Bulletin 236 January, 1918

The Agricultural Experiment Station

OF THE

Colorado Agricultural College

THE DANDELION IN COLORADO

By B. O. LONGYEAR

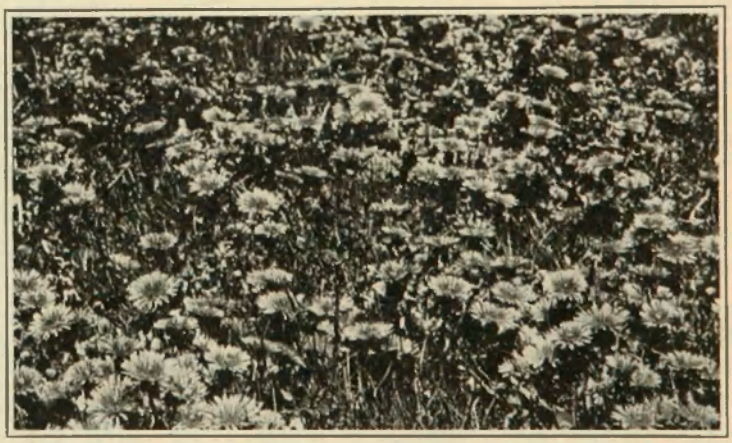

Fig. 1. May is the month of profuse bloom

PUBLISHED BY THE EXPERIMENT STATION
FORT COLLINS, COLORADO
1918

The Colorado Agricultural College

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THE DANDELION IN COLORADO

By B. O. LONGYEAR

Dandelions everywhere! They spring up along ditch banks, crowd into open places in alfalfa fields, or luxuriate in gardens and flower-beds. They swarm over vacant city lots, troop along the sidewalks, and encroach upon lawns to the very door-stone of rich and poor alike.

The common dandelion (*Taraxacum officinale Weber*) is generally recognized in our state as about the worst weed pest in lawns. A native of Europe, this plant was early introduced into North America, where it has overrun nearly all parts of the country except those of an arid or semi-arid character, and into these it has found its way wherever the land is brought under irrigation. Within our own range the dandelion seems to have found the conditions peculiarly favorable and entirely to its liking. Here we find it thriving, not only in lawns and gardens, but it is encroaching more and more upon the alfalfa fields of the irrigated plains and the meadows and pastures of our mountain parks.*

The moisture requirements of this plant determine in large measure its local distribution, and for this reason it seems unable to gain or maintain a root-hold upon the native prairie without irrigation. This same factor of soil moisture has been found to determine in some measure the distribution of the weed in lawns, the best watered portions being especially favorable for its growth. When once well established, however, the larger dandelion plants can often endure a temporary period of drought severe enough to kill out the lawn grass.

In its light relations, the common dandelion shows a wide range of adaptability. It is found growing vigorously in full sunlight as well as in the diffused light within the shadow of trees and buildings.

In its altitudinal range, the common dandelion may reach an elevation of 11,000 feet, where it can be found associating with one or more subalpine and alpine native species of less economic im-

* The red-seeded dandelion (Taraxacum erythrospermum) has been recently found by the writer in a lawn at Fort Collins. This plant closely resembles the common dandelion except that it is usually smaller. The leaves are more deely cut-lobed, the flower heads are fewer in number and smaller and the seeds are bright reddish brown instead of dull greenish brown in color.

portance. (Rydburg's Flora of Colo., Exp. Sta. Bul. 100, records it as reaching 7,000 feet. Prof. Ellsworth Bethel has found it occurring above 11,000 feet on the slopes of Arapahoe Peak and flourishing with unusual vigor at Arrow, 9,500 feet elevation.)

LIFE HISTORY OF THE DANDELION PLANT

The common dandelion may be described as an apparently stemless, herbaceous plant with a long, fleshy, perennial tap-root. Every part of the plant is permeated by a system of minute channels containing a milky juice (latex) which readily oozes out wherever a wound is made. The plant spreads readily by means of its numerous little seed-like fruits, each one being attached to a small parachute of downy hairs which enables the seed to drift

Fig. 2. This picture shows that the larger dandelion plants can survive a temporary dry spell in summer which will kill the lawn grass

before the wind often for considerable distances. The seeds germinate readily wherever there is sufficient moisture. During its first season of growth, the seedling dandelion plant produces merely a tuft of leaves at the top of its deep-growing tap-root. Early in the spring of the second season, and each season of its lifetime thereafter, the crown of the root sends up a new whorl of leaves in the center of which several flower-buds soon appear.

The Root.—The dandelion possesses a most remarkable root system. In plants two years old, it often extends to a depth of two feet or more into the earth, and while commonly in the form of a single tap-root, it occasionally possesses several main branches. One of the unusual features of the root is its ability to produce buds and shoots wherever it is cut off. This property is

possessed by all parts of the root, so that even a small piece left in the soil may give rise to a new plant in a few weeks' time. In one experiment, tried by the writer, roots were dug from frozen soil in midwinter, cut into inch lengths, and planted in moist sand kept at living room temperature. In about three weeks' time every one of these pieces had produced a number of small sprouts at the upper end. In another case a root nearly 18 inches long was cut into inch lengths, which were planted in moist sand. The results of this experiment are shown in Fig. 3.

It is for this reason that the dandelion is so difficult to eradicate merely by cutting it off, even to a depth of two or three inches underground. When cut off below the crown, the root usually sends up a number of shoots so that a cluster of new plants will be formed by this process.

The writer has found, moreover, that the dandelion will eventually form clumps or clusters of plants by a natural process of root division when left to itself. This process begins during the second year following the blooming period, toward the close of the season. As the blossom stems come from the center of the crown of the plant, this part of the root dies and becomes hollow. A number of buds which had formed earlier in the season around the margin of this hollow root crown have now given rise to short branches, each with its own crown of leaves at the top, but all united below to the common root. The crowding of these plants tends to further split the old root apart into separate strands until it eventually appears when dug as a bundle of distinct plants somewhat loosely united by the lower part of the old root. These new plants may also go through the same process of division so that in time an old plant may give rise to a large clump of densely crowded plants which have all arisen from one individual seedling.

During the growing season, and especially toward its close, the dandelion root tends to shorten somewhat, a process which produces a wrinkling of the surface and which draws the crown of the plant a little deeper into the soil, where it is better protected from adverse conditions.

The Leaves.—The dandelion foliage consists of a whorl of leaves borne upon a very short stem at the crown of the root. These leaves vary a good deal in number and size, depending upon the vigor of the plant, but are so familiar to most persons as to need no description here. During the colder parts of the growing season and in dry situations, the leaves usually spread out as flat against the surface of the ground as possible and form what is called a rosette, but in warmer weather, especially if the plants

are crowded by other taller vegetation, they stand in more or less erect tufts. This difference in habit of growth also corresponds in a large degree to the age of the plant. Thus during the first year from seed the rosette habit is characteristic, while in old plants which have a branched root crown the leaves are forced into erect clumps by mutual crowding. The leaves of plants growing

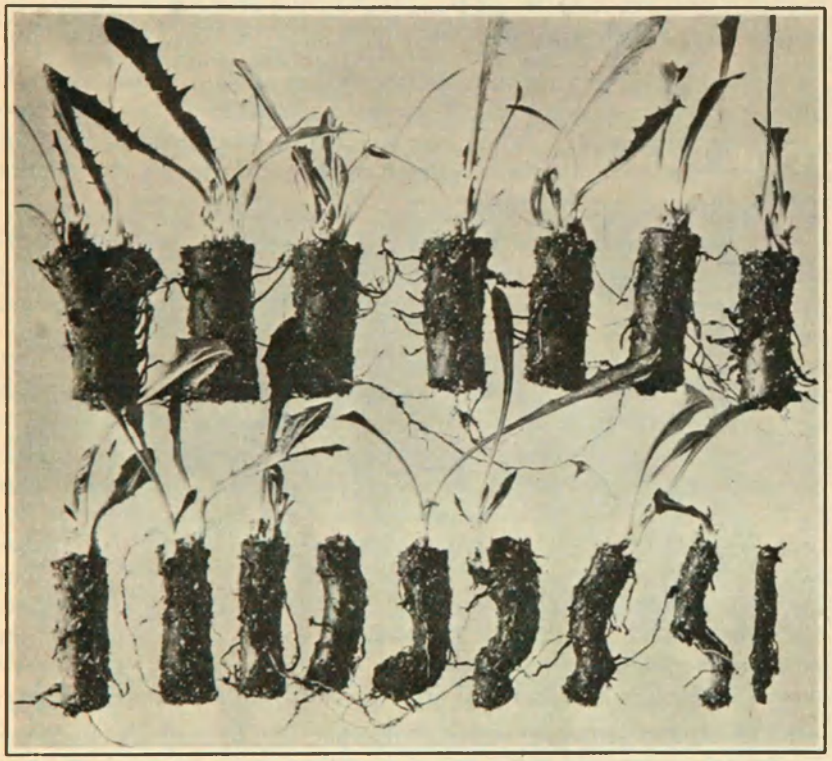


Fig. 3. One-inch lengths of a dandelion root sprouting after being in moist sand for 18 days. The smallest piece was 18 inches below the surface of the ground when the plant was dug up.

in shady places are thinner and more tender than those in full sunlight.

