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CRITERIA AND INDICATORS FOR AN EXPERT SYSTEM IN FRUIT-TREE LANDS AND ORCHARDS

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Abstract

The paper presents an integrated and operational set of measurable criteria and indicators as a basis for a harmonized comprehensive information system used for achieving an intelligent infrastructure to create an ecologic quantified and integrated model of the climate, land and infrastructure resources, specific to fruit-tree lands and orchards.

The objectives were to emphasize the monitorisation of the climatic conditions, soil fertility and biometrical measurements in some of the studied areas, in order to supplement the database.

INTRODUCTION

It is unanimously admitted, nowadays, that a category of assortments can achieve its biological potential (even in the case of an avant-garde technology is applied) only if the ecological offer of the area optimally satisfies the biological needs.

The specific objective of the paper is the management of the natural (climate, soil, relief etc.) and artificial (orchards, infrastructure) resources, as well as the quantification and the characterization of the indicators of these resources, in an expert system.

The purpose of the researchers is to show the criteria and indicators necessary for an expert system in fruit-tree lands and orchards in S.C.D.P. Bistrita.

MATERIAL AND METHODS

The researchers were carried out on Dystric Anthrosol from a Bistrita orchard, at two varieties of apple: Golden Delicious and Florina.

The physical properties as non-gleyed, non-pseudogleyed soil volume (%), particle size distribution (%), bulk density (g/cm^3), aeration porosity (volume-%), permeability (mm/hour) and resistance to penetration (kg/cm^2) were analyzed. Soil fertility was characterized by humus content (%), C/N ratio, content of total nitrogen (%), available P and K (ppm) and microelements (ppm). The chemical parameter as pH_{H2O}, total cation exchange capacity (me/100g soil), base saturation degree (%), exchangeable aluminum (ppm), total and active carbonates (%) and

exchangeable cations (%) were also determined according to the ICPA methodology [1].

RESULTS AND DISCUSSION

The results showed that from all the relevant scientific indicators for fruit-tree cultivation, the air thermic conditions have a basic role. These thermic conditions refer to the optimal average air temperature of months and of monthly intervals required for phenological phases, for each fruit-tree category at species/variety/rootstock level. The relevant *scientific indicators* for fruit-tree ecosystem are:

Temperature

The *minimum absolute temperature* with different values when decrease suddenly or slowly at species level; the *thermic amplitude* in: November-February for plum tree, cherry tree, apricot tree and peach tree; December-February for apple tree, pear tree and sweet cherry tree.

Rainfalls

Rainfalls are also quantified in the period of V-VII months for apple tree, pear tree, plum tree, sweet cherry tree, cherry tree and peach tree, and apricot tree.

According to this method, the frequency of repetitiveness of thresholds and optimal climatic intervals in the last 10 years is expressed by frequency (%) in five classes: null (frequency of 0-5%), very low, low, moderate and optimum (with frequency of 90-100%).

The paper prognosis the frequency of repetitiveness of thresholds and optimum climatic intervals and considers some studied fruit-tree species grouped considering the soil type. In this view, grouping the lands of fruit-tree patrimony in *no restrictions* lands, lands with restrictions and lands excluded from climatic point of view, will be achieved for further integration in the ecological quantified module.

In order to achieve the tasks of the objective and to develop the climatic model quantified in addition points, as well as to test and to validate in the field the thresholds and climatic intervals values, the climate data and the yield (between 1996 and 2005) were statistically processed. The obtained yields for apple in Bistrita orchard, at the 2 varieties of apple were studied in relation to the thermic amplitude (°C, XI–II months). For the studied years, the apple yield fluctuated, according to the climate and thermic amplitude (figure 1).

