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Integrated Strategies for Weed Management under Climate Change

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Abstract

Weed management and control has become a priority for sustainable agriculture in modern agricultural systems. Climate change and the accompanying problems and critical environmental changes and the increased demand for economic agricultural crops in conjunction with the exacerbation of weed resistance to traditional control programs and their increased adaptation and the damage of increasing environmental stress on plant diversity prompted the innovation of smart and emerging methods to manage weed control. Following modern and smart methods in conjunction with agricultural mechanization has become an urgent necessity in weed controlling. With the increasing global interest to reach an integrated unified strategy to reach the goals to achieve integrated weed management programs. In conclusion, Integrated strategy can be developed based on smart agriculture As alternative methods of weed management in the future.

Keywords: *Weed control , Critical condition, Emerging technology, Crop production, Sustainable agriculture*

1. INTRODUCTION

Food security, whether its availability, access, utilization and/or system stability, depends on climate [1]. Food security is likely to be vulnerable to climate change because climate plays a pivotal role in determining the growth, development and sustainability of all living organisms. Climate is defined as the sum of weather conditions for a given area, and is quantified as long-term statistics of meteorological variables [2]. These variables include temperature, wind, rainfall and hours of sunshine, all of which are essential for the growth, development and productivity of all type of plants including crops and weeds. Rising carbon dioxide and temperature in the atmosphere are expected to have direct and indirect consequences on agricultural production, sustainability and water availability, and thus on food security [3]. Extreme weather events associated with climate change are, in many ways, a more serious crop management concern from farmers' perspectives than more subtle changes caused by actual increases in temperatures, carbon dioxide levels, water availability and associated weather events. Changes and future development needs adjustments in technology, administrative practices and legislation [4].

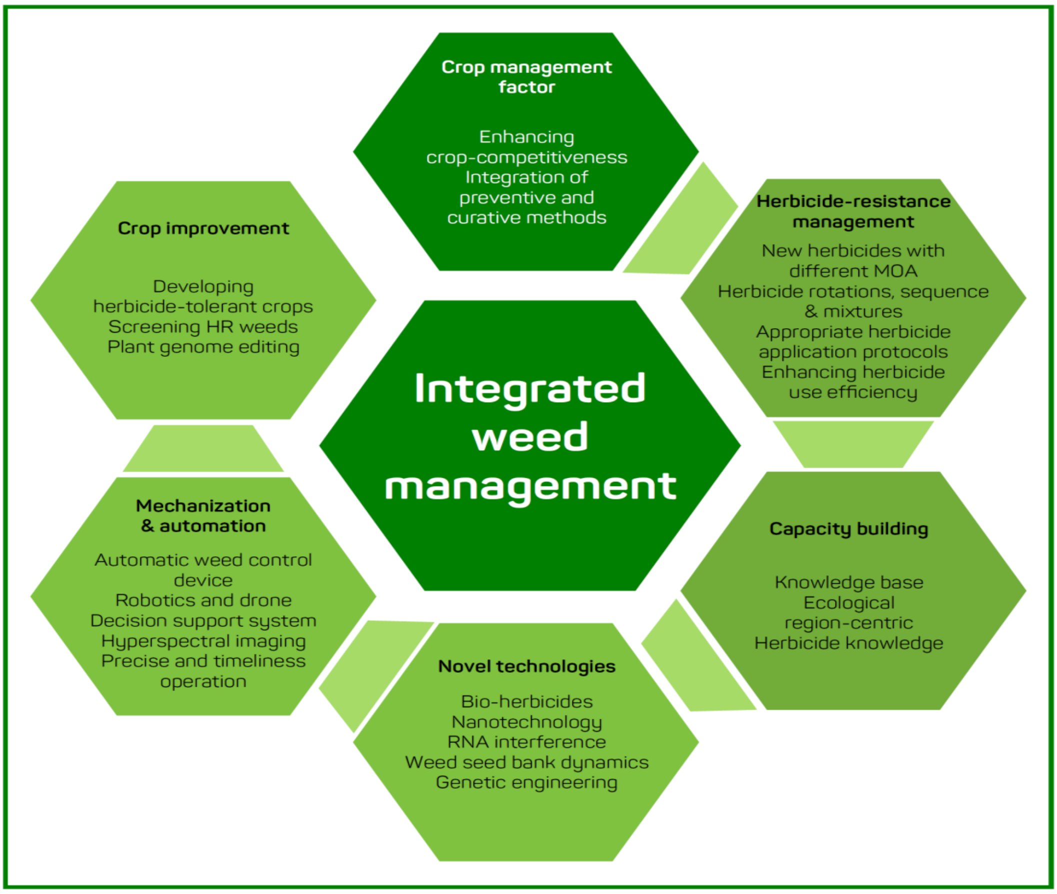


Figure.1 The interrelation of various components for integrated weed management [5].

