

Managing Corn Grown After Sugar Beets

Summary

- As corn acres increase in sugar beet areas, occurrence of corn-following-sugar beets syndrome (CFS syndrome) is increasing.
- Common symptoms of CFS syndrome, which are more pronounced under cool, wet conditions, are stunting, shortened internodes, purpling and reduction in vigor.
- These symptoms are very similar to those observed with “fallow syndrome.” Fallow syndrome occurs in corn or other crops in fields that were either fallowed or flooded the preceding year.
- Fallow syndrome is associated with a reduction in the population of soil mycorrhizae, which aid in P and Zn absorption by crop roots. Sugar beets are not a host for mycorrhizae.
- The most effective management practice to address CFS syndrome is use of starter or banded P and Zn.
- A comprehensive fertilization plan, good drainage and management of the corn crop also reduce losses from CFS syndrome.

Corn acres are increasing in geographic areas with sugar beet production. When corn directly follows sugar beets, it is frequently not as productive as corn after soybeans or other rotational crops. This is referred to as corn-following-sugar beets syndrome or CFS syndrome. With increased corn acres, the incidence of CFS syndrome is also increasing. This article will address the issue of CFS syndrome, including symptoms, possible causes, and management suggestions to reduce or overcome the negative effects often observed with this rotation.

CFS Syndrome: Possible Causes and Symptoms

A positive or negative crop rotational response may be due to many factors including soil moisture, fertility and compaction, plant residues, diseases, weeds, insects or allelopathy. Sugar beets use a great deal of water and may dry the soil to a depth in excess of four feet. Sugar beets are also heavy users of nitrogen (N) and may leave soils very low in available N. Sugar beets leave little crop residue. Sugar beet harvest can result in significant soil compaction, particularly if the soil is wet during harvest. All of these factors are considered to play a role in CFS syndrome.

Stand establishment of corn following sugar beets is usually normal, with little or no impact of CFS syndrome on emergence. Symptoms typically appear shortly after V1 and persist until corn is about two feet tall (V6). The factors that interact to create the condition of CFS syndrome can result in shortened internodes, purpling, and a general reduction in plant vigor. In severe cases stunting and reduced vigor may persist the entire growing season. Impact on grain yield can range from no impact to as large as a 50% reduction in yield, depending on growing conditions. CFS syndrome will have a greater impact on yield potential in seasons



Corn on right is exhibiting symptoms typical of CFS syndrome.

when the delay in early growth prevents the crop from reaching black layer prior to a killing frost.

CFS syndrome is most commonly observed during extended cool temperatures (highs below 65° F) and in wet or saturated fields. These conditions occur more frequently in the Red River Valley of Minnesota and North Dakota, but can occur in other sugar beet production areas in North America. Symptoms may be present when soil is dry, but are more pronounced in wet soil conditions. Poor drainage, low soil fertility, high soluble salt levels, and high pH seem to increase the incidence and severity of symptoms. Fields with these characteristics may be poor candidates for placement of corn after sugar beets.

Relationship to Fallow Syndrome

The symptoms described for CFS syndrome are very similar to the symptoms observed with a disorder called ‘fallow syndrome’. Fallow syndrome occurs in fields that were either fallowed or flooded the preceding year. Most crops have a beneficial association with soil fungi that colonize their root system. These fungi, called mycorrhizae, aid in phosphorus (P) absorption by crop roots. Mycorrhizae activity is often depressed after fallowing or moisture saturation, producing severe P-deficiency conditions. Mycorrhizae also aid in zinc (Zn) absorption, and Zn absorption will also be lowered when mycorrhizae populations are low. Most plants support mycorrhizae. However, plants in the lambsquarters family such as sugar beets, and in the mustard family such as canola do not support mycorrhizae. Fallow syndrome can be observed in soybeans and small grains, but is most severe in corn. The symptoms observed with CFS syndrome, and the fact that sugar beets do not support mycorrhizae, strongly suggest that CFS and fallow syndrome may be related. This relationship is also supported by the observation that CFS syndrome can be reduced by the addition of P, usually as banded or seed-placed fertilizer.

Management Suggestions

CFS syndrome can be reduced or prevented by careful selection of appropriate fields for corn production, hybrid selection and most importantly, executing a comprehensive fertility management plan.

