

JOHNSON GRASS CONTROL

with Dalapon and Liquefied Petroleum Burners

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Probably no phase of agriculture is undergoing more rapid change than the field of weed control. Advances in chemical weed control are little short of amazing, even to the weed research worker. This bulletin was written to supplement Bulletin 265, Johnson Grass Control, not to replace it. The methods for controlling Johnson grass described in Bulletin 265 are sound and widely used.

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Johnson Grass Control

With Dalapon and Liquefied Petroleum Burners¹

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This bulletin covers two recently developed methods of grass control: (1) use of the herbicide, Dalapon, and (2) L.P. (liquefied petroleum) burners. During the past few years both methods of grass control have become widely used by farmers and irrigation districts

When used properly, either dalapon or L.P. burners are effective in destroying Johnson grass. Frequently, control has been unsatisfactory, due to improper applications or failure to retreat Johnson grass at the proper time. This bulletin should aid users of dalapon and L.P. burners to obtain maximum control of perennial grasses at least cost.

Dalapon

Dalapon is a systemic herbicide that has proven effective for control of weedy grasses. When applied to leaves, some is absorbed,

enters the conductive system, and is carried or translocated to the roots and rhizomes. Dalapon destroys grass foliage, with initial symptoms (browning) usually evident at the tips and margins of the leaves. A single foliage application may completely kill, cause temporary dormancy, or have no visible effect on the rhizomes of perennial grasses.

Best results are obtained when dalapon is applied to foliage of vigorously growing grass. Initial effectiveness is **influenced by temperature**. When applied early in the spring, symptoms do not become evident for two to three weeks. However, during the summer symptoms usually become noticeable within a few days.

When dalapon is applied to the soil it may be absorbed by plant roots. However, it is most effective when applied to the foliage. Under most conditions, when used as a herbicide, dalapon is applied to the leaves.

Where dalapon is used on crop lands its fate in the soil must be considered. Under Arizona growing conditions it is readily leached and is decomposed by micro-organisms in the soil. High soil temperatures and ample soil moisture favor the rapid inactivation of dalapon. Under these conditions no residual

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Spot treating with dalapon to control Johnson grass in cotton.

effects on succeeding crops have been observed.

Dalapon is formulated as a sodium salt, a whitish, free-flowing powder, containing 74 percent of 2,2-dichloropropionic acid.⁴ (All recommendations in this bulletin are made on the basis of the commercial formulation.) Dalapon is readily soluble in water; thus its application is not limited to sprayers with mechanical agitation. The commercial formulation of dalapon contains a wetting agent. Frequent-

ly, however, adding two to four ounces additional wetting agent per 100 gallons of solution will increase the effectiveness of the herbicide.

Prolonged contact with concentrated dalapon should be avoided, for it may cause slight skin irritation.

SPOT TREATMENT IN COTTON

Scattered clumps of established Johnson grass in cotton fields have been difficult to control. Control has been obtained by cultivation and repeated hand chopping, a costly operation. In Arizona, early season (prior to first irrigation) growth of Johnson grass is the major weed problem to be solved

⁴Available under the trade names of "Dowpon" and "Radapon."

before cotton can be planted to a desired stand.

Spot infestations of Johnson grass in cotton fields can be eliminated through the proper use of dalapon. Two applications usually give good early season control. At layby, some fields require an extra application or one hoeing to eliminate late season growth of Johnson grass.

Timing Important

Dalapon should be applied when Johnson grass sprouts are 6 to 10 inches high. The first application is usually in May, shortly before first irrigation. Retreatment will be necessary, prior to the second or third irrigation when regrowth is about 8 inches tall. Delaying re-treatment until regrowth is 18 to 20 inches results in poor control because of incomplete coverage. Also, excessive amounts of cotton must be wet with spray to insure adequate grass coverage. When Johnson grass is treated at the proper stage, relatively little cotton is affected. Properly applied, dalapon will affect no more cotton than a hoeing.

