Nutrient (including iron) demand model in peach trees

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Introduction

Nutrient deficiencies occur in most areas devoted to agricultural practices, causing major losses to farmers. For instance, Fe deficiency in fruit trees growing in calcareous soils leads to decreases in fruit quality, yield and also to early tree death. Nutritional disorders in crops are corrected by adding mineral elements in standard routine treatments, often ignoring the real nutritional status of trees. Thereby, application of fertilisers on a regular basis can lead to an excess of available nutrients in relation to the real nutrient demand of crops. Such nutrient surplus can be either immobilised in the soil or leached, and can consequently contaminate superficial and underground waters. Therefore, our knowledge about nutrient budgets in fruit tree crops should be improved.

Material and methods

This study was carried out in peach trees and the variety used was Catherina grafted on GF677. Macro- (N, P, K, Ca and Mg), and micro-elements (Fe, Cu, Zn and Mn) were analized in pruning materials, flowers, fruit thinning, fruit harvest and leaves. Equations to estimate dry matter as a function of tree age or trunk diameter (not shown) were developed. The amount of nutrients removed during each event was obtained by multiplying the concentration of the element by the quantity of dry matter of the removed material.

Objective

An approach to develop a model for the annual iron uptake in peach is presented. The model is based on the hypothesis of the correlation between the amount of nutrients removed every year and the biomass increment. The aim of this work is to improve fertilizer use by adapting application rates to real requirements.

Results

The model uses a set of equations which explain the evolution of the amount of dry matter removed during the different events of the tree vegetative cycle. In this work results will be explained taking the iron as an example. The application of this approach with all nutrients will give us the nutrient demand during the peach vegetative cycle. Equations obtained to calculate the dry matter quantity at each removal event are indicated in the table, where Y is the quantity of dry matter removed at the correspondent event and X the peach tree age. For fruit harvest, flower abscission and leaf fall the dry matter quantity was the average measured in two years, because the allometric relationships found in the two years of study were quite different.

Removing event	Dry matter estimation (g) from tree age	Fe concentration ($mg.kg^{-1}$ DM)
Flower abscission	34.495	214.5
Fruit thinning	$Y = 67.04 X^2 - 2062.5 X + 15981$	72.71
Fruit harvest	1518.20	51.90
Green pruning	$Y = -20.947 X^2 + 408.27 X - 713.03$	92.05
Leaf fall	1104.87	235.07
Winter pruning	$Y = 0.6011 X^{2.8127}$	70.10

The total amount of removed iron during all the peach cycle will be:

$$Fe\ (g/tree/vegetative\ cycle) = 10^{-6} * [92.05 * [(-20.947) * X^2 + 408.27 * X - 713.03] + 70.10 * [0.6011 * X^{2.8127}] + 72.71 * [67.04 X^2 - 2062.5 * X + 15981] + 51.90 * 1518.20 + 214.5 * 34{,}495 + 235.07 * 1104{,}87]$$

FINAL IRON REQUIREMENT EQUATION

$$Fe\ (g/tree/vegetative\ cycle) = 1.701 + 10^{-6} * [(-2946.3) * (Tree\ age)^2 + 14.996 * 10^4 * (Tree\ age) + 42.137 * (Tree\ age)^{2.8127}]$$

Conclusions

The model uses as inputs the tree age and obtains as outputs the dry matter removed by vegetative material.

Some authors indicated that the tree growth and the evolution of trunk diameter are influenced by the tree density. That's why this work will be continued to follow more cycles in order to consider both the tree and the plantation effects and to upgrade the results with other peach cultivars.

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