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ARID CLIMATE IMPROVEMENT IN THE LOW PLAIN ARANCA WITH FRUIT TREE AND FOREST SHELTER - BELTS

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Abstract

The village territory Beba Veche is placed within the Low Plain Aranca in the western part of Romania of 9300 ha. The aridity of climate has been intensified because of wood cutting, and of an ample hydrotechnics and land improvement works. In present time there are 5-6 droughty years from ten years. The dominant soil types are Chernozems (44%) and Vertisols (37%). The shelter - belt must be composed of forest species but also from shrubs and fruit trees, like: Quercus, Fraxinus e., Robinia p., Alnus g., Cydonia o., Cerasus v., Malus d., Pirus s., Prunnus d.; Sorbus n., Corylus a., Hippophae r. The seedlings will be plant on 4 rows, with 2 m between rows and 1.5 m on the rows. The necessary of seedlings is about 375,000 seedlings and the costs can be recuperated in about 6-8 years.

Key words*: climate, shelter-belt, vertisols wind.*

INTRODUCTION

The Banat Plain is graduated in the high plain (Vinga, Gătaia, Socol, Buziaș), terrace plain (Recaș, Sudriaș, Biniș, Mureș) and low plain (Bega - Timiș, Moravița, Jimbolia and Aranca). As part of Banat Plain, Aranca Plain is characterized by the most dry climate from the Banat region (Rogobete et al., 2008; Rogobete et al., 2021).

Because until not long ago (19th century) the Low Plain Aranca were covered with water, ample hydrotechnics and land improvement have been effectuated (Man, 2015).

Beside the positive effects have existed some negative effects for example an overly coming – down for ground water table, up to three maters depth. Alongside with the precipitation deficit, it was been accentuated the necessity for shelter - belt.

The aridity of climate has been intensified also because the forest massif existing in the Banat Plain especially those around the settlements has been exhausted (Chisalita, 2015; Coste et al., 1997).

Similar phenomena has been noticed for Bărăgan Plain and Oltenia Plain by Lupu (Lupu, 1952) and Nesu (1999), which have proposed setting up forest belts for agricultural land.

It is appreciated that the forest belts will be diminish the evapo-transpiration, will maintain the snow layer a prolonged time, reduce the wind speed and in the same time contribute to increase the level of agricultural production.

It is necessary to mentioned the improvement the local climate, with positive effects of biodiversity. It can be added also the fruits production, wooden mass harvest and the presence multiplied of birds and other wild animals.

MATERIALS AND METHODS

In order to realize this thesis relative to shelter - belts, we have used the climatic data from weather station Sânnicolau Mare (30 km distance), the soil survey at scale 1:10.000 Beba Veche (OSPA - Timis - guide Rogobete), and a research theme from ICAS Timișoara (Adam and Rogobete, 2002) as principality bibliography sources. The materials used for shelter - belt in the Beba Veche territory were cadastral map 1:20000, drainage - system map 1:100000, soils map 1: 10000 (1994 year), climatic data with the frequence - speed and wind directions, and a list with adapted forest and fruits species for this area. The placement of the shelter belt in the perimeter of Beba Veche started to trace the network of the cadastral map. It has been realized an ideal network and after that was made a land

recognition, and we have remarked that is practically impossible to realize a complete network of shelter – belts, because there is not an agreement with the landowners, which accuse of loose the land. Also, the Romanian Natioanl Society of Land Improvement has deemed that the shelter belt must be placement only on one site of the channels for access of a mechanics maintenance.

RESULTS AND DISCUSIONS

The territory Beba Veche is situated in the western part of Aranca Plain, at the frontier zone with Serbia and Hungary and river Mureș and Galatca.

Figure 1. Map of Aranca Low Plain

Aranca Plain is a low plain (Figure 1), formed bu subsidence and has only 77-83 m altitude with numerous old and abandoned riverbeds, the plain being until the 18th century a huge swamp (Tarau et al., 2019).

After the ample improvement works effectuated in the 19th and 20th centuries, these lands become agricultural and land in crop use (Figure 2).

Aranca subsystem drainage, with an area of 55,582 ha is part of Sânnicolau Mare system which has 9 pumping station, with 63.47 mc/s water discharge installed.

Beside the positive effects there are some negative effects, for example an overly coming - down for ground water table up to three meters depth. Consequently, the radicular system of the plants has lost an important source of water - capillary fringe.

