First approach to the study of the nutritional requirements of strawberry tree

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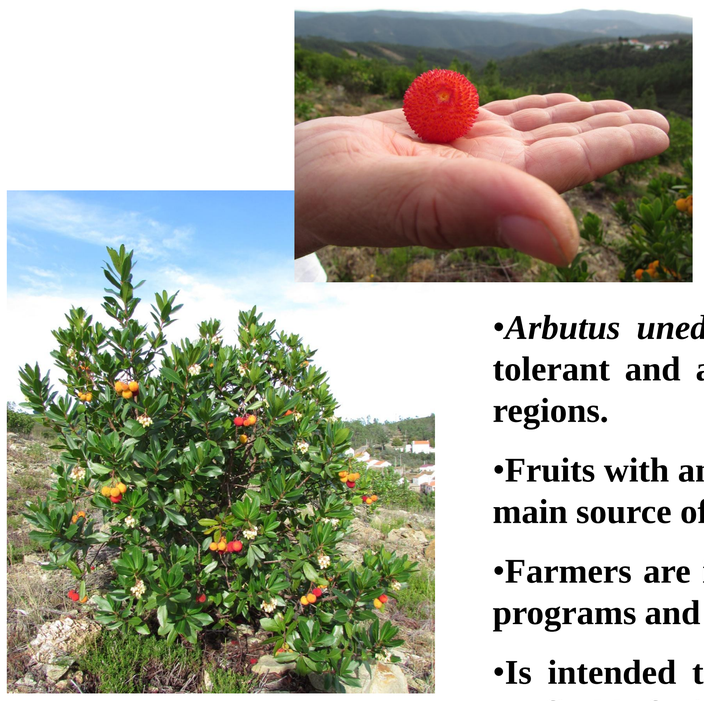

Fig. 1 – *Arbutus unedo* L. (Strawberry tree).

INTRODUCTION

•*Arbutus unedo L.*, known as strawberry tree, is a Mediterranean species sclerophyllous and laurel vegetation, drought tolerant and able to regenerate following forestry fires, making it interesting for forestation programs in Mediterranean regions.

•Fruits with antioxidant potential are edible and have been used to make a spirit called "Medronheira", which is currently the main source of income for owners.

•Farmers are interested on establishment of *A. unedo* new orchards, in the central region, taking advantage of the financial programs and reducing the risk of forest fires, due to the continuous area of *Pinus pinaster* and *Eucalyptus globulus*.

•Is intended to study the nutritional requirements of strawberry tree with the intention of converting wild plant into a profitable fruit species.

MATERIALS AND METHODS

• The study areas are located in the Center of Portugal, in the municipalities of Penacova, Pampilhosa da Serra and Oleiros and in the South, in the municipality of Monchique (Algarve) (Fig. 1), and the characteristics of the study sites are presented in the Table 1. The site index was assessed according to plants vigor on a scale from 1 to 5 (from the lowest to the highest vigor).

Table 1 - Biophysical characteristics of field experiments (Portuguese Environment Agency).

Municipality	Study areas/Site	Reference	*Site index* [(1)]	Age (years)	Average annual temperatura (ºC)	Average annual rainfall (mm)	Soil classification
Penacova	Vale Madeiro [(2)]	VM-RN14-14	4	22 [(4)]	15.0-16.0	800-1000	Cambisols
	Covão Nogueira [(2)]	CN-RN14-14	4			1000-1200	
	Covão das Medas [(2)]	CM-RN14-14	3			1000-1200	
Pampilhosa da Serra	Signo-Samo [(3)]	P07-A6-14	2	7	12.5-15.0	1200-1400	Cambisols
		PM07-A6-14	1	7			Lithosols
		P07-C0-14	3	7			Cambisols
		P12-CMAlt-14	2	2			Cambisols
		P12-CmAlt-14	3	2			Cambisols
Oleiros	Aziral [(2)]	Az-RN14-14	3	22 [(4)]	10.0-12.5	1200-1400	Cambisols
	Estreito [(3)]	E07-C0-14	2	7	7.5-10.0		
Monchique	Lameira [(2)]	LM-RN-XX-P14	5	wild	16.0-17.5	1000-1200	Luvisols
	Covada [(2)]	Co-RN-XX-14	4				

[(1)]plants vigor assessed on a scale from 1 to 5 (from the lowest to the highest vigor); (2)wild areas/natural regeneration; (3)orchards
[(4)] age after the last the forestry fire

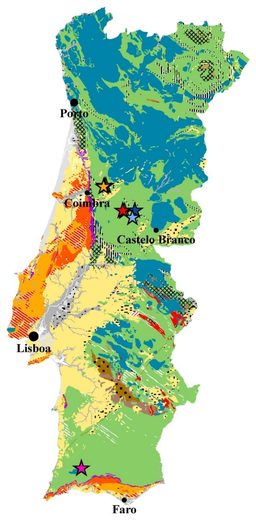

Fig. 2 – Study sites localization in lithology map (sites with shale).

