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SHORT COMMUNICATION

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Resin tapping activity as a contribution to the management of maritime pine forest

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Abstract

Aim of the study: In this work potential resin yield in a region of high forest ability where maritime pine is the main species was estimated in order to understand the viability of promoting resin exploitation.

Area of study: This study was conducted in Castro Daire County in central region of Portugal.

Material and methods: To quantify the resin yield of trees tapped for the first time two plots were installed in a maritime pine stand with average tree age 65 years. Before the beginning of the resin tapping, dendrometric tree variables were measured. Also, in a neighbouring stand, 25 trees were selected to check the relation between tree dbh and resin yield. Gum resin from every tree was weighted during the season. Estimates of potential resin yield in Castro Daire County were made based on data from National Forest Inventory plots, resin tapping legislation and resin yield values obtained in the field. Two scenarios were considered: high and low resin yield. To understand the intentions of forest owners towards restarting resin tapping activity 16 maritime pine forest owners were interviewed.

Main results: The results point out a high yield potential capacity for gum resin production in the County: values between 2,025 and 5,873 tons were obtained.

Research highlights: Results may highlight the important socio-economical role of the resin tapping activity and can be used to support national forest policies to the resin sector and give forest owners motivation to reactivate resin tapping activity.

Keywords: non-wood forest product; resin yield potential; forest owner.

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Introduction

Portugal holds a strong vocation for forest activities. According to the last National Forest Inventory (NFI), maritime pine forests occupy 23% (714,445 ha) of the territorial area (ICNF, 2013). Throughout the 20th century, maritime pine was the main species in the Portuguese forest but in result of poor management, forest fires and the incidence of forest pests such as the pine wood nematode, it became the third species in area (ICNF, 2013).

In the 20th century maritime pine was the most important species used as a source of gum resin obtained from living trees in Portugal. The country was an important world producer of this raw material, with yields higher than 100,000 tons before 1980 (CESE, 1996). Since then, the activity suffered a strong retraction, mostly due to forest fires and to international market competition, especially from China and Brazil, two countries that became large scale resin producers in that decade (Nieto & Herrero, 2013). In 2005, in Portugal, resin yield was around 6,000 tons and today resin tapping activity is residual (AR, 2015).

In the last few years, with the increase of rural unemployment, the social relevance of this activity in certain areas stood out. Also, resin and resin products are object of high demand worldwide, especially by the European chemical industry. Conjugated efforts and commitment of National and Regional level organizations and resin sector agents in Portugal and Spain, aiming at a sustainable exploitation of this resource, lead to an increased interest in developing the activity

in both Iberian countries. Gum resin provides also an additional income, and may result in the improvement of forest management practices, namely by understory cleanings and increased surveillance during the summer period when fire risk is high.

Taking all these reasons into account the objectives of this work are:

(1) to quantify the resin yield in trees tapped for the first time

(2) to check the relation between tree size and resin yield

(3) to determine the potential resin yield in regions of high forest ability and where maritime pine is the main species

(4) to check the intention of forest owners toward restarting or initiating resin tapping activity.

Study area and methods

This study was conducted in a region that fulfils the following requirements: interior rural areas with ageing population; high percentage of forest land use mainly with maritime pine; predomination of small dimension ownership; resin tapping activity in the past. Castro Daire County, with 37,907 ha, where 15,688 ha are occupied by forest and 11,184 ha by maritime pine forest, was selected (AFN, 2010). In this region climate has Atlantic influence, with warm to hot summers and cold winters. Annual precipitation is of around 1,200 mm, and mean annual air temperatures are close to 14 °C (PMDFCI, 2013).

The field work took place during the 2014 resin tapping season in neighbouring counties where we found two forest owners who intended to tap. At Sátão, the resin tapping work was performed by a non-local forestry services company. The area was a pure mature stand with 65 years of age. Two plots, with 2,000 m^2 each, were installed. Dbh, total height and height at the live crown basis were measured and the number of tapped faces was recorded in all the trees in the plots and stand variables were calculated (table 1). The tapping operations lasted from July to the end of October and only two resin harvestings took place. Resin from every tree was weighted just before the harvesting operation. Five woundings with application of acid paste were done, and two of them were coincident with resin harvestings.

At Figueiredo Alva, resin exploitation was undertaken by the forest owner who lived near the forest area. Here the trees were wounded once a week with application of acid paste too. In this case, it was not a typical forest stand, but the trees were distributed along a narrow strip. It was not possible to install plots. So, a set of mature pine trees were selected and tapped for the first time with the objective to check the relation between tree size (dbh) and resin yield and to obtain a reference value to be used in the scenario "high resin yield" assuming a positive relation between resin yield and number of woundings (Palma, 2007) . Dbh was measured in all the trees (table 1). The tapping operations lasted from May to November and six resin harvestings took place. Twenty woundings were done. Only one face was open in each tree.

