

# S ummer 2008



## ARGUS ADVISOR

News for Argus Control System Owners

There's a lot of 'green' talk in the air. Some of it is just 'greenwash', but there are a lot of opportunities for our industry to improve our 'green' image as well as moving some 'green' to the bottom line. Why not lead by taking advantage of these opportunities, rather than waiting until government bureaucracy imposes less-than-perfect regulations on us.

In terms of energy efficiency and environmental responsibility we should be less concerned with the absolute amount of energy that is used and more concerned with net energy efficiency. For example, you can always save energy by turning down the heat, but if yields and quality suffer, what have you gained? Some shifts in growing practices might actually increase your total inputs, but so long as the net effect is a reduction of the inputs per unit of output you'll be ahead both financially and in terms of the environmental impact of your activities.

The next few issues of the Argus Advisor will examine some of these opportunities. In this first issue we look at irrigation practices.

A handwritten signature in black ink, appearing to read "Alec Mackenzie".

Alec Mackenzie

### Reducing Runoff, Water, and Fertilizer Use



In the middle of an energy crisis, watering issues may not seem a top priority. However, since it takes the same amount of expensive energy inputs to grow a poorly watered crop as a healthy one, irrigation and nutrient management must remain a top management concern. Water management problems are probably the number one cause of poor quality, root disease, and overall yield shrinkage. Additionally, many regions are facing dwindling supplies of water suitable for irrigation and still others may be facing mandated runoff and nutrient containment regulations.

The Argus system provides an extensive range of irrigation scheduling tools to ensure that the correct amount of water is applied under all circumstances. With the advanced irrigation and nutrient control features of your Argus system you can time the proportioning of water

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# Take Control With Argus

and plant nutrients with great precision. You can also control runoff rates as well as manage capture and recycling systems. These capabilities can have a combined effect of increasing crop health and quality while simultaneously reducing runoff and the overall use of water and fertilizers.

There are many elements to an efficient irrigation system and to discuss them all would take up much more space than we have available. Proper irrigation system design is a key element in efficient watering, but there are other factors. When evaluating your watering practices you need to ask:

- ❶ How uniform is the water delivery?
- ❷ What is the delivery rate (how well is the delivery rate matched to the absorption rate of the plants and media)?
- ❸ How evenly do the plants dry out?
- ❹ What is the salinity (electrical conductivity) status in the root zone?

Problems with delivery uniformity, delivery rates, salinity, and uneven drying usually force you to apply more water than the crop actually needs. This in turn can cause excessive leaching and runoff, and media saturation conditions in parts of the crop that can lead to poor growth and root disease problems. For the most part, these issues can't be solved with automated controls alone, although there are some things you can do to minimize the effects of these problems.

### Control Considerations

For proper irrigation, the control system must decide:

- ❶ When to water
- ❷ How much water to apply

There are many reasons to apply water including:

- ◆ To replace water used by the crop
- ◆ To replace water evaporated from the media
- ◆ To deliver dissolved nutrients
- ◆ To remove salt accumulation

- ◆ To cool the roots
- ◆ To cool the plant surfaces (by direct evaporation and evapotranspiration)
- ◆ To increase climate humidity (reduce VPD through evapotranspiration)
- ◆ To protect outdoor crops from frost

Simple time clocks lack the capabilities for taking into account all of these reasons for watering. However, if required, all of these factors can be addressed by your Argus system. The more accurately your control system can determine the need for irrigating, the more efficiently it can proportion the water and nutrients.

### When to Water

The rate of crop water use changes constantly with the time of day, the weather, and the age of the crop. Your Argus system provides capabilities for tracking these conditions and making the necessary adjustments to the watering regime. The approach depends on your watering methods, preferences, and priorities.

For any watering requirement there are two general methods for making the watering decisions that will trigger an irrigation event:

- ❶ Indirect Prediction (feed forward)
- ❷ Direct Measurement (feedback)

With feed forward strategies, the control system looks at the conditions that influence the need for water rather than direct measurement of water use. For example, in greenhouses there is usually a very good correlation between the amount of accumulated light energy and the evapotranspiration volume. With irrigation scheduling based on light accumulation alone, the control system can often replace water with sufficient accuracy without ever measuring the actual soil conditions.

