Interreg Sudoe

EUROPEAN UNION

Transnational plans for the management of forest risks

PLURIFOR

European Regional Development Fund

Deliverable 3.2.1.

WP3

This document, integrated in the WP3 of the project, consists of an economic assessment report of the implementation of the eucalyptus weevil risk management plan (EWRMP).

For the economic evaluation of the implementation of the EWRMP for Portugal and Spain (Asturias and Cantabria) we used simulations based on a physiological based model, the 3-PG Model ("Physiological Principles that Predict Growth''). This physiological based model uses physiological principles and environmental variables, allowing, among others, the possibility of predicting the consequences of the effects of pests and diseases that cause defoliation in forest stands.

The adaptation of 3-PG for simulating the Eucalyptus weevil defoliation was a tool developed during WP2 of the PLURIFOR project. The model is here used to simulate the impact of defoliation caused by *Gonipterus platensis* in Eucalyptus stands productivity and wood production on different scenarios of defoliation. As a site example, we used the data from a coastal plot in the north Portugal, with a site index of around 22, which is considered very good. As 3-PG is a process-based model, it is sensitive to climate and site location. The model was run for those specific characteristics of that particular area. However, we need to consider that different climate and/or site characteristics, such as the available soil water, would produce different results.

The risk management strategies followed by each region (according to the EWRMP) were then applied in order to forecast wood volume produced for different defoliation intensities and using the corresponding risk management strategies.

The data used for the economic analysis was provided by the forestry companies (e.g. RAIZ, AltriFlorestal, CELPA).

All the simulations were made taking into account different spring attack scenarios of defoliation (Table 1), as described in the EWRMP. In each scenario, the same defoliation intensity was applied every year, after stand age 2 until the end of the simulation period.

Table 1 – Spring attack defoliation scenarios of eucalyptus by *Gonipterus platensis*.

Scenario	Attack intensity	Target crown	Total defoliation *
S0		*'no defoliation' scenario*	
S1	5%	one third	5% * 1/3 = 1.7%
S2	25%	one third	25% * 1/3 = 8.3%
S3	50%	one half	50% * 1/2 = 25%
S4	75%	two thirds	75% * 2/3 = 50%
S5	100%	two thirds	100% * 2/3 = 66.7%

* the percentage is distributed along the defoliation period (Mar-Jun), every simulation year

As different defoliation scenarios will involve different operations, such as insecticide applications, release of parasitoids and/or silvicultural practices, a set of treatments were also defined, so that attack-treatment combinations could be tested on the original stand data. In the model, we considered the practices described in the EWRMP of each region (Table 2). For Portugal we considered in the model two options: PT1 (application of insecticide from S3 to S5 defoliation scenarios) and PT2 (application of insecticide from S3 defoliation scenarios follow by clear cut at S5 scenario in 6 year-old stands). For Asturias and Cantabria, the release of the parasitoid *A. nitens*, insecticide applications and clear cuts of 6 year-old stands were considered in the model.

Table 2 - Operations per region versus defoliation scenarios.

Scenarios	Portugal (PT1/PT2)*	Asturias	Cantabria
S1	-	-	-
S2	-	Release of *A. nitens*	Release of *A. nitens*
S3	Insecticide	Release of *A. nitens*	Insecticide
S4	Insecticide	Insecticide	Insecticide
S5	Insecticide / Cut	Cut	Cut

* PT1 option follows the complete insecticide treatment prescription after age 6
* PT2 option cuts the stand at age 6

We follow different treatment options since: no treatment (NT), treat at age 2, and treat every year between ages 2 and *n* until age of revolution (Table 3). Treatment operations were repeated every year following each treatment prescription.

Table 3 - Treatments (once a year) executed in March.

Treatment	Description
2	treatment at age 2
2-3	treatment at ages 2 and 3
2-4	treatment at ages 2 through 4
2-5	treatment at ages 2 through 5
2-6	treatment at ages 2 through 6
2-7	treatment at ages 2 through 7
2-8	treatment at ages 2 through 8
NT	'No Treatment'

Results:

<u>Wood productivity</u>:

Volume yield (m^3) at cutting age in the different defoliation scenarios per region and per treatment is presented in Figure 1. The longer the treatment, i. e. repeated during more years, the more volume is produced, although differences between treatments are clearer mostly for scenarios over 50% defoliations (scenarios S3, S4 and S5).