Unlike other pests, weeds share the same trophic level with crop plants, and by competing for scarce resources they cause huge losses in crop productivity [6]. This chapter focuses on the dynamics of competition on weeds and how they are affected by climate, as this has important regional under critical conditioners.

2. INTEGRATED STRATEGY FOR WEED MANAGEMENT

2.1 *Weed Adaptation and Assemblages*

Weed scientists are currently confronted with the indirect impacts of climate change on weed adaptation Fig.2. Climate warming is increasing phenotypic plasticity in many weed species that may facilitate their invasive potential along environmental gradients. For this reason [7] used seeds of common ragweed *Ambrosia artemisiifolia* L. to determine variation in phenological and biomorphological traits when grown along a 1000 m elevation gradient in northern Italy, and under different temperature conditions in a growth chamber. They found that something common may become common upwards, and at the same time, the alternative diversity of groups currently at lower elevations in European diversity can be improved. Another major topic identified in weed science is the multiple processes and combinations of weeds in many sectors. Studying competition between weed crops, natural Ni inputs, weeds and landscapes on both weed diversity and abundance in the margins and centers of 115 research oilseed rape *Brassica napus* L. crops in western France [8], found that landscape is the main driver of weed populations in field margins. In particular, they pointed to high yield as the main driver of weed populations in the field core, and the number of meadows in the landscape of weed populations in the field margins.

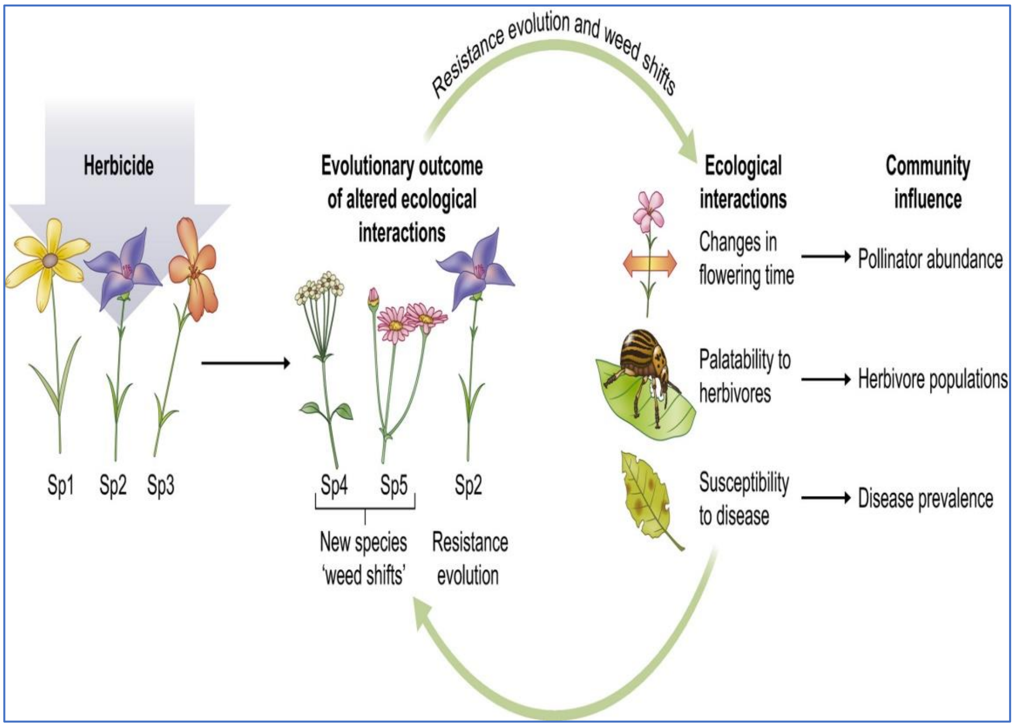


Figure .2 Potential eco-evolutionary dynamics within an agricultural weed community. [9].

