

## Regression of Tobacco Black-Shank Index on Soil Calcium

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### ABSTRACT

The development of tobacco black shank (*Phytophthora parasitica* var. *nicotianae*) in unfumigated soils was directly related to soil calcium expressed as per cent of soil cation-exchange capacity (CEC). Development of the disease in fumigated soils was quadratically related to soil calcium, with maximum disease occurring at a relatively high Ca level of 67% of CEC. Where black shank is an important factor in tobacco production, applications of liming materials should be kept to a minimum consistent with good yield and quality of the crop.

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Regression of tobacco black-shank (*Phytophthora parasitica* Dast. var. *nicotianae* [B. de Haan] Tucker) index on soil pH, K, and Mg were reported by Kincaid et al. (3), but results with Ca were conflicting and the relationship between disease index and Ca was left in question. Wills & Moore (4) working with nutrient solutions found that black-shank development was directly related to the concentration of Ca. We attempted to reconcile the differing results regarding the role of Ca by expressing Ca as per cent of soil cation-exchange capacity (CEC). Regression equations were determined in a step-wise manner, as previously reported (3). All tests of significance were based on a 90% level of confidence.

We subjected the data of Dukes (1) and Dukes & Apple (2), and also unpublished data which they kindly supplied, to regression analysis. They studied the inoculum potential of black shank in 99 samples of North Carolina soils. The soils ranged in CEC from 0.90 to 19.10 meq/100 g; and in Ca, from 6 to 84% of CEC. We assumed that the amount of Ca in the soil solution was more closely related to exchangeable Ca expressed as per cent of soil CEC than to the amount of Ca expressed either as lb. per acre or meq per 100

g. Therefore, we used as independent variables the amounts of K, Ca, and Mg expressed as per cent of CEC, as previously suggested (3), leaving pH and  $P_2O_5$  lb./acre unchanged.

Dukes & Apple (2) divided each of the 99 soil samples into subsamples. One set of subsamples was left unfumigated, and another was fumigated with methyl bromide before inoculation with a culture of the black-shank pathogen. For both unfumigated and fumigated soils, we derived estimated regression equations for disease index (1, 2) and soil analyses for K, Ca, and Mg expressed as per cent of CEC, and also pH and  $P_2O_5$ .

The results showed a relationship between disease index and soil Ca expressed as per cent of CEC. The relationship was not evident when Ca was expressed as amount present in the soil extract (3).

The equation for unfumigated soil follows: Disease index =  $-83.98 + 30.20(\text{pH}) - 2.509(\text{pH})^2 + 0.0833(\text{Ca}) + 0.1208(\text{Mg})$ . The disease was directly related to soil Ca expressed as per cent of CEC. Conditions in the unfumigated soil may be considered representative of the biologically complex field soils, which included competitors and antagonists of the pathogen (1). Where black shank is an important factor in tobacco production, applications of liming materials to tobacco fields should be kept to a minimum consistent with good yield and quality of the crop.

The equation for fumigated soil follows: Disease index =  $-71.90 + 27.55(\text{pH}) - 2.327(\text{pH})^2 + 0.229(\text{Ca}) - 0.00170(\text{Ca})^2$ . The disease index was quadratically related to soil Ca, with maximum disease occurring at a relatively high Ca level of 67% of CEC. Conditions in the fumigated soil are the more comparable to those in substrates used in laboratory or greenhouse studies. The relationship of Ca and other elements to the pathogenesis of black shank should be further investigated under controlled conditions.

### LITERATURE CITED

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