

## Reduce Disease Potential with Pre-Season Irrigation System Maintenance

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This year, with concern about higher energy costs and potentially reduced water supply, some extra time and a relatively small investment in equipment maintenance can significantly increase the profit potential of next year's crop. Uniformly applying the correct amount of irrigation water at the correct time is essential for quality potato production. To accomplish this, the irrigation system must be not only properly designed and installed, but also well maintained.

A good pre-season maintenance program can reduce pumping costs, increase water application uniformity, and allow adequate watering of a larger portion of a field with less total water applied. However, one of the biggest benefits may be the reduction in disease potential due to fewer and smaller areas of chronically wet or dry soil. Disease potential for several economically important potato diseases like Potato early dying (*Verticillium dahliae*), Early blight (*Alternaria solani*), and Black dot (*Colletotrichum coccodes*) can be reduced by minimizing plant stress and encouraging uniform, continuous growth with balanced fertility and optimum soil moisture levels. Disease potential for others (Pink rot or water rot (*Phytophthora erythroseptica*) may be reduced by maintaining good irrigation practices, and avoiding waterlogged soils, particularly under the wet central area of center pivots, or for Common scab (*Streptomyces scabies*), by avoiding low soil moisture during tuber set and early bulking (2-7 weeks from emergence) with soil moisture kept above 75% available on silt loam soils.

**Perform Required Center Pivot / Linear Move Maintenance:** Some of your most profitable winter reading may be the maintenance section of irrigation equipment manuals. They list maintenance intervals for machine – specific components. Because most machines are generally designed to meet less than peak mid-season ET, any breakdowns can be costly to crop yield and quality. Potentially more costly losses include increase in potato diseases favored by crop water stress such as Potato early dying (*Verticillium dahliae*), Early blight (*Alternaria solani*), and Black dot (*Colletotrichum coccodes*).

Any time the machine is not operating due to mechanical or electrical problems, it falls farther behind in ability to deliver water. “Catching up” to end water stress problems cannot happen until the peak period is over. General requirements such as checking tire condition and air pressure, checking gearbox lubricant levels or changing lubricant, checking alignment mechanisms and electrical connections are a starting point, but a complete maintenance program for each machine should be developed and followed.

**Check Pumping Plant Efficiency:** Worn, incorrectly sized or incorrectly adjusted pumps cost more to operate. In a new pump, about 80-85% of the electrical energy input can be transformed into useful flow and pressure. However, as pumps wear or need adjustment, the useful output can drop to as low as 50-60% of input energy. For example, IDWR tested several hundred pumps in Basin 36 in Southern Idaho several years ago and found the average efficiency to be 64%. The additional pumping cost between a 64% and 80% efficiency system on a 900 gpm pivot ranges from about \$700/year when using canal water to about \$1500/year for a 200-foot lift

from a deep well. Correcting these problems may be as simple as following proper repair and maintenance procedures, or may involve pump adjustment or replacement.

A potentially more costly problem due to worn or poorly adjusted pumps is the resulting reduction in system pressure. On solid set or set-move systems using impact heads, reduction in system pressure below the optimum range of 45-60 psi degrades the uniformity of nozzle discharge, resulting in areas of over or under irrigation. This is illustrated in **Figure 1**, which shows the wetting pattern on a sidewalk after 20 minutes of sprinkler application at 20 psi. The same trend, although not as extreme, was observed at pressures up to 35 psi. System pressure problems in a field situation are shown in **Figure 2**.

**Fix leaks & worn nozzles:** Leaks and worn nozzles may be the silent thief of production costs and yield / quality reduction. Although not obvious, they can cost you in four ways: 1) applying more water than needed, 2) reducing system pressure, 3) increasing pumping cost, and 4) creating conditions favorable for initiation and spread of disease. Although not as obvious as the first three items, diseases due to over-watering like Pink rot or Water rot (*Phytophthora erythroseptica*) can cause significant field and storage losses. Initial infection occurs in excessively wet areas and then spreads to adjacent areas of the field.

