NRCS	**Michigan Technical Note** **USDA-Natural Resources Conservation Service**

AGRONOMY 43
Instantaneous Application Rates and Runoff

General Information

Instantaneous application rate **(IAR)** is an important element of sprinkler irrigation performance. IAR is the PEAK intensity of water application at a point in the field at a given time. IAR is not the planned maximum sprinkler application rate, but what you would feel if you were standing under the sprinkler system. The goal is to design an application rate to prevent runoff, water erosion and ponds.

An observed runoff or erosion problem may be due to: 1/ improper sprinkler system design 2/ poor soil health (soil compaction) 3/ worn nozzles 4/ installation of the wrong nozzles. Improper sprinkler design may be a planning inventory error such as assuming the soil has a higher infiltration or the wrong intake family was used. Water infiltration rate is high when the soil is dry but as irrigation wets the soil surface water infiltration slows dramatically. Changes in the Irrigation system and/or management can sometimes alleviate these problems.

Sprinkler packages and nozzle changes will affect IAR. Some irrigators switched to low impact spray nozzles to reduce water loss by evaporation or wind drift. System capacity, soil intake family, and slope remain constant, but wetted diameter changes. A smaller wetted diameter can increase ponds and runoff.

Wetted diameter is affected by:

- Nozzle height from soil surface, the closer to ground level the smaller the diameter.
- Type of sprinkler device
- Operation pressure of the irrigation system
- Angle of nozzle operation

Correcting existing irrigation systems for a new wetted diameter to decrease IAR may include:

1. Changing the rate of advance/ revolution speed of the irrigation system.
2. Selecting new irrigation nozzles or devices. Fixed spray nozzles produce high instantaneous application rates on a small percent of area, while rotating spray nozzles produce lower instantaneous application rates.
3. Increasing nozzle spray trajectory angle from horizontal increases the wetted diameter with a greater angle.

Correcting an existing irrigation system to reduce the IAR may include:

- Changing the nozzle angle
- Using rotating pads or deflection pads
- Adjusting the nozzle/sprinkler from ground level.

Planning for a new irrigation system IAR may include:

- Increasing soil infiltration
- Changing tillage practices that result in high infiltration rates
- Increasing residue cover and surface roughness.

Practices that can reduce the runoff problems under center pivot systems converted to low-pressure systems include:

1. Reducing design flow capacity of system to the minimum required to meet crop water needs.

2. Utilizing pressure regulators at each sprinkler in fields with significant elevation differences.

3. Installing spray sprinklers on booms to increase wetted area covered.

4. Increasing the travel speed of pivot or moving sprinkler to reduce the amount of water applied on a given area during a given period of time

Instantaneous application rates can be compared to soil infiltration rates by visual observation and should be included as part of the IWM Plan. Walk or drive along the entire length of an operating pivot and observe any excessive ponds or erosion. Document the location of ponds, ephemeral gullies or rills to determine corrective action such as: adding cover crops, evaluating the current residue management system, reducing soil compaction, repairing drainage systems, etc. See the following St. Joseph County, MSUE publication under Irrigation Resources, Lyndon Kelly; *Reducing and Avoiding Irrigation Runoff* at the following Website:

http://www.msue.msu.edu/portal/default.cfm?pageset_id=28706&page_id=361029&msue_portal_id=25643

The University of Nebraska offers an Irrigation Water Management (IWM) software program called Center Pivot nozzle or CP Nozzle. CP Nozzle must be installed by IT in field offices where irrigation is important. CP Nozzle calculates potential runoff from combinations of soil type, slope, system capacity, system length, application depth and wetted diameter. This will facilitate technical assistance to irrigators when considering sprinkler package or nozzle changes or replacement.

MI NRCS Irrigation Water Management 449 Conservation Sheet suggests that *the maximum application rate to prevent runoff, ponds and erosion should not exceed 1 inch per hour.* Most center pivots are designed to apply 3/4 to 1 1/4 inch of water per hour according to: Nebraska Guide G96-1305-A, Water Runoff from Sprinkler Irrigation a Case Study.

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