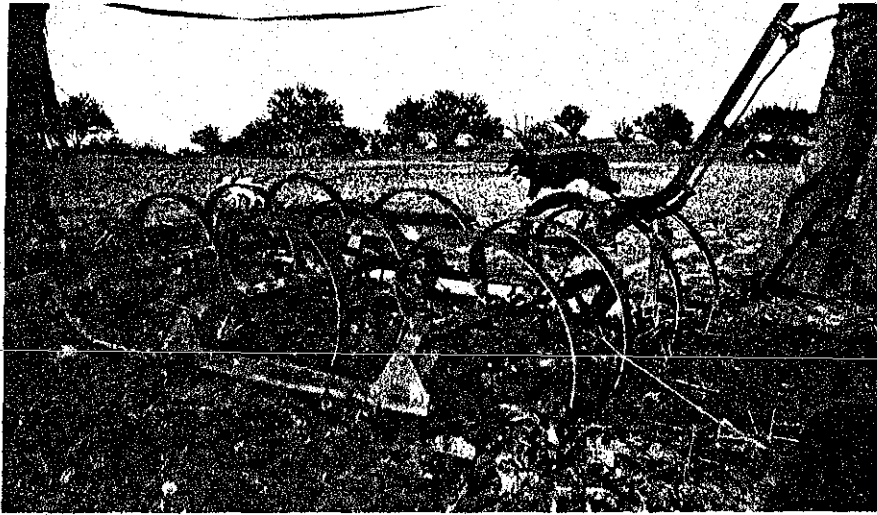
maximum number of samples that may be tested free of charge for any one citizen in any period of time and fix charges for tests or samples submitted in excess of those tested free of charge.

The violation of any provision of this article is a misdemeanor, and punishable by a fine of not more than five hundred dollars or by imprisonment in the county jail for not more than six months, or both. For a subsequent offense a fine, if imposed, shall not be less than one hundred nor more than one thousand dollars.

Mechanical control

There are a number of mechanical devices, both simple and complex which are used in weed control. The common garden hoe is used in large and small gardens. The weed puller is the best mechanical device to pull out lawn weeds possessing crowns. Cultivators, weed cutters and harrows are commonly used in orchards and vineyards. They are especially effective in keeping down annual weeds before the seeds mature. However, these common types of farm machinery may spread matured annual weeds or the rhizomes of certain noxious perennials if the operator does not use precaution. The plow and disc are used in the spring to turn under the covercrop, which includes some weed pests. The plow is used to do the preliminary work in making new lawns and turning under weeds of wastelands.

The "Farmall" is a popular garden tractor of the delta garden areas. It is a combination of a cultivator and weed cutter. It possesses large tires which go between rows.



