POTASSIUM DEFICIENCY IN SOUTH DAKOTA

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Abstract

South Dakota soils are typically very high in plant available potassium (K). However in the last several years there have been increasing reports of K deficiency on corn. A number of observations have been made concerning where K deficiency occurs and what factors are involved. A few research studies have been initiated to answer frequently asked questions by producers on K management for corn and soybean rotations in the state. Preliminary results indicate differential corn variety response to added K. Rate and placement data suggests 30 and 90-120 lb K20 to be applied as a band (2 x 2) or broadcast, respectively. Yield results from this year will be reported. Numerous stress factors (possibly limiting early root growth) have been observed to exacerbate K deficiency symptoms on corn.

Introduction

Historically the potassium needs of South Dakota crops have been met with native soil K levels. South Dakota State University soil testing laboratory summary results show only 2% of statewide samples are in the medium or lower categories of 1N NH_4OAc extractable K (Gelderman et al., 1999). However, in the NE part of the state, there are 5% of the samples in the medium category (80-100 ppm) and about 22% in the high category (120-160 ppm). In the last several years there are increasing reports and observations of K deficiency in corn and some on soybean. Composite field soil samples of 60-90 ppm soil test K have been found in NE South Dakota. In many cases however, field composite samples test above 160 ppm K but eroded hillsides or coarser textured areas may test below 100 ppm. Observations of K deficient plants in the field indicate areas that are large enough to do meaningful small plot research on K. Studies began in 1999 and will continue for several years to answer producer questions on this relatively "new" nutrient deficiency for our state.

Characteristics of K deficiency in South Dakota

Soils

Potassium deficiency on corn has been observed on soils from relatively older glacial advances of Wisconsinian age in NE South Dakota. Decreasing soil test K levels have been associated with steeper slope, courser texture, increasing precipitation, and older landscapes (Westin, 1976) within the state. Typically, K deficiency symptoms are found on the nearly level glacial outwash areas that are courser textured and underlain with sand or gravel. However, there have been confirmed K deficiency symptoms on till soils as well.

Field variability

Spatial variability of K deficiency symptoms on corn are common within a field. Large areas of deficient corn within a field may be associated with depth to sand or gravel. Areas of non

affected corn may not be underlain with sand or gravel or the depth to these deposits may be much deeper than the affected areas. Within the affected area, microvariability (within a few feet) is found between plants exhibiting deficiency and those that do not. Many of these non-affected areas have higher soil test levels than from soil under nearby affected plants. Row to row variability is often common within the larger areas of affected plants. Past wheel tracks may be an explanation for this variability.

Tillage

Observations on susceptible soils indicate higher incidence of K deficiency on corn under no-till than under those systems using more tillage. Instances of tillage passes within a no-till field have decreased K deficiency symptoms. In other instances however, compaction in a no-till field apparently alleviated K deficiency symptoms. Factors associated with degree of tillage that may affect these observations include soil density, soil temperature, and soil moisture.

Stress factors

Any growth stresses (compaction, too dry or loose soil conditions, wet soil conditions, and other nutrient deficiencies) can cause less root growth and tend to exacerbate observed K deficiency symptoms on marginal K testing soils.

Hidden Hunger

Large early growth response to applied K has been documented on plants with relatively few early (V4-V8) deficiency symptoms showing.

Rate and Placement

Limited studies to date have suggested 30 lbs K_2O/acre in a band (2 x 2) or 90 – 120 lb K_2O/acre broadcast under conventional tillage will maximize early growth and/or grain yield (Fig. 1 – Fig. 3). Limited data indicates K_2O rates are greater than currently recommended for a high (120 – 160 ppm) soil test (Fig. 3). Potassium deficiency symptoms have been observed with soils testing 150 ppm or less under conventional tilled systems. Calibration data is being developed for both conventional and no-till cropping systems for corn (Fig. 4).

