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# Intensive Agricultural Practices as Enhancers of the Dispersion of Invasive Species: Notification of the Observation of a Case with *Robinia pseudoacacia* L. in Alentejo (Southern Portugal)

Mauro Raposo<sup>1,2</sup> Carlos Pinto-Gomes<sup>1,2</sup> Leonel Nunes<sup>3\*</sup>

1. Department of Landscape, Environment and Planning, School of Science and Technology, University of Évora (Portugal), Rua Romão Ramalho, no.59, 7000-671 Évora, Portugal

2. MED - Mediterranean Institute for Agriculture, Environment and Development, Pólo da Mitra, Universidade de Évora, 7006-554 Évora, Portugal

3. ProMetheus - Unidade de Investigação em Materiais, Energia e Ambiente para a Sustentabilidade, Escola Superior Agrária, Instituto Politécnico de Viana do Castelo, Rua da Escola Industrial e Comercial de Nun'Alvares, 4900-347 Viana do Castelo, Portugal

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ABSTRACT

Invasive forest species are a recurring problem, which in Portugal assume a somewhat mediatic role, both because of the impacts they cause on biodiversity, but also because they enhance the accumulation of high amounts of fuel load, increasing the risk of forest fires. However, in some areas of the country, such as the Alentejo (South of Portugal), the scarcity of water did not allow, until now, the dispersion and rapid growth of some of these species, namely *Robinia pseudoacacia*, which has always remained under control, and it was never a real problem. However, with the growth of intensive farming practices, associated with vineyards, olive groves and almond trees, water and nutrients became available, enabling this species to grow and disperse. This communication presents an observation of several sets of *R. pseudoacacia* specimens growing with different agricultural holdings, raising the hypothesis that intensive farming practices may, in the short term, contribute to the dispersion of invasive species in regions where they were not a problem, if the situations reported are not followed up and studies are carried out to confirm the observations described.

## 1. Introduction

Invasive species have long been a problem identified in different parts of the globe, with an endless number of species following the movements of human populations

<sup>[1]</sup>. In fact, this has been the main reason for the dispersion of species, being transported by man, both consciously and inadvertently, spreading through all ecosystems, where they will compete directly with native species <sup>[2]</sup>. It is this competitive process that, for many times, is disadvantageous for

\*Corresponding Author:

Leonel Nunes,

ProMetheus - Unidade de Investigação em Materiais, Energia e Ambiente para a Sustentabilidade, Escola Superior Agrária, Instituto Politécnico de Viana do Castelo, Rua da Escola Industrial e Comercial de Nun'Alvares, 4900-347 Viana do Castelo, Portugal;

Email: [leonelnunes@esa.ipvc.pt](mailto:leonelnunes@esa.ipvc.pt)

local species that, although more adapted to edaphoclimatic conditions, face direct competitors adapted to much more severe conditions, which, when faced with new, more favorable conditions, present rates of faster growth and multiplication, occupying space and gaining access to resources, such as sun exposure, water and nutrients<sup>[3]</sup>.

There are invasive species in all biological kingdoms, which are widely studied in the available bibliography, with the most varied examples, and where the impacts caused on ecosystems are discussed, through the relationships between species, and how these relationships, often dominance, affect biodiversity, or rather, its loss, through the disappearance of the subjugated species, or which are unable to compete and react at the same speed<sup>[4]</sup>. For the case of Portugal, although it is also possible to find examples of invasive species in the animal kingdom, such as, for example, *Ruditapes philippinarum* (Adams & Reeve, 1850), which colonized the Tagus estuary and which most likely caused a decrease in populations of *Ruditapes decussatus* (Linnaeus, 1758)<sup>[5]</sup>, or *Xenopus laevis*, a frog that now colonizes Ribeira da Lage<sup>[6]</sup>, or even *Australoheros facetus*, a fish of neotropical origin, which now inhabits the Alentejo waterways<sup>[7]</sup>.

However, the Portuguese public opinion, less attentive and without access to scientific texts, is particularly aware of another type of invasive species, since they are often news for the worst reasons, during the seasonal period of high risk of rural fires, when referring to land occupation, not by the traditional species of the Portuguese forest panorama, but rather by the dense thickets formed by invasive species of distant origin, such as the species of the genus *Acacia*, from which the *Acacia dealbata* (Link, 1822) stands out, *Acacia malanoxylon* (R. Br. in WT Aiton) or *Acacia longifolia* (Andrews) Willd., all from Oceania, but also *Ailanthus altissima* (Mill.) Swingle, from Asia, or *Robinia pseudoacacia* L., from North America<sup>[8]</sup>.

