USE OF MINERAL ELEMENT CONTENT OF POTATO PETIOLES FOR PREDICTING YIELD POTENTIAL

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Abstract

Six potato clones (Kennebec, Norchip, Norland, Red Pontiac, Russet Burbank, and M6664) were grown in a split-plot designed experiment to study the relationship of tuber yield and the mineral element content of petioles, both measured at 14 day intervals during the growing season.

Seasonal trends in the N, P, K, and Mg content in petioles were highly intercorrelated. Concentrations of N, P, and K decreased with time, while Mg increased. Clones differed in the rate of change in these elements during growth. Trends in N, P, K and Mg content in petioles were highly correlated with tuber bulking. Change in N, P, K, and Mg concentrations are hypothesized to be a function of the sink strength of developing tubers.

For another set of potato clones grown in a replicated yield trial, the change in petiolar K content with time was the “best” variable associated with final tuber yields. A regression model [Model II: \( Y(cwt/A)=200.6223-1887.0150(b_k) \)] is given for predicting the yield potential of 18 clones. Given the slope of the petiolar K concentration \( (b_k) \) during growth, this model identified 9 of the 10 top yielding clones. Factors affecting the reliability of the model are discussed.

Resumen

Seis clases de papa (Kennebec, Norchip, Norland, Red Pontiac, Russet Burbank y M6664) se crecieron con diseños de bloques separados para estudiar las relaciones entre el rendimiento y el contenido de elementos minerales de los peciolos, ambos medidos a 14 días de intervalo durante la estación de crecimiento.

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Tendencias estacionales en el contenido de N, P, K y Mg en los peciolos fueron altamente correlacionados. Concentraciones de N, P, K disminuyeron con el tiempo, mientras que Mg aumentó. Los clones fueron diferentes en la taza de cambio. Las tendencias en N, P, K y Mg de los peciolos fueron altamente correlacionadas con la tuberización. Cambios en las concentraciones de N, P, K y Mg se hipotetizan como funciones del poder de reservorio de tubérculos en desarrollo.

Para otro grupo de clones crecidos en una prueba de campo replicada, el cambio en el contenido de K en el peciolo con el tiempo fue la "mejor" variable asociada con el rendimiento final. Un modelo de regresión [Modelo II: Y (cwt/A) = 200.6223 - 1887.0150 (bk)] se da para prevenir el potencial de rendimiento de 18 clones. Dada la inclinación de la concentración de K en el peciolo (bk) durante el crecimiento, este modelo identificó 9 de los 10 clones más rendidores. Se discuten los factores que afectan la seguridad del modelo.

Introduction

Conventional approaches of plant breeding are aimed at selection for yield, quality, and resistance to pests. Yield, a complex quantitative trait, is the phenotypic expression of several physiological and morphological characters. The function and interaction of these characters are the bases of varietal differences in yielding ability.

Donald (14) suggested another philosophy in plant breeding, the breeding of model plants or "ideotypes". Breeding crop "ideotypes" for yield requires identification of characteristics which are correlated with yield.

The distribution of dry matter and of N, P, and K in plants is similar. Grafting experiments using tomatoes and potatoes have shown that N, P, and K accumulated in tubers and fruits roughly the same as the dry matter in the plant (7). Similar patterns of distribution of N, P, K, and of 14C have also been observed (32). N, P, and K concentrations were at maximum values in the foliage at the time of tuberization; after tuberization the developing tubers became dominant sinks and N, P, and K concentrations decreased in the foliage. After tuber initiation 14C was moved out of the leaves and into the tubers. Prior to tuber initiation no definite pattern of 14C distribution was apparent. Kunkel et al. (27) have indicated that a low correlation existed between yield and the total amounts of N, P, and K in potato vines; however, the correlation between total amounts of these elements in the tubers and yield ranged from .90 for P to .93 for N and K.

Variatel differences in nutrient uptake and yield response have been reviewed by Vose (42). Varietal differences in accumulation of mineral elements have been shown in potatoes and many other plant species (10, 11, 25, 26, 36, 37, 42) and are heritable (36, 37, 42). Small genotype x