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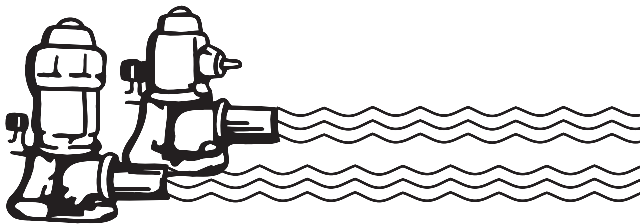

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water spouts

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Welcome to the Beginning of a New Growing Season

As we enter the 31st year for this irrigation newsletter, we are beginning to see a change in the climate of this region. Over the past 10 years, many people in different areas of North Dakota have had to live with excess water and periodic flooding. No area of the state has been excluded. However, that began to change last season as the southern third of North Dakota experienced a severe drought. At the same time, the northeast part of the state was still dealing with too much rain. Below normal precipitation last fall and almost no snow this winter have left many areas with inadequate soil moisture. If drought conditions persist, irrigation water management is going to be vitally important. Not only will individual irrigators need to pay more attention to water management, but access to water in entire aquifer systems could be affected.

The NDSU Irrigation Task Force, which I chair, selects the topics for articles in Water Spouts. We try to select topics to help better manage your irrigation systems and water resources. This year, we will watch for drought conditions and keep you updated on methods to help you do a good job of irrigating. The task force is comprised of the following individuals:

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At the end of each Water Spouts article, the author's name, telephone number and e-mail address (if the author has one) are listed. If you have any questions about any article, please contact the author by whatever means is convenient. If you prefer, contact me for help. If you want to look at past issues of Water Spouts, they are available on the Internet at the address shown at the top of this newsletter (under the pumps).

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Nitrogen Management in Potatoes – If We Only Knew . . .

Planting time is just around the corner, especially when it comes to potatoes. Some extremely mild days along with the lack of snow cover has many farmers thinking this spring will be early. As growers consider the various inputs needed for a successful potato crop, nitrogen rate and application timing probably enter into everyone's mind. How much should I apply? Should I split that into two, three or more applications? What are the consequences of applying too much or too little nitrogen? The list of questions could go on and on, and the answers to each question would vary with each grower, but there are some general recommendations that everyone should follow. First of all, consider your yield goal. Table 1 was developed by Dr. Carl Rosen, a soil fertility specialist at the University of Minnesota for potatoes grown on irrigated mineral soils.

Table 1. Nitrogen recommendation for irrigated potatoes on mineral soils.

	Previous Crop		
Yield goal	Corn, small grains, sugarbeets, potatoes	Soybeans	Alfalfa, clover, black fallow
(cwt/A)	N to apply (lb/A)		
Less than 200	75	50	50
201 - 300	100	80	50
301 – 400	150	130	90
401 – 500	200	180	140
500 +	250	230	190

As you can see, this table takes into consideration the previous crop and the nitrogen credit from this crop. The generalization that all cultivars grown on irrigated land in North Dakota respond similarly to nitrogen may be a bit simplistic; however, with the general short growing season and the inconsistent weather during bulking, the nitrogen requirements for a late maturing and an earlier maturing processing potato (i.e. Russet Burbank and Shepody) may be comparable or differ by less than 30 lb. N/acre. Dr. Jim Lorenzen and others conducted a series of nitrogen trials from 1993 through 1997 on four cultivars (Goldrush, Shepody, Ranger Russet and Russet Burbank) that varied in vine maturity from medium-early to medium late/late. They used four nitrogen rates (75, 150, 225 and 300 lb. per acre) and split this into at least three application timings. Results indicated that even though the earlier maturing cultivars were more responsive to nitrogen (Table 2), the highest total yield and greatest percentage of 6- to 16-oz. tubers was between 150 to 225 lb. N/acre. Only once did the highest overall total yield occur with the highest nitrogen rate, which was the 300 lb. N/acre treatment (Table 3). In fact, the highest yields for Ranger Russet and Russet Burbank were at 150 lb. N/acre three out of five years with rates above 150 lb. N/acre causing reduced yields (Table 2). Specific gravity generally decreased as the nitrogen rate increased (Table 3) and average fry color was darker with the higher nitrogen rates especially with Goldrush and Shepody (data not shown).

