ALABAMA COOPERATIVE Extension SYSTEM

ANR-790-4.4.7

ALABAMA A&M AND AUBURN UNIVERSITIES

Fertilizer Management To Protect Water Quality

Irrigation Systems And Fertilizer Management

American farmers use irrigation on more than 49 million acres of cropland annually. But intensive irrigation can result in nutrient losses to surface waters through irrigation return flows and nitrate losses to groundwater through leaching.

In fact, nitrogen leaching is a very serious problem on many irrigated soils for two reasons. First, the permeable soils that are commonly irrigated have high rates of leaching and nitrification. Second, a relatively high nitrogen fertilizer rate is used on most irrigated crops because good returns are expected.

Water quality deterioration due to poor irrigation management is not a major concern in Alabama, but producers need to be aware of potential problems and preventive measures. Only about 200,000 acres are irrigated on a regular basis in Alabama, of which about 153,000 is cropland. Nursery crops, golf courses, and other recreational areas make up the bulk of the irrigated non-cropland acres. Most producers use sprinkler systems and few apply fertilizers or other chemicals through the irrigation systems. Thus, most potential problems are associated with excessive runoff or leachate which may be transporting nutrients.

Determining Irrigation Rates

In most regions where irrigation supplements rainfall, water applications should be matched to a crop's actual moisture needs. To determine irrigation rates, farm managers must be able to balance crop moisture needs with available stored soil moisture, rainfall, and irrigation water.

Crop water requirements depend on both soil evaporation and plant transpiration. Plants consume, on the average, from 0.1 to 0.3 inches of rainfall or irrigation per day. Early in the season, soil evaporation is the primary factor in moisture loss. As the crop continues to grow, shading reduces evaporation, and transpiration becomes dominant. The peak water use period for corn, wheat, grain sorghum, and soybeans occurs during pollination. Crop moisture needs decline somewhat during late grain filling but are still important in determining ultimate yield levels.

Maintaining awareness of field soil moisture depends on frequent field monitoring. Assessing soil moisture—with a soil probe, by hand examination, or other soil moisture monitoring equipment—is essential. In addition to monitoring field moisture, weather stations and computer programs that predict water use and evaporation can aid producers in scheduling irrigation.

Soil water intake and water-holding capacity varies according to soil type. Table 1 illustrates the difference in soil's ability to store plant-available water and their maximum intake rate for sprinkler irrigation. Grower knowledge of such information is important when determining irrigation applications.

For example, if an irrigator applies 1.5 inches of water on a field whose maximum holding capacity is only 1 inch of water, leaching will likely occur. If water is applied faster than the soil's intake rate, runoff will likely occur.

When all these factors are considered together, producers will be able to balance stored soil moisture, rainfall, and irrigation water with crop moisture needs—maximizing yield capacity with minimum nutrient loss.

Table 1. Approximate Amounts Of Water Held By Different Soils And Maximum Rates Of Irrigation.

Soil Texture	Water Held (inches per foot of soil)	Maximum Rate Of Irrigation (inches per hour, bare soil)
Sand	0.5 to 0.7	0.75
Fine sand	0.7 to 0.9	0.60
Loamy sand	0.7 to 1.1	0.50
Loamy fine sand	0.8 to 1.2	0.45
Sandy loam	0.8 to 1.4	0.40
Loam	1.0 to 1.8	0.35
Silt loam	1.2 to 1.8	0.30
Clay loam	1.3 to 2.1	0.25
Silty clay	1.4 to 2.5	0.20
Clay	1.4 to 2.4	0.15

Source: Western Fertilizer Handbook, 1985.

Using Limited Irrigation

New irrigation water management techniques can increase efficiency in water use and reduce nutrient losses to the environment. The new techniques are referred to as “limited irrigation” and can be used on a number of crops, including cotton, winter wheat, barley, oats, grain sorghum, forage, and soybeans.

Limited irrigation is most successful when growing drought-tolerant crops, when seasonal rainfall is normal or above normal, or when soils have high water-holding capacities. Under limited irrigation, precise scheduling of irrigation is critical to maintain economic yields.

Limited irrigation techniques include furrow compaction, alternate furrow irrigation or wide-spaced furrows, elimination of pre-plant irrigation, surge flow irrigation, and low-pressure low-level sprinklers or drop-tubes on a center pivot or linear-traversing system.

Furrow compaction is accomplished by running a tractor tire over the furrow. This results in compaction which restricts water leaching beneath the root zone. As a result, more irrigation water is available to the plant roots.

Alternate furrow irrigation is accomplished by alternating a compacted furrow with a non-compacted or soft furrow to allow greater flexibility in supplying water to the crop. The soft furrow is used at times of rapid plant growth when maximum rates of water infiltration and nutrient uptake are necessary to maintain yields. The hard furrow allows application of slower, more measured amounts of water with less potential for leaching losses to groundwater.

The elimination of pre-plant irrigation can greatly reduce soil erosion and loss of nutrients. Instead, irrigation water is supplied in a well-calibrated manner after crops are planted. This technique ensures reduced water losses at the beginning of the season.

Surge flow irrigation can be used to maximize water uptake. This format uses intermittent application of water in furrow irrigation. Surge flow application of irrigation water provides a series of waves, or hydraulic heads, of water flowing down the furrows. The increased pressure generated by the hydraulic head greatly increases the rate of infiltration of water into the crop root zone. Thus, it increases the crop’s absorption of necessary moisture and nutrients.

Low pressure sprinkler systems and systems with drop tubes reduce evaporation losses and erosion rates common for high pressure sprinkler systems.

Benefits Of Limited Irrigation

In addition to reducing costs for pumping water, limited irrigation management can greatly reduce the potential for nutrient losses to the environment. Nutrient losses are minimized through reduced runoff and a reduced volume of irrigation return flows. These waters are often discharged to surface waters and can deliver significant quantities of nutrients to receiving streams. Also, three of the limited irrigation practices—furrow compaction, wide-furrow spacing, and surge flow—greatly reduce water percolation beyond the root zone, resulting in dramatically lowered potential for nitrate leaching into groundwater.

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ANR-790-4.4.7

This publication, supported in part by a grant from the Alabama Department of Environmental Management and the Tennessee Valley Authority, was prepared by James E. Hairston, *Extension Water Quality Scientist*, assisted by Leigh Stribling, *Technical Writer.*

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UPS, **New June 1995,** Water Quality 4.4.7