TEXAS A&M UNIVERSITY Soil & Crop Sciences

TEXAS A&M AGRILIFE EXTENSION

TAM-AAMM

Texas A&M—AgriLife Agronomic Monday Memo

Plant Tolerances to Salinity in Irrigation Waters and Soils

A wide range of salinity tolerance in Texas crops plus salinity management is key.

Fig. 1. Evaporative salt deposition (white) on clods near row of peanuts. This indicates significant salinity from the irrigation water or already in the soil. White crystalline materials usually form on high points in the field scape as salty water wicks upward toward high points then evaporates leaving salts behind. (Calvin Trostle).

The further west across Texas the more likely crops may encounter salty conditions, whether in irrigation water or in soil. In many cases water or soil conditions as determined by an appropriate test can ascertain the potential success of both traditional, alternative, or specialty crops. The numbers often suggest when salinity, in its different forms, is sufficient to conclude a producer should not plant a certain crop.

Fig. 2. Salt accumulation (white) from evaporative points on clods surrounding a young seedling, Reeves Co., Texas. Soil has a known heavy concentration of salts that is detrimental to crop plants without significant salt tolerance. (Calvin Trostle).

***Irrigation Water Quality Standards and Salinity Management Strategies*" (AGEN-PU-066)**

This is my preferred reference document for crop salt tolerances in Texas. It is compiled by Dr. Guy Fipps, Texas A&M AgriLife Extension biological and agricultural engineering (guy.fipps@ag.tamu.edu). It is available for download at AgriLife Learn (https://agrilifelearn.tamu.edu/) and other TAMU websites.

The document is attached.

Table 7 (crop salinity tolerances in soil) and Table 8 (crop salinity tolerances to irrigation water) are useful as they highlight commonly established standard salinity tolerances among 59 field, vegetable, forage, and fruit crops. For example, an irrigation water with electrical conductivity, or EC_{water}, of 1,600 µmmhos (micromhos) = 1.6 mmhos/cm (millimhos) = 1.6 dS/m (decisiemans per meter) or ~1,120 ppm total dissolved solids (TDS). According to Table 4, "Permissible limits for classes of irrigation water," this would be deemed a "Permissible" class of irrigation water. If irrigating grain sorghum, Table 8 (for irrigation water salinity tolerance) suggests this should be fine and you would experience no yield drag due to salinity *from the irrigation water*. But sorghum's 100% yield potential suffers if irrigation water EC is above the threshold of 2.7 mmhos/cm. However, if you were growing corn in the same situation, Table 8 suggests corn is sensitive to this level of irrigation water salinity. We would expect reduced growth. (The threshold for potential limited growth in corn lower at is 1.1 mmhos/cm).

Does this mean that sorghum would automatically be OK in the above irrigation environment? No. Soil salinity must also be considered as salts can accumulate in the soil root zone especially when there is a salt source in the irrigation water and rainfall is low. Thus, there is little flushing or leaching of the salts. If EC_{soil} soil salinity > 4.0 mmhos/cm (Table 7, soil salinity tolerances for crops) then restricted growth may be expected for sorghum. Like the irrigation water, corn (1.7) is also more susceptible than sorghum to soil salinity. In this case cotton would be suitable for both the irrigation salt level (100% yield potential if EC_{water} <5.1) as well as the soil salinity level (7.7).

How the information in AGEN-PU-066 can additionally be helpful is when a farmer asks about planting another crop in their rotation. Black-eyed peas (cowpea family) are a frequent consideration as a legume. But based on the information above (irrigation EC_{water} and EC_{soil}) AgriLife Extension would recommend the farmer not plant black-eyed pea due to likely intolerance of the existing salinity conditions, leading to poor growth and even crop failure.

Individual Variety & Hybrid Tolerance

Within crop tolerances, there are known individual varieties that may be salt tolerant more so than general varieties or hybrids that are grown. But the documentation of that higher salt tolerance may be absent. Some crops that have known documented salt-tolerant varieties include alfalfa and barley. Some seed companies may have information about their genetics for potential salt tolerance.

Can Soil Salinity and Saline Irrigation Water Be Managed?

Often, yes. This may involve different methods of irrigation application that reduce concentration of irrigation salts near germinating seeds or in the root zone of developing plants. For example, sprinkler irrigation over the top of a sensitive crop may hasten accumulation of salts in the soil surface. But applying saline water in a furrow where there is more downward movement could enable plants to establish. Flood irrigation, though inefficient in plant water use efficiency, can manage accumulated salts by pushing them deeper into the soil profile. And finally, soil salinity that involves salts like chloride be mitigated greatly from higher seasonal rainfall and even one large individual rain, which can make the difference in diluting salinity in the root zone.

For questions about salinity management in Texas crops, consult AgriLife soil scientists, agronomists, and our Department of Agricultural & Biological Engineering faculty that work with irrigation.

"Best Bets" for Salinity Tolerances Among Texas Crops

Some Texas crops stand out for soil salinity and irrigation water salinity tolerance. Each of these crops may have an increased role in managing salinity and retaining crop productivity. These include:

- Bermudagrass among perennial forages.
- Barley among winter annuals. Barley in general has good salt tolerance, but AgriLife Extension also has past barley variety testing at the former AgriLife Research station at Pecos. Results confirmed that 'Solar' from University of Arizona has exceptional

additional salt tolerance beyond traditional barley. (See https://cales.arizona.edu/pubs/general/resrpt2006/article12_2006.pdf)

- Cotton for summer cropping.

Salinity tolerance *mechanisms* among crop, forage, and horticultural crops may vary. These mechanisms can include the ability to 1) germinate in the presence of salinity, 2) exclude salinity at the root during water and nutrient uptake, and 3) the potential to isolate salts within the cell so that other cell functions can proceed with minimal restriction. These mechanisms may not be well known or understood among many plants.

For further information on salt tolerances among peanuts, cotton, grain sorghum, and corn, consult "Irrigation Water Quality: Critical salt levels for peanuts, cotton, corn, and grain sorghum," http://cotton.tamu.edu/Irrigation/L-5417%20Irrigation%20Water%20Quality.pdf

Where to Test for Soil & Irrigation Water Salinity

The Texas A&M AgriLife Extension soil test lab offers comprehensive salinity testing for irrigation waters and soils, see https://soiltesting.tamu.edu/sample-page/submittal-forms/

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From TAM—AAMM one year ago: "**The Purpose and Pros of Agricultural Small Plot Research.**" *Countering farmer skepticism about reliability of properly designed field tests.* (July 31, 2023).

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