Knowing how much nitrogen we're going to apply, we now need to address application timing. Nitrogen applied early in the season can easily leach beyond the potato root zone with heavy rainfall or excess irrigation and may increase the potential to increase groundwater contamination. Too much nitrogen before or at tuberization can delay tuber initiation, reduce yields, increase sugar-ends and decrease specific gravity. However, the nitrogen supply early in the season must also be adequate for vegetative growth. Research at Wisconsin (Kelling and Speth, 1998) looked at the timing of nitrogen application on irrigated potatoes from 1991 through 1996. Researchers applied a total of 120 lb. N/acre in 1991-1993 or 100 lb. N/acre in 1994-1996 in an attempt to not overshadow timing response with extra nitrogen. Each year, a blanket 30 lb. N/acre was

Table 2. Cultivar response to nitrogen from 1993 through 1997 at Oakes, N.D.

	Total Yield					6 oz. or Greater Tubers					Specific Gravity				
	93	94	95	96	97	93	94	95	96	97	93	94	95	96	97
	cwt/A					%									
75 lb. N/A															
Goldrush	246	401	332	171	210	72	60	64	62	69	1.088	1.082	1.076	1.077	1.074
R. Russet	273	367	307	118	177	72	64	77	56	68	1.101	1.097	1.086	1.081	1.089
R. Burbank	273	402	291	150	251	58	41	60	50	56	1.095	1.087	1.077	1.077	1.080
Shepody	265	321	292	157	161	80	63	84	73	73	1.090	1.087	1.076	1.083	1.079
150 lb. N/A															
Goldrush	328	428	305	223	288	75	75	72	78	73	1.081	1.079	1.069	1.076	1.076
R. Russet	328	440	313	163	259	74	71	75	72	70	1.098	1.093	1.084	1.079	1.089
R. Burbank	323	432	235	264	346	63	48	52	53	68	1.092	1.086	1.070	1.080	1.083
Shepody	322	387	340	267	316	76	77	77	78	85	1.088	1.084	1.075	1.081	1.084
225 lb. N/A															
Goldrush	326	490	319	342	325	82	77	76	79	71	1.078	1.077	1.067	1.075	1.070
R. Russet	334	407	302	176	249	74	66	76	57	76	1.094	1.089	1.085	1.081	1.089
R. Burbank	346	404	231	283	305	68	58	56	60	71	1.089	1.085	1.068	1.079	1.081
Shepody	380	483	258	307	334	86	87	77	82	87	1.080	1.083	1.069	1.078	1.081
300 lb. N/A															
Goldrush	327	467	252	276	301	72	85	73	77	63	1.073	1.074	1.066	1.071	1.066
R. Russet	293	428	248	191	264	75	57	68	67	74	1.095	1.088	1.081	1.081	1.087
R. Burbank	317	385	133	260	295	76	58	41	53	65	1.089	1.082	1.067	1.080	1.079
Shepody	342	528	253	361	321	89	85	82	82	83	1.080	1.078	1.070	1.085	1.080

Table 3. Nitrogen effect on potato yield and dry matter content from 1993 through 1997 at Oakes, N.D.