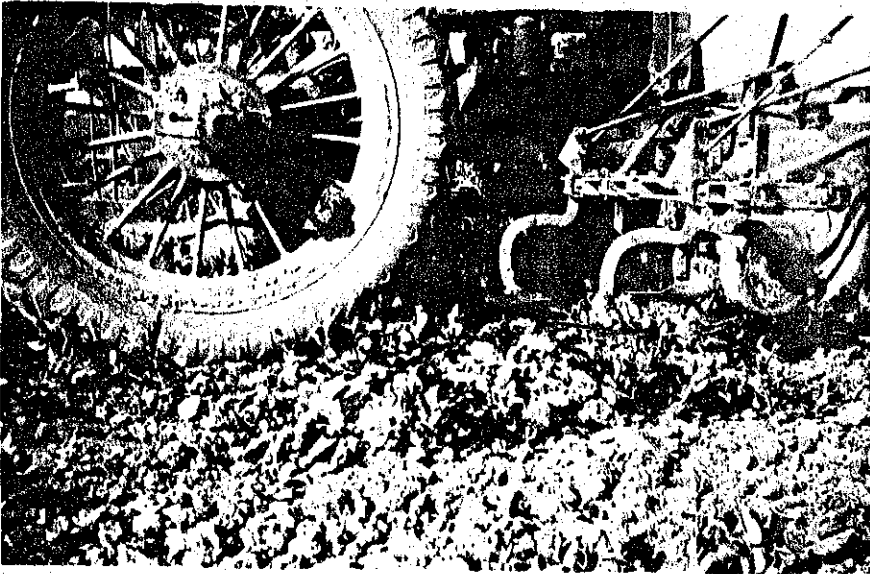
The spring toothed harrow



The garden and orchard cultivator



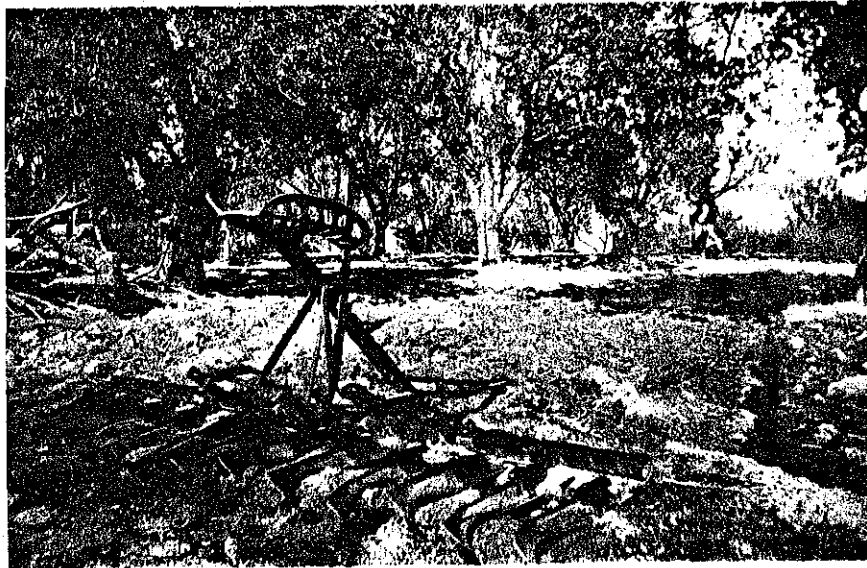
A blacksmith made weed cutter.



The "farmall," a popular cultivator and weed cutter of Sacramento County's garden lands.



The above shows a gardener hoeing out weeds in a river bottom cabbage patch.



The common weed cutter used in orchard and vineyard work.

The weed cutting devices are several horizontal blades which cut weeds between an equal number or rows of vegetables. The spring tooth harrow is another farm implement which cultivates and cuts weeds.

Chemical control

Chemical control of weeds has been given a great deal of study in California recently. Sacramento County has taken part in research in this matter and has profited by chemical control methods worked out elsewhere.

Chemical weed control may be classified under the following sub-heads: contact herbicides, selective sprays, translocated sprays, temporary and relatively permanent soil sterilants.

Contact herbicides include oils, dilute sulphuric acid, dilute sodium arsenite, two per cent sodium chlorate, iron sulphate, copper sulphate, and sodium metaborate. The contact herbicides kill only the tissues to which they are applied.

Dilute sulphuric acid is used as what may be termed a selective contact chemical. It is sprayed in grainfields in the Spring to kill the mustards (Brassica spp.) and wild radish (Raphanus sativus). This dilute chemical does not harm the grain plant so much because the latter has a narrow leaf. As the above mentioned grainfield weed pests appear early in the Spring, they become a very serious competitor for soil moisture and soil nutrients. If these weeds are allowed to reach their full height, they also compete with the grain for sunlight. In some cases the cost of harvest and seed cleaning may be so high that the farmer does not harvest



Brassica arvensis in a grain field is shown at the right in this photograph. The left portion of the picture shows where the grain had been treated with dilute sulfuric acid.

some of the infested grain fields. The author found a good example of this in the Citrus Heights district.