In fact, there are many current studies on the proliferation of invasive species in the Portuguese forest, where the work of Rodríguez-Echeverría et al. or Fernandes et al. about *A. longifolia*<sup>[9,10]</sup>, those by Le Maitre et al., where the different *Acacia* species that are currently found in Portuguese territory are addressed<sup>[11]</sup>, or researchers H. Marchante and E. Marchante, who since 2005 treat the problem of invasive species continuously, as shown by the large number of published works<sup>[12-24]</sup>.

The purpose of this communication is to present a situation observed during a campaign to collect seeds of native species carried out in 2020, where the occurrence of specimens of the species *R. pseudoacacia* was found to grow spontaneously in the vicinity of agricultural areas, taking advantage of the fertirrigation systems used in intensive

vineyard, almond and olive groves. Thus, we intend to alert you to a situation that, although it needs more studies and monitoring over time, has been found to be frequent, with the proliferation of this invasive species growing and dispersing, enhanced by associated practices intensive agriculture currently practiced in this region of Portugal.

## 2. State-of-the-art

The genus *Robinia* L. is native to North America and contains six species, namely: *Robinia Elliottii* (Chapm.) Ashe, *R. hispida* L., *R. luxurians* (Dieck) Rydb., *R. neomexicana* A. Gray, *R. pseudoacacia* L. and *R. viscosa* Vent<sup>[25]</sup>. Known commonly as black locust, is a small to medium-sized deciduous tree with a relatively straight trunk and an open crown<sup>[26]</sup>. Trees can reach 12-17 m, although 30 m is possible under exceptional conditions<sup>[27]</sup>. The trunk diameters reach up to 76 cm<sup>[28]</sup>. Young trees are characterized by persistent stout sharp spines that are located at the nodes of young branches and twigs<sup>[26]</sup>. The bark on the trunk is smooth in texture and reddish in color, which becomes darker and deeply furrowed with age<sup>[29]</sup>. Figure 1 shows an example of *R. pseudoacacia*.



**Figure 1.** Example of *R. pseudoacacia* located in Alentejo (Alentejo - Portugal)

*R. pseudoacacia* has been deliberately introduced to Europe on several occasions over the past 400 years<sup>[30]</sup>, Jean Robin (1550-1629) and his son Vespasien Robin (1579-1662), herbalists of the King Henri IV of France the first to cultivate it, also giving rise to its name<sup>[26]</sup>. Black locust is widespread across Europe, occurring from

Italy to Norway and longitudinally from Portugal to the Caucasus region <sup>[31,32]</sup>. Core areas the sub-Mediterranean to warm continental climates, where a rather high heat-sum is available <sup>[33]</sup> and prolonged drought is rare <sup>[34]</sup>.

Most likely, as with other introduced species, it initially had a purely ornamental role, having subsequently, after adapting to the new edaphoclimatic conditions, moved out into the natural space, taking advantage of conditions similar to those of its origin, which it found in Northern and Central Portugal. But they were not restricted to these regions, since they were also used as ornamental species in the most southern regions of the country, as evidenced by the list made and presented by Fernandes and Carvalho, where among many others, 83 examples of *R. pseudoacacia* in public gardens and streets in the city of Beja <sup>[35]</sup>. In fact, the presence of *R. pseudoacacia* is also referred to as a species with potential for honey production, so its quantity must be considerable, in order to justify the production based on this species, as the work of Soares et al., where the honey produced from *R. pseudoacacia* is presented as monofloral honey <sup>[36]</sup>.

As previously mentioned, there is already an abundance of work on the presence of invasive species in Portugal. It is also possible to find several references to the species *R. pseudoacacia*, both in the perspective of invasion of the forest space and its impacts, as shown by the works of Vitková et al., where the positive and negative perspectives of afforestation with this species are addressed, namely in Portugal <sup>[37]</sup>, or the relationship presented by Mourão and Martinho, about the species distribution area and the occurrence of forest fires <sup>[38]</sup>, but also in works on very different themes, such as the work of Compés et al., which analyzes the effect of *R. pseudoacacia* pollens in patients with pollinosis in an allergic pediatric population of Cova da Beira (Portugal) <sup>[39]</sup>.