Growers should begin by considering alternative crop rotations on poorly drained fields, or fields severely impacted by soil compaction the previous year from sugar beet harvest. CFS syndrome is particularly severe in fields where sugar beet roots were not harvested the previous year. Corn should be avoided in these fields. In fields where corn will follow sugar beets, test soil at least once every three years to assess P, Zn and soluble salts and then fertilize adequately based on the soil test results.

Broadcast applications of P and Zn, even at high rates, are not as effective in managing CFS syndrome as banded or starter placement of P and Zn. Applying the appropriate P and Zn in a band or as starter places the nutrients in close proximity to the small developing root system and allows for more rapid early growth during the period when CFS is typically observed (emergence to two feet). The entire recommended fertilizer rate can be safely applied on any soil type if your planter has the capability to apply the band two inches to the side and two inches below the seed. Banding of fertilizer at any time prior to planting, then planting over or near the band is as effective as banding with the planter. If the starter or banded application does not meet the total needs for P or other nutrients, the additional requirement should be applied as a broadcast application and incorporated.

Fertilizer placed with the seed, such as a starter application, should not exceed a rate of 10 lbs/acre of nitrogen plus potassium (K₂O) on medium or heavy-textured soils and a rate of 5 lbs/acre of N + K₂O on light-textured soils or it can reduce germination. The risk of starter injury to corn germination and stand establishment increases when soils are dry.



Plants on left showing symptoms of CFS syndrome received no starter fertilizer. Plants on right had 7.5 gal/A of 10-34-0 + 1 qt/A of Zn chelate. (Photo: Nic Prothero, Mahanomen, MN).

Other beneficial management practices prior to the growing season include minimizing soil compaction, improving field drainage and spreading sugar beet tare piles uniformly and adequately. CFS syndrome can also be reduced by specific corn management decisions. Select hybrids with above average stress emergence and early growth characteristics. Pioneer has developed a new stress

emergence score that can assist growers in positioning hybrids. Prepare proper seedbeds to insure good seed-to-soil contact. Avoid working ground when it is too wet. Carefully set planter depth to 1¾ to 2 inches to optimize corn germination and early root development. Use of animal manure can reduce the incidence and severity of CFS syndrome so long as the application does not result in soil compaction. These additional management suggestions may not eliminate CFS syndrome, but can significantly reduce the symptoms and potential associated yield losses.

Phosphorus (P) and Zinc (Zn) Application

The single most important management suggestion for CFS syndrome is to apply the correct rates of P and Zn, based on soil tests, in a band or starter application. The following table provides recommended P and Zn rates when applied as starter at various soil test levels.

Soil Test Level	Rate of 10-34-0*	Amount of N-P-K Applied
	(Gal/A)	(Lb/A)
Low	10	11-39-0
Medium	7	8-27-0
High or Very High	5	6-19-0

*10-34-0 is used here because it is a common liquid starter fertilizer, but any form of available P applied in a band at 20-40 lb/A P₂O₅ can be used with the same response.

There are numerous forms of Zn that are effective as plant nutrients. The most common forms are zinc sulfate and various types of chelates and complexes. The chelated forms typically are 9 to 14% Zn by weight and used at lower rates than zinc sulfate (either because of the belief that they are more available or because of cost considerations.) Growers should recognize that there is no current consensus among soil science researchers regarding the relative efficiencies of the various forms of Zn. The following recommendation is based on actual field experiences and is supported by extension research scientists in the upper Midwest: apply 1 to 2 qt/A of Zn chelate or complex or 6 to 12 lb/A of zinc sulfate as starter or in a band. When applying any form of Zn in direct contact with the seed, check with the supplier to ensure that the application will not be toxic to the seed and negatively impact germination.

Additional Resources

[Zinc for Crop Production](#). Univ. of Minnesota Extension Service. Publication # F0-00720-G0.

[Soil and Applied Zinc](#). Univ. of Wisconsin Cooperative Extension. Publication # A2528.

[The Fallow Syndrome](#). Dr. George Rehm. Univ. of M Extension Service. Minnesota Crop E-News. July 15, 2001.

This Field Facts was written by Zach Fore, with input and review by Extension scientists at Univ. of Minnesota, NDSU and individuals from Central Crop Consulting, Agvise Laboratories and American Crystal Sugar.