Bob and Allison,

The corn tar spot analyses are attached. You sent 3 dried samples of corn leaves with tar spot. In preparation for analysis, these were 'ground' in a kitchen blender and then separated into several subsamples based on size of particle as well as your punched spots so there are four analyses for each of the three samples. This was done to see if grinding was necessary since the leaves could be analyzed intact also. You can get an idea of the size of particles from the photo attached below. The 'punched leaf' samples are very coarse and are the large sizes from the blender. The 'punches' (#11-13) are the punched out spots from the leaves that you did. The '500 mesh' is the smallest material that passed my 500 mesh screen and the 'flour sifted' sample is what I sifted through a kitchen flour sifter (guessing about 200 mesh.

The 'punched' samples tended to be the lowest readings and for several elements, Cu and Mo, were below the detection level. Otherwise, it didn't seem to make much difference on the coarseness or fineness of the material being analyzed. The largest size had the main vein, etc. so I had anticipated some differences because of sequestering of certain (poorly mobile) being higher or lower because of that. The small differences between samples probably reflected more location effect from where the samples were collected. The spots are primarily MnO2 although there are generally many granules in the intercellular spaces which may account for the similarity in levels with the different particle sizes.

What I see in general relative to sufficiency ranges is a severe deficiency in Cu, Zn and S. Cu and Zn deficiencies would predispose to pathogen peroxidase and lactase enzymes for oxidizing Mn to the non-available form to shut down the Shikimate pathway for resistance. One thing stands out and that is the EXTREMELY HIGH Mn! Since there weren't any Mn toxicity symptoms apparent, this level must be primarily MnO2 which has accumulated as it precipitates and is not available physiologically. This oxidation is a virulence factor for many pathogens (take-all of cereals, rice blast, Xylella diseases, TAR SPOT, etc. If a culture can't oxidize Mn, it will not be virulent and cause disease! Cu and Zn sufficiencies + inhibit Mn oxidation and minimize or inhibit Mn oxidation and disease. Throwing in some Mn to compensate for that oxidized helps maintain physiological sufficiency and resistance. S is important for resistance also through the aromatic amino acids and protein formation (cysteine and methionine)

The only time I have seen this high Mn (Mn oxide or birnessite) is with Marasmius root rot of sugar cane induced by glyphosate herbicide used as a desiccant. Two weeks after applying glyphosate to dry up the foliage, 98 % of the mycorrhizae is gone and Marasmius is moving to the roots (parent and ration plants). Even Banana and Macademia nuts (high Mn levels) aren't close to this.

Sample #10 has light tan areas (similar to eyespot around tar spot) that are low to devoid of P, Cu, Mo; high in Mg, compared with the adjacent green areas of the leaf.

Thanks for your and Carl's help with this.
Don

Don M. Huber
Professor Emeritus, Purdue University
huberd@purdue.edu
(208) 615-1710 cell
9322 Big Foot Road
Melba, Idaho 83641