The most common control technique is the mechanical cutting of the trunk of established plants but cutting alone is only effective if repeated multiple times per year for many years, because cut stumps re-sprout and the root system produces extensive suckers, making effective control almost impossible <sup>[26]</sup>. For this reason, the joint use of chemical products, complements the control actions and increases the efficiency of the actions, preventing the resprout <sup>[40]</sup>.

### 3. Observation

As mentioned in the previous section, *R. pseudoacacia* is already a habitual and old presence in Alentejo, as confirmed by the bibliographic references analyzed. However, the occurrences identified are essentially linked to the specimens existing in gardens and public spaces, with an ornamental function. The specimens that are found

in the natural environment do not constitute a threat or a danger as an invasive species in the Alentejo, since the water scarcity conditions that occur in the region have never allowed the dispersion and rapid growth observed for this species. In other regions of the country, namely in the Minho region, where the soil humidity is high, which allows an accelerated growth and the rapid occupation of the space, preventing the growth of other species, namely the native species.

In the Alentejo it is possible to observe several large specimens, normally isolated, such as the one shown in Figure 1, also verifying that in its surroundings there are no more specimens in growth, so it can be inferred that, for one On the one hand, control when necessary is efficient, and that, on the other hand, edaphoclimatic conditions are not the most suitable for the proliferation of the species. However, with the exponential growth of intensive production agricultural units, mainly associated with vineyards, olive groves and almonds, with their fertigation systems, they most likely came to provide the water and nutrients needed to enhance rapid growth and the dispersion of the species.

In the identified situation, groups of *R. pseudoacacia* specimens were always found in the vicinity of agricultural fields, following the alignment of the ditches used for the drainage of water, thus ensuring access to water and nutrients, thus facilitating plant growth. In Figure 2, one of these sets of *R. pseudoacacia* can be seen, growing at the edge of the land occupied by vines. As can be seen, it is a set of specimens already with some dimension, and, if they are not controlled, can begin to produce seeds, which can later be spread, for example, through agricultural machines that, when mobilizing the soil, they can transport seeds to other areas, serving as aids to seed dispersal.



**Figure 2.** Set of specimens of *R. pseudoacacia* growing on the edge of a vineyard



Figure 3 shows young specimens growing close to another agricultural field. In this case, the specimens, perfectly aligned, and away from other specimens with capacity for seed production, may indicate the transport of seeds and their dispersion through the agricultural implements used in the management of agricultural holdings and in the cleaning of roadsides and from the ditches.



Figure 3. Specimens of *R. pseudoacacia*.

#### 4. Conclusions

The dispersion of exotic species is a process that has been going on forever, and can even be considered to have accompanied human migrations over time, some inadvertently, others premeditatedly, since they would serve to satisfy the most elementary needs, such as food or the supply of construction materials, among others. However, in a world in constant change, in which natural phenomena are increasingly accelerated by anthropic action, not to mention even driven and intensified, the proliferation of invasive species is considered a serious problem, and one of the main threats to biodiversity. In the case of invasive forest species, where *R. pseudoacacia* fits, it acquires an even greater aura of notoriety, since the proliferation of biomass in forests is greatly associated with these species, increasing the risk of occurrence of forest fires, which are so devastating the Portuguese territory.

There are already several methods associated with the control of these species, both using mechanical methods, such as cutting or peeling, depending on the species, but also using methods of a chemical and biological nature. In the case of *R. pseudoacacia*, and specifically in the

region where the situation reported here is observed, the most common method is to cut young specimens, which, being cut successively, end up dying. It is also a region in which water scarcity is the dominant factor, which also contributes to the fact that the species in question does not proliferate with the speed that is normally observed in other, more humid regions of the country.

For this reason, the occurrence of a considerable number of specimens of *R. pseudoacacia* along irrigation ditches in areas of intensive production of vineyards, olive groves and almond trees, where they have access to water and nutrients in abundance from the fertirrigation systems, makes this observation that is reported here assume a high importance. However, as mentioned, it is still a preliminary observation, and it is necessary to continue monitoring the situation, and try to identify new similar situations, in order to be able to confirm whether there is a cause-effect link associated with the occurrence of a direct relationship between species proliferation and intensive farming systems.

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