The Case of the Yellow and Twisted Maize

Around ear-set, a farmer near Sargent, in Custer County, Nebraska, noted chlorosis and the beginning of severe foliage deformation on many of the corn plants in his pivot-irrigated field. After calling an Ag Testing and Consulting firm to get help sorting out the problem, his son took some of the twisted corn plants, the letter below, and a soil sample to them for testing. The photos below were taken on July 22.

Photo A. North end of the field looking south. Note the taller corn in the background, where the symptoms were not as extensive as in the foreground.

Photo B. Injured plant on the east end of the field.

Photo C. Comparing a plant showing minimal damage to one with substantial damage.

Photo D. Root system of a damaged corn plant showing unnatural development of roots near the soil surface. Rootworm feeding was not severe. There is some appearance of "bottle brushing."

Dear [Consultant]:

This letter is a follow-up to our phone conversation in which I indicated to you that I have a field of corn that appears abnormal. At your request, I will provide you with information that may help us diagnose the problem.

The crop was planted on May 20. We applied starter fertilizer at planting using about 8 to 9 gallons of water per acre. Another 130 pounds nitrogen per acre was side-dressed later. The soil was fairly cold at planting and the weather has remained somewhat below normal temperatures this year. This field is irrigated by center pivot irrigation and moisture deficit was not a problem. We did not apply phosphorus.

The corn field has a lot of yellow leaves and I noticed this about the time of ear set. The symptoms were more predominant on the north side of the field, and some plants appeared to have abnormal leaves and small root systems. I have included some pictures so you can see this for yourself. I'm also having my son drop off some plants for you to analyze. In addition to the twisting and wrapping that you can see on the plants and in the photos, there was some lodging as well.

You asked me to explain our insecticide and herbicide programs as well. The previous year, the field was planted to corn and we used the herbicide Bicep II Magnum [www.syngentacropprotection.com/prodrender/index.aspx?prodid=676]. This year, the insecticide Lorsban 4E [www.dowagro.com/ca/prod/lorsban.htm] was applied as a T-band at 10 pounds per acre. On about June 18, the field was sprayed with a combination of Basis Gold [www2.dupont.com/Production_Agriculture/en_US/products_services/herbicides/Basis_Gold_herbicide.html] and Accent Gold [www2.dupont.com/Production_Agriculture/en_US/products_services/herbicides/Accent_herbicide.html] herbicides. The rate used according to the applicator was 14 ounces of Basis Gold and 3 ounces of Accent Gold per acre. This was sprayed on using a crop oil and ammonium sulfate carrier.

There seemed to be more damage in areas where overlap of the sprayer likely occurred, but there was some general damage evident over the entire field, and as I mentioned before, it was more predominant on the north side.

I would appreciate any suggestions you might have to help with this problem.

Sincerely,

Concerned in Sargent

Assignment: You assume the role of the Consultant.

Evaluate the analyses shown below along with the information provided above. Answer the questions: What is the problem? What caused it? How can it be corrected in the long term? Support your statements by pointing to specifics in the analyses and/or the information provided by the farmer.

Soil Test Results. Sample from northeast side of field.

1:1 pH	WDRF Buffer pH	Excess Lime Rating	Organic Matter LOI-%	NO_3 inches	NO_3 ppm N	NO_3 lbsN/A	Bray P1 ppm	K NH_4OAc ppm	SO_4 ppm S	Zn DTPA ppm	Fe DTPA ppm	Mn DTPA ppm	Cu DTPA ppm	Ca NH_4OAc ppm	Mg NH_4OAc ppm	Na NH_4OAc ppm
5.5	6.6	None	2.2	0-6	3.6	6	57	702	13	6.03	50.9	24.7	0.78	1256	190	8

Plant Pathology Test Results.

Some cortical rot, rhizoctonia, observed in sample. More information about disease provided below.

Rhizoctonia Crown and Brace Root Rot

Rhizoctonia crown and brace root rot of corn has been reported in Georgia in the southeastern United States and in France, New Zealand, and Japan and probably occurs in other subtropical to tropical areas. The disease may cause severe losses in localized areas and reduce grain yield up to 30%.

Symptoms: The first symptoms of *Rhizoctonia* crown and brace root rot are brown lesions on the mesocotyl and primary and lateral seminal roots of seedlings and juvenile plants. The most distinctive symptoms are large, reddish brown cankers on the adventitious crown and brace roots of large plants, frequently resulting in a terminal decay and disintegration of roots 2 to 5 cm below the ground. New lateral, tertiary roots may form immediately behind the disintegrated terminals of the crown and brace roots, but they may turn brown and disintegrate after a few centimeters of growth. Plants may lean or lodge because the root system is anchored poorly in the soil. Plants may be stunted or chlorotic, but frequently they cannot be differentiated from healthy plants unless they are leaning and the deteriorating roots are exposed.

Causal organism: Rhizoctonia crown and brace root rot is caused by the anamorph *Rhizoctonia solani* Kuhn AG-2 type 2 III B, intraspecific group 2B.

Disease Cycle and Epidemiology: *R. solani* probably survives in soil primarily as sclerotia and in colonized plant debris or on roots of weeds and susceptible hosts as sclerotia and sclerotial initials. It has survived for more than 9 months in fallow soil in Georgia. In naturally infested soil, the pathogen may be isolated from peanut pods at harvest and can survive for several months in colonized pods and empty shells left in the soil after harvest. It may survive between corn crops on legumes, grasses, and other temporary host plants.

Control: The fungus will infect corn roots at soil temperatures of 8 to 34^{o}C but causes more seedling root rot at 8 to 28^{o}C. In soils naturally infested with the pathogen, rotations of 1 year between corn crops may not reduce disease severity, but 2 years or more of nonhost crops coupled with good weed control may reduce innoculum to low levels that will cause few diseased roots. Naturally occurring saprophytic *Rhizoctonia* spp. and other basidiomycetes in the soil may compete with the pathogen and reduce root infection. Tillage practices have little effect on disease severity, but the disease is more severe in irrigated, intensively managed corn than in nonirrigated corn. Disease severity is increased by the herbicide

pendimethalin in early plantings at low soil temperatures. Control of plant-parasitic nematodes reduces disease severity. All cultivars of corn that have been screened are susceptible to the disease.

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