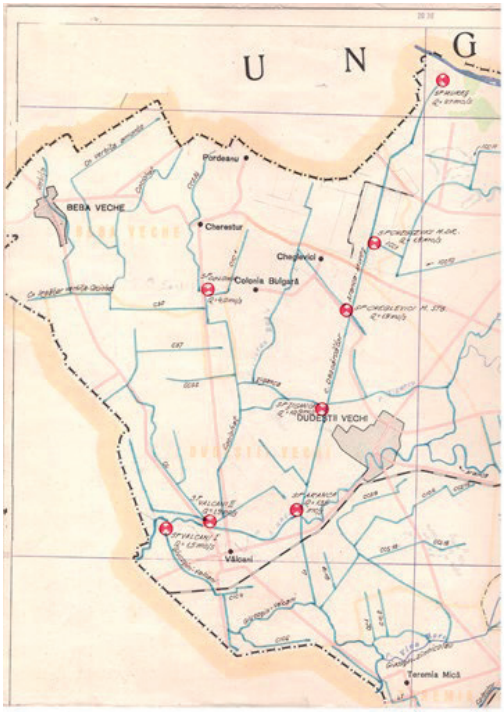

Figure 2. Map with land improvement works

At the present time, the ground water level fluctuates between 0.5-5.0 m depth and the chemical composition of the ground water is variable from one to other drilling, for example in the clayey deposits the total soluble salts content arrives at 3.0-5.0 g/l (Rogobete et al., 1997).

The total area of Beba Veche is 9300 ha. Which is composed of 7200 ha agricultural land, 600 ha built up, roads, 1500 ha drainage canals, and waste land. Aranca river is connected with Tisa river and by drainage system with Mures river (OSPA, 1994).

Shelter - belts are necessary for:

- village pasture, with a total length of 8.6 km and an area of 12.3 ha;
- channels in the agricultural land with a total length of 62.9 km and a area of 63.8 ha;
- village and exploitation roads and canals, with total length of 45.1 km, on 37.5 ha.

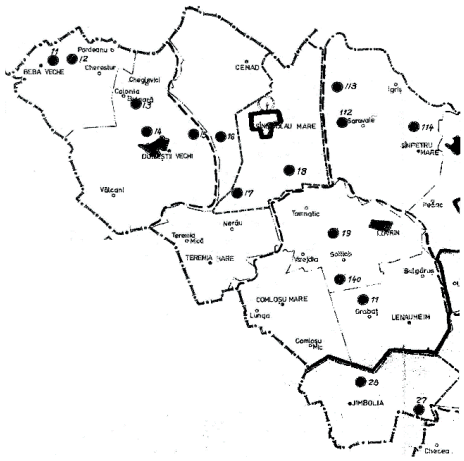

Figure 3. Hidrogeological control points

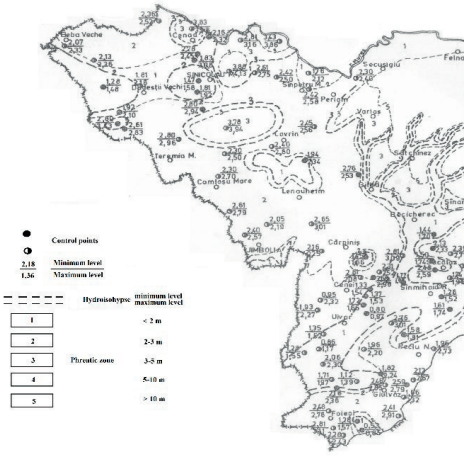

Figure 4. Hydrogeological map

From the climatic point of view, Aranca Plain is characterized by the temperate continental climate, with a topoclimate similar with steppe. The annual average temperature is 10.8ºC and 40 days tropical: July = 21.4ºC and August = 21.1ºC.

The multiannual average of precipitations is 536.3 mm, with the following values: July = 53.1 mm, August = 48.6 mm, September = 41.4 mm. It is necessary to specify it may be possible as 4-5 years from 10 years to be droughty, the precipitation deficit being accentuated by the wind with 30-40% (Mircov, 2015).

The initial natural vegetation of sylvosteppe, with *Quercus* sp. was replaced by agricultural crops and grassy vegetation, rich in halophite species, like Puccinelia, Statice etc.

The soil survey for Beba Veche (1994) and the map (Rogobete, 1997; Tarau et al., 2019) indicate for the agricultural Beba Veche territory (8817 ha) the soil cover (Table 1).

Table 1. Soil cover (8817 ha)

Soil type	AS	CZ	VS	GS	SN	Association
Surface, ha	528	3880	3263	160	104	882
%	5.99	44.01	37.01	1.81	1.18	10.0

Table 2. Quality class

Class	I	II	III	IV	V
%	10.31	26.85	27.21	34.39	1.24

From the Table 1, we can see that the dominant soil types are Chernozems (44%) and Vertisols (37%), which have the quality class I + II, respectively class III (approximately), but the soil cover from Beba Veche has important degradation processes, which affected all the soil types:

- water logging (surface water - 45% from total area, ground water = 67% from total area);
- salinization and sodication (78% from the total area);
- compaction (≈80 % from the total area).