Variety

Corn varietal differences on K deficient soils have been observed for many years. Differential varietal response from added K to corn under ridge-till or no-till have been reported at this meeting by Rehm (1990) and Vyn (1999), respectively. A study conducted this year on a medium testing soil indicates relative plant height increases of about 5 – 15 % increase above the check from banding 40 lb K_2O per acre (Fig. 5). Twenty hybrids were used of similar maturity (89 – 100 day) from five companies. Yield differences will be reported.

Rescue K treatments

Many producers are first aware of a K problem on corn when they observe symptoms at V4 – V8 growth stage. The question is then asked if in-season fertilization will improve growth of the affected plants. A small study was initiated to answer this question. Potassium was broadcast at 100 lb/a K_2O using 0-0-60 and a simulated cultivation on a low K test soil. Early growth appeared to be increased and symptoms lessened compared to check. Yield data will be collected and reported.

Soybean K deficiency and response

Past observations indicated soybean to be less sensitive to low soil test K with few deficiency symptoms observed. However several reported instances of K deficiency on soybean have been observed this year on soils with relatively low soil K tests. Yields from two residual K (applied to corn in 1999) studies will be reported.

SUMMARY

Potassium deficiency has been increasing in the last several years in South Dakota. Soils that have exhibited plant K symptoms tend to be older, more eroded, coarser textured, and under greater precipitation than non affected soils. Stress factors that possibly reduce root growth such as dry or loose soil have been observed to increase K deficiency. Observations and preliminary studies indicate variety, K placement, tillage, and fertilizer rate are important factors for managing K deficiency on South Dakota soils.

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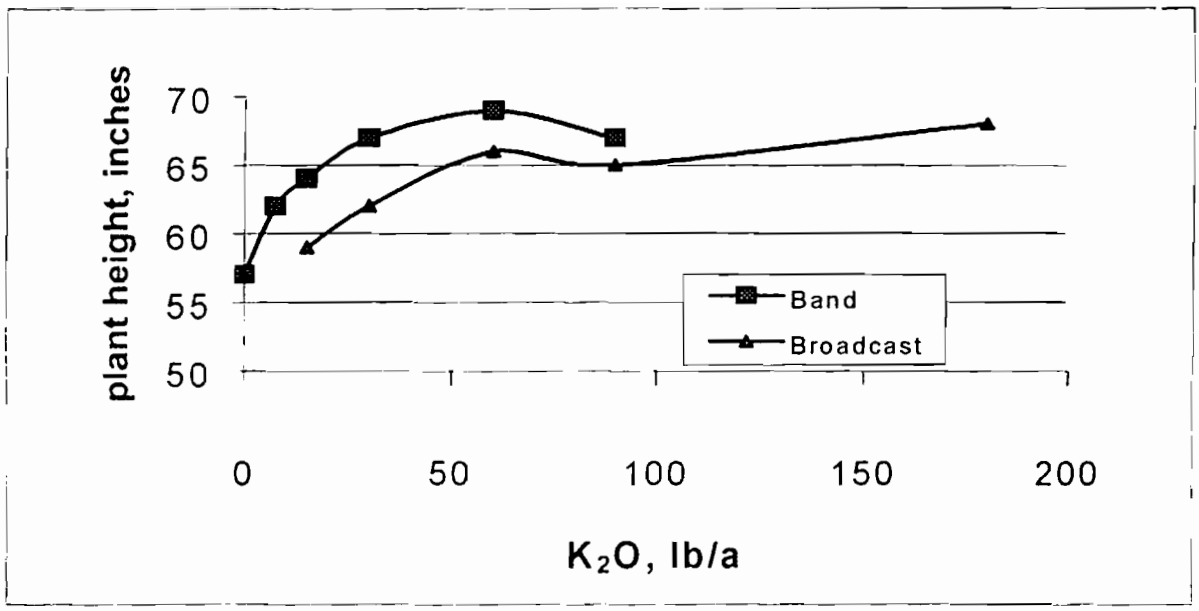

Figure 1. Influence of rate and placement of K on corn height (V10), Brookings Co., 2000.

