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A PRELIMINARY STUDY OF SOME HERBICIDES ON DANDELIONS

L. E. ARNOLD¹

The dandelion (*Taraxacum officinale* Weber) is one of the most common and persistent weeds in lawns and one for which no effective and practical method of eradication has been devised. Cutting the plants below the surface of the soil is effective if repeated frequently, but few individuals consider this method practical. Sprays such as iron sulfate which are supposed to have a differential action on dandelions and grasses leave much to be desired, while stimulating the grasses in an attempt to crowd out the dandelions has met with only moderate success. This situation led to a search for an effective method of application of a dandelion herbicide, and for a herbicide that is lethal to the plant, but does not persist in the soil. As the studies advanced it became apparent that eradication of the dandelions was only the first step in their control. While the dandelion plants were being eradicated it was necessary to stimulate the lawn grasses to prevent the rapid reestablishment of seedling dandelions.

The development of a device² whereby herbicides can be applied to the crowns of individual plants has introduced a new method of applying herbicides. This device, popularly called a "dandelion gun," applies measured quantities of the herbicide to individual plants. The construction of this gun is shown in figure 1. Unless otherwise indicated, the "dandelion gun" was used for the application of all herbicidal materials at the rate of approximately 6 cc. per plant.

TRIALS OF DANDELION HERBICIDES

Several materials were used in a preliminary way as herbicides for dandelions. A number of these proved undesirable for reasons set forth below, others show possibilities and will be used in further experiments. Sulfuric acid is very corrosive in the present

¹ The author is indebted to Dr. I. E. Melhus and Dr. W. E. Loomis of the Botany Department for valuable advice and direction in connection with this problem. The author is indebted also to the Furfural Division of the Quaker Oats Company for financial assistance and materials.

² This device was developed in June, 1929, by Dr. I. E. Melhus of the Botany Department.

types of applicators and in solutions of the strengths used does not eradicate the dandelions. Ammonium-thio-cyanate, recommended by Harvey (3) as an herbicide, gave fair control of the dandelions but was injurious to the lawn grasses and the bare spots formed were reseeded with difficulty. The same was true when an ammonium-thio-cyanate and furfural mixture was used. Summer-black oil sold by the Standard Oil Company was used in a mixture with furnace oil and gave a good control of the dandelions in limited trials but the unsightly appearance of the treated areas might be objectionable to some users.

A solution of ammonium sulfate, one part in two parts of water, has been effective in preliminary trials when used in the "dandelion gun." The data in table 1 show that three treatments with this solution effectively controlled both old and seedling dandelions.

An herbicide consisting of 10 parts coal-tar creosote and 90 parts distillate was developed at Iowa State College several years ago and has been extensively used in controlling ballast weeds on railroad right-of-ways. This mixture, designated as "CK10-90," is an effective dandelion killer, but is persistent in the soil, so that re-sodding is less rapid than is the case with other equally effective herbicides.

Furfural Herbicides.

Furfural herbicides were first developed by Melhus (4) and have proven to be effective against annual plants, but not against quack grass (*Agropyron repens* (L.) Beauv.), field bindweed (*Convolvulus arvensis* L.), and similar weeds. Rather surprisingly, an emulsion containing ten parts of furfural, 89 parts of kerosene or furnace oil, and one part of road oil, designated as "FK10-90," has been one of the most satisfactory herbicides used in these experiments for the control of dandelions. The mixture may be re-emulsified after long standing, and is convenient to use. Both the oil and the furfural are volatile and the toxic effects of applications as heavy as 1000 gallons an acre disappear from the soil within a week at moderate temperatures. The mixture can be used either for individual plant treatments, or as a broadcast spray, on very poor sod heavily infested with dandelions, although the present retail cost of furfural makes the spraying of large areas expensive. If the crowns of the dandelion plants are drenched with 6 cc. of "FK10-90," the percentage of complete kill is normally in excess of 95 per cent. The herbicide spreads through the plant, first into the leaves and then into the taproot, either completely killing the root or injuring it so seriously that it does not produce new top

growth. Furfural may be injurious to the sod when applied during hot weather as the fumes are toxic to the surrounding grasses.

Various furfural-water-distillate emulsions were tested in the search for a less expensive mixture. The most successful emulsion of this type was made with 52 per cent water, 40 per cent distillate, 2.5 per cent cresol, 0.5 per cent sodium oleate soap and 5 per cent furfural. This emulsion is easily prepared, stable, and convenient to handle and it gives a quick kill of the dandelion tops. In a single trial about 80 per cent of the treated plants were injured so severely that they did not recover.

Table I. Tests of Dandelion Herbicides

TREATMENT	AV. NO. DANDELIONS ON 100 SQ. FT. BEFORE			FINAL STAND 8/28/32
	FIRST TREATMENT 10/3/31	SECOND TREATMENT 5/12/32	THIRD TREATMENT 7/26/32	
None — check	594	---	823	895
Furfural alone	347	170	219 ⁷	38
FK10-90 ¹	546	72	152	54
Summer-black oil ²	---	262	138	34
Am.-sulfate sol. ³	477	236	181	6
Am.-sul. emul. ⁴	428	78	105	12
CK10-90 ⁵	488	33	38	13
Iron-sulfate spray ⁶	346	235	295	257

The Use of "FK10-90" as a Spray.