The physical and chemical properties for the main soil types will be presented in the next tables, corresponding to the WRB system.

Table 3. Haplic Chernozems (phreatic moist - variety)

Horizons	Ap	Atp	Am	AmBv	Bv	C_{Ca}
Depth, cm	0 -15	-22	-39	-50	-83	121
Clay	31.0	30.0	31.8	31.6	30.2	27.2
Silt	25.9	22.9	22.5	24.7	20.0	22.0
OC	1.60	1.48	1.23	0.99		
CEC	25.35	24.18	25.90	25.25	22.79	18.90
BSP	86.6	87.4	87.8	90.2	91.5	100
pH_{H2O}	6.65	6.80	6.80	7.05	7.25	8.55
BD	1.30	1.40	1.33	1.33	1.33	1.40

The soil type Chernozems has the best physical, chemical and mechanical properties and represents 44% but some of them are gleyic or sodic, or with compaction phenomena in the plowpan horizon, Atp.

Tabel 4. Pellic - stagnic - gleyic Vertisols

Horizons	Azy	$ABzyW_3$	BzyGox	BzyCz
Depth, cm	14 - 26	42 - 69	99 - 130	130 - 163
Clay	74.6	77.0	78.5	77.6
Silt	13.3	11.2	10.2	10.4
pH_{H2O}	6.85	7.20	8.10	7.95
OC	2.41	1.82		
CEC	64.38	71.20	69.50	73.00
BSP	95.5	98.0	100	100
Bs	1.27	1.27	1.32	1.32
K	20	<10	<10	<10
FC	32.6	33.9	33.8	33.5
AW	8.4	10.7	10.0	12.0

The content of clay, wich is the biggest from all soil type in Romania. The soil retains a great quantity of water but the available water is very small, only 10% from the value of field capacity (> 33 %).

Since the mineralogical content of clay is dominated by smectite, which is expandable, the wetting and drying cycles cause these clays to expand and contract.

Deep craching occurs from the surface causes slickensides on the structure faces and oblique shear planes. These soils are increasingly being cultivated mechanically for a great diversity of crop. Although they have a relatively high water holding capacity, shallow rooting crops may suffer from drought stress Vertisols are low hydraulic conductivity and become very hard when dry. Agricultural use ranges from grazing, wood production to crop production (wheat, sorghum, rice).

Table 5. Calcaric Fluvisols (phreatic moist variety)

Horizons	A_{oK}	C_K	C_{IIK}	C_{vK}
Depth, cm	0 – 24	36 – 55	55 – 85	170 – 200
Clay	27.4	17.8	20.6	30.9
Silt	23.0	15.5	27.2	21.9
pH_{H2O}	8.15	8.35	8.40	8.75
OC	1.33	1.19	0.49	
CEC	28.30	25.00	23.30	26.00
BSP	100	100	100	100
BD	1.30	1.42	1.40	1.50
K	810	1010	400	110
FC	21.4	15.5	17.3	22.2
AW	130	10.7	10.0	12.0

The third as wide - spread, Fluvisols (6%) are in generally stratified, moderate fertility, the available capacity is better than of Vertisols, and the water movement are very good. Fluvisols can be very compact and many have a high groundwater table and exhibit gleyic properties. In many cases Fluvisols flooding can limits the use for arable cropping but they are widely used for grazing.

The climatic data, the frequency and intensity of the wind and the relief conditions, impose shelter - belt installation in order to improve environmental conditions.

The composition of the shelter - belt must be in accord with the soil cover, each one of vegetable species having typically requirements. We consider that it is necessary to introduce in the shelter - belt composition shrubs and fruit trees in order to increase the fruits resources in the Beba Veche settlement (Rubtov, 1974; Traci, 1985).

The proposed species list for shelter - belt is:

- Trees: *Quercus robur*, *Fraxinus excelsior*, *Robinia pseudoacacia*, *Tilia tomentosa*, *Alnus glutinosa*, *Cydonia oblonga*, *Juglans nigra*, *Cerasus avium*, *Cerasus vulgaris*, *Sorbus aucuparia*, *Malus domestica*, *Pirus sativa*;
- Shrubs: *Corylus avelana*, *Sambucus nigra*, *Hippophae rhumnoides*, *Prunnus domestica*, *Prunnus cerasifera*, *Prunnus vulgaris*, *Prunnus spinosa*, *Rosa canina*, *Ribes nigrum*, *Ribes rubrum*, *Crataegus monogyna*, *Syringa vulgaris*, *Rubus ideaeus*.