The potential resin yield of Castro Daire County was estimated using data from 17 inventory plots from National Forest Inventory (NFI5) (AFN, 2010) in pure and mixed dominant maritime pine stands in the County: 14 plots with measured trees, 2 plots classified as "burned" and 1 plot classified as "occupied by young trees". For the calculations, in each one of the trees of these plots, legal restrictions for resin tapping in Portugal were taken into account: (a) trees with dbh < 25.5 cm were not included; (b) trees with 25.5 ≤ dbh < 35 cm, one tapped face; (c) trees with dbh ≥ 35 cm, two tapped faces. Mean yield values per face obtained at Figueiredo Alva and at Sátão were used in order to define two yield scenarios – respectively high and low resin yield. The resin yield was initially estimated at tree level, then summed over each NFI plot and finally reported to the hectare. Resin yield estimates for the Castro Daire County were based on the mean resin yield per hectare considering the 17 NFI plots mentioned above and reported to the total area of pure

Table 1. Characteristics of the two plots (Sátão) and the 25 tapped trees (Figueiredo Alva).

Site	N (ha^{-1})	G (m^2ha^{-1})	hd (m)	n	dmin (cm)	dg (cm)	dmax (cm)	hmin (m)	hm (m)	hmax (m)
Sátão – Plot 1	240	23.5	23.5	48	26.8	35.3	50.0	19.1	22.2	27.8
Sátão – Plot 2	280	26.3	24.6	56	25.3	34.6	46.3	17.5	23.4	29.6
F. Alva	–	–	–	25	27.7	37.3	47.8	–	–	–

N, number of trees; G, basal area; hd, dominant height; n, number of tapped trees; dmin, minimum diameter; dg, quadratic mean diameter; dmax, maximum diameter; hmin, minimum height; hm, mean height; hmax, maximum height.

and mixed dominant maritime pine stands in the County (AFN, 2010), considering the representativity of each NFI plot to the maritime pine area of the County.

In order to understand the intentions of forest owners towards restarting or initiating resin tapping activity, 16 maritime pine forest owners in Castro Daire County were interviewed. The questions focused on the socio-economic characteristics of the owners, experience with resin activity, and possible motivations to restart or initiate resin tapping.

Results and discussion

The variation in resin yield in each of the sites is great (Figure 1). Table 2 presents the resin yield obtained in Sátão and Figueiredo Alva. At Sátão, and considering both plots, the average yield was 1.91 kg/tree, with a maximum of 4.53 kg/tree and a minimum of 0.66 kg/tree. At Figueiredo Alva an average yield of 3.75 kg/tree was obtained, with a maximum of 7.42 kg/tree and a minimum of 1.95 kg/tree. This difference may be the result of the length of harvesting season, and number of resin wounds (Palma, 2007). Mean resin yield values per tree obtained in both sites are consistent with literature: 2-2.5 kg/face (Oliveira *et al*., 2000), 2-higher than 4 kg/tree (Nanos *et al*., 2001), 3.7 kg/tree (Tadesse *et al*., 2001), 2.39-3.21 kg/tree (Rodríguez-García *et al*., 2014, 2015). Mean resin yield values per face were used in the definition of the yield scenarios – high (3.75 kg/face) and low (1.31 kg/face) resin yield.

In Sátão, it is not observed a relation between tree size - dbh, total height and crown ratio (ratio between crown length and total height) - and resin yield per face (Figure 2). However a slight relation is detected between dbh and resin yield per tree (Figure 3). The short length of the tapping season, and the small number of wounds (five) may justify not only the low resin yield obtained but also the founded weak correlation. However in Figueiredo Alva trees were resin tapped throughout all the season (May-November) but the relation between dbh and resin yield was not observed (Figure 3). Rodríguez-Garcia *et al*. (2014) found that, on average, high yielder trees were taller and had larger dbh than low yielders with R^2 0.38 (between resin yield and dbh).

Resin yield has been reported to increase, in high yielders, in the years following the first wound opening (Rodriguez-Garcia *et al*., 2014). Hence, considering that pine trees were tapped for the first time in 2014, it is possible to admit that in next campaigns greater resin yields will be obtained in the studied plots.