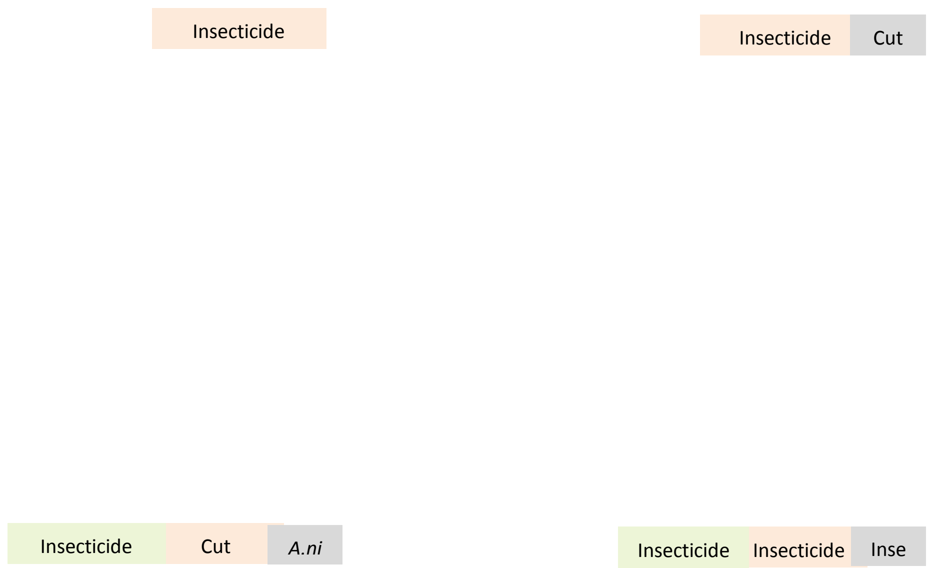

Figure 1 – Estimated volume yield (m^3) per region and per treatment in different defoliation scenarios.

The results allowed predicting volume losses at cutting age in function of the defoliation intensity (scenarios) (Figure 2). As expected, wood losses increases for higher defoliation scenarios. However, for low defoliation scenarios differences might be minor and not economically relevant. Regarding treatments, the longer the treatment, i.e. repeated during more years, the more volume is produced, although differences are clearer mostly for scenarios over 50% defoliation (scenarios S3, S4 and S5).

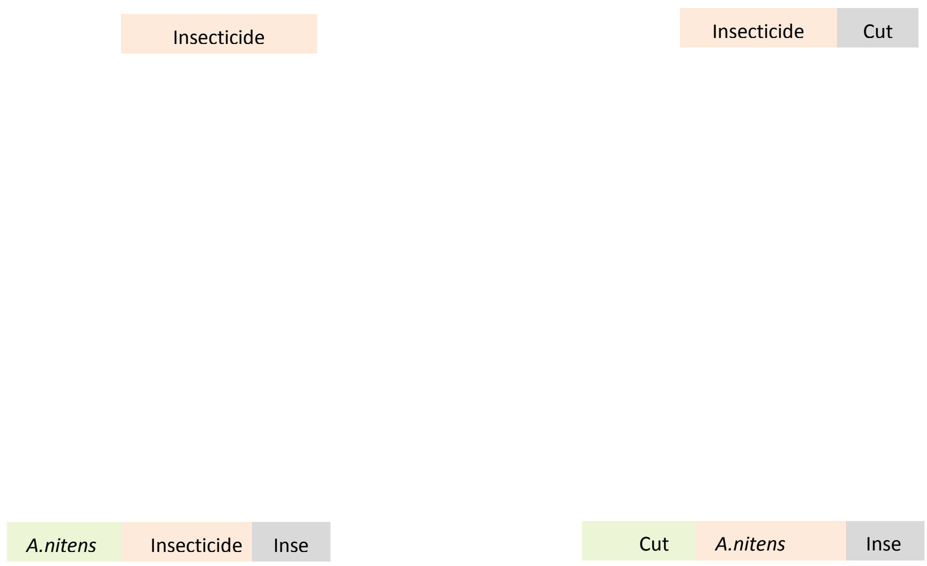

Figure 2 – Volume losses (%) per region and per treatment in different defoliation scenarios.

