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Be Careful Starting Your Irrigation System

If you have electric powered irrigation pumps and/or systems, please be careful when starting them the first time this spring. The most common problem we have is rodents getting into electric control boxes during the winter and causing damage. The damage may result from chewing on wires and control switches or corrosion caused by urine. If you don't look for this type of damage **before turning on the system,** some components could explode. You could be hurt if standing in front of the electric control box.

As a precaution, before turning on any electric equipment, open all electric control panels (this includes pivot control panels and tower boxes) and look for any evidence of rodent damage. Also, check electric motors and phase converters. If there is damage, look for the point of entry and plug it. I have seen several electric control boxes with mouse nests in them, and the point of entry was through the conduit from the motor. The screens on the electric motor had been removed and the mice entered the motor and followed the conduit into the control box. From the mouse's point of view, this was a perfect nesting situation.

If you think rodents only damage farm electric equipment, consider what happened to Stanford University in California several years ago. Rats entered the campus electrical system through underground conduits. They got into the 12,000-volt switchgear of a substation and caused it to fail. Several dead fried rats were found in the switchgear. The resulting power failure knocked out Internet access in the Silicon Valley and shut down classes, labs and homecoming festivities for over 24 hours.

Spring is always a busy time of the year, and sometimes it is easy to forget about getting the irrigation system ready. Here is a checklist to help get your irrigation system up and running smoothly.

- **Open and check electric control panels for rodents or damage before starting.**
- Check all motor openings to see if they are properly screened, again to keep out rodents.
- Measure and record the static water level in all wells.
- Visually inspect the piping system.
- Check all air release valves to make sure they are working.
- Replace any broken or old pressure gages.
- Check the sprinkler system for damage.
- Make sure all portable aluminum or PVC pipe sections have gaskets installed.
- Check gearboxes on center pivot towers for water accumulation. Drain water and replace with oil.
- Check the tire pressure on center pivots.
- With the center pivot running, visually check each sprinkler head to make sure it is working properly.

Tom Scherer (701) 231-7239
NDSU Extension Agricultural Engineer
tscherer@ndsuext.nodak.edu

Harvesting Prime Alfalfa Hay

Deciding when to harvest alfalfa to get prime hay is not an easy decision. Prime hay is defined as having a relative feed value (RFV) greater than 151. In the past, I would recommend harvesting alfalfa under irrigation no later than late bud to very early bloom for all harvests during the year. However, following this recommendation frequently caused the first harvest to be cut too late and the third harvest to be cut too early.

Dr. Ken Albrecht of the USDA Dairy Lab in Madison, Wisconsin developed the PEAQ (Predication Equations for Alfalfa Quality) system in the early 1990s. This system is a more reliable method of estimating forage quality of alfalfa in the field. The PEAQ system is based on observing and/or measuring two alfalfa growth characteristics within a target area of the field, the most mature stem and the tallest stem. The tallest stem may or may not be the maturest stem, but is merely measured to the nearest inch. The maturity stage is determined using the following:

Late vegetative .... Stem is more than 12 inches tall, no visible flowers
Early bud .... One to two nodes have viable buds, no visible flowers
Late bud .... More than two nodes have visible buds, no visible flowers open
Early flower .... One node with at least one open flower
Late flower .... Two or more nodes have open flowers

I did not become interested in the PEAQ system until 1998. Generally, prediction equations are accurate only in the environment under which they were developed. However, in 1998 a study across several locations indicated that the PEAQ system works effectively during the first harvest for all environments. The PEAQ system estimates the forage quality of alfalfa standing in the field. To obtain greater than 151 RFV in the bale, harvest must begin when the PEAQ system estimates the forage quality at 175 to 180, since harvesting losses will reduce the quality of the final product.

To illustrate how important the height of the tallest stem (the canopy in general) is in determining forage quality, see the following table.

Height of Tallest Stem	Late Vegetative	Early Bud	Late Bud	Early Flower	Late Flower
(inches)	Relative Feed Value				
20	213	201	191	181	171
25	191	181	172	163	155
30	173	164	156	148	141
35	156	149	142	135	129

The RFV decreases with increasing maturity, which is a long-known principle of forage quality effects. However, note that the RFV decreases with increasing height more than with increasing maturity! Even if the PEAQ system is not totally accurate, plant height must be taken into consideration when determining the optimum stage to harvest the alfalfa.

Under irrigation, the first harvest will grow to 30 to 36 inches tall depending on the particular year (temperature and date growth initiated). If you check in the table, note that harvest must begin in the last vegetative stage if prime hay is to be harvested in the first harvest! Most producers are not harvesting the first cutting early enough to obtain prime hay. Conversely, irrigated alfalfa will grow to about 20 to 25 inches in the third harvest. If the alfalfa is only 20 inches tall, harvest can wait until nearly 50 percent bloom and still expect prime hay in the bale. Waiting to 50 percent bloom will increase the forage yield partially offsetting that lost by the early first harvest.

Use the height of the alfalfa to make the decision when to harvest alfalfa. The taller the plant, the earlier harvest must begin to obtain prime hay. The shorter the plant, the more advanced maturity can be and still expect prime hay in the bale.