	Total Yield					6 oz. or Greater Tubers					Specific Gravity				
	93	94	95	96	97	93	94	95	96	97	93	94	95	96	97
	cwt/A					%									
75 lb. N/A	267	372	306	149	200	70	58	71	60	67	1.094	1.088	1.079	1.079	1.080
150 lb. N/A	326	422	299	229	302	74	65	69	67	75	1.089	1.085	1.074	1.079	1.083
225 lb. N/A	343	446	277	277	303	78	66	71	70	76	1.085	1.083	1.072	1.078	1.080
300 lb. N/A	320	452	222	253	295	70	66	66	69	71	1.084	1.080	1.071	1.079	1.078
Goldrush	308	446	302	253	281	78	66	71	74	70	1.080	1.078	1.069	1.074	1.071
R. Russet	303	410	292	162	237	73	69	74	60	73	1.097	1.092	1.084	1.080	1.089
R. Burbank	322	406	223	239	299	67	46	52	54	65	1.091	1.085	1.071	1.079	1.081
Shepody	322	430	286	273	283	75	75	80	79	83	1.084	1.083	1.072	1.082	1.081

applied at planting followed by either:

1) all at emergence (E)
2) all at tuberization (T)
3) all at 10 days after tuberization (T+10)
4) half at E and T
5) a third at E, T, T+10
6) a third at E, T+10, T+30
7) a fifth at E, T, T+10, T+20, T+30
8) a third at E, two-thirds at T
9) a third at E, two-thirds at T+10
10) half at T and T+10

The results indicated that during a low leaching year (1991 and 1995), a split application was not better than a single application (Table 4). Delaying the nitrogen application past emergence tended to improve size but also hurt quality (data not shown). During leaching years, (1992, 1993, 1994 and 1996) splitting was better. However, in 1992 and 1994 applications after hilling resulted in somewhat lower yield and size. This was attributed to the heavy rain events in early July compared to leaching events in late July and August during 1993 and 1996. Researchers summarized by suggesting that approximately one-third of the supplemental nitrogen (50-70 lb. N/acre) should be applied by emergence and that the remainder (100 to 140 lb. N/acre for Russet Burbank) be applied at early to mid-tuberization. Reserachers recommended continued petiole nitrate-N monitoring and that if leaching occurs prior to 65 days after emergence, apply an additional 30-50 lb. N/acre.

Table 4. Effect of N timing on Russet Burbank yield and quality at Hancock, WI, 1991-1996.

N treatments	1991	1992	1993	1994	1995	1996
	Total Yield (cwt/A)					
Emergence (E)	495	345	319	380	403	331
Tuberization (T)	550	311	343	367	412	341
T+10	516	270	299	358	226	402
50% E and T	514	351	342	401	438	313
33% E, T, T+10	526	312	338	359	432	356
33% E, T+10, T+30	536	319	328	358	392	341
20% E, T, T+10, T+20, T+30	555	323	372	338	403	336
33% E, 66% T	543	371	335	391	400	360
33% E, 66% T+10	528	325	308	330	455	411
50% T, T+10	—	308	346	351	437	371
	Grade A (%)					
Emergence (E)	79	54	60	83	61	63
Tuberization (T)	72	59	65	79	47	70
T+10	76	62	58	80	40	70
50% E and T	75	60	61	79	55	59
33% E, T, T+10	80	51	63	79	5	73
33% E, T+10, T+30	76	55	62	78	57	65
20% E, T, T+10, T+20 T+30	77	56	64	78	56	66
33% E, 66% T	78	62	58	77	55	67
33% E, 66% T+10	77	59	55	78	58	74
50% T, T+10	—	63	66	80	53	71
	US #1, 6-13 oz (cwt/A)					
Emergence (E)	218	55	14	81	111	21
Tuberization (T)	220	82	24	70	87	41
T+10	186	77	9	99	85	50
50% E and T	176	74	20	76	107	25
33% E, T, T+10	208	37	9	69	110	32
33% E, T+10, T+30	215	50	18	54	91	17
20% E, T, T+10, T+20 T+30	223	54	19	72	110	21
33% E, 66% T	202	84	12	81	84	29
33% E, 66% T+10	198	60	10	48	106	48
50% T, T+10	—	89	27	80	105	48

Table 5. Effect of N rate and timing on potato yield and quality at Dawson, N.D., 2001.

