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A BIOASSAY TECHNIQUE FOR DETERMINATION OF ARSENIC AND THE DIFFERENTIATION OF CACODYLIC ACID FROM ARSENIC TRIOXIDE

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Determination of arsenic in soils by atomic absorption techniques does not differentiate organic arsenic (e.g., cacodylic acid) from an inorganic form of arsenic (e.g., arsenic trioxide). Since cereal crops are more sensitive to organic forms of arsenic than to inorganic forms, a bioassay technique was developed.

Cacodylic acid or arsenic trioxide, expressed as ppm elemental arsenic, was uniformly mixed (V/V) with soil at rates of 0, 5, 10, 20, 40, 60, 80, 100, 120, and 160 ppm. A Gulf Coast Flatwood soil consisting of 93.9% sand, 3.7% silt, 2.4% clay, and 0.3% organic matter was used for all bioassay determinations. Ten seeds of sorghum, Sorghum vulgare L. var. Mor-Su, were planted per cup and the experiment replicated five times. All cups were maintained under greenhouse conditions.

Number of seeds germinated and height (cm) of all plants (soil surface to tip of longest blade) were obtained after 10 days.

Statistical analysis of the data indicated that height (in cm on a per cup basis) responded to a concentration range of 5-20 ppm As from cacodylic acid and 20-120 ppm As from arsenic trioxide. The average height of sorghum at 20 ppm As from cacodylic acid was 0.2 cm, while average height for 20 ppm As from arsenic trioxide was 5.2 cm. Average height of control plants was 6.2 cm. The multiple regression coefficients were .96 and .89, respectively. Equations for predicting concentration of arsenic were as follows:

$$\text{Log}_{10}T = 1.331 - 0.08h$$

Where T = ppm As from cacodylic acid
h = average height (cm) of sorghum (per treatment)
Std. Error of Est. = 0.076

AND

$$\text{Log}_{10}T = 2.041 - 0.093h$$

Where T = ppm As from As_2O_3
h = average height (cm) of sorghum (per treatment)
Std. Error of Est. = 0.123

Since there was virtually no overlap in the effective concentration range of the two arsenicals, an approximate value (ppm) could be obtained for the form of arsenic present when combined with data for total arsenic from atomic absorption analysis.