The surface of the dandelion leaf is covered with a thin epidermis which is readily wet by water and other liquids. This is one of the vulnerable points in the dandelion plant, as it makes possible the use of certain spray mixtures which readily destroy its foliage, while other plants, like the grasses, may escape with but little injury.

The Blossom.—Blossoming of the dandelion may begin sometimes as early as the middle of March, where plants are growing in sunny, protected spots. General blooming, however, is not usually well under way until the latter part of April, while May is the month of profuse bloom. This is followed by a partial resting period of decreased blooming, although blossoms may be found at any time during the summer and until severe freezing occurs in late fall. The number of blossom heads produced by one dandelion varies a good deal, depending upon the size and vigor of the plant. Small, stunted plants growing in dry parts of the lawn may produce only a single head at one time, while the large, thrifty clumps along roadsides and in the edges of gardens and fields may produce fifty or more at once.

Fig. 4. Thrifty growth of new rootlets and five sprouts from a one-inch length of dandelion root grown in a flower pot of sand.

The behavior of the flower heads from the time when they first open until the seeds are mature is interesting. The heads are borne upon hollow stalks which are from two to six inches or more in length. During cold or dry weather, these stalks bend down as close to the earth as the surrounding vegetation will allow, so that the flowers appear to rest upon the ground, but in warm weather, and especially in moist, shady places, they may stand erect. When through blooming, and after the flower head has closed for the ripening of the seeds the stem bends downward so as to bring the head close to the ground, where it remains for several days. In this position these closed flower heads are better protected from

injury than if they stood on erect stems, and it is difficult to cut them off with the lawn-mower during this time.

When the seeds are nearly mature, the flower stem begins to straighten up and at the same time elongates, thus lifting the ripened seeds into a better position for the wind to get at them.

In some cases, this seed-bearing stalk lengthens to a remarkable extent. Thus, the writer found one plant growing in partial shade and among taller vegetation, which had a seed stalk 29 inches tall.

Careful examination of the dandelion bloom will show that it consists of many very minute flowers crowded into a dense cluster at the upper end of the flower stalk and surrounded by two sets of narrow green bracts. The number of these little flowers in one blossom head varies greatly according to the size and vigor of the plant which bears them. Thus, the lowest number, 30, was counted in a blossom head from a small, stunted plant, while one of ordinary size was found to contain more than two hundred of the minute flowers, each capable of producing a single seed. The bracts of the outer or lower set turn downward, while those of the inner set form a close covering for the little flowers when not in bloom.

When about to bloom, these covering bracts spread apart and expose the crowded mass of tiny yellow flowers inside. Toward night the bracts close together but open again the next morning. In this manner the flower heads open during two or three successive days, after which they remain closed until the seeds are mature. From the first day of blossoming until the seeds ripen and the bracts open for them to escape, nine or ten days usually elapse.

Pollination of the Flower.—This consists in the transfer of the yellow powder (pollen) from the stamens of the flower to the stigma or tips of the pistil which produces the seed. Without this transfer of pollen no seeds would be produced. In the minute flowers of the dandelion head this process of pollination may take place in two ways. First, the powder-like pollen grains are pushed out of each little flower by the lengthening of the pistil during the process of blossoming. The two stigmas of each flower during this stage are closed in such a way that none of the pollen is apt to adhere to them from the stamens of their own flower. The crowded condition of the little flowers, however, almost insures the contact of the two stigmas, as they uncoil, with pollen from other flowers that are just opening.

The second method of pollination is by means of insects which visit the flowers and in crawling over them bring the pollen powder in contact with the stigmas that are ready to receive it. The common honey bee is prominent among such insects, while certain flower-visiting flies are capable of performing the same office.

The Seed.—Each minute flower of the blossom head produces one small, seed-like fruit, about one-eighth of an inch long. The top end is prolonged into a slender stalk nearly one-half an inch in length, with a tuft of spreading hairs at the apex. This little parachute not only enables the wind to readily scatter the seed, but it also causes the seed to drop end downward among the blades of grass. When thoroughly wet, these hairs readily mat

Fig. 5. Sprouts on dandelion roots cut at different depths. The left hand root was cut below the crown. All were taken from a lawn where the dandelions had been dug out seven weeks before.

together and cling to whatever object they are in contact with, thus permitting the seed to be at rest while germination takes place.

Germination of the Seed.—The seeds are ready to germinate almost as soon as they begin to leave the plant. Fifty seeds, just matured, were gathered June 22 and were put in moist filter paper on the following day. On June 28, twelve seeds had germinated, and by July 6 forty in all had sprouted. Fifteen days later seven more seeds germinated at one time, giving a total germination of 94 per cent. In this case there appear to have been two germination periods, the first covering 13 days and the last culminating at the end of 28 days.

In another experiment, made to determine how late in the season the plants can produce viable seed, 470 seeds were taken at random from several different plants on November 29. At this time the ground was frozen quite hard, although open, dry weather prevailed. Some of the blossom heads were not fully matured, which probably accounts for the low percentage of germination, 16 per cent at this time. It is evident, however, that some good seeds are being formed as late in the season as it is possible for blossoming to occur, and although these seeds are too late for germination at once, they will be on hand for early sprouting the next spring.

Fig. 6. How the dandelion root divides as it grows older. Left hand root one year old, right hand root three or more years old

In order to find out how soon after blossoming the flower heads were able to mature seed capable of germination when removed from the plant, the following experiment was carried on:

Eighteen flower heads, just opening for the first time, were picked and allowed to lie on the ground until wilted, after which they were taken indoors and allowed to become dry. Examination later showed that in no case had any seeds matured, although some of them had that appearance.

Thirty-six flower heads were marked with numbered slips of paper and careful records of them were kept during ten days.

Beginning with the fourth day, following the first opening of the blossoms, a few of the heads were picked each day during the remaining six days, at the end of which time all that were left had come to maturity. After being allowed to dry, seeds were taken from each head and examined carefully or submitted to a germination test.

RESULT OF GERMINATION TEST

Number of days after beginning of bloom when heads were picked	4	5	6	7	8	9
Number of heads examined	3	5	5	5	6	3
Highest percentage of germination from one head	0	0.7	0	5.0	16.6	25.0
Lowest percentage of germination from one head	0	0	0	0	0	8.3
Average percentage of germination	0	0.14	0	1.6	10.0	14.0

From this experiment it appears that at least seven days must elapse, after the first opening of the flower heads, before any but a negligible number of seeds mature sufficiently to germinate. This fact has an important bearing upon the control of the dandelion in lawns for the rapid increase of the plant is due largely to the seeds which are allowed to mature upon the premises. Most of these seeds drop upon the ground near the parent plants, especially during the quiet days, and when the lawn is being watered by the hose they are washed down in contact with the soil where the conditions for germination are most favorable. If all blossom heads, including those that have closed to ripen the seeds, are picked or cut off once a week, the seed crop will be practically prevented even though the blossom heads are left on the lawn.

NATURAL ENEMIES OF THE DANDELION

The dandelion, like most weeds, has no serious natural enemies capable of appreciably reducing its numbers or of holding it in check. Among insects are certain plant lice which sometimes infest the plants and cause them to appear unhealthy or may occasionally be so abundant as to kill the plants outright.

Fungous diseases of the dandelion, while not uncommon, seldom inflict serious damage to this host plant. One of the most common diseases of the dandelion is caused by a species of rust fungus (*Puccinia Taraxaci*) which produces numerous minute pustules of a dark brown color on affected leaves.