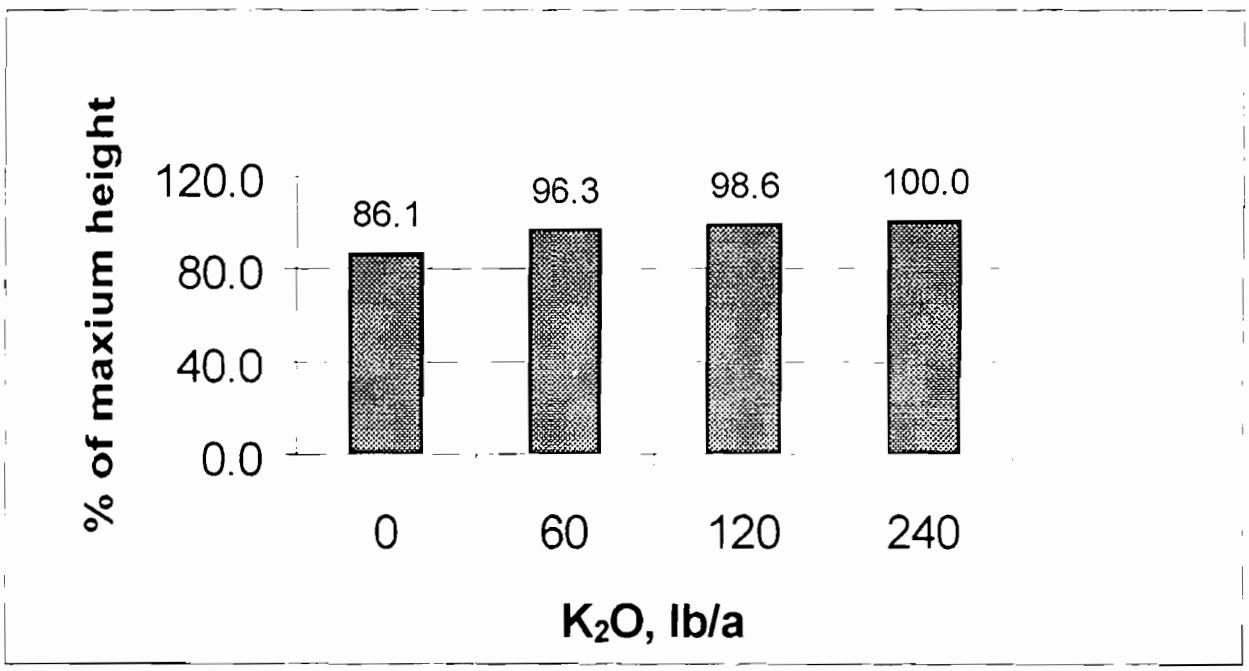

Figure 2. Influence of broadcast K on relative corn (V7 – V9) height, average of four sites, 2000.

