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YIELD OF CLINGSTONE PEACH ORCHARDS IN RELATION TO SOIL FERTILITY PARAMETERS IN NORTHERN GREECE

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Introduction

Peach trees (*Pr. persica L.*) are cultivated in a great extent in Vegoritis area (northern Greece). Especially, clingstone peaches are mainly produced and exported abroad as processed fruit.

Growth, mineral nutrition of peach trees and fruit quality characteristics depend upon plant material used (rootstock, variety) as well as the soil climatic factors prevailing in the area (Caruso et al., 1995). For normal plant growth and development, peach trees require large amounts of nutrient elements (Xie and Cummings, 1995).

This objective of this paper is to study the relationships between the main soil characteristics and the yield of peach orchards. This is crucial for investigation of soil quality as well as to control the inputs of chemical fertilisers and optimise crop yield.

Materials and Methods

Thirty-one clingstone peach orchards grafted with late maturing scion cultivars on peach seedling rootstocks were randomly selected for the conduction of this study during the year 2000. The area of the studied orchards ranged from 0.5 to 1 ha and the age of the trees ranged from 7 to 15 years old. Planting density was 400 trees/ha and standard cultivation practices were applied regarding irrigation, insect, disease, and weed control.

Soil samples were taken for each field from 0-30 cm, 30-60 cm and 60-90 cm depth and analysed for pH, free $CaCO_3$ content (%), electrical conductivity (mmhos/cm), organic matter content (%) as well as P, K, Ca, Mg, B, Mn, Zn, Fe and Cu mineral content (ppm) (Table 1).

The physicochemical soil characteristics were determined according to the following: pH, electrical conductivity (mmhos/cm), $CaCO_3$ content (%) and B content by Jackson (1958), P content by Olsen (1954), organic matter content (%) by Walkey Black method (Jackson, 1958), exchangeable potassium extracted with NH_4OAc by Arnold (1970) and the microelements Mn, Zn, Fe and Cu extracted with DTPA by Lindsay and Norvell (1978).

Only nitrogen fertilisers were applied at a total rate of 300 kg/ha one month before flowering as base application (200 kg/ha) and during fruit set period as a top dressing application (100 kg/ha). The nutrients P, K, Ca, Mg, B, Mn, Zn, Fe and Cu were applied occasionally when soil nutrients were inadequate.

Yield (t/ha) was recorded by weighing the orchard yield at harvest. Multiple regression analysis was performed for yield prediction based on soil parameters studied. The predicted versus the observed yields were also compared (Velemis et al., 1998). In addition, the component effects of the soil parameters on peach orchards yields were defined. Statgraphics 3.0 package was used for the statistical analysis of the recorded data.

Results and Discussions

Table 1 presents the range of certain characteristics of the studied soils. The observed orchards yields ranged from 9 to 50 t/ha with a standard deviation (sd) of 13.5 t/ha and a mean yield 32.5 t/ha.

Table 1. Range of soil parameters in peach orchards at the area of Vegoritis.

Parameters	Values	
	Lower	Higher
pH (1:1 in H_2O)	6.85	8.80
$CaCO_3$ (%)	1.32	44.00
E.C.(mmhos/cm)	0.24	2.87
Organic matter (%)	0.65	2.53
P (mg/kg soil)	4.31	118.38
K (mg/kg soil)	60.00	600.00
Ca exch. (mg/kg soil)	238.00	1046.00
Mg exch. (mg/kg soil)	34.80	120.00
B (mg/kg soil)	0.13	0.96
Mn (mg/kg soil)	1.08	38.60
Zn (mg/kg soil)	0.34	7.60
Fe (mg/kg soil)	2.08	20.90
Cu (mg/kg soil)	0.78	6.92

Multiple regression analysis showed that peach orchards yields was highly correlated with the studied soil parameters [r^2 (adj.)= 0.931] (Fig. 1). However, by applying a stepwise variable selection program, the parameters pH, $CaCO_3$ content, electrical conductivity, P, K and Cu were found to be the most important variables for yield prediction [r^2 (adj.)= 0.938] (Table 2). Since our research target was to study the effect of each soil parameter on peach orchard yields, all of them were included in the model (Figs 2-4).