A species of mildew (*Sphaerotheca*) is also not uncommon upon the foliage of this plant, but the damage caused is slight. Another fungus (*Synchtyrium*) produces tiny swellings or galls upon the leaves of the dandelion which results in a partial stunting of the foliage without killing it.

Apparently the most important natural enemies of the dandelion are found among the seed-eating birds. Thus it is common to see quite large flocks of siskins, small, sparrow-like birds, feeding upon the maturing seeds of the dandelion, especially dur-

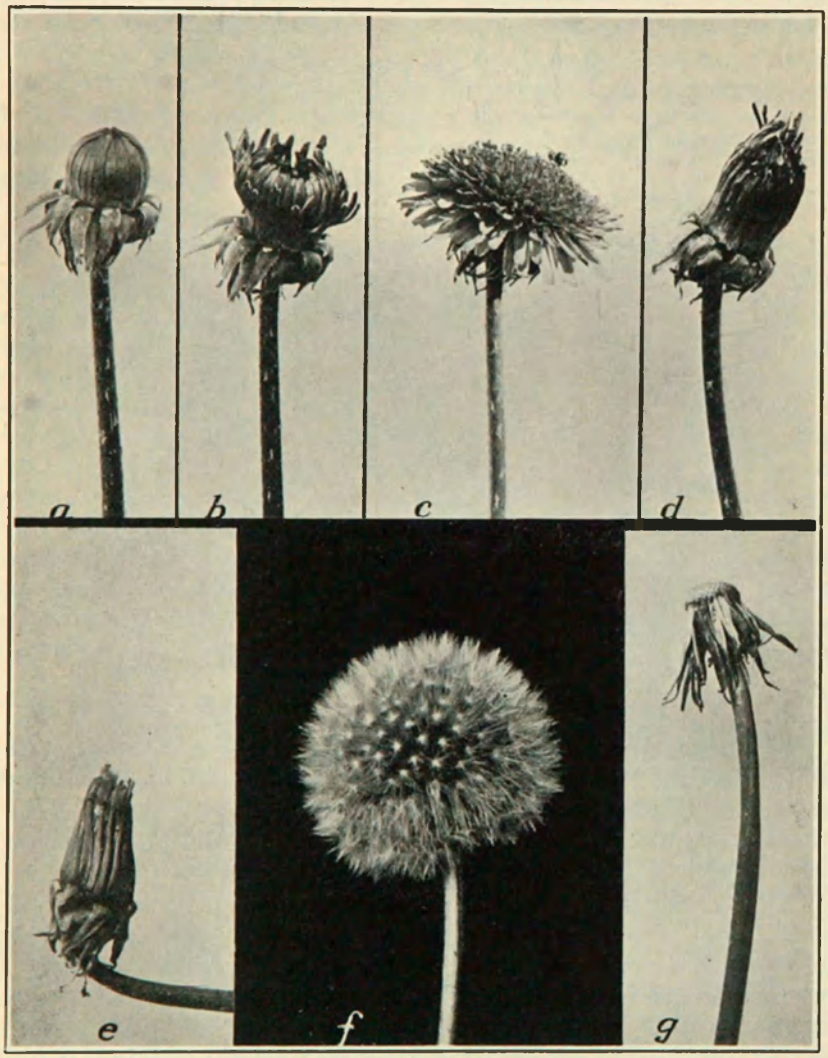


Fig. 7. A flower head photographed at different stages in its development. (a) The day before blooming. (b) Just opening for the first time. (c) In full bloom on the second day of opening and insect pollination being effected. (d) Closed at end of third day. (e) Closed and bent down while ripening the seed. Compare the shape in this condition with that of the bud stage (a). (f) Straightened up and fruiting on the ninth day after first blooming. (g) Tenth day; the "seeds" all gone.

ing the season of freest blooming. These little birds usually attack the closed heads, in which the seeds are nearly mature, by removing some of the bracts from one side, after which they pick out the seeds and devour them in large numbers. The common house finch and the goldfinch consume a great many dandelion seeds in the same manner, while even the despised English sparrow has been occasionally observed at the same good work.

EXPERIMENTS IN THE ERADICATION AND CONTROL OF DANDELIONS IN LAWNS

During several years experiments have been carried on by the writer at the State Agricultural College for the purpose of learning the most effective and cheapest methods of eradicating and controlling the dandelion in lawns. These experiments have included the means commonly employed for this purpose, such as digging and the use of gasoline, while particular attention has been given to the matter of spraying with iron sulphate.

The following records give the methods employed and the results of this series of experiments to the present time:

Experiments in 1909

A piece of old lawn, in which the dandelions were uniform and so thick as to nearly hide the soil, was selected on the College grounds. This was laid off into small plats of equal size and treated as follows, using commercial sulphate of iron, or "copperas", dissolved in water and applied with a bucket spray pump so as to thoroughly wet the foliage of every plant:

Plat No.	Strength of Solution	Date of Application	Result October 1
I....	20%	August 6, August 31, September 23	No dandelions to be found
II....	10%	August 6, August 31, September 23	Less than 1% of dandelions present
III....	5%	August 6, September 23	About 20% of dandelions present
IV....	2.5%	August 6, September 23	Dandelions injured to some extent

The first spray on Plats I and II caused the dandelion leaves to turn black and die, but new leaves were pushed out from the strongest and oldest plants in a few days. The grass was also somewhat blackened at first and throughout the experiment the color was a darker green than that on untreated areas. By the first of October all dandelions had completely disappeared from Plat I, while only two or three were to be found on Plat II. It is evident that a 15 per cent solution should be practically as effective as the 20 per cent for this purpose, and that three applications, the first as soon as the plants are in full leaf in spring, the second in about three weeks and the last in midsummer, should

prove effective in controlling this pest. Although the grass was very thin on the areas treated, it soon began to thicken, and by October 1 formed a fairly close sod. Nearly all of the white clover was killed by the two strongest solutions.

The contrast between the treated and untreated areas was especially marked during the period of active blooming the next spring, the clear sod of the treated plats being surrounded by a thickly scattered growth of dandelions in flower. This effect was noticeable during at least three seasons following the application of the spray.

Experiments in 1910

In the spring of this year three plats, each 10x20 feet, were laid off on the College campus and treated as follows: Plat I sprayed four times, using a 10-percent solution of iron sulphate; Plat II sprayed four times, using a 15-percent solution of iron sulphate, Plat III, check plat, unsprayed. The sprayings were applied April 25, May 5, May 17, and May 27, about one gallon of the solution being used for each 150 square feet of lawn at each application. The live plants on all three plats were counted the following spring, May 10, 1911, with the following results:

Number of Plat.....	I	II	III
Treatment	10% iron sulphate, 4 sprayings	15% iron sulphate, 4 sprayings	Check, untreated
Number of plants alive after one year.....	200	209	1,574
Percentage of live plants in terms of Plat III.....	6.32	6.60	100

According to the above, the weaker solution gave slightly better results than the stronger. This may be accounted for in part perhaps by the fact that the plants were apparently somewhat more numerous on Plats II and III than on I at the beginning of the experiment. The good effects of the sprayings on Plats I and II were apparent during at least three following seasons.

Experiments in 1915

During this year more varied experiments in the control of dandelions were conducted than before with special attention to the use of iron sulphate. A lawn of uniform character in which the dandelions had gained a considerable foothold was found and laid off into plats of 100 square feet each, the corners being marked by small wooden stakes driven into the ground, level with the surface. A chalk line was tightly stretched along the boundaries of the plats and the dandelions within each area were carefully counted, including all sizes. The following table gives the treatment accorded each plat, together with the results in percentage of plants killed:

METHODS USED AND RESULTS OBTAINED IN 1915

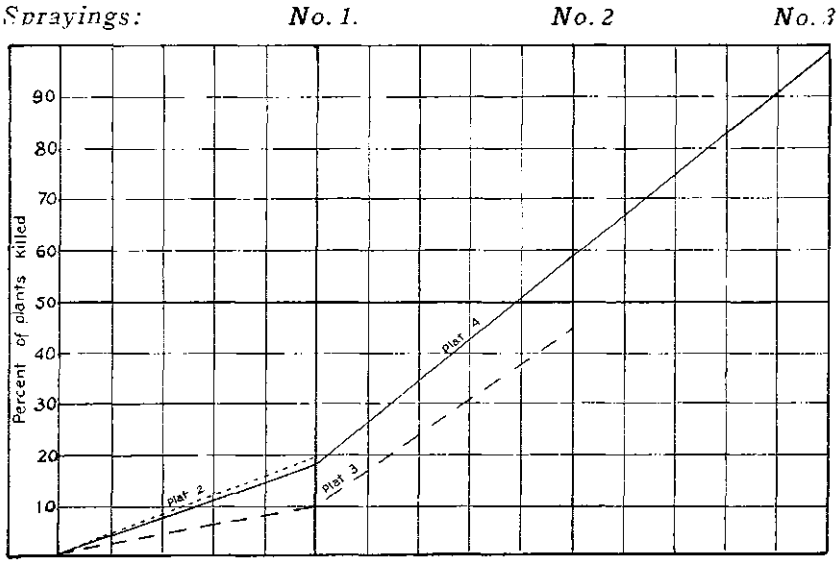
Plat No.	Treatment of Plat	Dates	Plants Number of		Percentage of Plants Killed	Cost of Treatment	Material Used	Labor, Minutes
			Before	After				
1	Check plat, untreated	—	659	—	—	—	—	—
2	Sprayed once with solution	July 6	859	696	19	$.04	1 gal.	4
3	Sprayed twice with solution	July 6 and 21	630	349	45	.08	2 gals.	8
4	Sprayed 3 times with solution	July 6 and 21 Aug. 5	913	10	98.9	.12	3 gals.	12
5	Check plat, untreated	—	1031	—	—	—	—	—
6	Gasoline put on each plant	July 3 and 10	634	32	95	.25	0.33 gals.	55
7	Two applications of dry iron sulphate	July 13 and 28	649	—	80 Estimated	.15	4.75 lbs.	15
8	Check plat, untreated	—	520	—	—	—	—	—
9	All plants dug out	June 30	665	235	64.7	.40	—	120
10	One late spraying with iron sulphate solution	Sept. 21	650	233	64	.04	1 gal.	4

The solution of iron sulphate used was made by dissolving 1¼ pounds of the dry granular salt in each gallon of water, thus making approximately a 15-percent solution. The pump used was an ordinary bucket spray pump with an extra length of hose attached and with a three-foot stick wired to one side near the nozzle to serve as a handle in directing the spray (Fig. 12). In most cases two men worked together, one to operate the pump while the other held the nozzle.

The costs were determined upon an estimate of 20 cents per hour for labor and 2 cents per pound for granular iron sulphate, delivered in 100-pound bags. These figures, while true at the time of starting the experiments, are possibly somewhat low at the present time. The lawn was well sodded and was well cared for during the experiment. It was not allowed to suffer by drought and was clipped about once a week during the season of active growth. The low results following the first spraying of Plats II,

III, and IV, were due in part to uneven application of the spray. The original plants which survived the first two sprayings were found to be feebly sprouting and were thus easily killed by the third spraying on September 21, the original ten plants still alive on Plat IV were very feeble but were accompanied by a considerable number of new seedlings which had come in since the last spraying.

Plat III, when examined May 23, 1916, showed 112 plants capable of blooming while Plat IV had but six. Plat V, treated with gasoline, required a second application a few days after the first to kill plants missed the first time. While this treatment shows a high efficiency, it is relatively expensive, due to the cost



of gasoline, which was charged for at 25 cents a gallon. The gasoline was applied by means of an ordinary tin oil can, about one teaspoonful to a plant being used. A small spot of grass is killed out around each plant by this treatment, but in a few weeks' time this fills in again. When counted May 23, 1916, 173 plants were growing on the plat but of these only five were sufficiently large and vigorous to bloom, most of the remainder being evidently seedlings which had come in since the treatment.

In the case of Plat VI, the dry iron sulphate, in granular form, was sifted on by means of a tin can with perforated cover. The first application killed 28 per cent of the plants, while the sur-

vivors were much weakened. Some thinning out of the grass followed the two treatments of this plat.

Plat IX, when examined 28 days after digging, showed a few sprouts from dug plants, while numerous seedlings were showing, with leaves 1 to 3 inches long. The examination of May 23, 1916, showed 235 plants, which includes the seedlings that survived the winter.

Plat X was sprayed late in the year to determine what effect this might have as compared with that done early in the season. When examined May 18, 1916, the remaining plants, 233, were nearly all very small and weak, while hardly a dozen were strong enough to produce any bloom.

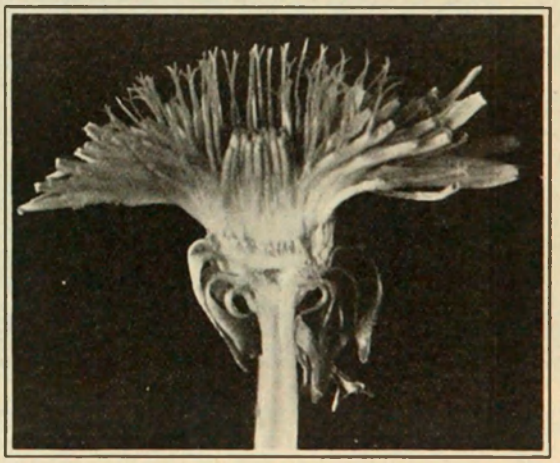


Fig. 8. Sectional view of dandelion head, showing the numerous little flowers (florets) of which it is composed. Those in the center have not yet opened. Twice natural size

Experiments in 1916

The experiments during this season were for the purpose of securing further data on the effects of digging and spraying the dandelion.

Plat I covered an area of 18 square feet and contained 92 plants, mostly of fair size, when dug May 13. The plants were dug to a depth of ½ to 3 inches, with the purpose of determining:

1. If plants dug in early spring will bloom during the latter part of the season.

2. The number of plants that fail to recover from the process.

None of the plants had bloomed by September 2, at which date they were counted and dug again. It was also found, at this date,

that an increase of 15 plants had taken place, consisting apparently of new seedlings together with the recovery of most of those first dug out. On May 10, 1917, there were 57 plants on the plot, including the smallest, all of which were somewhat inferior in size and vigor to those outside this area. This denotes a total reduction of about 47 per cent from the two diggings.

Plat II consisted of a strip 5x38 feet in a lawn from which the dandelions had been dug during the preceding May. The plants on this area, 302 in all, were dug again on September 23.

The area, when inspected May 15, 1917, showed a decrease of 105 (36) per cent, and those left were small and weak, with about

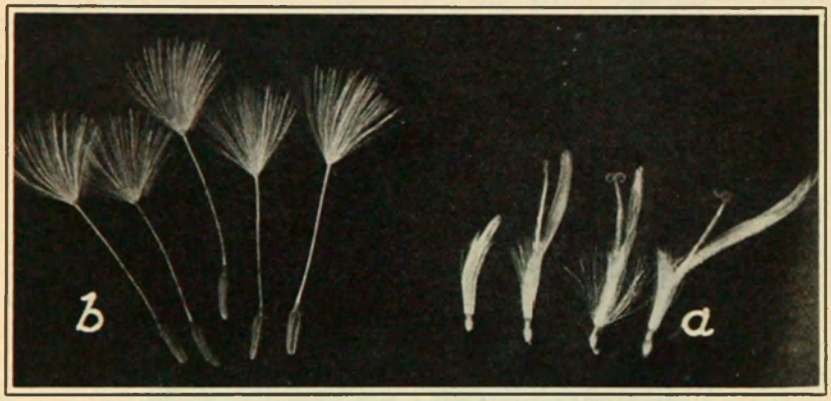


Fig. 9. (a) Four florets in different stages of blooming, taken from the same flower head. (b) Mature "seeds" with parachute of hairs. Twice natural size.

10 per cent able to produce bloom. The results of these two experiments seem to indicate the importance of digging in late summer and autumn, in addition to that in spring. The first or early digging prevents the ripening of seeds by the plant, while the later digging weakens them by causing new growth, at the expense of reserve food, late in the season, or kills them outright.

Plat III covered 190 square feet in the same lawn as Plat II. This area was sprayed September 23 with an 8-percent solution of iron sulphate. Inspection of this plat on May 15, 1917, showed an increased number of plants amounting to nearly 19 percent, consisting, evidently, of new seedlings. From this experiment it appears that one weak spraying is of little effect in controlling the weed, even when used late in the season.

Plat IV covered an area of about 120 square feet in a different location on the same lawn as the preceding plat. This was given

an application of a 12-percent iron sulphate solution on September 16, and an 8-percent solution applied October 10.