When dalapon is used in cotton, the farmer must consider time of application in relation to other cultural operations such as cultivation, fertilization, and irrigation. If Johnson grass in the furrow is treated, the interval between application and the following cultivation is important. To achieve maximum control, at least **three days should elapse** between dalapon application and cultivation. As a systemic herbicide, the root kill by dalapon is related to the amount translocated to the roots. Removal of top-

growth soon after spraying will decrease the effectiveness of dalapon.

Application of Dalapon

Johnson grass foliage should be thoroughly wet with dalapon solution. One pound of dalapon per five gallons of water is the solution usually recommended and most widely used. The amount of dalapon needed to spot treat a moderate infestation of Johnson grass is usually three to six pounds per acre. Clumps of grass are actually sprayed at the rate of about 50 pounds per acre.

Dalapon users sometimes vary the concentrations of sprays to meet their particular conditions. High concentrations of dalapon (one pound per gallon of water) may cause a rapid browning of grass foliage. Rapid browning occasionally occurs when using the recommended rate if temperature and humidity are high. High concentrations or overapplication should be avoided for "contact-type" browning may interfere with the translocation of dalapon. Apply dalapon to achieve maximum root kill. Rapid destruction of top growth is not compatible with maximum translocation of the herbicide into the roots.

Effect on Cotton

For optimum control, Johnson grass must be thoroughly wet with dalapon spray. Some cotton will also be sprayed. Young cotton plants sprayed directly with dalapon are severely stunted or killed, but careful application can minimize amount of cotton affected;

TABLE I

Effect of spot treatments with dalapon

Percent of stand killed by dalapon	Yield of seed cotton expressed as percent of untreated check				
	Yuma 1958	Acala-44 Tempe 1958	Mesa 1958	A-44-WR Marana 1957	Marana 1958
0	100	100	100	100	100
10	92	97	90	97	101
15	96	94	95	93	99
20	95	100	97	94	88
25	92	96	102	95	100
30	88	93	100	92	91
35	89	92
40	90	79
Calculated yield of checks in pounds per acre	4,913	3,914	2,492	2,840	2,300

and although applications of dalapon reduce initial stand of cotton, yields have not shown a proportional decrease. This is illustrated in the data in Table I from tests at various locations in Arizona. Applications were made directly over the row to simulate spot treatments. Prior to first irrigation, ten to 40 percent of the row was treated.

In most tests, where 10 to 25 percent of the cotton plants were killed by spot treatment, cotton yields were not affected or only slightly reduced. Growth of lateral branches on adjacent untreated plants was stimulated and bare spots covered over.

Where stands were reduced 30 to 40 percent by spot treatments,

yield reductions were sometimes significant. Increased growth of untreated plants adjacent to treated spots did not compensate for excessive stand reductions.

Very heavy infestations of Johnson grass can best be controlled by summer fallow and proper crop rotation. If one to ten percent of the row is infested, dalapon can be used to control Johnson grass. When 30 to 50 percent of the row is infested, use other control methods.

When dalapon is applied as a spot treatment some spray will drift to adjacent cotton plants. Table II contains data from tests conducted in 1958 in which low rates of dalapon were applied to young cotton plants to simulate spray drift. Dala-

TABLE II*Effect of direct application of low rates of dalapon*

Rate of dalapon in pounds per acre	Yield of seed cotton expressed as percent of untreated checks	
	Acala-44 Tempe	A-44-WR Marana
0	100	100
1	103	108
2	103	103
3	103	101
4	98	106
5	100	97
6	97
Calculated yield of checks in pounds per acre	3,756	2,248

pon was applied directly over the entire row at rates of 1 to 6 pounds per acre prior to the first irrigation.