Although Sacramento County as yet has not used sulphuric acid in grain field weed control to any great extent, there is every reason to believe that it will be started. There are a number of large grain owners who would profit by using this method over a number of years. This method of control was introduced from France, England and Italy and the first experimentation in California started in 1934. San Joaquin, Yolo and Butte Counties lead in this work at present.

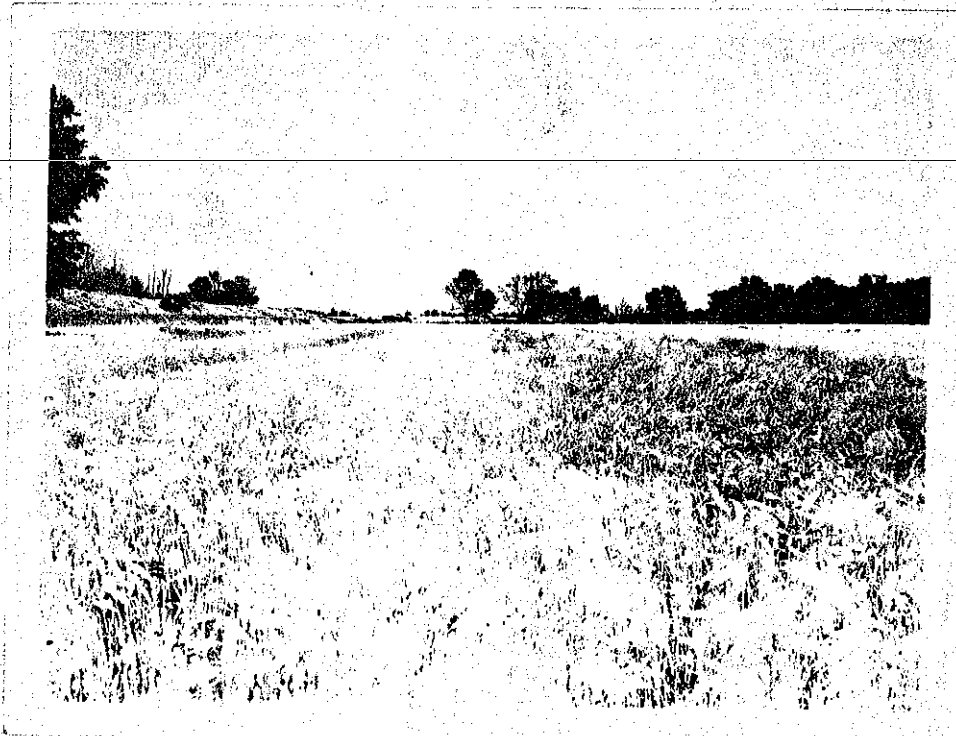
The time of application is a very important factor to consider in applying the acid. Experiments show that the best time to spray is when the grain is six or seven inches high. If the grain is higher than this, the recovery time is longer. If the spraying is done before the grain reaches this height, there is a good chance for reinfestation of weeds. Most of the spraying in the neighboring counties is done in March and April and this would apply to Sacramento County.

The action of this acid on plant tissues is more rapid on warm dry days than on cool days. If rain falls after acid application, the effectiveness is reduced. No serious effects result if two hours elapse after application. Fog and heavy dew have much the same effect as rain. In general, ten per cent sulphuric acid by weight applied at the rate of one hundred and thirty gallons per acre give the best results.

Sulphuric acid spray has an effect on Amsinckia, Chenopodium and other more or less minor grainfield weeds.



Mustard plants in the best stages of development for treatment with sulfuric acid are shown at the left. The corresponding sizes of grain plants are illustrated at the right. A six inch rule is shown in the middle. (Courtesy of Mr. W. C. Ball)



The above show the effect of sulfuric acid treatment on lodging of grain. In the center the treated grain is shown standing erect, while the dark strips on the right and left of the center are unsprayed areas in which the grain and weeds are lodged. Still further on the right and left are other treated strips.