This plat, when inspected May 15, 1917, showed a decrease of 36 per cent in the number of plants at first present, while those left were weak and small with only about 10 percent able to produce a few under-sized flower heads. Apparently about 25 percent or 30 percent of young seedling plants had grown up and appeared in the last count. The results of this work compare favorably with that in 1915, Plat III, considering the weaker spray used in this case. Considerable injury to the grass resulted from the first application, which appears to have been due in part to the rather dry condition of the ground in this plat. Similar results have been noted under such conditions, in other cases. By June 1, 1917, the grass had entirely recovered on this plat.

GENERAL OBSERVATIONS

Spraying.—Weed control by means of chemicals, known as herbicides, has been practiced for a long time both in Europe and in this country. The chemicals that have been experimented with and employed for this purpose include common salt, copper sulphate or blue vitriol, iron sulphate or copperas, sodium nitrate, sodium arsenate, ammonium sulphate, potassium chloride, potassium sulphide, slaked lime, corrosive sublimate, carbolic acid, formaldehyde, coal tar creosote, gasoline and kerosene, or coal oil. While many of these are effective in killing weeds they are also destructive to other vegetation as well and are therefore unsuited for use on lawns or in fields where crops are grown.

A suitable herbicide to be used as a spray for eradicating weeds in lawns must be capable of killing the weedy plants without serious injury to the lawn grass. In the case of the dandelion, sulphate of iron or copperas has been found to be the most useful and practicable selective herbicide. Iron sulphate, unlike common salt, is not apt to produce an injurious cumulative effect upon the soil as the chemical becomes oxidized and combined with certain common constituents of our soils and is thereby rendered insoluble and inert. In fact the application of iron sulphate seems to stimulate a healthy growth of the grass, after its immediate effects are passed, so that the lawn appears of a darker green than before.

Strength of Solution.—Most of the work done elsewhere, especially in the spraying of grain fields for the control of wild mustard, has been done with a solution made by dissolving 100 pounds of the granular iron sulphate in a barrel, about 50 gallons, of water. Our own experiments seem to indicate that a somewhat weak-

er solution, made by dissolving the iron sulphate in water, at the rate of 1¼ pounds to a gallon, is practically as effective as this stronger solution, is less apt to injure the grass, and is a little cheaper.

Time and Frequency of Spraying.—From the experiments tried here it appears that slightly more effective results may be expected from late summer or mid-autumn treatment than earlier in the season. This is perhaps due in part to the fact that most

Fig. 10. Showing behavior of the flower heads on a plant in open lawn. The bloom is produced quite close to the ground with closed heads bent as low as possible during seed-ripening. In the fruiting stage the heads are lifted up by the straightening and lengthening of the flower stalk

of the young seedlings which start in the early summer can be killed by the later spraying and that the plants which do survive the treatment are much weakened too late in the season for complete recovery before going into the winter.

As to the number of applications, it is evident from all the tests here that at least three sprayings, properly performed, are necessary to eradicate the plant. Two thorough sprayings in autumn will greatly reduce the weed, however, and prevent a large

percentage of bloom the next season. It should be the aim, however, to entirely prevent the re-seeding of the lawn each season from plants permitted to go to seed upon the premises. Where neighboring lawns are badly neglected, spraying is necessary at least every alternate year together with some digging or other treatment in order to keep the pest under control. The sprayings, to be most effective, should be repeated as soon as the dandelions have partly recovered from the first treatment, an interval of about three weeks between sprayings having been found desirable. The plants should be allowed to put out new leaves, the time for the next spraying being due a little before the new foliage is fully grown. In this way the plants are forced to use up their reserve material in the root by growing a new set of leaves which are again destroyed before they are able to do much in the manufacture of a new food supply.

Application of the Spray.—There appears to be some relation between the method of applying the spray and its effectiveness. Thus, it has been found that better results are secured by using a fine, forcible spray, which drives the solution well into the crowns of the dandelions, than by sprinkling it on with a hand sprinkler. For this reason a good spray pump should be used, capable of producing a strong, spreading mist-like spray. For the small lawn, a good bucket pump with brass cylinder and fittings is desirable. The solution of iron sulphate shauld be made and used either in wooden or graniteware vessels, as it is apt to discolor and corrode iron surfaces, even though galvanized. For larger lawns, a spray pump attached to a barrel mounted on wheels forms the most serviceable outfit, while for large areas, such as parks, a power outfit, like those used for field or orchard spraying, is the most practicable.

It is desirable to cover every part of the lawn surface as evenly as possible, in order to hit any small plants that may not show plainly at the time of spraying. Where the plants are especially numerous, however, the spray may be applied more freely than elsewhere. One of the difficulties in applying the spray evenly over the whole surface may be largely overcome by moving the spray nozzle back and forth in one direction across the lawn and then going over it again at right angles to the first, using only half the total amount each time.

Effects of the Spray.—Observations upon the effects of the iron sulphate spray on the foliage of the dandelion were not made with a view to the physiological explanation of its action. The effectiveness of common salt as an herbicide is said to be due to

its power of absorbing moisture from the plant. Iron sulphate appears, in addition to this action, to produce a chemical effect upon the dandelion leaves whereby they turn black. The most pronounced effect appears to be due to the action of the chemical upon the green coloring matter (*chlorophyll*) of the leaf, whereby it is partly decomposed, a dark-colored material being left in the leaf as the result. It was noted that the application of the iron sulphate to dandelion foliage caused the milk or latex in the leaves and flower stalks to ooze out in drops, sometimes of considerable size, within half an hour. This phenomenon, while offering an interesting subject for study, has not been investigated sufficiently by the writer for an explanation. It appears to be due to the absorption of the iron salt by the cells of the leaves and flower stalks and the production of sufficient internal pressure ***(turgor)*** to rupture the cell walls and liberate the latex. It is possible, moreover, that a corrosive action upon the tissues of the leaf takes place which weakens or partly destroyes the cell walls which confine the latex of the plant. The effect is most rapid in warm weather when the spray becomes concentrated upon the surface of the plants by evaporation of the moisture and when the plants are full of the milky juice. Blackening and withering of the dandelion foliage, due to applications of iron sulphate, are hastened by direct sunlight. This was shown by densely shading a portion of a treated plant for three days. At the end of 9 hours the plants exposed to direct sunshine were blackened, while the shaded ones were only slightly discolored. At the end of three days, however, there was practically no difference in the blackening of the shaded and unshaded plants.

Fig. 11. Flower heads from which the ripening seeds have been removed and eaten by birds.

In order to secure the maximum effects of the iron sulphate spray, it is desirable to apply it during comparatively dry weather, altho in some of our experimental work a light shower a few hours after the application did not appear to decrease its effectiveness. It is advisable, however, that no irrigation be given the lawn within less than 24 or 36 hours after the spray is applied during clear weather and during cloudy weather this time should be

extended to 48 hours. Good care in the matter of irrigation and mowing the lawn should follow the spraying in order to encourage the growth of grass.

The iron sulphate spray causes a darkening of the lawn grass and may even kill a portion of the leaves in some cases. It was noted that where the ground was quite dry at the time of spraying the injury to the grass was much greater than where plenty of moisture was present. A good time to apply the spray is the day following rain or a thorough irrigation of the lawn. Under suitable conditions the grass will recover in a week or ten days and will usually show a darker green color throughout the remainder of the season than unsprayed lawns.

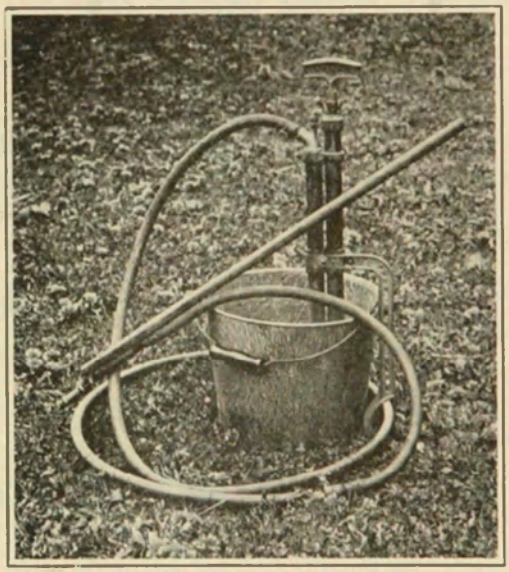


Fig. 12. A suitable outfit for spraying a small lawn.