Dwain Meyer (701) 231-8154
NDSU Professor, Forage Management
dmeyer@ndsuext.nodak.edu

Economic Impact of Irrigated Potato Production and Processing in Central North Dakota

Agriculture has always been a major component of North Dakota's economic base, although its relative contribution has been declining. In an attempt to improve the fortunes of agriculture, production and processing of high-value crops, like irrigated potatoes, have received increased emphasis. Increasing demand for frozen french fries and processors' desire to contract irrigated potato production offered a unique opportunity for central North Dakota farmers. Growers organized with the intent of forming a cooperative to process their irrigated potatoes. However, capital requirements to build a processing plant, install irrigation, and grow potatoes were beyond their capabilities. Eventually a private business became involved; plant construction began in 1995 and potato processing late in 1996. Contracts were awarded to 33 growers for 15,000 acres of irrigated potatoes.

Development of irrigated potato production and processing industries in central North Dakota has had a significant economic impact because of the capital-intensive nature of these industries. Building the processing plant and start-up costs for irrigation and potato equipment had a one-time economic impact, whereas processing plant and production expenditures have annually recurring impacts. The purpose of this study is to estimate the one-time economic impact of construction/start-up costs and the annual impacts of production and processing. These economic impacts will measure the effects that industry expenditures have had on the Jamestown area economy.

Construction/start-up phase economic impacts include the in-state expenditures for plant construction, grower investment for irrigation equipment, growers' purchases of potato machinery, and grower outlays for potato storage facilities. Expenditures (to in-state entities) for the processing plant were $10.5 million, irrigation equipment amounted to $23.1 million, and growers' expenses were $3.4 million and $13.0 million, respectively, for machinery and potato storage facilities. These expenditures were distributed through the construction, retail trade, business and personal services, and household sectors of the economy.

All construction-phase expenditures were summed by sector and applied to the North Dakota Input-Output model. The model uses multipliers to measure the total economic activity generated by each sector for an additional dollar of expenditures in a given sector. Economic impacts resulting from the two-year construction-phase included increased levels of personal income ($27.8 million), retail trade activity ($44.1 million), business activity for all business sectors ($80.8 million), and increased level of total economic activity ($115.5 million). The increased level of economic activity would result in an additional $2.7 million in state tax collections. Peak employment during plant construction was 260 workers, with additional 1,139 secondary (indirect and induced) full-time equivalent jobs created.

Operational-phase direct expenditures were also determined. These impacts differ from those of construction/start-up because they occur each year the plant is operating. In-state processing expenditures for payroll, benefits, utilities, repairs and maintenance, supplies, insurance, and transportation amount to $33.4 million annually. Potato producer operational expenses also are included in this phase. Growing irrigated potatoes involves a high level of input expenditures. Potatoes are usually grown in a three-year rotation, so a three-year irrigated crop budget was used to determine an annual average outlay. This average outlay was used to estimate expenditures net of the most likely non-irrigated crop (wheat for this analysis). Net expenditures were used to measure the economic impact of irrigated potato production. Potato production expenditures totaling $22.0 million were distributed to the transportation; communications and public utilities; retail trade; finance, insurance and real estate; business and personal services; and household sectors of the economy.

Operational-phase expenditures for processing and production were summed and applied to the Input-Output to determine the economic impact. Annually recurring operational-phase economic impacts included $47.7 million in increased personal income, $47.7 million in additional retail sales, $89.5 million in added business activity for all business sectors, and an increase in total economic activity of $147.6 million. Increased revenues from three major state taxes associated with these levels of economic activity totaled $3.1 million annually, highlighted by $2.2 million in sales and use tax collections. Currently, 250 full-time equivalent workers are employed at the processing plant, with an additional 1,569 secondary jobs created.

Although only 33 growers produce irrigated potatoes for the central North Dakota plant, the economic impacts affect a large geographic area. Jobs, business-receipts, and tax revenues have all increased as the result of production and processing of a high-value agricultural crop. Each dollar spent in the production and processing activities creates another $1.66 in other sectors of the state economy, for a total of $2.66. These measures clearly show that this economic development project has had a significant economic contribution in central North Dakota, particularly in the Jamestown area.

For a complete discussion of the economic impact of irrigated potato production call the NDSU Agribusiness and Applied Economics office at (701) 231-9495 and ask for a copy of Report No. 452, Economic Impact of Production and Processing of Irrigated Potatoes in Central North Dakota.

Randal C. Coon and **F. Larry Leistritz** (701) 231-7455
Research specialist and Professor, respectively
NDSU Department of Agribusiness and Applied Economics
rcoon@ndsuext.nodak.edu and lleistri@ndsuext.nodak.edu

Problems with Corn Emergence?

