Hydrocyanic Acid Content of Certain Sorghums under Irrigation as Affected by Nitrogen Fertilizer and Soil Moisture

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Arietal trials and fertility experiments (6, 7) have indicated that certain combine-type grain sorghums are promising as a cereal crop under irrigation in the Columbia Basin in central Washington. When grain sorghums were recommended for the first time in 1951, there was some concern as to the possibility of HCN poisoning of cattle. Such danger might exist in case of cattle accidentally grazing a field of immature plants, drought damaged plants, or pasturing when there is second growth present.

Some investigators (2, 3, 4, 5) have reported that grain sorghums contain less HCN than common forage sorghums and more than Sudan grass. However, in cyanogenetic plants the quantity of HCN which can be developed varies with the growth conditions and variety. It has been reported that larger quantities of HCN can be developed in second-growth plants than in older plants, that plant growth arrested by drought favors the development of HCN (4, 11), and that HCN development is increased by nitrate fertilizer application (9). The latter has been of special concern because the recommended commercial fertilizer rates have been from 100 to 160 pounds of available nitrogen per acre in the irrigated Columbia Basin (6).

It is well known that growing sorghums do not contain free HCN, but that it occurs as cyanogenetic glucosides (4). The HCN is liberated by the action of an enzyme normally present in the sorghum plant if conditions are favorable (9, 10).

Experimental Treatments and Procedure

This experiment was conducted on virgin Ephrata fine sandy loam soil on the Moses Lake Development Farm. The indigenous fertility of this soil was high, as shown by the production of 70 bushels of corn per acre without added fertilizer in an adjoining experiment. Other experimental data from this farm has shown grain sorghum yields to be comparable with those of corn (6).

The experiment was laid out in a split-plot design with moisture treatments and nitrogen levels as main plots and varieties as subplots. The main plots were eight rows wide and 128 feet long. The subplots were four rows wide and 32 feet long. The treatments were:

**Moisture**

1. The moisture tension was maintained below 800 cm. of water at the 9-inch depth throughout the season. A mercury manometer tensiometer was placed in each of the four rows of a main plot.

**Fertility**

1. No fertilizer.
2. 160 lbs. nitrogen per acre applied in spring with ammonium nitrate.

**Varieties**

1. Black Amber (common).  
2. Early Hegari T.S. No. 25248. 
3. Double Dwarf White Sooner T.S. No. 25249.  
4. Sudan grass (common).

The moisture-fertility plots were randomized in four replicates, and the varieties were randomized in each main plot.

The varieties were seeded in rows 34 inches wide May 29, 1951. On July 7 the fertilizer was sidedressed 4 inches to the side of the plants and 4 inches from all plots were irrigated uniformly until three weeks before the grain sorghums would normally head. Irrigation was continued July 25 on the No. 2 moisture treatment. The leaf samples of the grain sorghum wilted in the field were taken.

The leaf samples were taken by selecting active plants in the center rows of the plots and the leaves of the stalks and green leaves from the stalks. The first sampling was made Aug. 14. No Sudan grass samples were taken because the crop was mature. All plants were then cut to 6 inches above the ground, and normal irrigation resumed, keeping all plots at a moisture tension of 70 cm. of water. The sampling of the second-growth plants from all plots was made Sept. 24.

In the laboratory the midribs were removed from the leaves and the latter were cut into 1/2-inch pieces according to the procedure of Franzke, et al. (3). These were macerated by hand and separate 10-gram subsamples were used for determination of HCN and moisture determinations. The drying was obtained by oven drying the samples at 70°C for 24 hours.

For the HCN analysis the samples were spiked with a small amount of distilled water for a few hours, intermittently with a commercial food liquidizer (Waring Blender). The material was transferred into Kjeldahl flasks and allowed to digest overnight at room temperature. It was then determined by the acid-titration method (17, 18). The results are reported as parts per million (ppm) of HCN on a moisture-free basis.