Calcium application at preemergence and during bulking may improve tuber quality and grade.

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Work done on potato nutrition prior to emergence has focused largely on fertilizer application along with the seed piece. Experiments have been conducted to determine adequate rates, formulations, and placement of this starter fertilizer in many cultivars (Haverkort and Waart, 1994). Additionally, post emergent applications of nitrogen rich fertilizers have also been examined (Alvarez-Sanchez et al, 1999; Fiebert et al, 1998; Panique et al 1997; Chu et al, 1984; Roberts et al, 1982; Roncha et al, 1997; Morena et al, 1994; Evanylo, 1989). Recommendations can be found for various cultivars to ensure newly developing leaf material has adequate nitrogen to promote vigorous plant establishment. However, these applications do not target developing sprouts specifically. In the case of starter fertilizers, usually these are placed in bands below and to the side of the planted seed piece (Chu et al, 1984; Clough, 1994; Simmons et al, 1980). In this location, developing roots are the target of the fertility application. Further nutrient application made at emergence does not target the emerging sprout.

Several experiments have been done to determine how sprouts grow and develop (Dyson and Digby, 1975; Davies and Ross, 1985). It was noted that sprouts can develop necrotic lesions below the apical tip, which is generally designated as sub apical necrosis (Dyson and Digby, 1975). This necrosis can eventually cause the apical sprout to senesce (Dyson and Digby, 1975). The death of this apical meristem results in the loss of apical dominance of the sprout and the eventual breaking of lateral buds lower down on the sprout. This translates into a greater aboveground stem number resulting in more

numerous, smaller tubers (Iritani et al, 1983; Haverkort et al, 1994). It has been shown under controlled conditions, that the application of calcium to the developing sprout will reduce or prevent the development of this sub apical necrosis and thereby permit the apical meristem to remain healthy and reduce lateral branching of the buds on the lower portion of the sprout (Dyson and Digby, 1975).

Little attention however has been paid to sprouts developing under field conditions and how fertility treatments prior to emergence may effect subsequent plant growth and development. The focus of this study was to examine the effect of a preemergent application of nitrogen and/or calcium, to the sprouting tuber, on the subsequent growth and development of the plants in the field. In addition, a post emergent application of nitrogen and calcium beginning at hilling was also made to study the effect that nitrogen and calcium have on tubers that have already begun to develop.

Materials and Methods

Timing of relevant applications of nutrients and crop scheduling events is given in Table 1. A-grade commercial seed was purchased and cut using a commercial seed cutter (Milestone Blackfoot Inc., Blackfoot, ID). This cut seed was stored for 6 days at 50°F and 90+% relative humidity to allow seed to heal prior to planting. It was machine planted using a customized planter modified for research use (Gallenberg, Antigo, WI). At planting starter fertilizer (6-10-19, JayMar Inc., Plover, WI, applied at a rate of 536 $lb \cdot a^{-1}$) was incorporated into the furrow 5 cm below and to the sides of the seed piece.

Plots were established in a randomized complete block design with all treatments appearing in each block and 5 replications of each treatment. Plots consisted of four 20 foot rows the inner two treated rows serving as the experimental unit and the outer two

rows serving as guard rows. A precise record of nutrient timing and application totals appears in Table 2. All guard rows received 150 lb·a^{-1} nitrogen from solid ammonium nitrate (34-0-0), delivered by hand using calibrated measuring cups. Non split nitrogen control plots were treated in an identical way with all nitrogen applied by hilling.

Preemergent and post hilling applications of nutrients were done in the following manner. Solid ammonium nitrate (PreAmNit), liquid calcium nitrate (9-0-0-11, HydroAgri of North America) + solid ammonium nitrate (PreCaNit), or a mixture of calcium chloride (98+% reagent grade, Aldrich Chemical Co., Milwaukee, WI) + calcium nitrate + urea (99% reagent grade, Aldrich Chemical Co., Milwaukee, WI) (PreCUC) were solubilized in 3 gallons of irrigation water. Total nitrogen and calcium were balanced across all split application treatments at 150 lb·a^{-1}. An additional application of 50 lb·a^{-1} nitrogen and calcium was made at hilling + 8 weeks, due to a 5" rain which followed the last scheduled application (hilling + 6 weeks). The 3 gallons were equally divided into four 1 gallon watering cans. These were used for hand application of nutrients to the hill. Care was taken to target the top of the hill and application rate was slow enough to avoid runoff into the furrows. Two cans were applied to each row, with the application of each can beginning at opposite ends of the row to minimized the chance for uneven application along the row. All plots were irrigated with a center pivot irrigation system. Conventional management practices for potato production in the central sands area of Wisconsin were followed with regards to cultivation and pesticide applications.

Several measurements of quality were used to evaluate treatment performance during the growing season and following harvest. A visual rating of stand quality was

taken at 64 days after hilling. Each plot was evaluated individually by 3 independent raters for its stand quality and health. Plots were rated on a scale of 1 (100% of foliage senesced) to 10 (100% of visible foliage healthy).

Plots were machine harvested, with a customized harvester (Gallenberg, Antigo, WI), following chemical vine desiccation and tubers were washed and machine graded based on tuber size. Following tuber grading 4-6 oz and 6-13 oz tubers from each plot were separately bagged and transported to Madison for storage (41°F, 60% relative humidity) until evaluation could occur. Each of the two size categories from each plot were treated separately for evaluation of internal quality. From each sack 100 tubers were selected and cut longitudinally to expose the internal cortex, pith and medulary tissue. The half showing the least defect was immediately discarded and the remaining half was saved for visual rating. A count of any internal disorder visible in the cut section including bruise, hollow heart, internal brown spot, and brown center was taken.

Calcium samples were collected from healthy nondefected tubers by selecting three groups of ten tuber halves following internal quality evaluation. These halves were then sampled for calcium by taking a fresh 0.25 inch slice from the 10 tuber halves in each sample. Slices from each 10 tuber sample were then bulked together for calcium analysis. Each slice was cut lengthwise and the meduallary tissue was separated from the periderm by cutting along the cortical ring. Meduallary tissue was selected for calcium analysis, because it is within this tissue that the internal defects evaluated for traditionally develop. The tissue exterior to the cortical ring was not used for calcium analysis in this experiment. The meduallary tissue for each of the 10 tuber slices was bulked together