Degree of nozzle wear may be checked for brass nozzles by inserting the base of a drill bit of the correct size into the nozzle. If the spray around the drill bit extends more than 15 feet, nozzle wear is about 10% and the nozzle should be replaced. The cost of new nozzles can usually be recovered in less than one year by energy savings alone. Savings in disease reduction can be significantly higher. The scope of this problem is large. In a 1978 UI study, Dorrell Larsen found that in irrigation systems supplied by canal water, 77% of nozzles tested were either worn or badly worn and required replacement. In systems supplied by deep wells, 52% of nozzles were either worn or badly worn. Recent field observations indicate that leaks and worn nozzles are still a major problem.

Leaks and worn nozzles can add significantly to system operating costs. For example, in a 1981 study of 9 set-move laterals, Dorrell Larsen and Tom Longley found that measured lateral discharge ranged from 99-146% of the design discharge. The average was 19% extra water pumped due to leaks and worn nozzles. Added horsepower **per lateral** to pump the extra water lost through leaks and worn nozzles ranged from 0 to 8.9 Hp, with an average of 3.6 Hp. At \$0.05 per kwh, the cost of leaks and worn nozzles **per lateral** ranged from 0 to \$407, with an average of \$102.50. If increased disease potential was also included, costs would be even higher.

**Improve system application uniformity:** As indicated in UI Bulletin 824 "Irrigation Uniformity", in a system with poor application uniformity, about 34% of the field area will be over-watered by more than 3 inches, with an equal area under-watered by the same amount. Only 10% of the field area will receive optimum irrigation. In contrast, a system with high uniformity will over or under-water only 9% of the field area by more than 3 inches, while 34% of the field will receive optimum irrigation. Difference in potato crop value between these two situations was estimated to be about \$140/acre (UI Bulletin 824 "Irrigation Uniformity").

Poor system uniformity in pivots and linear move systems can be caused by plugged or sticking

pressure regulators or by nozzles placed in the wrong location (**Figure 3**). In general, pressure regulators on low-pressure systems have a useful life of about 10,000 -14,000 hours (about 5-7 years), depending on the quality of the irrigation water. As they age, the moving parts within the regulator tend to stick in one position, particularly in water with high levels of dissolved minerals. As a result, the output of a 15 psi regulator may range from 5 to 25 psi, creating bands of over or under-watering.

As strange as it sounds, a significant number of pivots have had nozzles installed in the wrong location. This also produces bands of over or under-watering (**Figure 3**). Therefore, taking the time to double-check the location of nozzles on a new or re-nozzled system is certainly worthwhile.

**Reduce surface runoff:** Ideally, irrigation systems are designed to uniformly apply the correct depth of water. Presence of surface runoff means that some areas are not receiving the intended water and other areas, where the water ponds, are receiving excess. Both insufficient and excessive irrigation can reduce crop yield and quality. In addition, areas of excess water tend to be “hot spots” for disease development. Runoff from center pivots tends to collect in pivot tracks. Potato diseases that favor wet soil conditions tend to start near pivot tracks, (Figure 4) and in the chronically over-watered area under the first span. If conditions are favorable, disease then spreads to the rest of the field. Pesticides and fertilizers applied through the irrigation system are also non-uniform if the water uniformity is less than optimal. Water lost to runoff under sprinkler systems is truly “wasted water”, something no one can afford this year.

Runoff can be reduced or eliminated by reservoir tillage to increase surface storage, reducing water application per irrigation, and by proper selection of water application packages on pivots and linear-move systems. On soils prone to surface sealing and runoff, water should be applied in a manner that produces the lowest droplet kinetic energy per unit area. This means applying smaller droplets over a larger area. Some applications packages (Wobblers, Iwobs, Spinners) apply water in all areas of a wetted circle at once. Application resembles a gentle rainfall. Others, such as rotators, apply water in a few slowly-rotating high-intensity streams which apply more kinetic energy per unit area and produce more severe crusting and runoff. Within the “gentle rainfall” group, Spinners will produce smaller droplets. Drop size for the Wobblers or Iwobs can be reduced by increasing pressure (higher pressure = smaller drops).

Although spray nozzles are inexpensive and can produce small droplets at the correct pressure, the wetted diameter is only about 20 feet, or only 20% of the area covered by all the application packages listed above. As a result, the application rate is about 5 times higher under the spray nozzles, making them more prone to surface runoff on the outer pivot spans.

Entering this growing season with well-maintained and properly repaired irrigation equipment is well worth the effort. It may even help you sleep better at nights. This summer on some hot windy day when you see your neighbor’s machine down for repairs, you will be glad you spent time on pre-season maintenance.