The sites which are predicted for shelter - belts planting and alignments presents very various aspects, such as:

- channels with different depths;
- with exploitation roads on the both sides;
- with only one road;
- with lateral road.

The shelter - belts planting can be realized on the side of channels which can have > 1.5 m depth or < 1.5 m depth:

- in the first case, plantation will be realized only of one side, with 10 m in width. The forest or fruit trees will be planting in the middle of the shelter - belt;
- in the second case will be planting 1-2 rows on the side of channel with *Salix alba* or *Cerasus avium*.

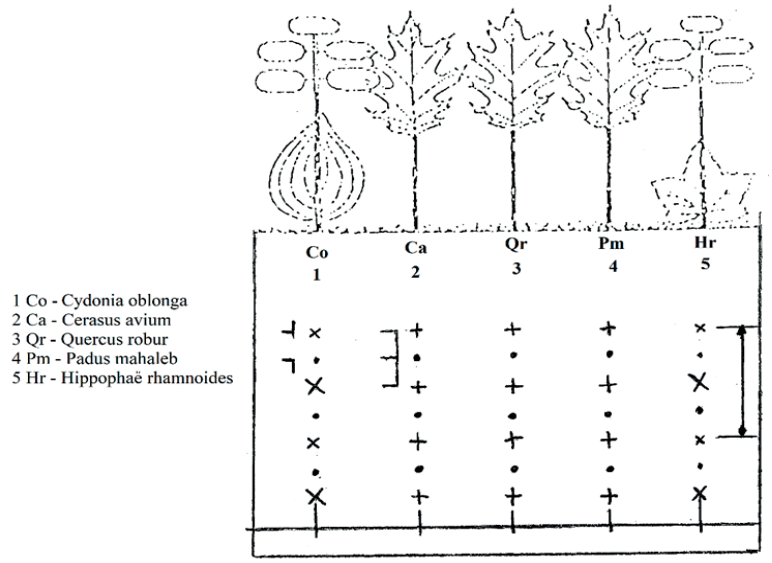

Figure 5. Mixed shelter - belt with Q. r. in the middle of row and fruit trees

The seedlings will be plant on 4 rows, with 2.0 m between rows and 1.5 m on the rows between seedlings.

The seedlings can be obtained in local nursery, which have 100-150 m^2, after a while of 2-4 years.

Table 6. Necessary Seedlings for shelter belts and alignments

- for pasture	31600 pieces
- in the perimeter of agricultural land	249380 pieces
- for alignments (secondary roads and channels)	43600 pieces
Total seedlings	324580 pieces

Table 7. All the costs for setting and maintenance shelter - belts (computation base on maize production and price)

year I	- tillage, planting, maintenance (mechanized and manual)	≈ 430 million lei
year II	- maintenance	≈ 269,414 million lei
Total year I + II ≈ 700 million lei		

A rough estimation of the total necessary seedlings for the Beba Veche village shows about 375.000 (with 20% insurance). Current expenditure with the establishment and maintenance in the first 4 years are estimated to be of about 250.000E.

After 10-12 years, the shelter - belts reach maturity and create a microclimate with a favorable effect on agricultural production, effect estimated through an increasing of about 8-10% for the level of the production.

At this must be added the plus production of wooden mass and fruits.

The gains obtained annually are estimated of about 80 mill E so that it can be recouped the initial investment in four years.

CONCLUSIONS

The shelter - belt realization presumes to use the cadastral maps of 1: 10.000 scale with the soil cover, with the drainage system, which has the stations pumping and the main and secondary drainage channels, the village roads and the exploitation roads, the hydrological and hydrographic maps and of course the climatic data.

These materials allow to realize the shelter - belt corresponding with the environmental factors and with the requirements of the used receipt, respectively the type of species. The economic computations prognosticate a retrieval for the cost after 10 years.

Shelter - belt, with forest and fruit trees improve the quality of life and the biodiversity.

Due to the great capital expenditures, we propose to realize only a network shelter - belts in a closed circuit which can delimits an area of about 200-300 ha and this area will be protected against winds from all directions.

The Hungarian researches have proposed to located shelter - belts on different angles in comparison with the principal wind direction.
Such an integrated system of shelter - belt is enough if covers 2-3% of agricultural land.
The placement of shelter - belt must to take account of the property owner their acceptance.
In variety of trees and fruit trees which be planted are determined by the soil types, climatic conditions and some plats characteristics, like drought resistance, depth of root and needs for firewood and fruits.

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