With feedback control, the computer measures the results of previous waterings to figure out what to do next. This often includes measurements of the soil moisture by a variety of means. There are even sensors for

measuring the water status within the plant, although these are not widely used commercially.

The control system triggers watering events based on these measurements. In theory, this is an almost perfect way to proportion water since it provides a direct indication of the current conditions. However, in practice there are always problems with representative sampling, sensor accuracy, sensor failures, and sensing costs. Still, many growers do find this the best way to water.

It's possible to combine feed forward and feedback strategies to cover all the bases. In such instances, predictive calculations are used as the basis for irrigation decision making, and feed back sensors provide confirmation and fine tuning corrections to the predictive models. Whatever strategy you decide to use, the most important thing is the reliability of the information that the control system uses to make its watering decisions.

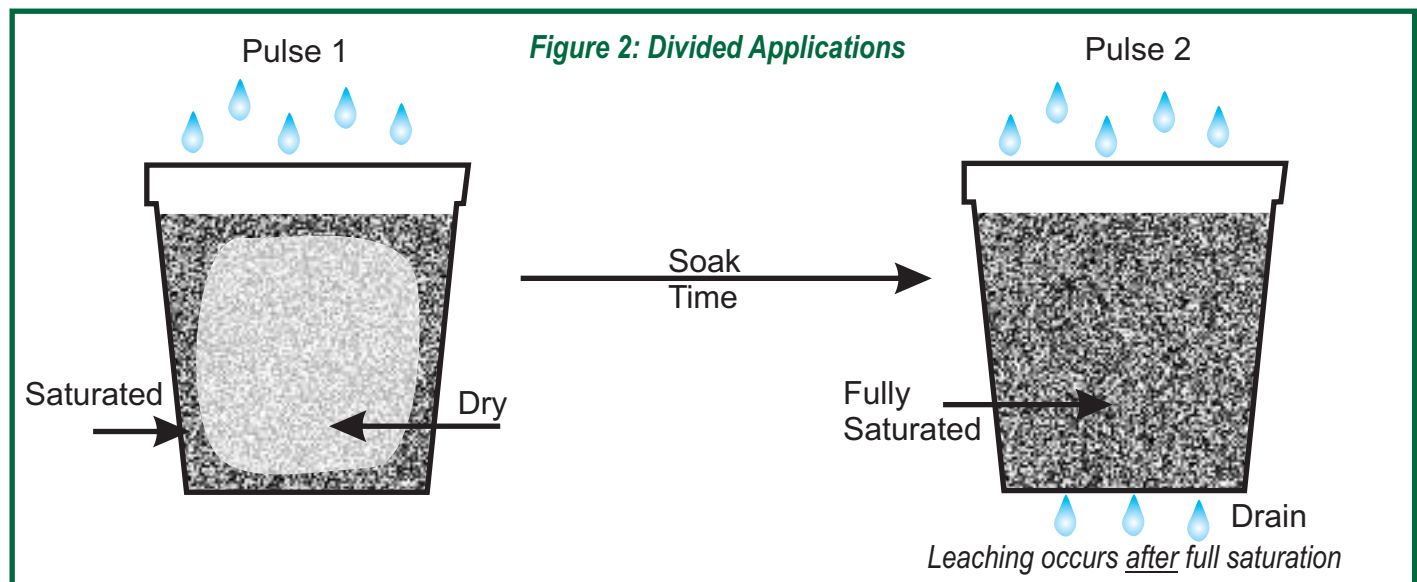
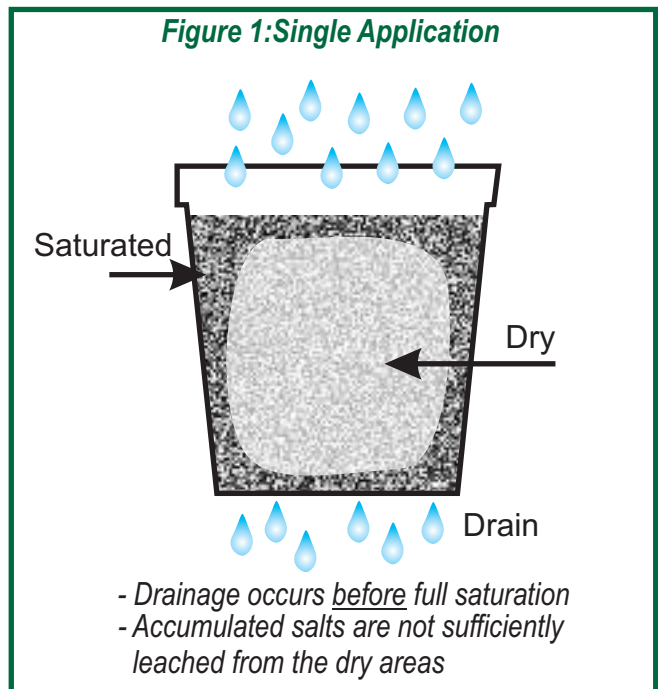
### Deciding How Much to Water

