Weed control methods in the context of the EU green deal

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Introduction

Weeds have always been a problem in all crops because they can affect production, while also reducing product quality due to competition for natural resources.

On the other side, weeds can be considered valuable indicators of biodiversity due to their role in providing ecosystem services. In this sense, it is necessary to carry out an effective and sustainable process of weed management, integrating the different control methods (mechanical and chemical) in a harmonious way, without harming the entire ecosystem.

Sustainable agriculture and the current requirements, but especially the perspective ones, give special importance both to the factors that contribute to the increase in production - dynamic factors (such as solutions or hybrid, fertilizer, water, etc.) and to the factors of crop protection against diseases, pests and, in particular, weeds (Ioan Oancea, 2003).

According to Cousens și Mortimer 1995, weed interference is one of the most important limiting factors which decrease crop yields and consequently global food production. Weed represent about 0.1% of the world flora and in agroecosystems, weeds and crops have co-evolved together right from the prehistoric times as revealed by pollen analysis studies.

A study carried out by Ioan Oancea, 2003, demonstrates that the level of harvests on plots heavily infested with weeds represents 35-40% compared to the production potential that we can obtain under normal conditions.

Production practices in orchard trees and vine cropping systems vary greatly by crop and growing region. Proper weed management is an integral part of a sustainable orchard production system and can have positive effects on agricultural sustainability by increasing agroecosystem productivity and improving ecological services (Tworkoski and Glenn, 2012; Fracchiolla et al., 2015). An important issue for the production of perennial crops is weed management (Carvalho et al., 2016). Weeds negatively affect orchards and small fruit plantations and compete with cultivated plants for water, nutrients, space, and sunlight; weeds stunt tree growth in young orchards and reduce yield quality and quantity in mature trees (Atay et al., 2017; Abbas et al., 2018).

Weed pressure can reduce tree growth from 15% to 96%, while yield losses can reach 35% because of the adverse impact on fruit quality in which the fruit excluded ratio reaches 45% (Abouziena et al., 2016). Some weeds growing around tree trunks serve as hosts for pests and pathogens that infect the trunk and roots (Shweta et al., 2018). Weed density in fruit orchards varies with location, climate, season, soil type, crop grown, irrigation, fertilization system, and the history of orchard agricultural practices (Futch et al., 2019).

Weed management have been a major challenge for crop producers from the start of agriculture. At the earlier times, since no synthetic chemicals were known, weed control was achieved by some methods such as hand weeding, crop rotation, polyculture and other management practices that were low input but sustainable. With the discovery of synthetic herbicides in the early 1930s, there was a shift in control methods toward high input and target-oriented ones (Singh et al. 2003).

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Methodology

The main method used was to study the specialized literature in the specialized field. The documentation was extensive and exhaustive regarding the methods of combating weeds in agricultural crops and especially those applicable in fruit growing, in correlation with the integrated management of crop protection.

Results

The notion of integrated weed control is more recent than that used in the field of crop protection against diseases and especially pests.

In 1996, B.S. Post and F.G. Wijnauts points out that the weed control strategy must consider:

-Strategic (long-term) factors that relate to the farm's objective, rotation and crop rotation, choice of crop and field, basic works of the soil etc.

-Tactical factors (short-term) that take into account crop maintenance techniques, optimal sowing period, density, cultivated variety or hybrid, fertilization, amendment, etc.

-Operational factors (from the season/vegetation period) that consist of chemical, biological, mechanical and physical countermeasures.

Several techniques and combinations of weed control are possible and accessible.

However, strategies can be different due to differences in the distribution and abundance of weeds in and between fields (soils). The farmer, the one who manages the agrosystem, is asked to decide the most effective technical combinations to combat.

We must emphasize that within the integrated weed control methods both direct methods (manual and mechanical weeding, weeding) and indirect methods (crop rotation, balanced use of fertilizers and amendments, basic soil work) are preferred etc.).

Figure 1. The factors influencing the weed control strategy (Post and Wijnauts)

Results

In the green deal context, human health, biodiversity and farm sustainability are severely affected by the toxic substances of many chemical pesticides, which have been blamed for soil and water degradation. The European Union's (EU) recent legislative frameworks set citizens' needs and demands as the major task for the organization of the agricultural sector in the member countries (Peeters, A. et al. 2020).

The formerly typical and conventional crop and food production systems have now been modernized with the introduction of novel cultivation techniques, the digitalization of agriculture, new food chains, optimized labeling, monitoring for carbon emissions and the sustainable use of chemicals and water (Riccaboni, A. et al. 2021). The "greening" across the Union is followed by ecologically friendly practices that promote safe products and ensure human health, the results of which, though, remain under debate.

Weeds are considered a major threat for the sustainability of different agricultural systems. New integrated weed-management techniques, strategies and tools are being exploited to combat weeds in the era of the EU Green Deal, in parallel with the "agricultural greening" and the "Agriculture 4.0" movements which could be characterized as the main stimuli that will shape the food and agricultural sectors.

The European Commission has set a concrete strategic plan to reduce the use of chemicals, enhance biodiversity and assist farmers in decision-making processes to increase farm sustainability within the borders of the Union. These goals are in line with and are supported by the directives of the United Nations for sustainable production.

Main conclusions

Tillage is one of the key primary alternative weed control methods. This provides weed control in the tree row more effectively and conveniently compared to other approaches. On the other side, mulching is one of the best alternatives to chemicals, as it minimises weed problems in the fruit orchard by suppressing weeds at an early growth stage.

In terms of cover crops they are a promising alternative delivering multiple positive ecosystem services, especially for dryland farming systems, to reduce both tillage and herbicide input. Mowed or soil-incorporated cover crops were more effective than herbicide or mechanical weed control.

Another method is conservation agriculture (CA) wich refers to the bare minimum soil disturbance by applying reduced tillage, choosing diversified crop rotations, and using cover crops and residues to manage emerged weeds. CA provides desirable positive traits to agroecosystems, including reduced greenhouse gas emissions among others, it may lead to significant alterations in weed flora by promoting either the dominance of annual or perennial weeds, grasses or broadleaves and small- or large-sized weed seeds.

Integrated mechanical work, integrated mowing (mower and brush or disc) and integrated tillage (blade weeder and integrated mowing) were less effective compared to herbicide use, but integrated methods increased orchard biodiversity and had no adverse effects on tree growth, fruit yield and quality. Regarding the average costs per hectare, it was proven that chemical weed control reduced costs by 66.5% and 72%, respectively, compared to integrated tillage and integrated mowing.