Chemigation

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INTRODUCTION

Chemigation is the application of agricultural chemicals (fertilizers, micro nutrients, fungicides, herbicides, insecticides, nematicides, soil conditioners, growth regulators, and biological agents, as well as gray water and animal wastes) into water flowing through an irrigation system. Chemigation is an efficient and economical means of applying inputs necessary for crop, turf, nursery, greenhouse, and landscape management, among others.

In Kansas, chemigation is defined by state law (K.S.A. 2-3301 et seq, Kansas Chemigation Safety Law) as "any process whereby pesticides, fertilizers or other chemicals or animal wastes are added to irrigation water applied to land or crops, or both, through an irrigation distribution system." Chemigation by Kansas definition, should therefore not be confused with the chemical treatment of water such as chlorination, fluoridation, hard water remedies, pH adjustment, or the addition of antibiotics among others, where irrigation water is not applied to land or crops, or both, through an irrigation distribution system.

Chemigation can be conducted using drip/trickle, flood, furrow, and sprinkler irrigation systems. Drip/trickle and subsurface systems can only be used for chemigation of soil-applied agricultural chemicals. Flood and furrow irrigation systems can, at times, present problems with chemical application uniformity and may limit some chemical applications. Sprinkler irrigation systems (solid set, center pivots, lateral move, etc.) can accommodate both soil and foliar applied chemicals and are the primary method of choice in Kansas.

Just as there are benefits and risks associated with applying agricultural chemicals using conventional (ground and aerial) methods, there are benefits and risks associated with chemigation. In some cases, with proper management, better application efficiencies offer a reduction in the amount of agricultural chemical used, timely application, and less impact on the environment.

The most significant risk when utilizing chemigation is for water source contamination due to backsiphonage, backpressure, or over irrigation. To minimize risks related to chemigation, an irrigation system must be properly designed, equipped and operated. Safety equipment must be added to the system and procedures followed to ensure operator and environmental safety as well as the desired results of the chemical application. Proper management and maintenance of the recommended safety equipment is essential for successful chemigation. Mandatory safety equipment, record keeping, permitting, certification, and management requirements are outlined by the Kansas Chemigation Safety Law.

ADVANTAGES AND DISADVANTAGES TO CHEMIGATION

The application of chemicals through an irrigation system offers many advantages. Advantages obtained depend on the type of irrigation system used and the type of chemical being applied, among others.

Advantages

Properly designed and operated irrigation systems may apply chemicals more uniformly than aircraft or some ground sprayers.

Chemigation allows prescription and timely application of chemicals based on crop requirements even when fields are too wet for tractors or it is too foggy for aircraft or even at night. Proper timing also allows for application under the proper optimum weather conditions so that reduced rates of chemicals might be effective.

Many chemicals require moisture for activation or precise depth of incorporation. The appropriate amount of water applied through irrigation can incorporate chemicals to the desired depth and, at the same time, provide moisture for activation. The amount of irrigation applied depends on soil type, soil moisture content, and depth of chemical incorporation required.

Chemigation allows for the application of chemicals under various tillage situations and is, therefore, compatible with reduced or no-till farming.

In those soils or regions where soil compaction is a problem, applying chemicals through irrigation can reduce compaction caused by tractors and other tillage implements.

Mechanical damage to the crop by sprayers is reduced by chemigation.

Chemigation reduces operator exposure to chemicals. It is essentially a closed transfer system and an operator is not required in the field during the entire application.

Chemigation may reduce environmental hazards associated with spray drift.

Chemigation of post-emergence soil-acting herbicides may reduce crop phytotoxicity and increase activity.

Applying chemicals through an irrigation system can save 40% or more in chemical application costs. Greater savings can be obtained when two or more inputs are applied simultaneously (co-chemigation).

Chemigation can reduce energy consumption for application up to 90% and, in some cases, eliminate the need for soil incorporation.

Chemigation systems may simplify cultural practices and improve crop production and quality if used correctly. Timely fertilizer applications can significantly increase crop yields.

Disadvantages

Chemigation requires considerable management input and personnel training. Certification of the operator for chemigation systems is required in some areas of the United States.

Chemigation requires a change in management techniques.

Some chemicals may react with irrigation system components and solutions may be corrosive to irrigation equipment.

Using an irrigation system to apply chemicals may apply moisture to the crop at a time when it is not required or when the soil is already too wet.

Additional equipment and capital outlay may be required for chemigation.

Chemigation increases application time compared to aerial spraying, so climatic factors may interfere or delay application.

Not all chemicals are labeled for use in chemigation.

Some chemicals, due to their chemical properties may not be suited for chemigation.

Environmental concerns exist in regards to the persistence and movement of chemicals in the soil profile and for the possibility of backsiphon or direct contamination of the water source.

Irrigation Scheduling Using Evapotranspiration (ET):
Example Schedule

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Irrigation scheduling can be accomplished by keeping an account of crop water use relative to the amount of water available for withdrawal from the soil profile. Measurement of crop water use or evapotranspiration (ET) can be indirectly measured by monitoring soil water levels or calculated using weather information and specific crop growth characteristics. Calculating crop water use, although an estimate, is an reliable and accurate method that is finding favor with many irrigators since the information can be gathered and delivered electronically to the office and eliminates much of the labor involved in indirectly measuring water through soil sampling. Some soil monitoring is still necessary to confirm scheduling accuracy and account for rainfall and other variations. KSU bulletins, Scheduling Using Evapotranspiration Reports for Center Pivots, L-915, and Furrow Irrigation, L-914 are available from your county extension office. This example will follow the procedures discussed in those bulletins and will assume use of a center pivot system.

Basic Scheduling

Irrigation Scheduling Steps:

1. Determine the total crop water use (ET) since the last update.
2. Determine the effective rainfall and irrigation since the last update.
3. Update the schedule.
4. Begin irrigation when soil water depletion equals or exceeds the net irrigation application amount.

To initiate the scheduling steps, characteristics of the field (soil) and irrigation system and certain management guidelines must be determined.

Determine the Active Root Zone of the Crop

For the bulk of the season, a managed root of three feet for most field crops is a general recommendation. However, some soils may have restrictions that reduce root penetration. Early season irrigation should account for a shallow root zone, either using information from crop production handbooks or visual inspection through digging. Record a root zone depth of 3 feet on line A of Table 3 for this example.

Determine the Soil Water Storage Capacity

Sandy soils hold less water than silts or clays. Specific information is available from a NRSC county soil Survey. KSU bulletin L-904, Soil, Water, Plant Relationships,