Corn should begin emerging after about 100 to 125 growing degree-days (GDDs) have accumulated following planting. To accumulate this many GDDs can take anywhere from one to three weeks after planting depending on the temperature. Here is a list of common things to look for if you encounter an emergence problem in corn this spring:

- No seed present. May be due to planter malfunction, bird or rodent damage. The latter often will leave some evidence such as digging or seed and/or plant parts on the ground.
- Seeds hollowed out. Seed corn maggot or wireworm. Look for evidence of the pest.
- Celeoptile (shoot) unfurled and underground. Could be due to premature exposure to light in cloddy soil, planting too deep, compaction or soil crusting, extended exposure to acetanilide herbicides under cool wet conditions or may be due to extended cool wet conditions alone.
- Seed with poorly developed radicle (root) or coleoptile. Coleoptile tip brown or yellow. Could be seed rots or seed with low vigor.
- Seed swelled but not sprouted. Often poor seed-to-soil contact or shallow planting — seed swelled then dried out. Check seed furrow closure in no-till. Seed may also not be viable.
- Skips associated with discolored and malformed seedlings. May be herbicide damage. Note the depth of planting and what herbicides were applied then compare with injury symptoms such as twisted roots, club roots or purple plants.
- Lastly, note the patterns of poor emergence. At time they are associated with a particular row, spray boom width, hybrid, field or residue that may provide some additional clues to the cause.

Duane Berglund (701) 231-8135
NDSU Extension Agronomist
dberglun@ndsuext.nodak.edu

Advances in Precision Irrigation

Practically everyone associated with agriculture has heard of site-specific farming, and many farmers are using various aspects of the technology. You might wonder what is happening with “site-specific” irrigation commonly called variable-rate precision irrigation. Most often, precision irrigation is associated with self-propelled sprinkler machines such as center pivots and lateral-moves.

Precision irrigation is concerned with varying the amount of water applied at specific locations in a field. In a way you could call it designed non-uniformity. This concept is fundamentally opposite to the concept of applying water uniformly along the entire length of the sprinkler system. Designing a sprinkler system to apply water uniformly helps to minimize pumping energy use, meet crop water requirements and minimize excess irrigation. However, there are many reasons why variable-rate application would be a desirable feature of a sprinkler system.

First, we know most fields have areas with different soil properties that affect water holding capacity, infiltration and root-depth. These areas would produce better if they received either more or less water than the most common soil in the field. Second, many fields have low spots where excess runoff water collects. Some fields have areas that are too steep to irrigate and some have rock outcroppings. Third, many fields have small wetlands within their boundaries that don’t need to be irrigated.

Although precision irrigation strives to apply different amounts of water to sub-areas in a field, it still must do it uniformly. However, precision application of water with an irrigation system is still in the research and development stage.

Precision irrigation research can be divided into three areas of development.

1. Variable-rate water application devices (sprinklers usually)
2. Control systems for location specific variable-rate application of water
3. Decision criteria for how much water to apply at different growth stages of the crop to specific areas in the field

Presently, there are no commercially available variable-rate sprinkler control packages for these machines. However, researchers are developing technologies that will eventually be available.

NDSU Extension Service
Agricultural and Biosystems Engineering
P.O. Box 5626
Fargo, ND 58105-5626

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Variable-rate water application

Water and pneumatic control valves for individual sprinklers have been used on center pivots for many years. By setting a switch contact at the pivot, the sprinklers could be turned on or off at various locations in the field. You might call this a form of precision irrigation, but the only option was either on or off. New research concentrates on being able to vary the amount of water.

Research is progressing on three methods of doing this. The first involves mounting sprinklers on a separate manifold that extends either the full length or a partial length of a pivot span. A valve on the manifold is turned on for a portion of a specified time-period. For example, at some location in the field the valve might be on 45 seconds out of each minute. This would apply 3/4 of the full amount to that portion of the field. The second method uses multiple manifolds on each span. The sprinklers on each manifold, when on, apply a set portion of a base amount. For example, for three separate manifolds under each span, the sprinklers could be selected to apply 1/7, 2/7 or 4/7 of the base amount. Two manifolds could also be used. One system could have sprinklers that apply one-half the base amount or one manifold could apply 1/3 and the other 2/3. The third method of variable rate application is controlling the flow from each individual sprinkler. There may be many ways to accomplish this but currently the method being developed involves a control mechanism to insert a pin into the orifice of the nozzle. This reduces the cross sectional area of the nozzle, thus reducing the flow.

Variable-rate control systems

Whichever variable-rate application system is used, the control systems are all based on some type of microprocessor technology. The control system must be robust, reliable and easy to work with. It has three important functions:

1. Communicate with each of the control zones (whether individual sprinklers or manifold valves)
2. Keep track of the position of each control zone on the center pivot or lateral move
3. Control the amount of water to apply in each zone.

Quite often digitized soil and topographic maps of the field are referenced by the controller along with the position and speed of the pivot or lateral to determine application amounts for each location in the field.

Variable-rate decision criteria

This is probably the most difficult and least understood part of precision irrigation. The criteria for how much water to apply at certain locations as well as the majority of the field is going to change as the crop matures throughout the growing season. The criteria will be affected by the type of crop that is planted. Weather will affect the timing and application amounts. It is possible the irrigation decision criteria could change from week to week during the growing season and from one year to the next. In order to get wide spread acceptance, this technology will have to be easy to understand and almost transparent to the irrigator.

Tom Scherer (701) 231-7239
NDSU Extension Agricultural Engineer
tscherer@ndsuext.nodak.edu