The iron sulphate treatment may be expected to kill out most of the white clover in the lawn. In cases where the lawn consists largely of white clover it may appear that the spray has killed the grass, while in reality there may have been but little grass present at the start. Most lawns that are badly infested with dandelions are sure to have a poor stand of grass. In all such cases it is advisable to re-seed the lawn after the last spraying, using a garden rake or other tool to loosen up the surface of the soil so that the seed may germinate well.

Iron sulphate solutions will stain light-colored objects a rusty color and for this reason it should be applied carefully along sidewalks, curbings and foundation walls. It is desirable where extensive work is being done to protect such surfaces with boards, old canvas, or other covering during the application of the spray. The iron sulphate is not poisonous and no fears need be entertained in handling it, with the exception of its tendency to dis-

color or stain some objects, especially those that are light-colored or which contain compounds of tannin.

Amount Required.—In the experiments carried on by the writer it was found that 1 gallon of the solution of iron sulphate would cover 100 to 150 square feet of lawn surface. More of the spray was required to do a thorough job when the grass was high than after it had been recently cut, hence it is a matter of economy to mow the lawn just before each application.

Use of Dry Iron Sulphate.—This method of using the iron sulphate, while about equally effective with the spray, was found to be much more expensive than the latter, due to the larger amount required to secure equally good results. Injury to the grass is more apt to occur than with a spray. The granular iron sulphate can be readily applied by using a tin can or small covered pail with the bottom punched full of nail holes, which permits of its being used as a large shaker.

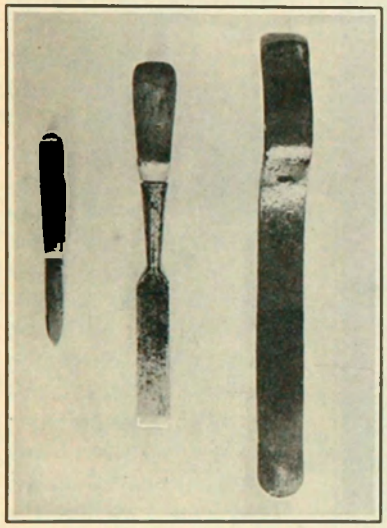


Fig. 13. Tools used by the writer in digging dandelions. The pocket-knife is employed principally as a makeshift when the other tools are not at hand. The right-hand implement, made from an old buggy spring, is the chief reliance for serious and effective work.

Gasoline, Kerosene and Creosote.—Gasoline forms a very effective herbicide for killing dandelions, but its cost is apt to be prohibitive except on small areas and where the plants are few in number. About one teaspoonful of the liquid applied in the center of the plant is usually sufficient, although large plants often require twice that amount. The treated plants soon wilt and in a day or two appear quite dead. In many cases the entire root will be found in a shriveled condition and can be pulled out of the ground.

The gasoline will also kill the grass around each treated plant, the spots often being two or three inches across. As the gasoline soon evaporates, the grass may re-occupy these spots after a few weeks' time, but where a great many plants are present, this injury becomes rather serious in the aggregate.

The cost of clearing a lawn from dandelions with this method varies greatly, being almost directly in proportion to the number of weeds present. It is a useful method to employ where the

plants are comparatively few and of good size. In the case of lawns containing many small plants, it is correspondingly expensive in time and material required in addition to the injury suffered by the lawn. Kerosene has been found about as effective as gasoline, and may be used in the same way. A large sized oil can forms a convenient means for applying the liquid.

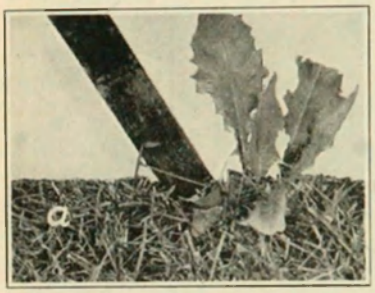


Fig. 14a. Taking out a dandelion with the right hand tool shown in Fig. 13., cutting the sod close to plant.

Coal tar creosote, such as is used in treating timber to make it last, is capable of doing good service as a herbicide. It is applied in the same manner as gasoline, but in smaller amounts, from one-fourth to one-half teaspoonful being enough for each plant of good size. Its effects appear to be most pronounced if the liquid is applied when the ground is rather dry.

Digging the Dandelion.—This is the most familiar and common method of combatting the dandelion in lawns. There are two general methods of digging. The first consists in cutting the root off and removing the severed part of the plant, while the lower portion of the root is left in the ground. This the common method of digging and varies from shallow to deep digging, the former being the prevalent practice. The second method of digging aims at the removal of the entire plant, including practically all of the root.

Fig. 14b. Inserting tool.

The chief advantages of digging are that it at once removes the offending weed from sight, it requires little or no outlay for special tools or material, and it can usually be done on a small place without other expense than the patience and time of the owner. Its disadvantages are that it fails to kill more than a small percentage of the plants, when performed in the usual way, unless repeated frequently; it is a slow and laborious task, and it cuts many small holes in the lawn. Our experiments indicate

that if dug out early in the season, by the first method, just before the plants mature seed, and again in autumn, the dandelion can be kept under excellent control, especially if the lawn does not become seeded heavily from outside areas.

Digging is useful, also, in connection with spraying in order to remove the few plants which may survive that treatment. It was found that plants cut off below the crown will sprout up again from the depth of even 4 inches. Plants thus dug, however, will not bloom again during that season, except possibly in a very few cases. This fact makes it possible to control seed production in plants on the premises, but of course does not hinder seeding from outside sources.

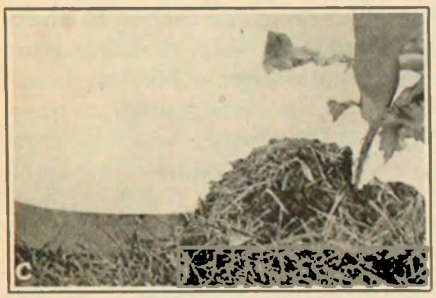


Fig. 14c. Prying up and pulling out plant.

Digging is commonly performed with a stiff-bladed knife, a spud, or a chisel. A cheap wood chisel with one-inch blade is a suitable tool for the work and permits of deeper cutting than a pocket knife. The writer has used the smallest leaf from an old buggy spring and has found it to be the most effective tool thus far tried for this purpose. One end was sharpened on a grindstone and the other was shortened and bent into a convenient handle in a blacksmith shop. With this tool the largest plants can be readily cut several inches below the surface and pried loose with two or three simple motions. It is not necessary to dig a hole in the sod, but the plants can usually easily be lifted out when loosened in this way. Having the lawn well watered, so that the soil is quite soft, facilitates the operation and in some cases the entire tap root will pull out of the ground, especially when they are pried up instead of being cut off underground.

Fig. 14d. The plant removed and the sod pressed back into place.

Digging by the second method, while not commonly employed on the small lawn, is entirely effective, as it permanently dis-

poses of each plant by removal of the whole root. This is the method employed by the gardeners in charge of the Denver City Parks, where it is practiced successfully over several hundred acres of public lawns. A special tool has been devised for this purpose which closely resembles one to be found on the market except that it is straight and of equal width throughout and is less deeply notched at the end. Being also stiffer, it is better adapted to prying the plants out of the ground. The dimensions of this tool are: Blade, 1 inch wide, ¼ inch thick, 8 inches long, outside of the handle.

The most suitable time for taking dandelions out of the lawn with this tool is while the ground is quite soft, following a rain or an irrigation. The point of the tool is pushed into the soil about 4 inches away from the plant to be removed and at an angle of about 45 degrees. No attempt is made to cut the root but instead it is pried out by pushing downward on the handle of the tool. The plant is then pulled out by grasping it just below the crown, after which the sod is pressed back into place with the foot.

In lawns where the sod is thick and tough it is often desirable to first cut it open close to the plant with the point of the tool. This causes the sod to split open, when pried up, in such a way that the plant can be easily lifted out with the fingers.

The removal of dandelions by this method requires more time than by the common way of digging, but it is the most effective means of destroying the plants in one operation without the use of herbicides.

Deep digging, which removes only the upper part of the root, while not preventing the sprouting of the part left in the ground, is nevertheless advisable as it requires a longer time for sprouts to get to the light. This means delayed blooming and reduced vigor, while some of them may entirely fail to reach the surface.

