

Nitrogen fertilizer applications, for maximum fertilizer efficiencies and crop yields, should be based on the N required by the crop during its various growth stages. The objectives of this paper were to identify the N requirements of the potato plant (*Solanum tuberosum* L.) during growth and to evaluate selected soil and plant tissue tests as indicators of the plant's N status. Growth analysis data and soil and petiole NO₃-N concentrations were obtained at predetermined time intervals from N fertilization treatments in replicated field studies on a coarse-silty mixed, mesic Durixerollic Calciorthrid soil. Maximum early tuber growth occurred when leaf area index was between 2.5 and 3.2 and the tops contained between 79 and 100 kg N ha⁻¹ at the start of linear tuber growth. A preplant N fertilizer application between 67 and 134 kg ha⁻¹ gave these characteristics under the experimental conditions. The maximum dry matter production rate per day (approx. 250 kg ha⁻¹) occurred when there was between 80 and 140 kg N ha⁻¹ in the plant tops and roots. An average tuber growth rate of 0.75 Mg ha⁻¹ day⁻¹ required a N uptake rate of 3.7 kg ha⁻¹ day⁻¹ to prevent the loss of N and dry matter from the tops and roots. Sufficient N was available for this rate when the soil NO₃-N concentration was > 7.5 mg kg⁻¹ (0.46-m soil depth), corresponding to 15 000 mg kg⁻¹ NO₃-N in the fourth petiole. Soil and petiole NO₃-N concentrations may be used to adjust the N fertilization rates during the growing season. This practice has the potential of increasing the overall N fertilizer use efficiency and final tuber yields within the climatic, disease, and variety limitations.