The potential resin yield for Castro Daire County, considering the low and high resin yield scenarios, is 2,024.5 tons and 5,872.6 tons, respectively. These values are quite optimistic knowing that the global resin yield in Portugal was slightly above the 6,000 tons in 2011 and 2012 (AR, 2015). These values can be considered the resin yield potential. However, the results from the 16 interviews revealed that local forest owners have a low motivation to restart or to initiate resin tapping activity and the main reasons pointed out are: the non-existence of a resin market, the lack of forest workers, high costs associated to resin activity when the work is sub-contracted, high risk of fire (re)occurency. These reasons are enhanced by the forest characteristics: small property dimension, not easy accessibility, unevenaged structure, natural regenerated with high density after a fire occurrence, and dense understory revealing lack of management.

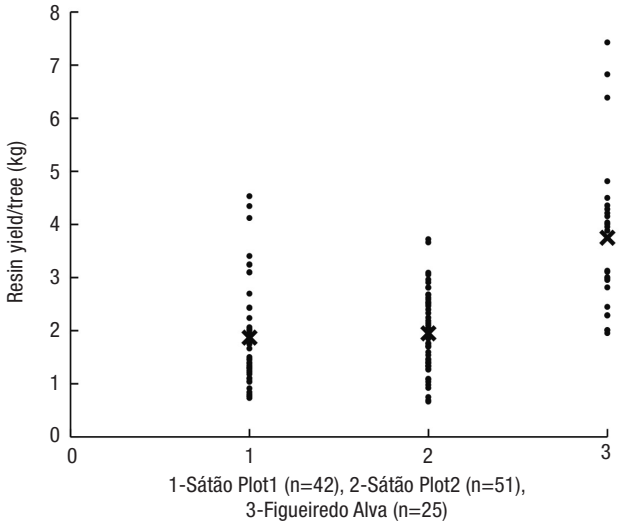

Figure 1. Variation of resin yield per tree in each site. Crosses represent the mean values; n, number of tapped trees.

Table 2. Resin yield in Sátão and Figueiredo Alva.

	Sátão*	Figueiredo Alva
	Total yield per face (kg)	
Average	1.31	3.75
Maximum	2.91	7.42
Minimum	0.55	1.95
	Total yield per tree (kg)	
Average	1.91	3.75
Maximum	4.53	7.42
Minimum	0.66	1.95

* values presented are the mean values of Plot 1 and Plot 2.