Prevention of Seed Production.—On account of the fact that the spreading of the dandelion is almost wholly dependent upon seed, it is evident that the prevention of seeding is an important matter in the control of the weed. While it is usually impossible to prevent the going-to-seed of plants outside of one's own boundaries it should be done upon the premises. As previously noted, it has been found that at least seven days, after the first day of blossoming, are required for seeds to mature sufficiently to germinate. Thus, if all flower heads were removed once a week from the lawn, there would be no danger from this source. Mowing the lawn each week, especially during the period of profuse blooming, will take care of a great many flower heads except those which lie too close to the ground to be cut off by the mower. Those

which have already passed the early stages of bloom and have bent down to ripen their seeds are also apt to escape unless other means are taken to destroy them.

Hand picking is often employed and is very effective but tedious. A tool especially designed for gathering the flower heads of the dandelion, in all stages of development, has recently been put on the market. This tool consists of a rake with teeth which resemble those of a saw blade, except that they are longer, and it is used in the same manner as a rake. With this rake (Fig. 15) the young flower buds, the heads in bloom and the seed-ripening heads may all be gathered in one operation. Its thorough use over the lawn once a week should entirely prevent seed production on the premises, altho the plants are still left in the ground.

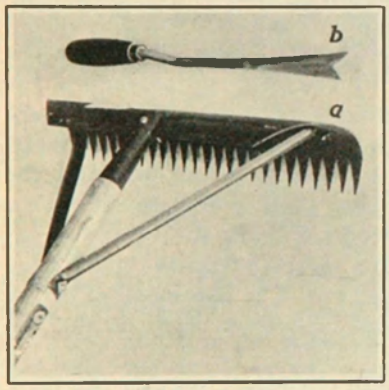


Fig. 15. (a) The Dandelian rake. It is used to remove the flower heads in the prevention of seed production. (b) A dandelion digger found on the market. Its chief defect is the thin blade, which does not permit of deep digging without bending.

Poultry versus Dandelions.—Most persons who have raised poultry are aware of the fact that chickens, ducks and geese are fond of the dandelion tops and will eat them in preference to grass. In one case under the writer's observation an area of 8 or 10 square rods of lawn is used each spring as a pasture for about forty or fifty young chickens. The grass is cut only a few times during the growing season, merely enough to keep it from going to seed. No dandelions are to be seen on this area, altho no attempt is made to destroy them. The chickens keep them and the white clover eaten down as fast as they appear, but do not seem to molest the grass, which forms a deep sod.

This suggests the feasibility of employing a light, portable yard which could be moved over the lawn during the months of April and May and would permit of utilizing the dandelions for growing chickens, ducklings or goslings. Side and back yards, which are often allowed to become badly infested with dandelions, could thus be made to yield considerable forage in raising the growing flock and at the same time be cleared of this weed for the remainder of the season.

Lawn Grass and Dandelions.—The foundation for most lawn mixtures is Kentucky Blue Grass, a plant which is capable, under

favorable conditions, of competing successfully with most other plants in occupying the soil. Blue Grass does best on strong deep clay loams with good drainage, but where there is always moisture present. On light sandy soils it is difficult to maintain a dense sod without the use of ample water and the application of fertilizers and winter mulch. Many lawns are started on poorly prepared ground, which often consists of the subsoil excavated in digging the cellar for the dwelling or which has had the surface soil entirely removed in grading. Or, in some cases, the foundation upon which a lawn is to be made is built up from a varied assortment of old mortar, bricks, rock fragments, coal ashes and dump-heap rubbish mingled with some earth and covered with a thin layer of top soil. A lawn which has been started on a suitable soil after deep and thorough preparation, using plenty of the best grade of lawn grass seed obtainable, should resist the encroachment of weeds and last for a long time without reseeding.

It is a matter of common observation that the presence of thin places and bare spots of ground in a lawn serve as invitations for the entrance of weeds. In some cases good results have been secured by occasional re-seeding of the lawn, especially where the grass has died out or become thin. Sometimes the temporary lack of water for irrigation in summer or the extreme dryness which occasionally prevails in winter cause the grass to die out in certain places. These areas should be well seeded again as soon as the damage is discovered the next spring in order to keep up a full stand of grass. In one case inspected, the lawn, which at first consisted principally of dandelions, had been quite well reclaimed by seeding thickly with blue grass and white clover seed raked into the surface of the soil but without other effort at removing the weeds.

One lawn which the writer has had under observation during several seasons has actually improved to such an extent that the dandelions have been greatly decreased in numbers and vigor simply by giving regular attention in the matter of watering and clipping the lawn. This lawn was established, however, on a fertile soil capable of producing heavy crops of alfalfa, sugar beets and grain.

In many cases it is difficult to maintain a good lawn on account of the soil being filled with the roots of shrubs and trees besides being shaded to such an extent that the grass cannot successfully compete with the more adaptable dandelion. When for any reason the lawn grass has become badly depleted and the ground covered with dandelions, it will often give better results to plow or spade up the ground, preferably in autumn, remove all dandelion roots and rubbish, and re-seed it the following spring

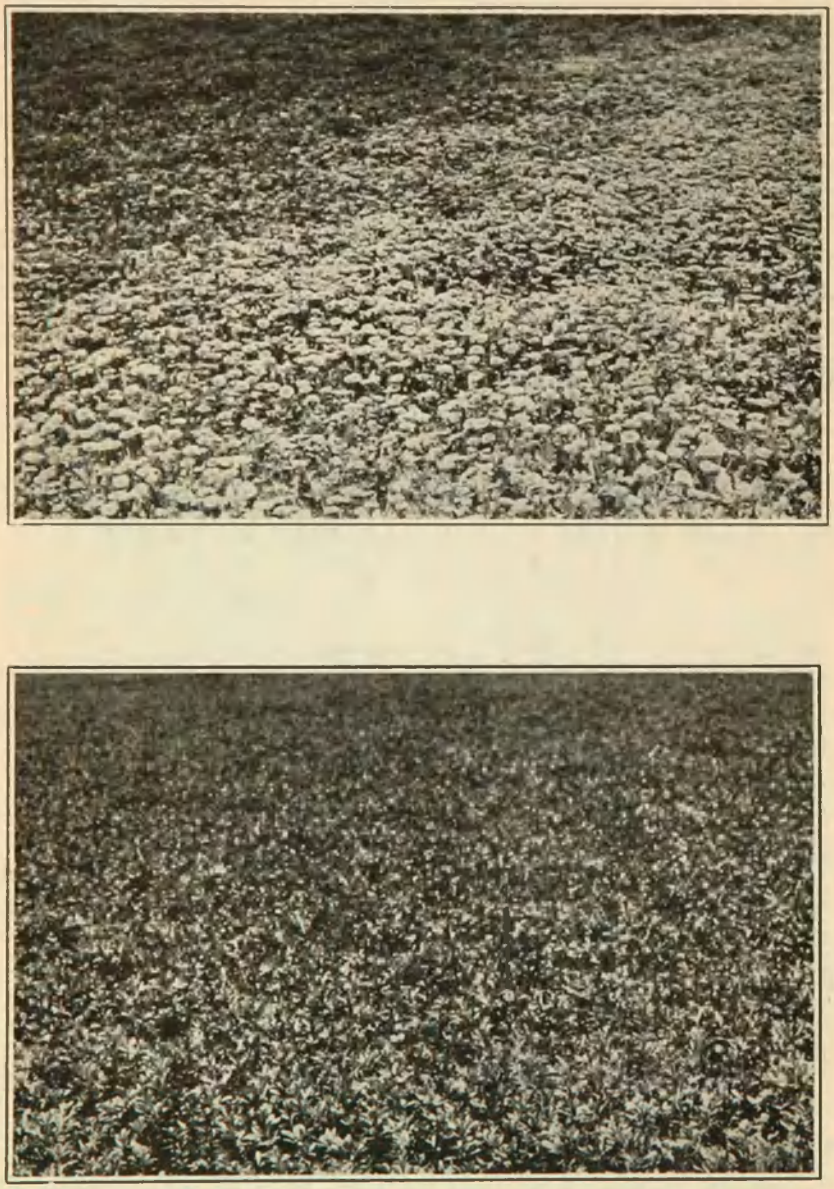


Fig. 16. Photographs of two alfalfa fields less than ten rods apart. Note the dandelions in the upper apparently crowding out the alfalfa, while in the lower none appear. The fields have been seeded about the same length of time, but the first has been injured by trampling and in other ways the alfalfa has been killed out, allowing the weeds to enter

after thorough preparation by deep tillage and fertilizing with decomposed manure.*

NO EASY, CERTAIN METHOD OF EXTERMINATION

It is evident from the foregoing that there is yet no easy, certain method known to the writer by which the dandelion may be exterminated and held in check for any considerable length of time. A beautiful area of velvety lawn, free from the cheerful golden blooms of dandelions in May, of their fluffy gray heads in June and of their ragged, mussy foliage throughout the season, tells of persistent, painstaking effort on the part of someone to keep it so. The very difficulties involved in maintaining a fine weed-free lawn will always distinguish the owner as a person of good taste and diligence, no matter what may be his financial rating.