With flow-through watering systems (as opposed to ebb and flood systems), you must carefully control the applied volume for each watering. This is to:

- ◆ Conserve water and nutrients
- ◆ Prevent excessive runoff
- ◆ Prevent salt accumulation

The correct amount to apply at any given time depends very much on your growing methods, the current conditions, and your irrigation equipment. If your irrigation system delivery rate exceeds the absorption capacity of the media (see Figure 1), consider dividing the total water to be applied into two or more pulses (see Figure 2). This provides a 'soak-in time' between pulses, reducing the amount of runoff as well as achieving more even moisture distribution throughout the crop.

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The traditional method for preventing salt accumulation in planting media has been to provide enough water to achieve some leaching from the root zone with each watering. Usually 20-30% 'overdrain' has been recommended. However, when you combine the typical distribution inaccuracies of the irrigation equipment with uneven drying conditions in the zone, it's not unusual for this amount to be 50% or more in practice. If you are using drain-to-waste practices this can be wasteful of both water and nutrients.

One strategy to reduce overall runoff is to provide the occasional 'heavy' leaching with smaller volumes in between. This offers the possibility of substantially reducing water use and reducing runoff. However, this does require strict attention to salt levels throughout the crop and the varying accumulations that might occur due to uneven water delivery and media drying rates. The less you leach, the more pronounced these differences can become, particularly in crops with longer production cycles.

### Management and Monitoring

Full or partial recirculation of irrigation water can greatly reduce waste and run-off, but this must be balanced against the potential for pathogen spread and the need to maintain correct nutrient ratios in the root zone. Your Argus system can be used to manage this process by controlling the pumps and associated filtering and sanitization equipment needed for recirculating systems.

Even the best automated irrigation systems must be carefully managed. Though it may be possible to automate all of your irrigation events, watering should never be a 'set and forget' activity. There are just too many things that can go wrong. You need to be constantly monitoring the crop, and making fine tuning

adjustments as necessary. This includes monitoring moisture and salt levels in the crop on a regular basis.

With irrigation, you often need to make judgment calls, particularly for the things the computer can't 'see'. Should you increase the watering rate for the entire zone because of a few dry edges or just water the dry areas manually to 'even things up'?

Care and attention to your watering practices can pay large dividends. Not only can you reduce the amount of water and nutrients you use, but you can cut down on runoff while at the same time increasing yields and quality.

For more information, please see the following articles on our web site:

- ◆ *Irrigation System Design and Automation Considerations*
- ◆ *Controlling Moisture Levels in Soils and Planting Media*
- ◆ *Irrigation Techniques and Automation*
- ◆ *Argus Advisor Summer 2005 - Irrigation Strategies*

## Control Questions?

Do you have a control question, topic, or comment that you'd like to see in our newsletter? Drop us a line or an e-mail and we'll try to answer it in an upcoming issue.

## See us in Ohio

Once again Argus will be at the annual OFA Short Course and trade show **July 13-15th**. You can find us at **Booth1021**. We hope to see you there!