(Courtesy of Mr. W. E. Fall)

The equipment used for spraying the solution includes a brass boom coming from a tank. It also has separate compartments for the acid and water. They are mixed in the exact amounts inside and in this manner extra handling of the acid is eliminated. The nozzles on the boom are arranged to spray evenly over the grain and weeds. The equipment which comes in contact with the acid is brass.

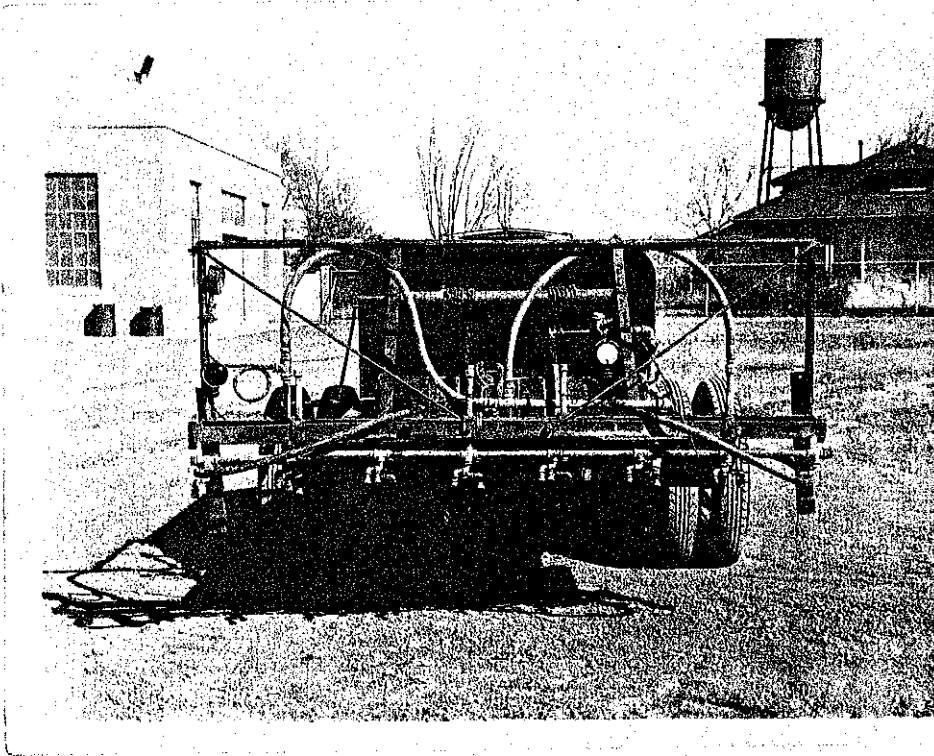
Copper sulphate has been found to be a good contact spray for the Xanthium spp. It may be applied by means of a pressure spray.

Diesel oil has been used almost exclusively in the work of the Highway Commission. This contact herbicide is valuable in penetrating through seeds. It may be applied with any pressure spray machine. The diaphragm-pump knapsack sprayer may be used for small operations. Dilute sodium chlorate may be applied by this sprayer. Sodium chlorate may be considered a temporary soil sterilant.