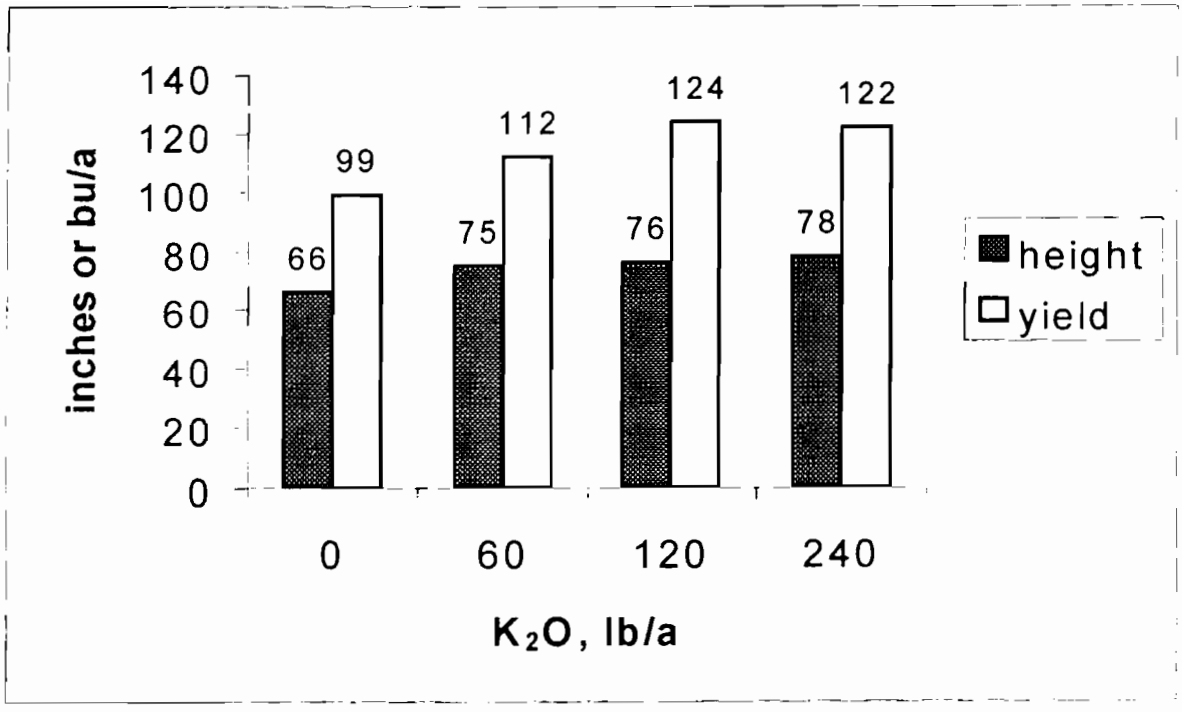

Figure 3. Influence of broadcast K on corn height (V13) and grain yield, 1999.

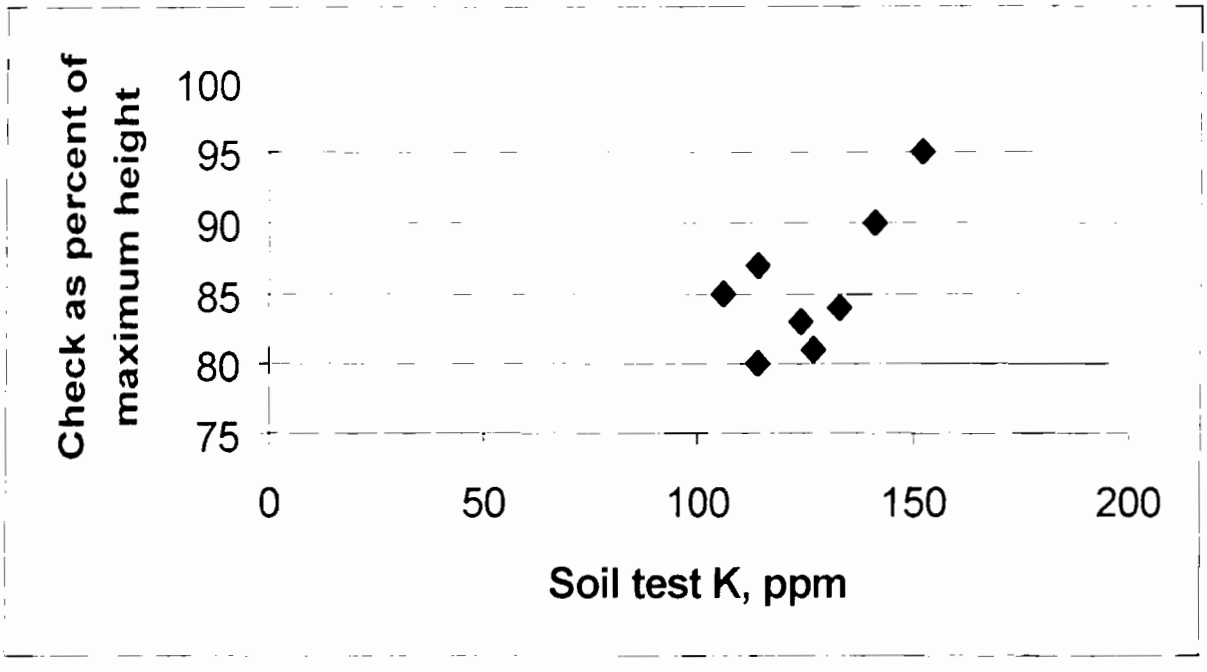

Figure 4. Relative corn height response to added K as influenced by soil test K.