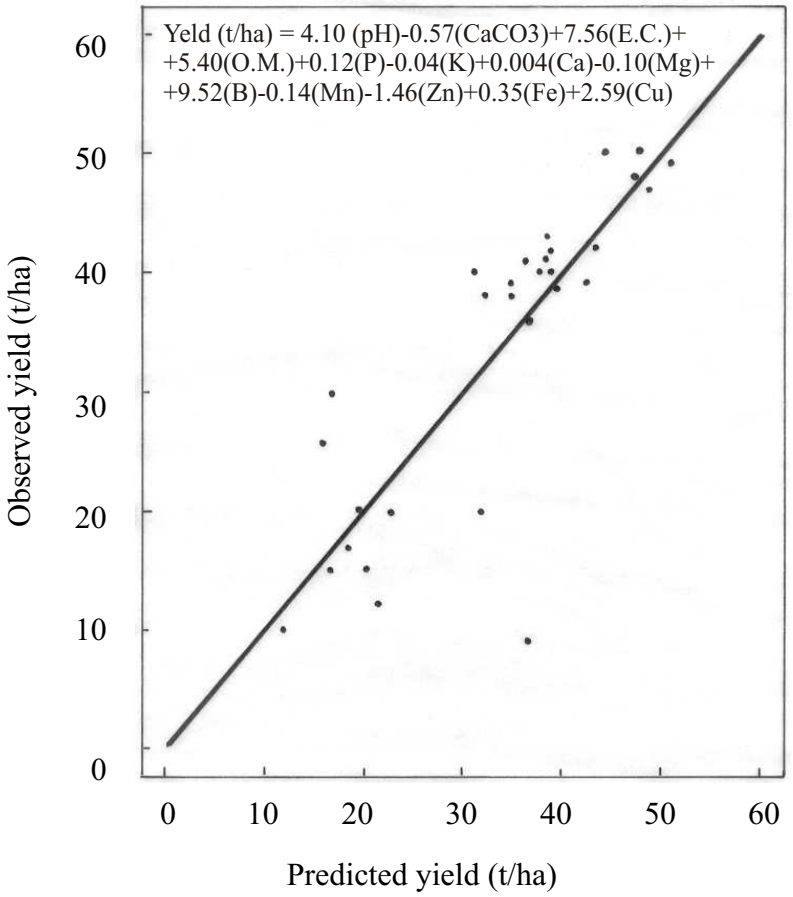

Figure 1. Observed and predicted yields of peach orchards related to certain physical and chemical soil parameters {r^2(adj.)= 0.931}.

Table 2. Significance of soil parameters in relation to peach orchards yields resulted by a stepwise variable selection program.

Significant parameters	**F-value**	**Non significant parameters**	**F-value**
pH	30.87	**Organic matter**	0.06
$CaCO_3$	13.88	B	0.05
E.C.	7.80	Mn	0.16
P	4.55	Zn	0.29
K	7.32	Fe	0.20
Cu	8.89	Ca	0.09
		Mg	0.22

