Improved Hybrid and Soil Management in Western Irrigated Corn Production

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Introduction

Hybrid corn production in the western Great Plains can be feast or famine. This area can deliver bin busting corn yields produced during our warm days, cool nights, productive soils and the all important irrigation water to complement our deficit rainfall. The famine side of corn production shows up too often when rainfall and irrigation are limiting and fertilization timing is not optimum to meet the demands of a growing corn plant. These pictures show the same hybrid growing just a few steps from each other. One hybrid is receiving adequate water while the lower hybrid is stressed from insufficient amounts of water that do not supply consumptive use levels of irrigation or rainfall.

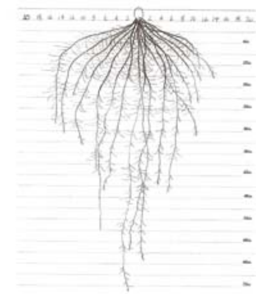
We recognize: Colorado Corn Growers Association; the Irrigation Research Foundation (IRF), Yuma, CO; Orthman Manufacturing; and Monsanto Company for allowing us to present data that impacts hybrid corn production. We have been investigating corn growth and effect on yield from 2003 to 2010 and offer some insight on hybrid growth and development under conditions in eastern Colorado. We outline additional studies that would help complete a picture of corn growing agronomics.

Methods

Our objective is to grow a corn crop that is able to maximize production under full or limited irrigation by improving root zone management. The following studies at the IRF and at other research sites show improved corn rooting by using:
- •Strip-till tillage system
- •Fertilization – pre-plant with strip-till and near or in-furrow at planting followed by precise applications of nitrogen through the pivot.
- •Hybrid root architecture varies indicating that not all hybrids will access water and fertility equally.

1. This poster documents three corn root types that incorporate rooting growth patterns studied in the Colorado Corn trial at the IRF.
2. We will identify the benefit of below row fertilization and multiple applications of nitrogen through Strip-tillage, planter and pivot.

Competitor



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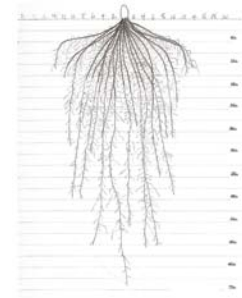

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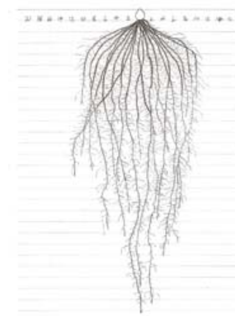

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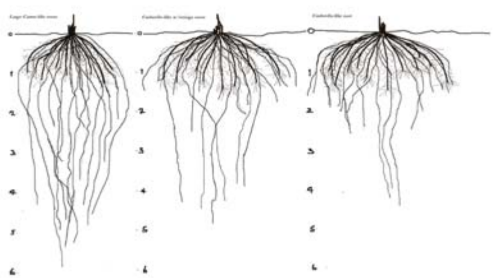

Root Architecture	Root width at 36 inches	Root width at 48 inches	Root volume in cubic inches
Large carrot type	**20**	**14**	**5937**
Umbrella like with strings	**16**	**11**	**4117**
Umbrella like	**10**	**7**	**3305**

Corn Root Architecture

A joint study with Colorado Corn Growers Association and the Irrigation Research Foundation has been documenting root growth and development of eight hybrids over a three year study. Eight producers of seed corn sold in eastern Colorado were contacted and asked to provide seed to be planted under full and limited water. The companies were free to provide the hybrid of their choice. The study was begun in 2008 with three root digs at 25, 55 and 110 days after emergence. Yields were collected on the hybrids under both full and limited irrigation. A full set of data was collected in 2008 and 2010. The 2009 trial was terminated in late July when a hail storm destroyed the crop; only the early root dig is available for analysis in 2009.

The root profile studied in 2008, 2009 and 2010 show consistency in the pattern of root development allowing hybrid entries to be placed in one of three root profile "buckets" or said another way root architecture falls into one of three pattern types

1. **Large carrot type root** - defined by a deeper root profile with a more even distribution of roots
2. **Umbrella-like with strings root** – this root architecture has much of its root mass distributed in the upper third of the rooting profile but has significant root extensions that reach farther down into the soil profile.
3. **Umbrella-like root** – much of the root mass of this corn is grown in the upper third of the soil and has the fewest roots penetrating to lower soil depths.

Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible.

Fertility Placement and Timing

The IRF staff has been taking soil samples prior to planting, mid season and after harvest to analyze movement of nitrogen in the soil profile. We assume and have observed that a deeper, more extensive root system will be able to access and use more of the available nitrogen and that less will be lost to leaching below the root zone from rainfall and irrigation. Initial data confirms applied nitrogen can be better managed by using relatively small doses of N applied at critical times during plant development. We are incrementally applying N with the strip-till operation, with the planter and with four applications through the pivot. Additional studies will be needed to estimate amount of applied N that is lost to the plant by leaching. We also hope to provide suggested guidelines around the amount of N applied to reach our yield goal. We believe that choosing hybrids with root architecture that can scavenge N at deeper levels in the soil, along with precise placement (that corresponds to physiological root development) and N timing, we can maintain or improve current yield levels without corresponding incremental increases in nitrogen.

Soil Water Probes

The IRF is conducting a study of capacitance probes with Earthtec Solutions that can assist with irrigation timing and help monitor movement of ions (nitrates) in the soil. This information can help determine root growth and uptake of nitrates at various soil depths. A limited irrigation study in 2010, showed promising results. More study is needed to confirm that ion movement can be attributed to nitrogen and that judicious use of irrigation can produce consistent corn yields under full and limited irrigation.

Summary

•Corn root architecture falls into one of three main types:
- **•Large carrot type**
- **•Umbrella like with strings**
- **•Umbrella like**

•Corn root architecture determines the following:
- **•Corn rooting depth**
- **•Volume of soil explored**

•Fertility placement is key:

• Below row fertilization:
- **•Maximizes nitrate uptake**
- **•Minimizes nitrogen loss via leaching**

•Pivot applications of nitrogen can:
- **•Provide N at correct time and growth stage**
- **•Reduce N requirements**

•Root digs and soil probes can be used to:
- **•Root digs have verified root architecture**
- **•Soil probes may also provide an estimate of rooting volume in the soil**
- **•Probes may help determine N movement along the rooting zone.**