Where the dandelions are thoroughly established in small areas and the sod is very poor it may be desirable to kill all of the plants and reseed the grass. "FK10-90" is admirably adapted to this purpose. On April 12, 1932, two plots covered with dandelions were sprayed, one at the rate of 1000 gallons and the other at the rate of 500 gallons an acre. On April 16 the plots received ammonium sulfate at 300 pounds an acre. On April 19 the plots were seeded with a lawn grass mixture and on May 11 there was a uniform stand of grass about two inches tall on both plots. A few dandelion plants remained on the plot receiving 500 gallons an acre, the other plot was free.

As indicated above, in warm weather (April and September) there have been no evidences of residual toxicity when grass has been planted one week after spraying. Applications at the rate of 1000 gallons an acre have killed all dandelions present on our

¹ 10 parts furfural, 1 part road oil, 89 parts distillate, by volume.

² 25 parts S-B oil, 75 parts distillate.

³ 4 lbs. ammonium sulfate per gallon.

⁴ 15 parts 40 per cent ammonium sulfate solution, 5 parts furfural, 1 part water gas tar.

⁵ 10 parts creosote, 90 parts distillate.

⁶ 1.5 lbs. ferrous sulfate per gallon, 80 gallons an acre.

⁷ Increases represent seedling plants.

plots. Five hundred gallons an acre will kill all but a few dandelions and is probably the most economical rate of application. The few remaining plants can be treated individually.

Iron Sulfate Sprays

The use of ferrous sulfate sprays for the control of dandelions has been advocated by Adams (1), Bolley (2), Munn (5), Pammel and King (6), and others. Because of differences in wetting, and possibly other factors, broad-leaved plants are more seriously injured by ferrous sulfate than are the grasses. In our experiments an application of 80 gallons an acre of an 18 per cent (1.5 lbs. in one gallon water) ferrous sulfate spray has, under favorable conditions, killed all of the dandelion leaves wet by the spray while the blue grass (*Poa pratensis* L.) in the same plots showed some burning at the tips of the blades, but was apparently not otherwise injured. Four series of plots have been treated with iron sulfate sprays for comparison with the other treatments reported. In two experiments, one on poor soil heavily infested with dandelions and one in moderately heavy shade, three iron sulfate sprays have killed all white clover (*Trifolium repens* L.), but have resulted in no observable reduction in the numbers of dandelions. In two series where sprays were used on good soils there was some control by one application in October, particularly when the grass was fertilized prior to the application of the sulfate. The stimulating effect of the fertilizer on the blue grass favored the formation of a dense turf unfavorable to the recovery of the injured dandelions.

AMMONIUM SULFATE FERTILIZER AS AN AID IN DANDELION ERADICATION

Any program of dandelion control must take into account the heavy reseeding by the weed which normally occurs, otherwise the carefully cleared lawn will be reinfested within a short time. Fortunately, although the older plants survive all ordinary grass land conditions, the seedlings are rather intolerant and do not compete well in heavy turf. The effect of the more vigorous growth of fertilizer lawn grasses on the survival of dandelion seedlings is illustrated in table 2. Without the use of fertilizer the dandelions on the untreated plots increased 50 per cent between October 1931 and September 1932. When two 300-pound applications of ammonium sulfate (October 1931 and April 1932) were used to increase the growth of the bluegrass, the seedling plants which

started in the early summer of 1932 and were counted on July 15, apparently failed to survive the dry weather of July and August, so that in September there was no appreciable change in the number of dandelions in the fertilized plots. There was, however, a marked suppression of the growth of the older plants and very few flowers formed in these plots.

Table 11. *The Relation of Fertilization to Dandelion Control. (Ammonium sulfate Fertilizer 300 pounds an Acre in October, 1931, and 300 pounds in April, 1932)*

TREATMENT	AV. NO. DANDELIONS ON 100 SQ. FT.				
	ORIGINAL COUNT 10/3/31	COUNT JUNE 12, 1932		SEEDLINGS AUGUST 28, 1932	
		CHECK	FERTILIZED	CHECK	FERTILIZED
None — check	587	823	725	308	10
Furfural alone	341	219	20	31	0
FK10-90	505	152	12	50	3
Sum.-black oil	262	138	120	39	8
Am. sulfate sol.	462	181	77	4	1
Am. sul. emul.	428	105	51	10	2
CK10-90	488	38	21	12	5
Iron sul. spray	343	296	69	64	18
Average of treated plots	404	161	53	30	5

The data presented in table 2 bring out clearly the part played by ammonium sulfate in aiding in the eradication of dandelions. In every treatment the number of seedlings appearing in the plots was less when ammonium sulfate was used.

SUMMARY

1. The approach to the problem of dandelion eradication has been made chiefly through the application of the herbicide directly to the crowns of individual dandelion plants by the use of a device called a "dandelion gun." Individual plant applications of herbicides, on the basis of our results, appear to be the most promising method for the control of dandelions on small areas.

2. It was found that several herbicides were effective in the eradication of dandelions. These herbicides are: Furfural (technical), "FK10-90," Summer-black oil, Ammonium sulfate solution, Ammonium sulfate emulsion, and "CK10-90."

3. The application of ammonium sulfate, under favorable weather conditions, stimulated the formation of a dense turf that prevented dandelion seedlings from becoming established.

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