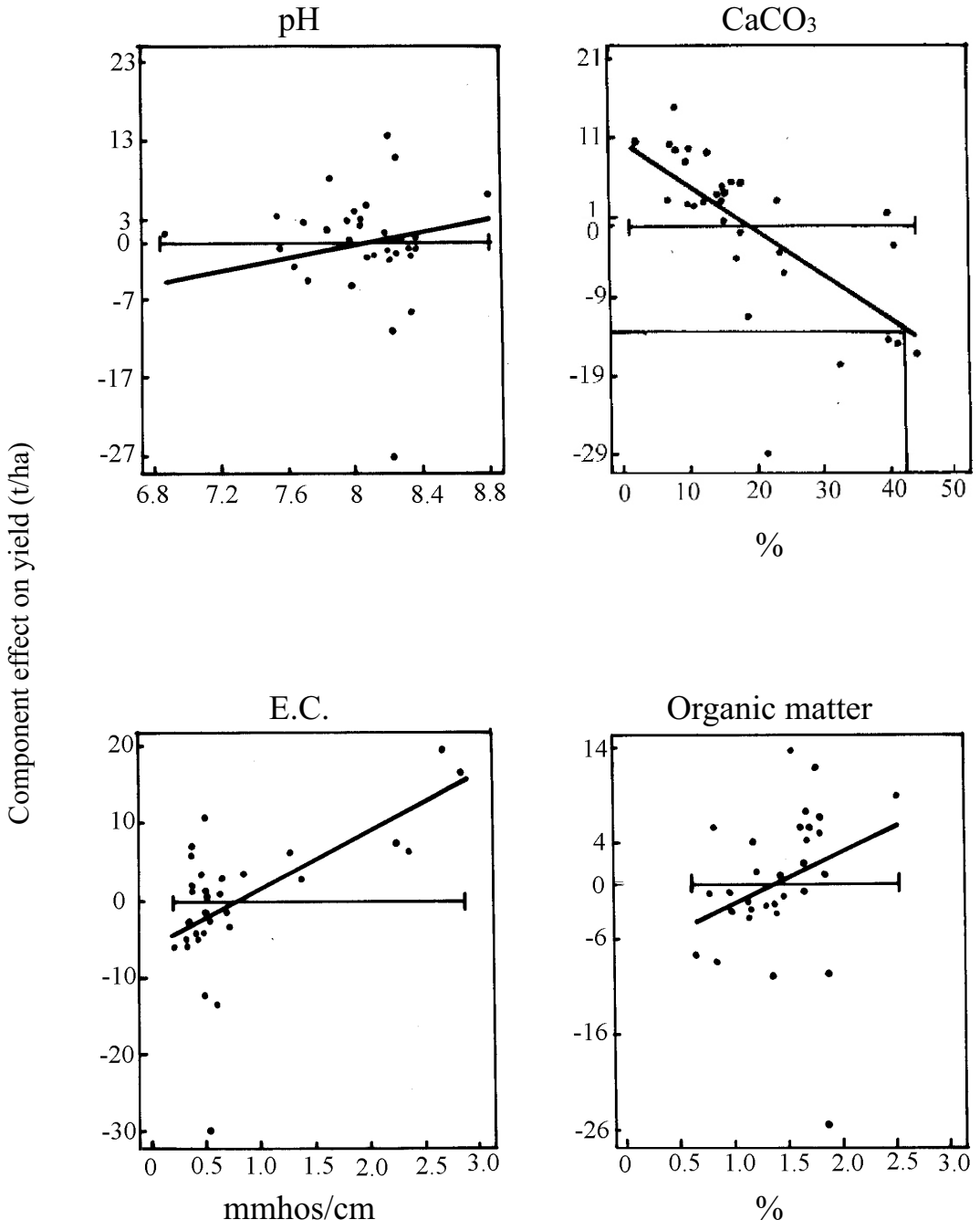

Figure 2. Component effect of soil pH, $CaCO_3$ content, electrical conductivity and organic matter content onure peach orchards yields (sd=13.5 t/ha).

