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HERBICIDES THROUGH SPRINKLERS

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Herbigation — application of herbicides via irrigation water — is a practical means of applying herbicides. This method is attractive for weed control because it is an added use for a sprinkler irrigation system. Currently only thiocarbamate herbicides and associated mixtures are registered for use on Idaho's crops by this application method. **Research and conclusions reported here refer only to Eptam and Eradicane.**[1] This application method can be used on potatoes, sugarbeets, alfalfa, clovers, corn and beans, plus some crops not important in Idaho.

A sprinkler irrigation system and a sprayer boom are similar in principle, and herbicides may be applied by either. Each one is basically a pipe with outlet branches along its length, and both are subject to the same principles of hydraulic flow and delivery. The uniformity of application by some sprinkler systems is at least as good as that obtained by most conventional sprayer methods.

The variations in types of agricultural sprinkler system design preclude generalizations about differences between sprinkler systems and conventional spray systems, except that sprinkler systems may be considered extremely high volume sprayers that spray extremely low concentrations of herbicides. Factors such as nozzle height and spacing, droplet size, spray pattern, coefficient of uniformity, stream orientation, concentration constancy, rate of travel, continuity of movement and drain-and-fill characteristics are determined by the system design. These may dictate whether a particular system is suitable for herbigation.

Research at the University of Idaho Research and Extension Center at Aberdeen has shown that sprinkler systems can be satisfactory for herbicide application. Small and large scale studies with center pivot, fixed (solid set) and portable (wheel or hand move) systems have shown consistently good results from carefully planned and executed applications. Results reported from farmers have not been consistently good, however. Performance failures that have been examined closely have invariably been found to result from neglect of one or more of the important principles of herbigation weed control.

PRINCIPLES OF HERBICIDE APPLICATION THROUGH SPRINKLERS

1. Irrigation equipment should be in top operating condition.

A pump failure during the process of injection into irrigation systems can result in crop injury where the irrigation lines drain and the effect of herbicides may be seen for a long time after such an accident. Freedom from nozzle plugging, correct nozzle sizes and adequate sprinkler head rotation must be verified before injection to avoid weedy or overdose areas.

2. Emerged weeds resist herbicides currently registered for herbigation.

Weeds that have emerged are normally tolerant to the currently registered thiocarbamate herbicides. Weeds that escape cultivation will likely also survive herbigation. New weeds will be killed as they emerge, since herbicides approved for sprinkler application are effective only on germinating seedlings.

3. Wind can cause poor weed control.

Application during windy periods can result in serious pattern disturbances. Wind is a more serious problem with fixed or portable systems than with continuously moving center-pivot systems. Even with center-pivot systems the effect of wind on herbicides applied to hill

[1]Use of trade names refer only to currently registered herbicides for local use, that have been tested in Aberdeen, and does not imply non-recommendation of other products. Continuing herbigation research at Aberdeen suggests that herbicides with different chemical properties may require different application techniques.

culture can result in poor weed control on the leeward side of beds or hills. Though sprinkler droplets may be somewhat larger than sprayer droplets, their elevation at the top of their trajectory when released from a center-pivot system is 15 to 20 feet. They may be as susceptible to lateral displacement and pattern disturbance by wind as droplets released from a conventional ground sprayer operating 20 inches above the ground.

Even low winds can cause most of the irrigation water and herbicide to be deposited on the windward side of a potato hill with occasional dry spots showing on the leeward side of the hill. Schedule herbicide application carefully to avoid winds of 10 mph or more. During the spring windy season, winds generally diminish to acceptable levels about an hour before sundown and remain at low levels until almost mid-morning.

4. Brief injections are satisfactory.

Thirty-minute injection periods result in uniform application in calm conditions. This procedure can facilitate herbigations with nonmoving systems (wheel lines, hand lines or solid-set).

5. On silt loam soils, the first half of an irrigation set is the best time to inject the herbicide in a nonmoving system.

On such soils, this must be followed by four hours of irrigation to incorporate, or wash the herbicides deep enough to be effective.

6. Sandy soils require less water for incorporation than loam or silt loam soils.

Center-pivot systems on very sandy soils may operate at 100 percent rotation, which will apply about 0.2 inches of water. This will move to a depth of 1.5 to 2 inches during irrigation and continue to a depth of 3 to 4 inches.

7. Overirrigation can result in poor weed control.

Do not apply water beyond the water-holding capacity or infiltration rate of the soil.[2] Otherwise, leaching, ponding, runoff or overdose may occur. Add no more water than is necessary to bring the soil moisture content back to 100 percent available soil moisture in the upper 3 to 4 inches of soil.

8. Anti-pollution systems can prevent trouble.

Injection system check valves, mainline check valves, air relief valves and electrically interlocked irrigation and injection pumps can prevent well pollution, chemical spills and herbicide misapplication.

9. Surviving weeds should be killed.

Cultivation or an appropriate additional herbicide may be necessary if the herbigation does not kill all the weeds. This can normally be done without undue loss of thiocarbamate effectiveness.

[2]See Current Information Series 236, Available water-holding capacities of soils in southern Idaho, by R. E. McDole, G. M. McMaster and D. C. Larsen, for additional information.