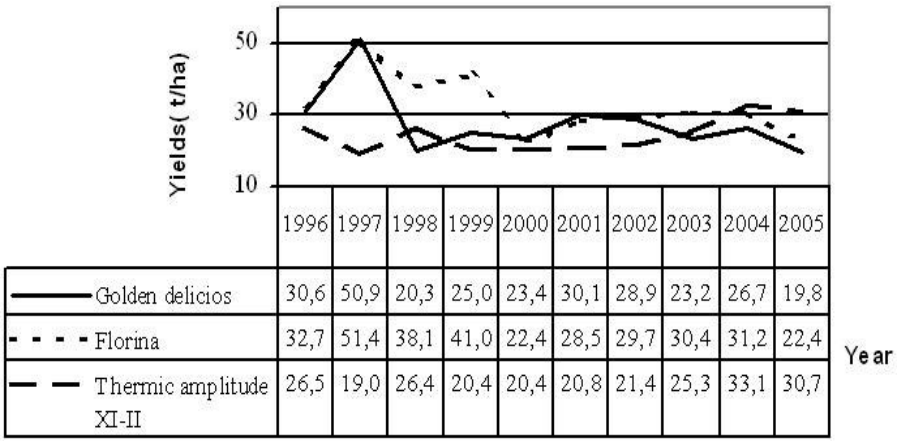

Fig. 1. The variation of the yield levels (t/ha) in relation to the thermic amplitude (°C, XI –II months) for apple: Golden Delicious and Florina, S. C. D. P. Bistrița

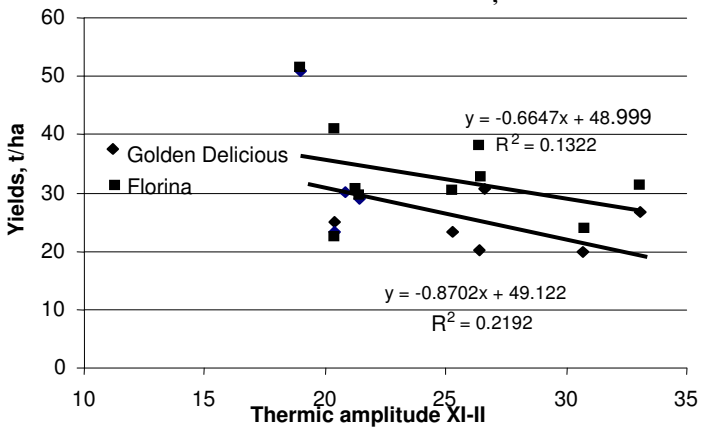

Fig. 2. The relation between the yields and thermic amplitude (°C, XI-II months) for apple: Golden Delicious and Florina, S. C. D. P. Bistrița for 1996-2005

The yield decreases while the quantum of this thermic element is higher than 20ºC, as shown in figure 1 and 2.

Soil fertility

Soil is an essential component of the fruit-tree ecosystems. The paper has in view to quantify relief, drainage and soil conditions (active edaphic volume, pH, salinization, alkalization, mobile Al content of acid soils and $CaCO_3$ in relation

with depth of Cca, Cpr, Rz horizons, and active $CaCO_2$ in carbonates horizon) and industrial pollution [2].

Baseline values for relief, drainage and soil condition depending on their role in the fruit-tree ecosystem are granted with addition points. Depending on their baseline values, the fruit-tree lands are also grouped from the soil characteristic point of view in no restriction lands, lands with some restrictions and lands that cannot be used for fruit-tree cultivation.

To accomplish this objective, one important activity was to sample the soil for physical and chemical analysis in order to characterize soil fertility. The granulometric data (table 1) emphasize that Dystric Anthrosols from Bistrița orchard have a sandy-loam texture.

Table 1

Phisycal properties of Dystric Anthrosol from Bistrita

Horizon	Depth horizon	Non-gleied non-pseudogleyed soil volune	Granulometric fractions (%)				Bulk density	Porosity aeration	Permeability	Resistance to penetration
			Coarse sand 2,0-0,2	Fine sand 0,2-0,02	Loam 0,02-0,002	Clay < 0,002				
	cm	%	mm				g/cm^3	% vol.	mm/hour	kgf/cm^2
Do	30	100	28,0	37,0	14,8	20,2	1,23	26	89,97	4
Do/R	20	100	29,8	38,1	16,0	16,1	1,17	32	152,8	3
R	50	100	26,6	33,3	18,2	21,9	1,10	30	215,68	2
0-100	*100*	100	*28,1*	*36,1*	*16,3*	*21,9*	1,23	26	89,97	4

The bulk density is higher in the surface horizon (1.23 g/cm^3), decreasing drastically in the lower horizon (1.10 g/cm^3 - 1.17 g/cm^3).