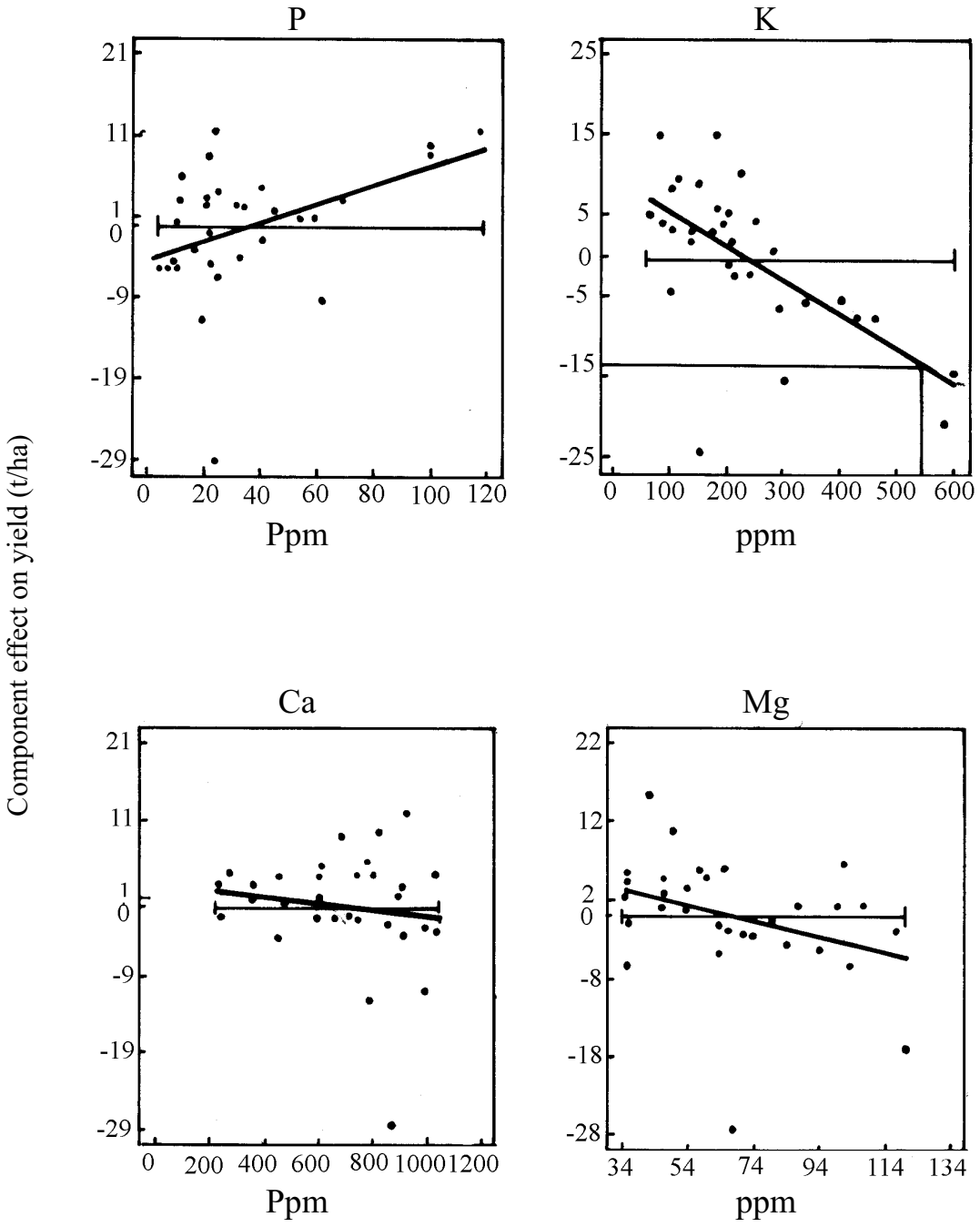

Figure 3. Component effect of soil P, K, Ca and Mg content on peach orchards yields (sd=13.5 t/ha).