Applications of 1 to 2 pounds per acre of dalapon simulating spray drift to cotton did not affect the rate of cotton growth or cause malformed leaves. Application of 3 or more pounds per acre of dalapon caused foliage malformation. These plants produced normal foliage within 3 to 6 weeks. A temporary stunting was caused by application of 5 and 6 pounds per acre of dalapon. However, at harvest all plants appeared normal and cotton yields were not affected by applications of dalapon far greater than those resulting from spray drift.

Neither spot treating nor direct application of low rates of dalapon

to young cotton affected fiber properties (length, strength and fineness) or boll components (boll weight, seeds per boll, percent lint, lint index. etc.).

When dalapon is applied to grass foliage a portion of the spray falls to the soil. Some of this dalapon will be taken up by the roots of adjacent cotton plants. The response of cotton to soil applications of dalapon was studied in 1958 in a test conducted at Tempe. On June 10 prior to the second irrigation and July 1 prior to the third irrigation, several rates of dalapon were applied as a directed spray to the soil covering the furrow from row to row.

The applications of dalapon made June 10 caused severe leaf and flower malformation, square shed

TABLE III*Effect of soil application of dalapon*

Dalapon treatment		Yield of seed cotton expressed as percent of untreated checks	Boll weight in grams
Date	Pounds per acre		
Untreated check		100	6.4
6/10	4	100	6.5
6/10	8	91	6.1
6/10	12	83	6.2
7/1	4	97	5.6
7/1	8	103	5.5
7/1	12	108	5.7
7/1	16	94	5.4

Calculated yield of checks
in pounds per acre 3,535

and excessive growth. There was no visible effect on cotton treated July 1. Table III contains data on the effect of soil applications of dalapon on seed cotton yield and boll weight. Total yield of seed cotton was reduced by the higher rates of dalapon. The July 1 applications of dalapon reduced boll size. None of the dalapon treatments affected fiber properties.

Where dalapon is applied to scattered clumps of Johnson grass the amount of herbicide reaching the soil will not affect cotton growth or yields. Where very intense stands of Johnson grass are treated or general applications of dalapon are made to the soil, the growth and yield of cotton will be adversely affected.

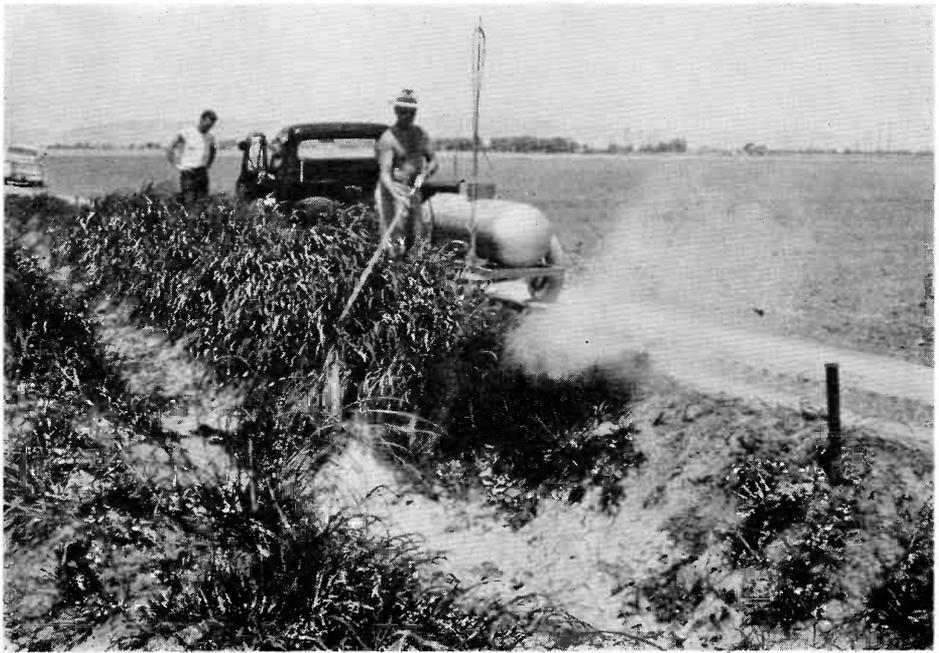
Equipment

Hand (knapsack) sprayers are satisfactory for application in

very light infestations of Johnson grass. For average infestations a tractor or trailer-mounted sprayer is needed.