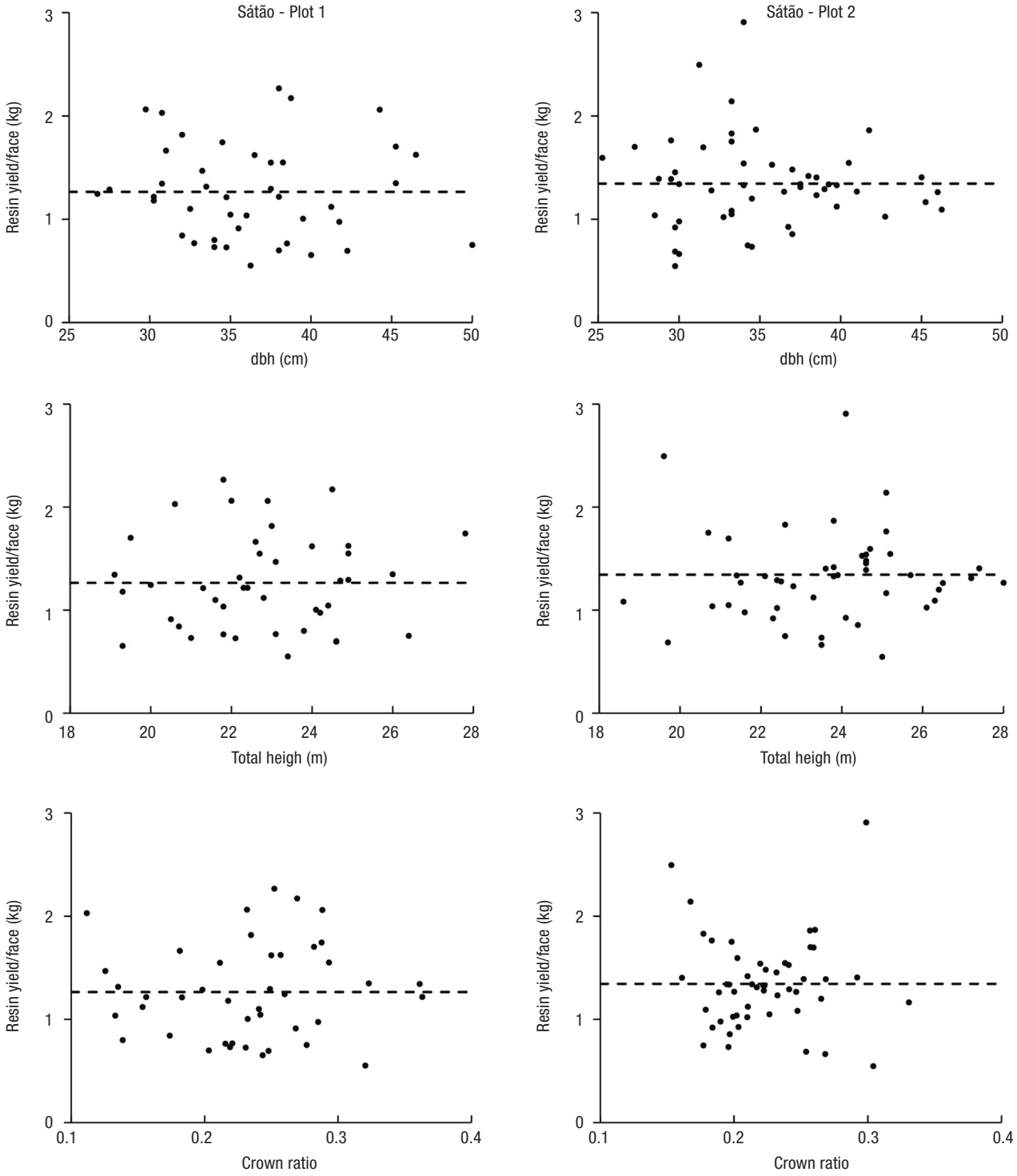

Figure 2. Relation between tree size and resin yield per face in Sátão (Plot 1 and Plot 2). Dotted lines represent mean resin yield.

Conclusion

Under proper management, maritime pine forests can provide multiple economic benefits. Resin tapping activity can be interesting for the maintenance and enhancement of the maritime pine forests, as it increases its internal rate of return and allows the forest owner to obtain annual revenues to practice a more active forest management. However, forest owners reveal low interest to restart or maintain the activity. Hence, promoting tapping as a financially attractive activity is essential to encourage these agents, as resin production depends essentially on forest owners.

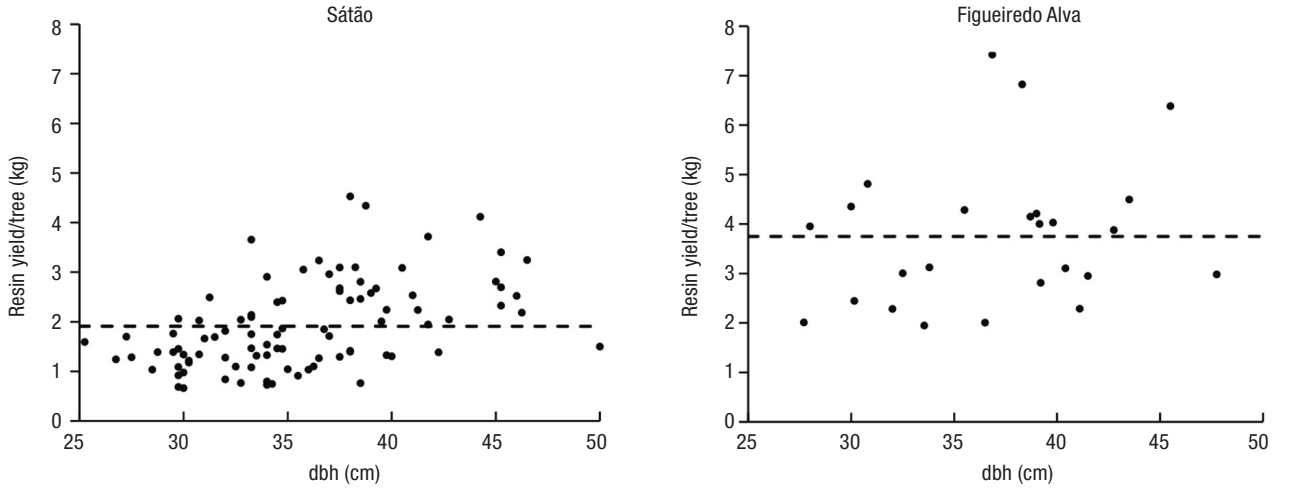

Figure 3. Relation between tree dbh and resin yield per tree in Sátão (Plot 1 + Plot2) and Figueiredo Alva. Dotted lines represent mean resin yield.

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