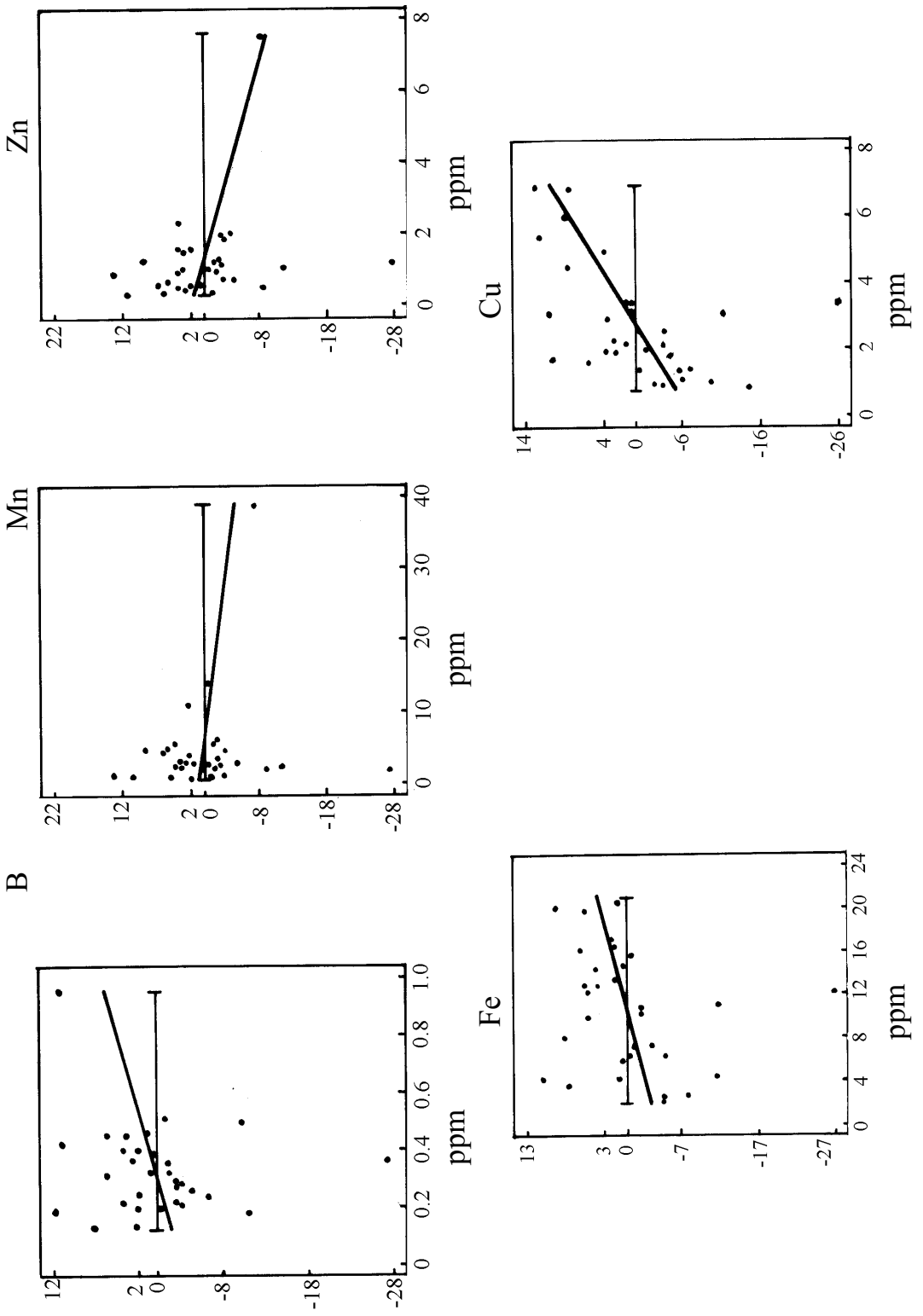

Figure 4 .Component effect of soil B, Mn, Zn, Fe and Cu content on peach orchards yields (sd=13.5 t/ha)

Conclusions

In regard to the effect of physicochemical soil properties, the study concluded that, the higher the values of pH, electrical conductivity and organic matter content the higher was the yield while opposite results were obtained with the respective values of $CaCO_3$ content (Fig. 2). Although the positive effect of pH, electrical conductivity and organic matter content, their effect on yield was found not be significant. In contrast, soil $CaCO_3$ content values higher than 42% affected yield significantly because yield response was reduced by more than the standard deviation of the mean yield (sd= 13.5 t/ha).

In addition, increased soil content in P, B, Fe and Cu had a positive effect, while in K, Ca, Mg, Mn, Zn a negative one (Figs 3 and 4). The effects of the above-mentioned nutrients, except K, were not considered significant because of their small influence on yield. In contrast, soil K content values higher than 540 ppm affected yield significantly because yield response was reduced by more than the standard deviation of the mean yield.

From the above results obtained in this area and considering the multiple regression, all the soil parameters included in the study were highly related to orchards yields. In addition, the component effects of $CaCO_3$ and K soil content on peach orchards yields were considered significant with upper threshold values 42% and 540 ppm respectively.

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