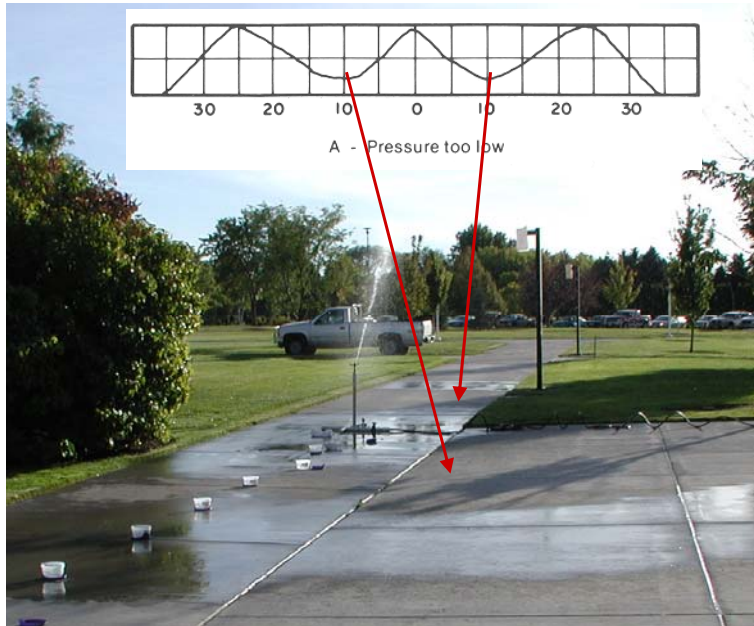


Figure 1. Water distribution from a sprinkler test using a brass nozzle at 20 psi system pressure for 20 minutes.



Figure 2. Poor uniformity on wheel line irrigated field.

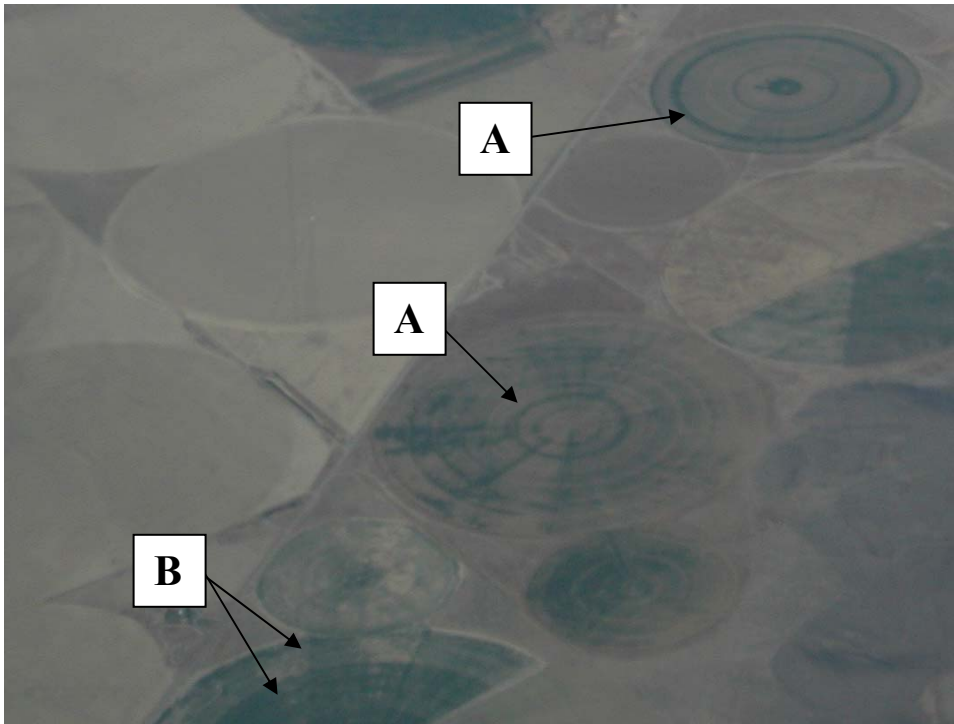


Figure 3. Poor center pivot uniformity due to malfunctioning pressure regulators (A) or incorrect nozzles on spans (B).