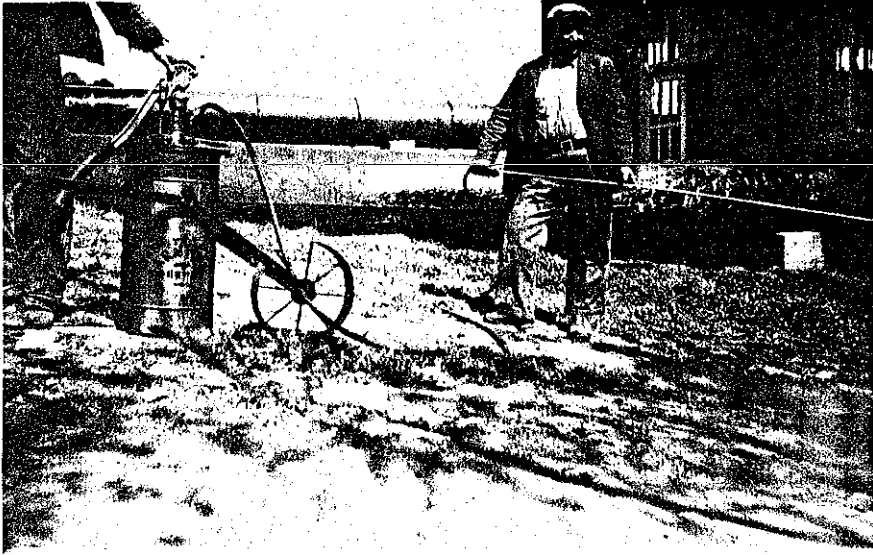
Translocated sprays not only affect the tissues to which they are applied but under certain conditions are carried to the underground system. A solution of one-half per cent arsenic trioxide in the form of sodium arsenite and five per cent sulphuric acid by weight has been found most satisfactory. Arsenic acid and arsenic trichloride have the same effect on plants.

The acid arsenical method is used during the summer when the water loss by the leaves exceeds that of the roots.

When a plant with a large water deficit is sprayed with a strongly acid solution the living cells of the leaves and



Rear view of the grain field sulfuric acid
sprayer, showing boom folded for transportation.
(Courtesy of Mr. W. E. Ball)



A wheelbarrow type pump weed sprayer.

stems are killed and rendered permeable. When this happens, all moisture, free to move, goes into the conducting system. If the spray contains arsenic, it will move to the underground tissues and kill them. The plants must have a large top growth to allow sufficient arsenic application. It is a common practice to make the acid arsenical application at night to prevent evaporation. Two applications are better. ~~Water applications the next morning have value in this~~ practice.

The acid arsenical method has worked best on Russian knapweed, Centaurea repens and variable on morning glory, Convolvulus arvensis.

The acid arsenical spray may be applied with any orchard spray equipment. It is best to have bronze-lined cylinders since porcelain is etched by the acid. It is also best to have all brass plumbing. A modification of the acid arsenical method is the "jar" or "dipping" procedure. Sulphuric acid does not have to be used. The tops of the perennial weeds are bent over and immersed into a solution in the jar containing one per cent arsenic trioxide by weight. The foliage is rendered permeable and the poison goes to the root system. The jar method is effective on individual growths of morning glory, camel thorn and white horse nettle. The results are less favorable on Russian knapweed, hoary cress and alkali mallow.

The arsenical stock solution is composed of four parts by weight of arsenic trioxide, one part of sodium hydroxide, and three parts of water. These chemicals dissolve rapidly

when mixed and also evolve heat. Sodium arsenite is formed as a result of this mixture.

Experiments with the acid arsenical spray show that a satisfactory mixture must contain at least one-half of one per cent of arsenic trioxide by weight with five per cent sulphuric acid. A small quantity of this spray for a three gallon knapsack spray may be made by adding one-fourth of a pound of the arsenic stock solution to three gallons of water. This should be stirred well. One and a quarter pounds of concentrated sulphuric acid should then be added and mixed.

Temporary soil sterilants include sodium chlorate and carbon disulphide. Sodium chlorate may be applied dry or in solution. It will leach into the soil by means of rain and irrigation water. This chemical is absorbed by the roots of the weed and if it is strong enough it will kill the weeds. Application of the chemical in solution may be made with any pressure spray machine. The formula of three pounds of sodium chlorate per square rod in three gallons of water is a good average figure. Tests show that toxicity of chlorate runs higher in soils of the coarser textural grade. Alluvial soils of recent origin show the lowest toxicities and old weathered soils show the highest. Heavy clays and adobe clays show high toxicities, while the peats of the delta area show low toxicities.

This chemical is more effective on Russian knapweed, Centaurea repens and morning glory, Convolvulus arvensis. Hoeing of plants severely injured by the chlorate absorbed from the soil weakens them. This procedure increases the

effectiveness of the chemical treatment. Continuous leaching with irrigation water has proven the best means of ridding the land of residual chlorate.