THE DANDELION AS A FIELD WEED

Weeds are sometimes classified according to the habitat which they find best suited to their particular mode of life. Thus we have weeds of waste ground; weeds of lawns, pastures, and meadows; weeds of cultivated crops, and weeds of grain fields. The dandelion belongs to the first two classes and is not an important factor in the growing of grain and tilled crops. This is due to the fact that the dandelion is a low-growing plant which requires room to spread its foliage close to the ground and that it cannot spread laterally much underground. Furthermore, it does not produce seeds until the second year of its growth from seed and is therefore easily destroyed by cultivation before this occurs.

The dandelion has become an important field weed in some parts of Colorado, especially in native pasture lands of mountain valleys below 8,000 feet elevation. In such localities the dandelion, with its ability to grow where it is cold, often finds the soil moisture and the open spaces which it delights in and here it thrives wherever bare ground or thin spots among the native grasses occur.

When once established the dandelion is apt to remain and to take advantage of every opening that appears. In such cases there seems to be but little to recommend in combatting this weed, except to avoid over-grazing the pastures and to use the methods

* For those who desire to start a good lawn, the writer recommends the reading of an article on the subject by Samuel Parsons, Jr., in the American Cyclopedia of Horticulture.

of improving the stand of forage plants employed by the Federal Forest Service* in some regions.

These methods involve the following means: (1) Fencing and resting the land during parts of one season or for parts of several seasons, (2) rotation of pastures, (3) reducing the number of stock grazed on a given area, (4) reseeding the area with or without previous cultivation.

The seriousness of the dandelion as a weed in the alfalfa field is a matter which has elicited considerable discussion in this State. There are those who claim most emphatically that dandelions will crowd out alfalfa, while others, with equal positiveness, declare that they cannot. Alfalfa is doubtless our most persistent and dependable cultivated forage plant, and under favorable conditions it can compete successfully with almost any other plant classed as a weed. In fact, alfalfa is recommended as one of the best smother crops to be used in crowding out farm weeds.† In some cases, however, the alfalfa may not succeed well and may die out, thus opening the way for the less exacting weeds. The alfalfa may fail because of one or a combination of unfavorable factors. These may be :(1) Unfavorable climatic conditions which lead to winter killing, (2) unfavorable soil conditions, either due to chemical or physical composition or lack of proper moisture conditions, (3) improper treatment of the crop in its management on the farm, and (4) injuries caused by parasitic diseases, insect pests and rodents. The fact that alfalfa can hold its own against all weed encroachment, in many cases for long periods, is clear evidence that when weeds do appear to crowd it out there exists some one or more conditions unfavorable for its thrifty growth.

In a measure, alfalfa is capable of crowding itself out. Thus it has been found that, during the first few years, following a heavy seeding, there is a reduction in the number of plants in the stand amounting often to nearly two-thirds, without any decrease in the production of the crop. This thinning of the stand is the natural process by which the weaker plants are eliminated by the more vigorous ones, but it normally ceases when a balance has been established between the surviving plants. When, however, this thinning continues to such an extent that weeds like the dandelion

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* Bentley, H. L. "Experiments In Range Improvements in Central Texas." Bur. Plant Indus. Bul. 13, 1902.
Cotton, J. S. "The Improvement of Mountain Meadows." Bur. Plant Indus. Bul. 127, 1908.
Forbes, R. H. "Range Improvement and Administration." U. S. D. A. Experiment Station Bul. 115, pp. 85-86, 1901.
Griffiths, David. "Forage Conditions and Problems in Eastern Washington, Eastern Oregon, Northeastern California and Northwestern Nevada." Bur. Plant Indus. Bul. 38, 1903.

† See Farmers' Bulletin 660, "Weeds: How to Control Them." U. S. D. A.

appear in considerable numbers, it indicates that the conditions are in some way unfavorable. The appearance of numerous weeds in the alfalfa, which seem to be crowding it out, calls for a careful study of the soil and moisture conditions, and the presence of diseases and injurious insects and animals and the system of management, to determine what corrective measures, if any, can be employed.

SUMMARY

1. The common dandelion is our most noticeable and persistent weed in lawns in Colorado. It sometimes becomes a bad weed in meadows, pastures and in alfalfa fields where the stand is becoming thin.

2. The plant gains entrance and spreads by means of its wind-wafted seed-like fruits. Irrigation water taken from ditches along which the weed grows plentifully may also carry the "seeds" onto the land. As the plant gets older, the tap root may split up into several strands by a natural process of division and thus produce large clumps. Any part of the root, when cut off and left in the soil, may sprout and produce a new plant by means of adventitious buds.

3. The dandelion plant does not produce blossoms and fruit during the first year from seed. Its most profuse period of bloom and seed is during May and June. About nine days elapse between the first opening of the flower heads and full maturity of the seeds. Only a very small percentage of the seeds are mature enough to germinate by the seventh day following first blooming of the flower head. Flower heads picked or cut off when in bloom and left to lie on the lawn will not produce mature seed, capable of germination.

4. The dandelion has no serious natural enemies capable of keeping it under control. Certain seed-eating birds consume large numbers of the ripening seeds and thereby reduce the number scattered.

5. The dandelion can be controlled in lawns by persistently employing one or a combination of the following methods:

(a) By establishing the lawn on a carefully prepared seed bed with the ***best*** grade of lawn grass seed obtainable. A mixture containing 10 per cent of white clover seed is desirable when quicker results are wanted in securing a soil cover. Dead spots and thin places in the sod of old lawns should be re-seeded each year to maintain as dense a growth as possible and thereby discourage the entrance and growth of weeds. Early spring is the best time for this renewal seeding.

Old lawns on poor soil, where much bare ground and weeds occur, will sometimes demand plowing or spading the soil, removing roots and rubbish and fertilizing well. This is preferably done in late autumn and should be followed the next spring by thoro harrowing or raking and the sowing of the best grade of lawn grass seed.

(b) By applying about one teaspoonful of gasoline or kerosene in the crown of each plant by means of an oil can. This may be done at any time during the growing season and is especially effective in killing the older and larger plants which would sprout up if cut off. Care should be taken to apply only enough to kill each plant, as an excess will cause dead spots in the lawn grass.

(c) By digging the dandelion plants as deeply as possible at least once each season, preferably in spring just before blooming. This will kill a fair percentage of the plants and will prevent those which sprout from blooming during the season. A second digging in autumn before the end of the growing season will destroy a still larger number and greatly weaken the survivors. Digging may be done in such a way as to remove the entire plant and thus destroy it at one operation. This is the method employed in some of our large city parks where the dandelion is controlled over large areas.

(d) By prevention of seed production of plants growing on the premises. This can be accomplished by early digging, the use of gasoline on individual plants, frequent clipping of the lawn and picking the flower heads while in bloom at least once a week, and by early spraying with a suitable herbicide.

(e) By spraying badly infested lawns at least three times at intervals of about two weeks, using a solution of iron sulphate in water, 1¼ pounds to the gallon. The most effective results have generally been secured in late summer. Apply the spray in the form of a fine, forcible mist which will drive the solution down into the crowns of the plants. Cloudy, damp weather is favorable if the application is not followed by rain within 12 to 24 hours. Use a spray pump with brass fittings and do not put the solution in galvanized iron, tin or iron vessels. All utensils should be thoroly rinsed with water after using and the working parts of the pump kept well oiled. Wear old clothing and gloves while applying the spray and avoid getting any of it on walks, curbings and foundations or other objects where a rusty stain would be objectionable.

(f) According to our experiments, the cheapest and most effective method of eradicating the dandelion from a lawn, when

labor costs are considerered, is by spraying with the iron sulphate solution.

(g) The dandelion cannot crowd out alfalfa where the latter is growing under favorable conditions, and under proper management, as shown by fields which successfully resist the encroachments of this weed. Where this appears to be the case, a careful study of conditions should be made in order to find out, if possible, the limiting cause. In most cases a proper system of crop rotation should be employed, which involves a period of cultivation.


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