As a result, the aeration porosity is very high and the permeability is also extremely high, which could positively influence the tree roots development.

Soil fertility (table 2) is also emphasizing by the data of physico-chemical analysis as organic matter and N, P, K.

Table 2

Fertility of Dystric Anthrosol from Bistrita

Horizon	Depth horizon	Humus	C/N	Total nitrogen	Available P	Available K	Microelements					
							Fe	Cu	Mn	Zn	B	Co
	cm	%		%	ppm							
Do	30	2,66	14	0,132	8	295	63	8	200	3	0,3	4
Do/R	20	1,53	9	0,117	16	137	59	6	148	3	0,2	4
R	50	1,20	9	0,090	6	120	54	3	96	2	0,1	3
0-100	*100*	*1,55*	*10*	*0,106*	*10*	*154*	57	5	131	3	0,2	4

The organic matter content is low, excepting of bioaccumulation horizon, and has directly influences the N, P, K values. The analytic data form table 2, show a low content of total N, a low level of mobile P and a high content of mobile K in the surface horizon.

Biometrical measurements

Biometrical measurements concern with the measurements of roots and trunks.

The indicators for roots biometry are:

The roots frequency representing the number of the roots, calculated according to the depth (from 10 to 10 cm) of soil profile, until 100 cm depth. In the field, the roots from each group of diameter were counted, according to the depths, and recorder in the field register card (figure 3):

1. The surface of root section;
2. The main root masse;
3. The indices of roots distribution.

The indicators for trunk biometry are:

1. The trunk of real age - use for the plantation characterization and for the expeditive estimation of fruit-tree yield;
2. The trunk of conventional age is use for the correlations with soil properties.

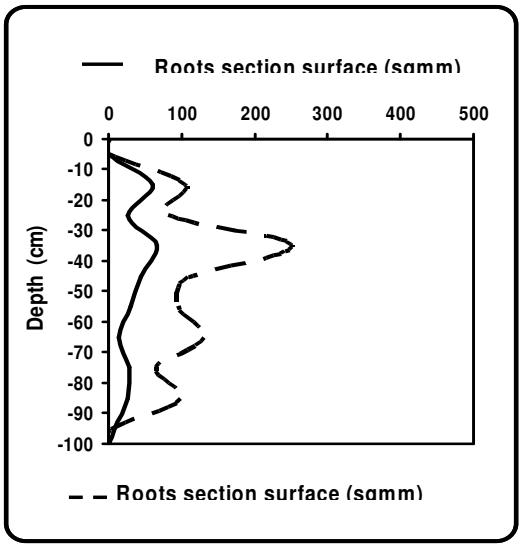

Fig. 3. Biometrical measurements at apple tree, Florina-SCDP Bistrița

The influence of soil conditions on trees trunk thickness is synthesized in these tow indicators for trunk biometry. These indicators react at the presence in soil of limiting factors inducing modifications opposite of normal distribution of the fruit trees root system [3].

CONCLUSIONS

1. The obtained yields for apple in Bistrita orchard, at the 2 varieties of apple were studied in relation to the thermic amplitude (°C, XI–II months). For the

studied years the apple yield fluctuated, according to the climate and thermic amplitude.

2. The granulometric data emphasize that Dystric Anthrosols from Bistrita orchard have a sandy-loam texture.
3. The organic matter content is low, excepting of bioaccumulation horizon, and has directly influences the N, P, K values. The analytic data show a low content of total N, a low level of mobile P and a high content of mobile K in the surface horizon.
4. The trunk biometry showed the influence of soil conditions on trees trunk thickness by the aim of two indicators: the trunk of real age and the trunk of conventional age.

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