<u>Costs</u>:

The costs of the application of protection actions such as release of parasitoids (*A. nitens*), application of insecticides, etc. can also be taken into account in the model. Treatment costs provided by forestry companies and considered in the model are presented in Table 4. No other costs were considered in all analysis.

Table 4 - Treatments costs (per ha).

Operation	Treatment	Monitoring	Total
Insecticide	40€	3€ (HR) + 0.8€ (travel)	43.8€
A. nitens	6.69€ (*oothecae*) + 1.78€ (launch)	1.40€	9.87€

The difference between incomes and costs, given by the final net present value (NPV) is presented in Figure 3. In scenario S5, treatments 2-6, 2-7, and 2-8 are only applied on Portugal 1 site, as the other regions decide to cut the stands before the remaining treatments would be applied, so there is no data for Asturias, Cantabria and Portugal 2 in those situations.

As expected, the greater the defoliation scenarios, the higher will be the costs of treatments. However, perform treatments for more years than for less years is more compensatory, especially for treatment 2-7 years (Figure 3 and Figure 4).

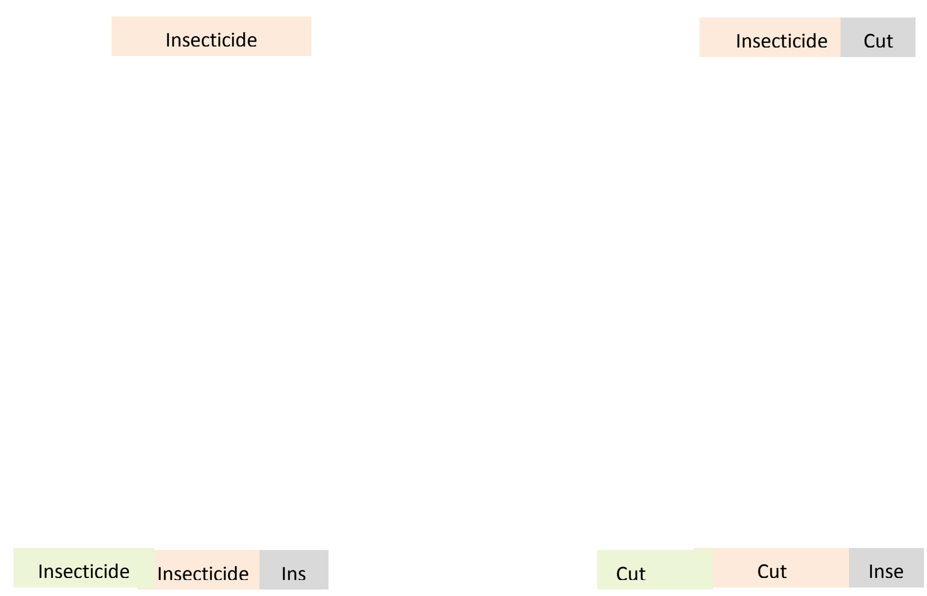

Figure 3 – Final net present value.