• Samples of soils, organic layers and leaves were collected in orchards and natural regeneration areas (from 2 to 22 years old) (Table 1, Fig. 3).

Fig. 3 – Orchard (P07-A6-14) in Signo-Samo (Pampilhosa da Serra) and natural regeneration area (Az-RN14-14) in Aziral (Oleiros), in Cambisols derived from shale.

• The analysis:

1) Soils analyses: pH, organic matter, P_2O_5, K_2O, exchangeable cations and the micronutrients Fe, Cu, Zn, Mn

2) Organic layers: dry matter, organic matter, N, C/N and nutrients

3) Leaves: N, P, K, Ca, Mg, S, Fe, Cu, Zn, Mn and B

were performed by ESAC, in the laboratory of soil and fertility and employing the methodologies of the laboratory.

• Means, standard error (SE), maximum and minimum values are shown, and the principal component analysis (PCA) was carried.

RESULTS

• The analysis of soil samples (n=67) revealed soils with:

- **Acid pH;**
- **High levels of organic matter;**
- **Very low levels of extractable phosphorus;**
- **Mean levels of extractable potassium and K^+ exchange;**
- **Very low levels of cation exchange Na^+, Ca^{2+} and Mg^{2+};**
- **Some variation in the extractable content of micronutrients Cu, Zn, Fe and Mn;**
- **Lowest levels of zinc and very high content of iron.**

Table 3 - Organic layers (n=63)

Organic layer parameters		Mean ± se
Dry matter (DM)	(ton/ha)	6.1 ± 0.62
Total carbon (TC)	(%)	42.2 ± 0.96
Organic matter (OM)	(%)	79.6 ± 1.16
Nitrogen (N)	(%)	0.83 ± 0.03
C/N		50.6 ± 1.60
Phosphorus (P)	(%)	0.03 ± 0.00
Potassium (K)	(%)	0.22 ± 0.01
Calcium (Ca)	(%)	0.75 ± 0.06
Magnesium (Mg)	(%)	0.18 ± 0.01
Sulphur (S)	(%)	0.28 ± 0.01
Copper (Cu)	(mg kg⁻¹)	12.5 ± 0.43
Zinc (Zn)	(mg kg⁻¹)	52.6 ± 1.66
Iron (Fe)	(mg kg⁻¹)	6171 ± 476
Manganese (Mn)	(mg kg⁻¹)	374 ± 68.9

Table 3 – Leaf analysis (n=97)

Leaf nutrients		Mean ± SE	Min	Max
Nitrogen (N)	(%)	1.03 ± 0.02	0.72	1.46
Phosphorus (P)	(%)	0.05 ± 0.00	0.03	0.18
Potassium (K)	(%)	0.33 ± 0.01	0.17	0.83
Calcium (Ca)	(%)	0.61 ± 0.03	0.11	1.49
Magnesium (Mg)	(%)	0.12 ± 0.00	0.05	0.25
Sulphur (S)	(%)	0.22 ± 0.00	0.14	0.44
Copper (Cu)	(mg kg^{-1})	4.87 ± 0.23	2.00	16.5
Zinc (Zn)	(mg kg^{-1})	38.3 ± 1.09	15.1	75.0
Iron (Fe)	(mg kg^{-1})	43.3 ± 1.93	15.8	97.9
Manganese (Mn)	(mg kg^{-1})	51.1 ± 3.86	11.7	188
Boron (B)	(mg kg^{-1})	30.9 ± 2.07	9.07	93.6

• The nutrients in leaves (Table 3) are similar to the lowest values standard refers by Freire (2007) for small berries production of *Vaccinium* spp, other Ericaceae specie as *Arbutus unedo*.

•The PCA analysis (Fig. 4) shows that the Factor 1, Factor 2 and Factor 3, explain 28.7%, 22.5% and 10.8% of the total variance.

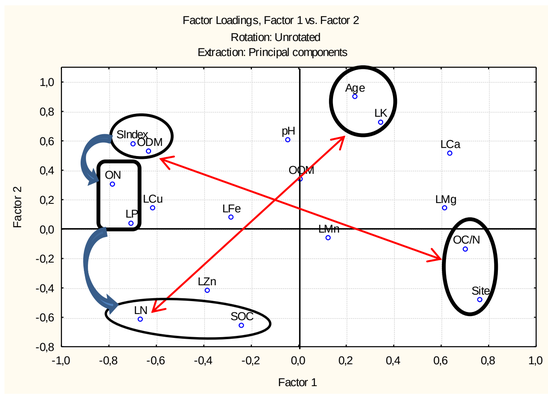

Fig. 4 – PCA analysis (soil/S; organic layer/O; Leaves/L

CONCLUSIONS

•The results suggest that it is important maintaining the organic residues of crop and natural regeneration species, due to the relevance of organic soil layers on dynamics of nutrients of the ecosystem, corroborate by Magalhães *et al*. (2011) and management of the fruit cultural system.

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