PORTABLE IRRIGATION SYSTEMS

A comparison of ground sprayer vs. wheel move sprinkler application of Eptam of a silt loam after potato planting indicated the portable system could be successfully used to apply a herbicide (Table 1). In this case, the sprinkler application was somewhat less effective than application with a sprayer followed by incorporation with a rolling cultivator. The herbicide was injected into the irrigation sprinkler system for 30 minutes. The injection began one-half hour after beginning each of two consecutive 8-hour irrigations. This provided the normal overlapping of water and herbicide from consecutive irrigations of "sets" that occur as portable (wheel or hand) lines are moved across the field.

Table 1. Effect of different methods of Eptam application on control of test plants.[1]

Application method	Control of wheat %	%
Sprinkler	77	95
Sprayer	100	99
No Eptam	0	0

[1]1976 results on silt loam.

Table 1 shows that, in this situation, the sprayer method was considerably more effective (100 percent control) for control of the less susceptible wheat than was the sprinkler method (77 percent control). For the ryegrass, which is highly sensitive to Eptam, the sprinkler method was approximately as effective as the sprayer method (95 percent control for the sprinkler vs. 99 percent control for the sprayer). These data suggest that herbigation may provide complete control of very sensitive weeds, but in more adverse circumstances it may be less effective than conventional sprayer procedures. These data are from one year's experience on a single site; more confidence in these conclusions should result from further tests.

FIXED (SOLID-SET) SYSTEMS

Studies with solid-set sprinkler irrigation systems on loam have shown that the timing of herbicide injection during an irrigation can be critically important to weed control. We compared Eptam injections (1) throughout an 8-hour irrigation set, (2) during the first 4 hours of the set and (3) during the last 4 hours of the set. Application of Eptam during the first 4 hours of the set gave about as good weed control as did application throughout the 8-hour set (Table 2). No weed control resulted from Eptam injection only during the last 4 hours of the set. The chemical apparently was wasted. Table 2 also shows that weed control was complete when the herbicide was applied with conventional ground-sprayer equipment, while the herbigation allowed a few weeds to survive.

Comparisons of shorter 30-minute injection periods during the first, middle and last hour of the irrigation sets show that Eptam should be injected early in the

Table 2. Effect of the time of an Eptam injection on weed control.[1]

Period of injection	Grass control %
First half of irrigation set (4 hr)	98
Last half of irrigation set (4 hr)	0
Entire irrigation set (8 hr)	95
Before irrigation[2]	100
No herbicide	0

[1]1976 results on silt loam.

[2]Eptam applied with conventional sprayer before irrigation and mechanically incorporated.

Table 3. Effect on weed control, of a 30-minute Eptam injection at different periods during an irrigation.[1]

Period of injection	Grass control %
First hour of irrigation	99.9
Middle hour of irrigation	99.3
Last hour of irrigation	49.5
Before irrigation[2]	100.0
No Eptam	0.0

[1]1976 results on silt loam.

[2]Eptam applied before irrigation with a conventional sprayer and mechanically incorporated.

irrigation set when this procedure is used on loam soil. Table 3 suggests that a 30-minute injection any time up to the middle of an 8-hour set should provide satisfactory control, but the earlier in the set after the initial startup, the better.

These results and recommendations are based on trials on a loam soil. Results may be quite different on a sandy soil. Further testing and experience will be needed on sand.

CENTER-PIVOT SYSTEMS

Research shows that herbicide application through center-pivot irrigation systems has been as good as application with conventional tractor-mounted equipment. Table 4 shows the results of application through a center-pivot on sand where the lateral was moving at 100 percent rotation, wetting the sand to 3 - to 4-inch depth.

Weed survival in the sprayer-tested plots may have been due to inadequate mechanical incorporation with the rolling cultivator used for those treatments. This is a problem frequently encountered with mechanical incorporation in hill culture such as is used in potatoes. While a rolling cultivator may do a complete job of destroying weeds mechanically, it may not necessarily do a thorough and uniform job of mixing herbicide into the surface layer of an undulating potato hill. Surviving weeds in the sprayer-tested plots and sprinkler plots alike were small, weak and relatively noncompetitive. For this reason, both treatments provided acceptable weed control from a practical standpoint.

Table 4. Weed control by Eptam applied through center-pivot sprinkler and sprayer.[1]

Method	Grass control %	Pigweed control %	Overall control %
Sprinkler	98.7	95.4	97.7
Sprayer	96.5	88.0	94.2
No Eptam	0.0	0.0	0.0

[1]1975 results on sand soil.

RULES TO FOLLOW

1. **Check the sprinkler system.** Replace old or excessly worn sprinkler nozzles, seals and bearings, leaking pipe gaskets or other fittings.
2. **Calibrate** the injection equipment carefully.
3. **Kill all emerged weeds** before applying thiocarbamate herbicides such as Eptam or Eradicane.
4. **Avoid winds over 10 mph** when injecting herbicides.
5. **Inject herbicides for brief periods** (not less than 30 minutes) to save time when using portable or fixed systems on loam.
6. **Inject only during the first half** of normal irrigation sets on loamy soils so 4 hours of clear water follows for incorporation. Sandy soils may require different procedures.
7. **Use light irrigation** on sandy soils to avoid leaching the herbicide too deep.
8. **Use anti-pollution** systems.
9. **Kill surviving weeds** by cultivation or other herbicides.
10. **Apply herbicides by sprinklers only if** the label directions specifically permit; follow directions explicitly.

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