



## Weed Management Under Drought Conditions in a Changing Climate

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**DOI:** [10.31080/ASAG.2023.07.1217](https://doi.org/10.31080/ASAG.2023.07.1217)

**Received:** December 01, 2022

**Published:** December 15, 2022

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### Abstract

Agriculture is the most affected sector by climate change since its development is closely related to natural resources use. For this reason, it is affected by variations in temperature and rainfall. Climate change could further undermine efforts to mobilize water resources for agriculture, due to reductions observed in precipitation at the lowest tropical latitudes. A clear vision of the impact of climate change on weed management in a hot-arid environment is crucial to understand the vulnerability of crop yield in the Mediterranean region. Water resource amounts in many regions of the world, and water availability between crops can be inadequate in areas where natural rainfall is deficient.

The research related to interactions between rising carbon dioxide and other anticipated environmental changes is mostly unknown. This commentary has presented a clear and broad discussion of the most recent opinions on this topic. Particularly in the Mediterranean region, knowledge of these potential interactions may be crucial in safeguarding weed threats or production losses in irrigated agriculture.

**Keywords:** Agricultural; Climate Change; Crops; Management Crop; Greenhouse Gas; Agro-Ecosystems

### Introduction

Farming represented a safe of values, productions, and tradition for civilizations and offered sustenance by constituting an identity card for the territories and the inhabitants. Moreover, farming plays and will continue to play a predominant role in food production and the sustainability of the world's population. The world's population needs a vast amount of food, about 60% more than current, to feed 9.5 billion people in 2050 [1,2]. The continual increase in the world's population, coupled with rising consumption, especially in emerging countries, highlights the urgent need to produce more food to meet the growing demand [3-5]. In other words, it is necessary to provide more food but in a sustainable manner (sustainable intensification) [6]. Agriculture is the most affected sector by climate change since its development is closely related to natural resources. For this reason, it is affected by variations in temperature and rainfall. And today, more than ever, agriculture is called to bear witness to the legacy to be left to future generations through sustainable paths.

Climate change is now widely recognized as a significant global environmental problem [7]. Climate describes the long-term trend of weather occurring in a given location. These climate patterns play a crucial role in shaping natural ecosystems, and the human economies and cultures that depend on them. The magnitude and rate of future climate change will depend on the number of greenhouse gases emitted. Anthropogenic action has produced a high amount of greenhouse gases into the atmosphere over the last ~150 years, and recent analysis suggests that carbon dioxide emissions are unprecedented. These include CO<sub>2</sub>, which is released almost entirely from fossil fuels' combustion utilized in energy production and methane and nitrous oxide, released by agriculture and industry sectors [8].

Until now, farmers have adapted, autonomously, to the gradual climate change of the past [9]. However, the acceleration of the latter, observed in the last 30 years and the consistent and rapid change in climate, foreseen for the immediate future [7] requires

directing the transformations of agricultural systems towards less vulnerability and greater resilience. It must be said that agriculture suffers the effects of greenhouse gases and contributes to their determination. The relationships between climate change and agriculture are numerous and complex [10]. Agriculture has a double role, two opposite sides of the same coin, it is both a direct producer of greenhouse gasses and provides for the sequestration of CO<sub>2</sub> present in the atmosphere.

In an arid environment such as the Mediterranean basin, climate change models forecast a decrease in mean annual precipitation and more extreme events (i.e., less rainy days and more extended drought periods between events), along with seasonal changes. Recent analysis and projections for the Mediterranean region [11] indicate that the Mediterranean Sea's terrestrial area has endured ten of the twelve driest winters since 1902 within the last 20 years. Furthermore, this increase in drought frequency cannot be attributed to natural variation alone but appears to be directly related to anthropogenic climate change [11]. The IPCC reports [12,7]. reported that climate change was likely to be associated with water availability scarcity. Indeed, drought in some area of the world may become so widespread and so severe in the next decades and the extent to which current drought indices may no longer work properly to quantify future drought [13]. Climate change could further undermine efforts to mobilize water resources for agriculture, due to reductions observed in the rain at the lowest tropical latitudes [6]. Some scientists predict a further decline in rainfall and an intensification of extreme events [14,15]. Irrigated water withdrawals already cause stress situations in many of the irrigation districts in the world [4,6]. In this way, a water crisis is already facing the world with very few possibilities that irrigation lands can expand on a large scale. This situation increases the need for water management in dry crop systems to ensure the water needed for food production and develop resilience to deal with future risks and uncertainties related to water use [4,6,16].

For the arid and semi-arid regions, farming is intensive, highly specialized and variable. Subsistence agriculture occurs side by side with commercial agriculture. Land use is highly dependent on water availability, either as the total amount of precipitation - the length of the summer drought, the availability of melting snow and mountain streams, or access to irrigation. Climate change effects on agricultural water security have been widely discussed in these last year's [17,18]. Although existing research have addressed impact of climate change on agricultural water use, few studies have considered the effects on weed management in arid environments. As climate change imposes potential new limits to water availability, it is likely to alter crop-weed interactions and crop losses from

weeds. Safeguarding crop productivity by protecting crops from weed damage is a primary requisite for ensuring that food and feed can still be produced in sufficient quantity and quality even with an uncertain climate. For this reason, a clear vision of the impact of climate change on weed management in a hot-arid environments is crucial to understand the vulnerability of crop yield in the arid and semi-arid regions. Climate change is unequivocal, largely anthropogenic, and, given the lack of effective global mitigation, very likely to continue throughout the 21st century [19]. The rise in atmospheric CO<sub>2</sub> and associated changes in climate, particularly extreme events, have potentially significant negative consequences for agricultural productivity [20]. In this regard, the Mediterranean region may be particularly vulnerable, especially concerning water availability [11].

Although many of these vulnerabilities have been enumerated in national and international assessments of climate change and agriculture [2,7,19]. relatively less consideration has been given to biological interactions at the agroecosystem level that relate to pests, weeds, and disease [21,22]. It may be due, at least in part, to the idea that because of the different photosynthetic pathways, weed limitations may be less of a concern with projected increases in atmospheric CO<sub>2</sub> for the different photosynthetic pathways between weeds and crops. As is becoming more evident, however, this is not only a simplistic interpretation of future weed threats [23], but, given that weeds remain the single greatest limitation to crop yield globally [24], an interpretation that emphasizes how little is known regarding weed-crop restrictions and agricultural productivity in a changing climate, is crucial. The research related to interactions between rising CO<sub>2</sub> and other anticipated environmental changes, is mostly unknown. Yet, particularly in the Mediterranean region, knowledge of these potential interactions may be crucial in safeguarding weed threats or production losses in irrigated agriculture. Since weeds will exert additional pressure for weed crop-competition due to climate change [22] more experimental activity could be useful to better manage yield loss in future.

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