Many types of spray equipment can be adapted for the application of dalapon with little cost and effort. A continuous running power take-off is the usual power source, although an auxiliary motor is often used on trailer-mounted sprayers. Roller, gear, vane, and diaphragm pumps capable of delivering about eight gallons per minute, are used. A by-pass pressure regulator is used to control pressure and provide agitation in the spray tank. The shutoff valve and pressure gauge should be mounted within easy reach and view of the driver.

For spray guns, Spraying Systems Trigger Teejets with 18 to 24-inch extensions and TG 3.5 full cone or 08 fan-type nozzles or equi-



Controlling Johnson grass on ditchbank with L. P. Burner

valent have proven very satisfactory. Spray guns are sometimes fitted with cone-shaped shields to minimize spray contacting cotton foliage. Most spray rigs have two to four spray guns connected to the delivery pipe by 10 to 20 feet of $\frac{1}{4}$ -inch hose. Operators of spray guns may ride on platform mounted on the front of the tractor. A better application is sometimes obtained if operators walk beside and behind the tractor.

Equipment used to apply dalapon should be cleaned after each operation. Dalapon is easily removed by pumping clean water through the sprayer.

DALAPON FOR DITCHBANKS

The use of dalapon to control Johnson grass along ditchbanks is

an accepted practice by farmers and water users' associations. Properly applied, it is probably the most effective and economical method to control established Johnson grass. For the applicator, the use of dalapon is a cleaner and more comfortable operation than other control methods.

Grass foliage should be **thoroughly wet** with a solution containing one pound of dalapon per five gallons of water. Best results are obtained if dalapon is applied when grass is 12 to 15 inches high and growing vigorously.

Variation in speed of initial action of dalapon has frequently worried users. Rapid topkill is obtained when applications are made during the hot, humid weather of July and August. A complete top-



Regrowth of Johnson grass was vigorous after six burnings at four week intervals.

kill may be obtained within three to five days after treatment. When applications are made during the cool weather of spring or fall, symptoms of dalapon develop slowly. Complete topkill may be delayed for two weeks or more. This does not mean the treatment is ineffective; it is due in part to retarded plant response at lower temperatures.

A single application of dalapon under Arizona conditions will not suppress Johnson grass throughout the entire season. Generally, an application of dalapon stops growth for about six weeks. Then regrowth occurs. Retreatment should be made when Johnson grass has again reached a height of 12-15

inches. When the first application is made during early April, two or possibly three retreatments are needed later in the growing season. However, when such a schedule is followed almost complete control will be obtained. During the following year the weed control program can switch to prevention of re-infestation by Johnson grass seedlings or encroachment by annual broadleaved weeds.

Dalapon is also effective in destroying Johnson grass when initial treatment is made in July or August. Retreatment will be necessary in late September or early October. Two applications of dalapon (the first in mid-summer and the second in early fall) will frequently de-



Johnson grass was dead after twelve burnings at two week intervals.

stroy established Johnson grass. Occasionally, there is some delayed regrowth the following spring that requires an additional treatment.

Dalapon does not have a prolonged residual toxicity in the soil, nor is it effective against many broadleaved weeds. New weed infestations, therefore, may develop unless effective weed control practices are employed. The seedlings of annual and perennial grasses can be killed by using lower rates of dalapon (one pound of dalapon in 10 to 15 gallons of water). Broadleaved weeds can be controlled through use of aromatic oil-water

emulsions or by flaming. For long range ditchbank weed control, alternating applications of dalapon with aromatic weeds oils and/or L. P. burners may be the most effective program.

