FERTIGATION THROUGH SURGE VALVES

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SURGE FERTIGATION

"Fertigation" or adding fertilizer through irrigation water has been practiced by both sprinkler irrigators and conventional surface irrigators with some success for several years. Depending on the system and the contour of the land, the fertilizer applications may vary considerably in efficiency. If an irrigator attempts to add fertilizer through conventional surface irrigation, more runoff of the fertilizer and less uniformity of application may result than if surge fertigation is practiced.

The ability to add fertilizer through the surge valve system is a significant advantage. Liquid forms of fertilizer may be added through the system during the next-to-last cutback cycle. At this point of the surge irrigation, the irrigation set should be wetted through the entire length of run, and the soaking or cut-back cycles should be almost complete. The last cutback cycle should be reserved to flush any excess fertilizer solution out of the system and to move some of the applied fertilizer into the upper portion of the soil profile. If the calculated flow rate of the liquid fertilizer is too great for the capacity of the application system, the "fertigation" application may be split between two or more cutback cycles as long as the last one is reserved for flushing the system and moving the fertilizer into the soil.

Since phosphorus does not readily move in the soil, it may be added at each cutback cycle or at the beginning of the cutback irrigations to maximize any penetration of the phosphorus into the soil profile that may occur. The last cutback cycle must be reserved to flush the system since most phosphorus fertilizer solutions are composed of ammonium polyphosphates.

Advantages of adding the fertilizer through the surge valve are many when the system has been designed and installed properly:

1. The fertilizer is added rapidly and efficiently.

2. Deep percolation losses of nitrogen fertilizer are minimized.

3. Gaseous losses of nitrogen are minimized.

4. No powered equipment is run through the field; fuel is saved.

5. The fertilizer may be added when the crop needs it.

Disadvantages are few:

1. The flow rate of the liquid fertilizer must be calibrated which is analogous to calibrating a fertilizer spreader.

2. Some "pitting" of the metal components of the delivery system may occur if the last cutback cycle is not saved to flush it; ammonium in liquid fertilizer is able to cause precipitation of salts from the aqueous solution which subsequently corrode metals, particularly aluminum.

There are two ways to add liquid fertilizer through the surge valve. The first is to allow it to flow by gravity through a constant head metering valve at some convenient point before the surge valve, such as into an alfalfa valve or an open channel. The second is to employ a powered injector system before the valve; this is necessary when a head of water must be overcome by the fertilizer application. Careful management must be practiced to keep the fertilizer from running off the end of the field; shutting the fertilizer water supply off when the flow reaches about 90 percent of the length of the run will minimize any runoff that may occur. Ideally, no runoff will occur when the soak cycles are properly set. Also, if the irrigation water is being pumped from groundwater sources, appropriate backflow protection must be employed. Tailwater recovery systems will negate the unanticipated problems of runoff.

Several things must be known before applying the fertilizer through the surge valve:

1. How many pounds of the fertilizer are needed per acre?

2. How many gallons of the material are needed?

3. What is the weight per gallon?

4. What is the acreage under the surge valve?

5. How long is the cutback cycle in minutes?

6. What is the application (flow) rate?

The flow rate can be set by using a marked container and a watch with second marking capabilities. By timing the flow and adjusting the discharge valve, the

required flow rate can be closely set. If the applicator uses a commercial injector, the flow rate may be simply dialed into the system.

In this project, liquid nitrogen fertilizer was added to three fields of corn during several irrigations. The summary of these additions is presented in Tables 1, 2 and 3. The liquid fertilizer used in all cases was UAN, 32 percent N. Since UAN is slightly acidic and the systems were flushed free of fertilizer during the last cutback cycle, no pitting of the metal components was noted.

The fertilizer was applied with a gravity-fed constant head metering device at the Field 1 and Field 3 farms. The fertilizer was applied with a small, inexpensive 12 volt powered injector pump at the Field 2 farm.

TABLE 1. Fertilizer additions, Field 1.

Irrigation method	lbs. N/A	Time
Surge	40	Pre-plant
	64[1]	3rd irrigation
	84[1]	4th irrigation
Conventional	40	Pre-plant
	130	Lay-by

[1] Surge fertigation.

TABLE 2. Fertilizer additions, Field 2.

Irrigation method	lbs. N/A	Time
Surge	44	Pre-plant
	50[1]	2nd irrigation
	50[1]	3rd irrigation
	50[1]	4th irrigation
Conventional	44	Pre-plant
	150	Lay-by

[1] Surge fertigation.

TABLE 3. Fertilizer additions, Field 3.

Irrigation method	lbs. N/A	Time
Surge	44	Pre-plant
	120	Lay-by
	80[1]	6th irrigation
Conventional	44	Pre-plant
	200	Lay-by

[1] Surge fertigation.

At the Field 1 and Field 2 farms, the fourth irrigation took place just before tasseling of the corn, and the sixth irrigation at the Field 3 farm occurred just before tasseling.

Yield comparisons from the Field 1 and Field 2 farms are presented in Table 4. No yield data was available from the Field 3 farm.

TABLE 4. Yield comparisons.

	Silage yield, tons/acre	
Farm	Conventional	Surge
Field 1	15.6	20.0
Field 2	23.2	27.8

Since a slightly greater amount of N was applied through the surge system than under conventional irrigation at the Field 1 farm, yields were calculated as pounds of silage per pound of N applied. Table 5 presents this data.

TABLE 5. Pounds of silage per pound of N applied, Field 1.

Irrigation method	Pounds silage/lb. N applied
Conventional	183.5
Surge	210.0

The yields indicate that a greater efficiency of nitrogen use occurred under surge fertigation and irrigation than under conventional irrigation.

In addition, soil samples were taken from the Field 1 farm after the growing season. Each data point represents the average of four sample points. The data is shown in Table 6.

TABLE 6. Residual nitrate nitrogen, Field 1.

Method of irrigation	Feet, depth of sample	Mg/Kg nitrate-nitrogen
Surge	0-1	14.0
	1-2	8.3
Conventional	0-1	5.5
	1-2	5.8

The surge irrigated and fertigated side of the field contained more residual nitrogen in the upper part of the soil profile than did the conventionally irrigated and fertilized field.

The fertigation that was practiced on the Field 3 farm occurred during the 6th irrigation. Approximately 80 pounds of nitrogen per acre was applied to the corn during the next-to-last cutback cycle of the surge irrigation. Five days after the irrigation, samples were taken at the 1/4, 2/4, and 3/4 distance of the length of run. The field length was 740 feet. The samples were analyzed shortly thereafter for nitrate-nitrogen content. The data is presented in Table 7.

TABLE 7. Nitrate-nitrogen, Field 3 farm.

Distance	Depth inches	Mg/Kg Nitrate-nitrogen	
		Surge	Conventional
1/4	0-1	26.8	13.8
	1-2	13.0	15.2
2/4	0-1	24.3	14.2
	1-2	15.7	14.0
3/4	0-1	24.0	18.2
	1-2	14.2	18.1

The data indicated that more nitrate-nitrogen was available in the soil for the corn's use as a result of the fertigation. Because only nitrate-nitrogen was applied, the total amount of nitrogen present was not apparent, probably because the ammoniacal form of nitrogen had not undergone biological oxidation before soil sampling and determination of the nitrate-nitrogen were performed.