	Application Timings			
N Rate (lb/A)	No splits	3 splits	6 splits	9 splits
R. Burbank	Total Yield (cwt/A)			
0	346			
90		350	338	399
120		361	349	393
180		337	394	389
240		314	310	369
Shepody				
0	269			
90		354	335	375
120		396	378	382
180		325	372	307
240		297	311	293
R. Burbank	US #1 (cwt/A)			
0	309			
90		319	313	364
120		314	319	359
180		299	361	351
240		282	282	331
Shepody				
0	255			
90		343	320	356
120		361	362	359
180		300	345	287
240		250	257	259
R. Burbank	Specific Gravity			
0	1.082			
90		1.082	1.077	1.082
120		1.083	1.082	1.079
180		1.078	1.081	1.076
240		1.075	1.074	1.079
Shepody				
0	1.083			
90		1.083	1.079	1.084
120		1.074	1.082	1.077
180		1.081	1.077	1.076
240		1.07	1.066	1.079

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Other researchers have also looked at nitrogen management for potatoes under irrigation. Results have shown that excessive applications during tuber initiation can cause excessive vine growth and delay tuber growth up to 10 days. Excessive nitrogen during tuber bulking can promote late season vegetative growth and delay maturity (Ojala et al., 1990). In Minnesota, Dr. Rosen showed that nitrogen uptake significantly preceded dry matter accumulation (Rosen, 1994). Total N uptake reached near maximum level approximately 70 days after emergence even though less than 60 percent tuber growth had occurred. Unfortunately, no research has been published on the effect of periodically applying small amounts of nitrogen after hilling through irrigation (spoon feeding).

Preliminary research at NDSU during 2001 examined two cultivars (Shepody, Russet Burbank), five nitrogen rates (0, 60, 120, 180, 240 lb. N/acre) and three application timings (33 percent at planting, hilling and hilling+21 days; 16.7 percent at planting, hilling and four, 14-day intervals till the end of July; and 16.7 percent at planting, hilling, hilling+14 days and six, 8.3 percent applications at approximately 10 day intervals until the third week in August). Results indicated that with Russet Burbank there was an increase in the total and number one yield with spoon-fed treatments (Table 5). The highest nitrogen rate (240 lb./acre) caused a yield decrease and specific gravity decreased as the nitrogen rate increased. With Shepody, the highest total and number one yield was with 120 lb. N/acre (Table 5). Nitrogen application timing had no effect on yield or specific gravity. Nitrogen rates above 120 lb./acre caused a yield decrease and specific gravity decreased as the nitrogen rate increased. Therefore, there may be benefit to the spoon-feeding approach for nitrogen management with Russet Burbank.

In summary, nitrogen management is extremely difficult due to the mobility of the compound and Mother Nature. If we knew what weather conditions (air temperature and rainfall) we were going to face this season, we would know how much nitrogen to apply and when to make those applications. The problem is that we can't predict such factors. Therefore, we need to make environmentally conscious decisions when it comes to nitrogen management. We need to give proper nitrogen credit for the previous crop. We need to apply reasonable amounts of supplemental nitrogen which research has shown to be around 180 lb./acre when there is approximately 40 lb./acre residual nitrogen. We need to make split applications given the possibility of leaching rain events and we need to monitor nitrogen uptake by the plants, making sure that we don't apply nitrogen too late in the season when plant uptake and use in tuber bulking is unlikely.

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Winter Injury/Kill in Alfalfa

The 2002-2003 winter will go down in the record books as relatively mild with a cold latter part in February and March. One might think that perennials like alfalfa should have little problem surviving the winter. However, I am very concerned that North Dakota may experience significant winter injury or winter kill in alfalfa as a result of less-than-average snowfall. Actually, total snowfall isn't as important as the distribution of snow relative to outbreaks of sub-zero temperatures. Very cold temperatures with a lack of snow cover cause the soil temperature to decrease markedly compared to snow-covered areas.