Carbon disulphide, a clear volatile liquid is a temporary soil sterilant. It vaporizes to give an extremely toxic gas, which is heavier than air. This chemical may be applied by a mechanical device consisting of a three-standard sub-soiler. It also possesses a container, valves and fittings. This mechanism may be pulled around by means of a Caterpillar tractor. It is a good practice to cultivate the soil before applying carbon disulphide. This assures a number of soil spaces for the gas to enter. If the same soil is rolled after the application, the gas will be "sealed" in.

Carbon disulphide leaves the soil rapidly so that crops may be grown. Its main drawback is the expense. This chemical may be applied to small patches of nut grass or Bermuda grass by a sprinkler. The vapor is retained in the soil of the weed infestation by means of a dampened canvas.

Relatively permanent soil sterilants are used on roadsides, ditchbanks, fence lines and waste lands. These chemicals kill all plant life. Sodium arsenite, at present shows the most promise. The toxicity has been found to vary in different types of soils. Toxicity is greater in lighter sandy soils than in heavy clays. Four pounds per square rod is a good average amount of the chemical to apply. The stock solution is composed of four parts by weight of arsenic trioxide, one part of sodium hydroxide and three parts of water. Pressure spraying outfits may be used in applying

sodium arsenite.

Borax mixed with sodium chlorate has given successful results. At present, the county horticultural commissioner is using this combination on Canada thistle. The best ratio for the two chemicals is one pound of sodium chlorate to eight pounds of borax. The dry application varies from four to sixteen pounds per square rod. The residual effect of this combination lowers the probability of reinfestation by seedlings.

Experiments carried out at Davis show that thallium sulfate is very toxic in soils but varies with the soil type. The chief drawback is the cost. Treated grains with thallium sulfate have been used for squirrel bait. At least 5,000 pounds of squirrel bait carrying one percent of the chemical uniformly distributed would be necessary to sterilize an acre completely.

Chemical herbicides in general are receiving a great deal of study at present. Soil types are being studied with relationship to the amount of a certain chemical or combination of chemicals needed to destroy weeds. To date several California soils have been studied from this standpoint. Sacramento county soils studied include the Stockton and Columbia groups. In the future more soil types and their chemical herbicidal relationships will be worked out in order to give individuals interested in controlling weeds a better idea as to how much of a given chemical or combination of chemicals should be applied to a given type of soil.

Miscellaneous Control Methods

Miscellaneous methods of weed control include flooding,

cropping, smothering and burning.

Flooding is popular in some parts of the State, but the author has not seen any such projects of this nature carried out in Sacramento County. The agricultural commissioner has mentioned a proposed project to flood hoary cress but this as yet has not been carried out. Flooding was first given consideration when it was observed that water in rice fields would kill morning glory and other perennial weeds. If flooding is to be carried out, six to ten inches of water should stand over the infested area. The weeds should not contact the air. It is common to plow the area before flooding. The best results of this method are gained in the eradication of Russian knapweed and hoary cress. The main drawback of flooding is the availability of water for this purpose and the lay of the land. It is a fact that not all of the weeds grow in low places where they may be flooded.

Alfalfa is a very good plant to use in the cropping method. Areas infested with morning glory have been planted to alfalfa and the competition has reduced the vigor or eradicated the weed. Ladino clover acts the same way as alfalfa. The author has observed one plot of ladino clover planted where Bermuda grass once thrived. At present there is very little of the weed left in that patch.

Smothering with straw, paper and manure may be carried out with small weed infestations. Tar paper placed over small patches of Bermuda grass is effective. The manure has a tendency to burn the weed as well as to shut off the

light. Johnson grass and Russian knapweed have been successfully smothered.

Burning weeds is quite common. This is followed after the application of diesel oil along roadsides. Weeds in waste places may be cut green before the seeds ripen, and allowed to dry for a period and then burned.

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