Dalapon has also proven successful for controlling Bermuda grass. This grass is more susceptible than Johnson grass to dalapon. Complete destruction of Bermuda grass is often achieved with one application. Spots of Bermuda grass in cotton fields or general infestations on ditchbanks are treated in the same manner as Johnson grass.

TABLE IV

Costs of controlling Johnson grass on ditchbanks with L. P. burners, aromatic weed oils, and dalapon

Treatment	Number of Applications	Chemical Cost/Acre	Labor Cost	Total Cost
L. P. Burners	12	\$106.09	\$77.25	\$183.34
L. P. Burners plus Dalapon	6	51.35	52.47	179.90
Aromatic Weed Oil	7	113.45	28.56	142.01
Dalapon	4	94.48	17.33	111.81

Prices used in above table: oil = 20¢/gallon; L. P. burners = 4¢/pound; dalapon = \$1.07/pound; labor = 2 men at \$1.00 per hour each.

LIQUEFIED PETROLEUM BURNERS

During the past several years, many farmers have purchased L. P. burners adapted for controlling weeds along irrigation ditches. Frequently, improper use of L. P. burners has resulted in costly, temporary control of established Johnson grass. However, if burning is done at the proper interval, control of grass is possible during a single growing season.

Using butane-propane fuel mixtures, L. P. burners produce a flame approximately 3000 degrees F. at the burning point. The quick rise in temperature ruptures plant cells, resulting in the destruction of stems and foliage. Most users overburn by delaying moving on until weed growth has become completely desiccated and actually ignites.

Extreme burning is not necessary and actually is undesirable. Flame should be applied only until top

growth wilts. This top growth will dry within a few days. The dry weed residue is readily destroyed by the next burning and provides fuel which aids in the destruction of Johnson grass regrowth. Overburning is very expensive, while a well managed operation can be equally effective at nominal cost. Proper degree of burning can best be determined by experience and close observation of the results.

To obtain maximum weed control by flaming, **repeated burning** must be conducted on a definite schedule. On experimental plots best control was obtained when grass was burned every two weeks. Twelve to fourteen burnings during a single season at two-week intervals have eliminated established Johnson grass. When burned at two-week intervals, regrowth continued to be vigorous until mid-summer, then an abrupt loss of plant vigor and rate of growth became evident. Reduced plant vigor was the result of repeated destruc-

tion of top growth, which probably caused a continued decline of carbohydrate reserves in the Johnson grass rhizomes, as the plant used these reserves to establish new top growth. Failure to burn at the proper interval allows Johnson grass to recover and benefits of previous treatments are lost.

As the interval between burnings was lengthened, the Johnson grass had time to replenish its carbohydrate reserves and was more difficult to kill. When burned at three-week intervals, there was a gradual reduction in grass population, but complete control was not achieved during a single season. When the burning interval was extended to 4 weeks, very poor control was obtained. During mid-summer Johnson grass became very rank and more resistant to flame injury. Burning the rank growth of grass required excessive amounts of fuel. Burning at the four-week intervals gave temporary removal of top growth, but no reduction of the Johnson grass stand.

Growth of Johnson grass usually is most vigorous along unlined irrigation ditches. Control of Johnson grass with L. P. burners is more readily accomplished along lined canals where soil moisture may be limited and the grass is less vigorous. Fewer burnings are required for complete control of Johnson grass along lined canals. However, complete control of Johnson grass along unlined canals is possible in one season when burning is conducted at the recommended two-week intervals.

COSTS OF CONTROL ON DITCHBANKS

Where two or more effective methods of controlling weeds are available, relative costs should be considered. A test was conducted to determine costs of controlling Johnson grass on an unlined ditchbank with L. P. burners, aromatic weed oils and dalapon. Burning and herbicide applications were scheduled to obtain maximum control with each method in a single season.