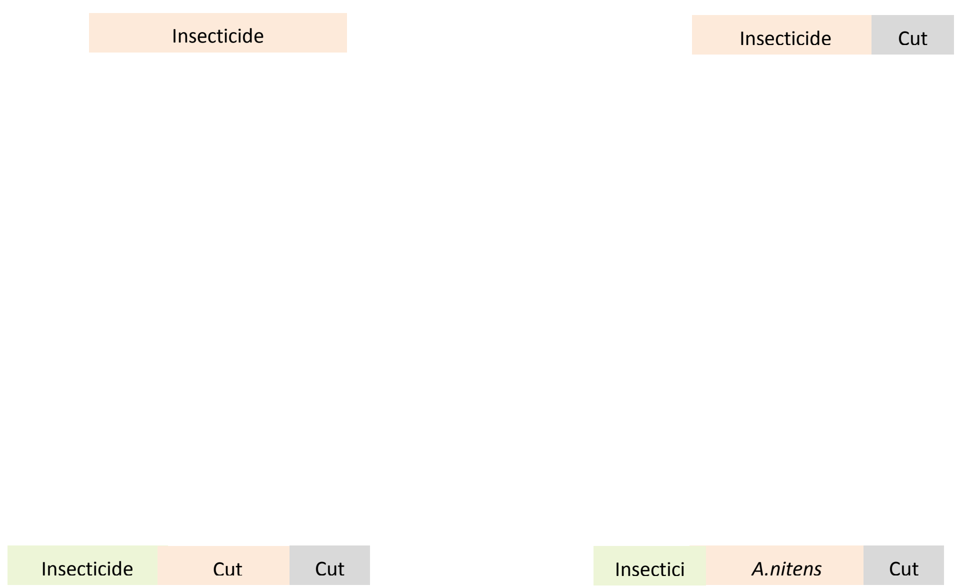

Figure 4 – Gains versus losses compared to no defoliation scenario.

Comparing the options of treatment versus no treatment, the gains in treating the stands compared to not treating are higher in the case of the higher defoliation scenarios (S4 and S5), especially when trees are treated longer, i.e, for more consecutive years (Figure 5). In the lower defoliation scenarios (S2), the costs of treatment overcome the gains of not treating, especially the longer the treatment duration. In scenario S3, however, there are gains in treating, except when stands are treated longer (where treatment costs still do not outweigh the gains) compared to shorter treatments.

As the defoliation scenarios increase, more important is the application of the plan as it allows reducing the damages.

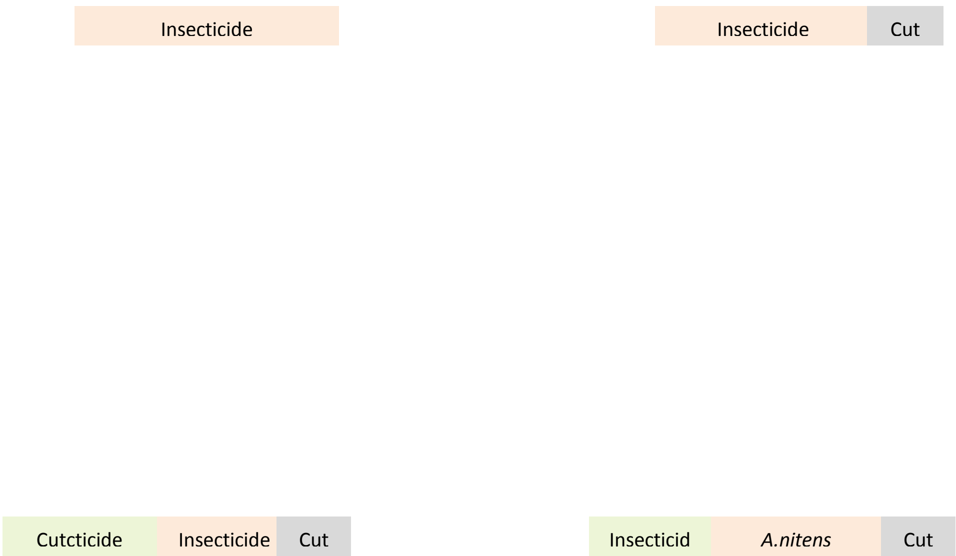

Figure 5 – Costs of treatment versus no treatment options.

Conclusions:

We used the 3PG model, to perform an economic assessment of the eucalyptus weevil plan for Portugal and Spain (Asturias and Cantabria). The model allowed the prediction of wood production, simulating forest stands in different site and weather qualities, taking into account the impact of different defoliation intensities. It further allowed predicting the outcome of different treatments, providing information in the definition of management plans and better decision-making processes.