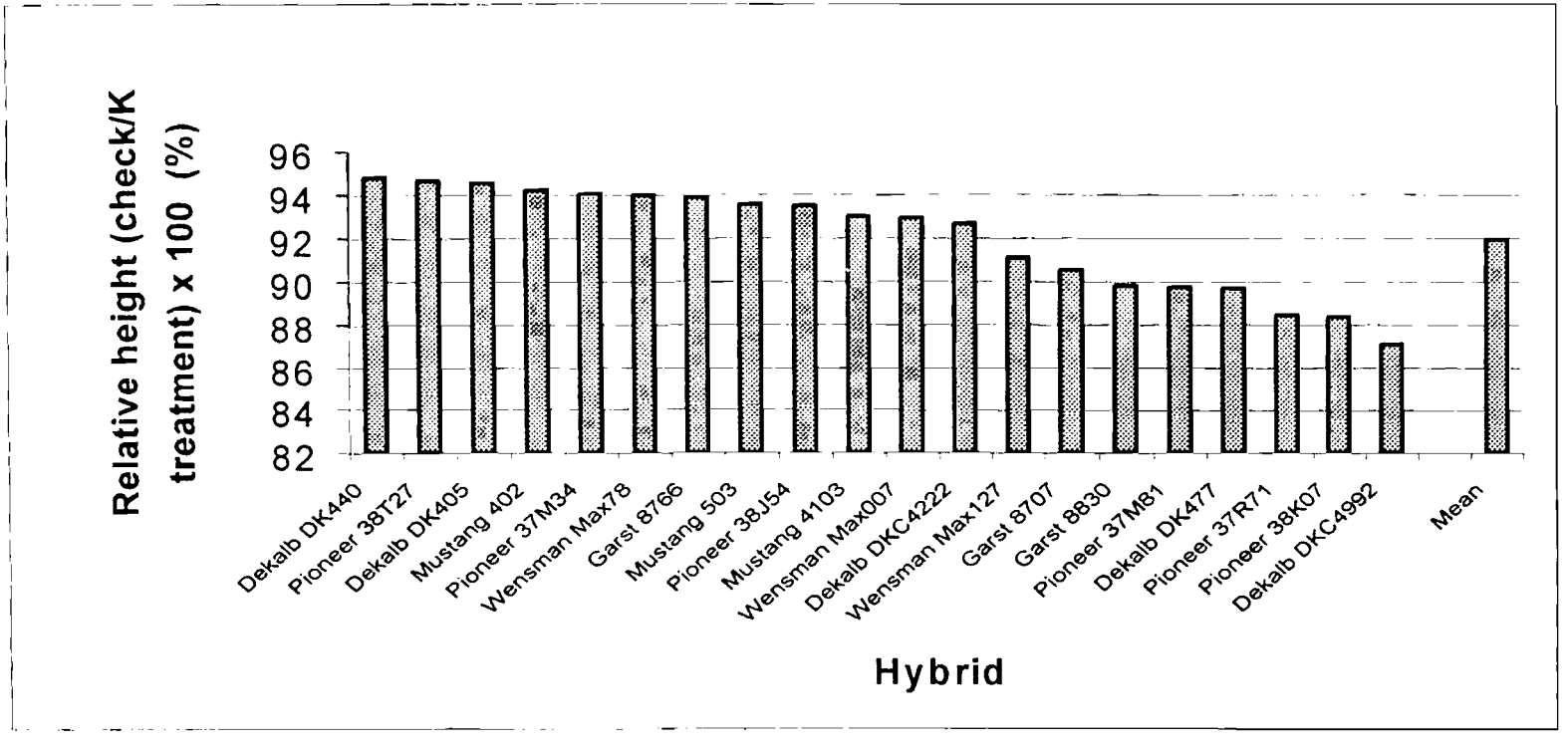

Figure 5. Relative corn plant height as influenced by variety and K treatment (40 lb/a K_2O as 2 x 2), Brookings, SD.

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