Extended Abstract
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Paper/Poster Title	**Can the adoption of sustainable agricultural practices solve the problem of pest resistance to pesticides?**

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Abstract	***200 words max***
The paper focus on the study pest management strategies when the choices of one farmer affect those of his neighbour, causing an externality in the form of pest resistance to chemicals. We compare the choices of these farmers to the choices of a social planner. We find that despite the sustainable strategy of one of the farmers (mixed treatment), individual control efforts do not maximize benefits socials. This inefficiency of individual management comes from the externality, i.e. the effect of the neighbourhood that the farmers ignore. Thus, to correct this inefficiency, we introduce a tax in the model of these farmers. With this tax, farmers tend to behave in a socially optimal way.	

Keywords	Pest resistance, heterogeneity of farmers' strategies, externality.
JEL Code	C73, H23,Q18 see: www.aeaweb.org/jel/guide/jel.php?class=Q)

Introduction *100 – 250 words*

Pest resistance to pesticides is a phenomenon that becoming more and more worrying. We observe a strong decrease in the effectiveness of pesticides due to their excessive use (Martin, 2015). This resistance makes management very costly and represents an economic threat in the agricultural world. According to Laxminarayan and Simpson (2002), nearly $40 million is spent on this fight each year. This cost is explained by the fact that in the face of resistance, farmers tend to use more pesticides or replace ineffective pesticides with newer pesticides that appear more expensive (Norton et al 1989). This increases expenses and decreases farm profits (Pannell et al 2004).

Thus, economic analyses of the resistance and its management have been carried out to solve this problem (Martin, 2015, Pardini and Espinola 2020). They focus on only one variable, chemical treatment. Contrary to them, we add in our model a second variable, the mechanical treatment which seems preferable to the only use of the chemical from an environmental point of view (Cuyno et al., 2001).

We consider two farmers, one using chemical and the other chemical and mechanical. We suppose that the mixed treatment farmer's strategy is guided by the adoption of an agri-environmental scheme. He receives a lump-sum subsidy that covers the losses resulting from the adoption of these sustainable practices. Although the adoption of sustainable farming practices by one of the farmers may have a positive impact on pest management, one wonders if this is verified when considering the effect of one's neighbour who uses only chemicals.

Methodology	*100 – 250 words*

In the same way as Cornes et al. (2001), Pardini and Espinola-Arredondo, (2020), we develop a discrete time model. We reduce our model to two periods and this allows us to sufficiently examine the intertemporal effects of pesticide resistance. Our model is closer to the modelling of Pardini and Espinola-Arredondo, (2020). These authors focus on only one variable, chemical treatment, and consider two farmers who are assumed to be homogeneous in the sense that they adopt the same pest management strategy. Contrary to their paper, we consider heterogeneous farmers, adding the mechanical treatment for the second producer. So, one of the farmers uses a chemical treatment accompanied by a mechanical and the other uses only a chemical. We assume that the strategy of one affects the other, thus causing an externality. We measure chemical treatment as the total amount of pesticide used by the farmer to control pests (Regev et al 1983).

Results	*100 – 250 words*

We compare individual management to socially optimal management. Our results show that in the individual management, farmers use more pesticides than would be socially optimal (regulator model).
Also, we find that despite one farmer's sustainable strategy (mixed treatment), individual control efforts do not maximize social benefits. This inefficiency of individual management comes from the externality, i.e. the effect of the neighbourhood that the farmers ignore. Thus, to correct this inefficiency, we introduce a tax on chemical use. Its objective is to increase the economic cost of a chemical treatment. With this tax, farmers tend to behave in a socially optimal way.

Discussion and Conclusion	*100 – 250 words*

Pest resistance to herbicides is a major issue for the coming years, hence the need for sound management and well-designed policies to address this challenge. In our study, we present a discrete-time model for determining optimal management of pest resistance to chemicals. In addition to the chemical treatment generally used in the literature to control pests, we add a second variable mechanical treatment in our model. The addition of this variable seems preferable to the sole use of chemicals from an environmental point of view (Cuyno et al., 2001). We compare two management models, the private and the socially optimal. The comparison of these two models allows us to conclude that the amount of pesticides used in the individual model is still higher than that of the regulator, which is socially optimal.