All treatments began April 12, 1957. Burning was conducted on a two-week schedule for 22 weeks. Aromatic weed oils and dalapon were applied when regrowth was 12-15 inches high. The combination treatment (L. P. burners plus dalapon) was burned every two weeks for 12 weeks. After mid-July, dalapon was applied whenever regrowth attained a height of 12-15 inches. (Previous research indicated dalapon to be most effective when the initial application was made during July or August.)

Established Johnson grass was completely destroyed in one season using dalapon, burning, and combination treatments. Seven applications of aromatic weed oils greatly reduced and weakened the stand of Johnson grass but kill was not complete.

The most expensive control method was the use of L.P. burners (\$183.34 per acre). There was little difference in chemical cost of the various treatments. The high total cost of burning was due to the high labor requirement. The combination of burning and dala-

pon cost slightly less than burning alone (\$179.90 per acre). The use of aromatic weed oils was intermediate in cost (\$142.01 per acre). Since grass control was incomplete, the cost of retreatment the following year must be considered. Dalapon was the least expensive (\$111.81 per acre) control method in this test. The data obtained in this test agree with cost figures of irrigation districts using these methods to control Johnson grass.

The general appearance of the

ditchbank throughout the season also influences which method will be used to control Johnson grass. Regular burning resulted in a very clean ditchbank. The presence of dead grass following repeated applications of aromatic weed oils or dalapon caused the ditchbank to appear cluttered and shabby. Where dalapon was used, the annual broadleaved weeds, which increased as the Johnson grass weakened, added to the shabby appearance of the ditchbank.

Other Publications Available

Other publications from the University of Arizona dealing with weed control are available free from your county agricultural extension agent or at the College of Agriculture.

Johnson Grass Control.....	Bulletin 265
Chemical Control of Annual Weeds in Cotton.....	Bulletin 283
Weeds of Crops in Southern Arizona.....	Bulletin 296
Growing Onions in Arizona.....	Bulletin 280
Carrots in Arizona.....	Bulletin 285
Kill Weeds in Small Grains.....	Circular 217
When You Buy or Build a Field Sprayer.....	Circular 249
Arizona Ranch, Farm & Garden Weeds.....	Circular 265
Dalapon Controls Bermuda Grass.....	Report 176

TIME TABLE FOR JOHNSON GRASS CONTROL

FIELD CONTROL:

Cultivate—to eliminate seedlings and control established plants between rows.

Spot treatment—for light infestations

Spring and summer

1. Dalapon in cotton
Apply to foliage when grass is 6-10 inches high.
Retreat regrowth as needed.
2. Hoe at 2 to 3-week intervals.
3. Soil sterilants
Apply to soil and irrigate.

Fallow—for general infestation

Spring—shallow plowing in April.

Summer—Plow at 5-week intervals through May, June, July, August and September.

Winter crops

Plant competitive winter crops—barley for hay or pasture.

Plant cultivated winter crops—vegetables.

Proper management of summer crops—prevent establishment of Johnson grass.

Plant, fertilize, irrigate, and control diseases and pests to increase competitive ability of summer crops.

DITCHBANK CONTROL:

Spring, summer and fall:

Dalapon

Apply to foliage when grass reaches a height of 12-15 inches.

Repeat whenever regrowth reaches height of 12-15 inches.

Aromatic weed oils

Apply to foliage when grass reaches height of 12-15 inches.

Repeat when regrowth is 12-15 inches high.

L. P. burners

Burn when grass is about 12-15 inches high.

Burn at 2-week intervals for entire season.

Soil sterilants

Apply to soil prior to summer or winter rains.

GOOD FARM PRACTICES—the key to weed control—use at all times.

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Your County Agent has a wide variety of free bulletins written by Arizona agricultural scientists and directed at Arizona conditions and problems. Use your County Agent and Your County Home Agent. They are there to serve you.

And when the Branch Experiment Station near you has a field day, to show and tell about its work, attend and learn from what is told and displayed there.

Harold E. Myers

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