ABSTRACT

The use of pesticides in agriculture is still essential to achieve adequate control of pests. However, there is an important social pressure towards the development of measures for minimizing the impact of pesticides on the environment and reducing and controlling the risks associated with their application.

One way to achieve these goals is the rational application of pesticides by properly adjusting the amount of product to the actual needs and specific conditions of the application (pest to be controlled, machinery and pesticide used and vegetation to be treated). However, applying large quantities of product is fairly common, in order to ensure the result, without taking into account that this practice normally entails an excessive release of products that pollute the environment and increases production costs.

In order to rationally adjust the amount of product to be applied in a treatment, it is necessary to study the relationships between the quantity of deposited active ingredient, how it is deposited and how it affects the control of the pest, evaluating if there are differences between their natural developmental stages. This thesis has served to scientifically develop these relationships, using California red scale, *Aonidiella aurantii* Maskell (Hemiptera: Diaspididae) and its different developmental stages as an example, because it is a key pest in citrus. Throughout the thesis, two types of the most widespread products against this pest have been used: organophosphates and mineral oils. From the response models established in this thesis, minimum deposits for maximum effectiveness of these products on each stage of development of the California red scale are inferred. For example, minimum necessary deposit against young stages with organophosphate pesticides is 1.01 µl/cm^2 and 3.41-4.72 µl/cm^2 in the case of mineral oils, while optimal deposits against adult stages increased to approximately 4.72 µl/cm^2 in all cases, mixing the products at the registered concentrations against California red scale in citrus.

Subsequently, the response models of the insecticides have been validated in field conditions. Treatments designed from models, which depend on the response, the size of the canopy and the leaf density of the vegetation, have been compared, in terms of efficacy, with respect to conventional treatments, based on volumes close to the runoff point. Despite having obtained lower levels of coverage with the proposed treatments (60-70% against 90% obtained with the conventional treatments), no statistically significant differences of efficacy have been found, with around 40% of pesticide savings.

The thesis also demonstrates that, once a certain threshold has been reached (which is different for each stage of the pest), generating greater coverage does not increase efficacy, thus demonstrating that the amount of organophosphate insecticide or mineral oil used can be reduced by optimizing the spray application volume, taking into account the targeted volume of vegetation.

Finally, the thesis proposes and validates a method to estimate the quality of a treatment, based on the deposits made on water sensitive paper after application. It uses observed coverage data and relates them to the expected efficacy.