Alfalfa crowns can survive two-inch soil temperatures in the range of 12 to 15° F, very similar to the killing temperature of winter wheat except the crown is much shallower in wheat than alfalfa. Dr. John Enz, the NDSU climatologist, reports that NDAWN had 12 sites in North Dakota that recorded soil temperatures at the two-inch depth. Remember that these sites are under turf grass cover and would be warmer than an alfalfa field.

Searching the records, eight sites were found with two-inch soil temperatures less than 15° F this past winter. The Langdon area has the most concern with three, 60-plus hour periods with soil temperature less than 15° F and a minimum soil temperature of 7° F. Minot and Williston are the other areas of concern with soil temperatures below 15° F for 60-plus hours and minimum soil temperatures in the 8 to 10° F range. These areas will likely experience winterkill on older stands and winter injury on new stands. The Fargo area may also have some winter injury or kill, with several incidences of soil temperature less than 15° F, but the duration has been much less. Areas near Grand Forks, Harvey and Dickinson have had no temperatures less than 15° F, while Carrington, Streeter, Bottineau and Hettinger have had one or two dates with less than 15° F for short time periods.

Sites that have been exposed to less than 15° F soil temperatures for short durations will likely show marked effects of management on winter kill or winter injury. Producers in these areas that have old stands, took a fall harvest, are under four-cut management, have nutrient deficiency(s), have less persistent varieties or a combination of these will experience more winter kill or injury than producers that have new stands, took no fall harvest, are under three-cut management, have good soil fertility or have persistent varieties.

Producers located in the Langdon, Minot and Williston areas should dig plants from a few representative areas as soon as the frost goes out of the soil. Split the roots. If the root is soft, yellowish in color and somewhat stringy in nature, the plant is most likely dead and the stand should be terminated. If the root is firm and white, the plant is probably alive. If the center of the root is black, but the outside is white, the plant has Fusarium root rot probably caused by a previous year's winter injury. If the root has no black in the interior, is somewhat yellow on the interior and the outside is white and firm, the plant has had serious winter injury but may survive.

The best method to determine if a winter-injured stand is still productive is to count the number of stems per square foot. If you have 50 plus stems per square foot, the stand will be fully productive. If you have 30 to 40 stems per square foot, the first-harvest yield will be less than normal but I would delay the first harvest until 25 percent bloom on uninjured plants and wait to see how many stems occur in the next harvest. Alfalfa has the ability to repair some winter injury and regain some of its productivity. If you have less than 20 new stems per square foot, consider terminating the stand and seeding a new one.

Unfortunately, winter injury and/or winterkill will be a factor this year in many alfalfa fields. Keep a close eye on your fields this spring so a decision can be made early whether to rotate to another crop if necessary. One should not attempt to thicken up the stand by over seeding following winter kill or reseeding the stand on the same field without an intervening crop since autotoxicity could be a major problem.

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Take Care When Starting Your Irrigation System

If we have a dry spring, many irrigation systems are going to be started earlier than normal. If you have electric powered irrigation pumps and/or systems, please be careful when starting them the first time.

The most common problem is rodents getting into electric control boxes during the winter and causing damage. The damage may result from rodents 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.

Filling pipelines can be another major problem when irrigation pumps are turned on for the first time in the spring. Pipelines, especially those that go through low areas and swamps, should be filled very slowly. This means setting the valve at the pump site so it is about one-quarter open. Filling the pipeline slowly allows air to escape easily and prevents damage due to water hammer. It is not uncommon for irrigation dealers to be called in the spring to repair a ruptured pipeline because it was filled too fast and residual ice left in the pipe caused a blockage.

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.
- ❑ **Fill pipelines slowly; make sure all the air is out of the system.**
- ❑ 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.

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