2.2. Preventive Methods for Weed Management

Integrated weed control systems, indirect or preventive methods have a major role in reducing the impact and improving the effectiveness of direct control methods Fig.3. Prevention mainly depends on managing the soil seed bank and improving the competitiveness of crops against weeds. Preventive methods include crop rotation, cover crops, mulching, selection of row spacing and seeding rate, etc. Combining them is often associated with higher weed control ability than a single method [10]. Study by [11], evaluated the impact of different weed management options (i.e., pseudobuckets, allelopathic water abstractions, clear vision, and checking for weeds and weeds) on grass plants in different barley cropping systems. From this study, it was observed that the addition of mung bean *Vigna radiata* L. or mainly alternating with barley *Hordeum vulgare* L. and allelopathic water spreads can prevent weeds, on how use of chemical pesticides.

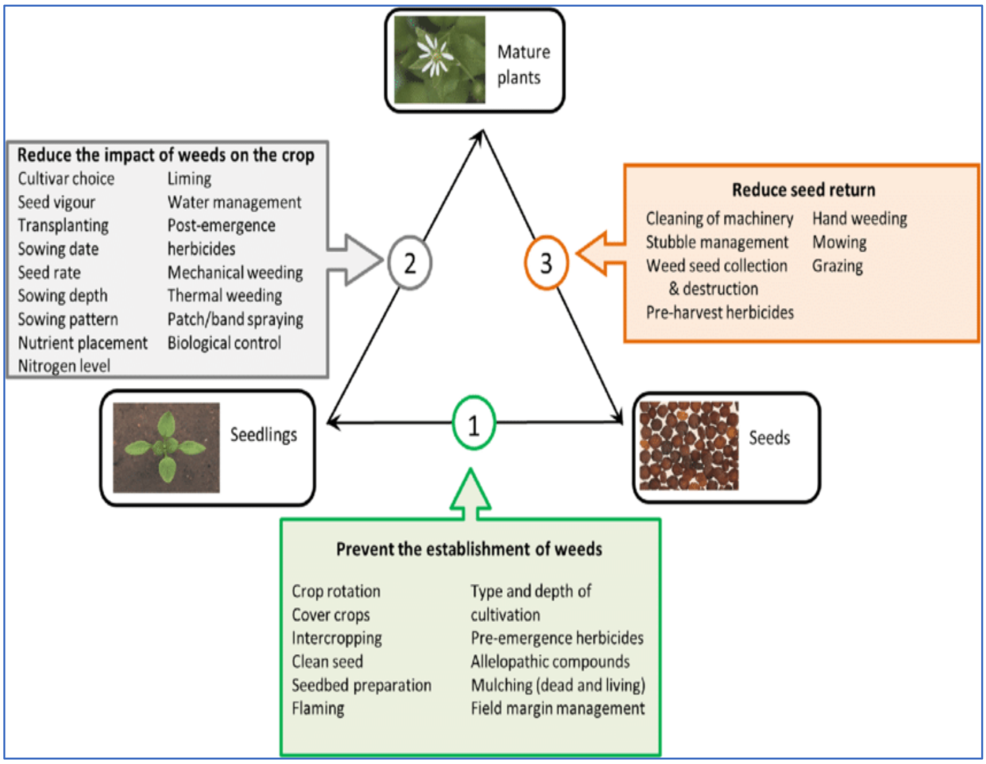


Fig.ure.3 Weed control tactics are mentioned where they are expected to have maximum effect on weed survival and Weed control tactics affecting weed survival at different stages of their life cycle [12]..

Hence, FRI and allelopathic water extracts have been demonstrated as a valid alternative to herbicides in barley production. Study [13] showed the effect of row spacing (18 or 36 cm) saw seeding (73 or 140 kg ha−1) on Russian thistle *Salsola tragus* L. in spring barley and spring barley in the Pacific Northwest. They concluded that an increased need for assistance in sowing or planting vegetables in rows may be necessary in the coming year with a very beneficial effect on yields in years in need of an effect in the area under study, while none may be needed in years in which medical assistance. Regarding taxa with study potential [14] so far it has been investigated in more than 10 farms in central-eastern sicily the ability of ancient herbaceous landraces to control weeds versus cultivars in order to separately study the non-direct effect of landraces in reducing weed pressure without relying on chemical weed control. They reported that ancient durum wheat lines were associated with a 47% reduction in soil seed bank size and a 64% reduction in aboveground weed biomass compared to modern varieties. Furthermore, weed species compositions of modern and ancient taxa were completely separated for both soil seed and neophytes, with the latter showing few specific associations with major weeds. The researchers attributed the high weed suppression capacity of ancient durum wheat lines to the combined effect of competition and allelopathy. They reported that ancient durum wheat lines were associated with a 47% reduction in soil seed bank size and a 64% reduction in aboveground weed biomass compared to modern varieties. Furthermore, weed species compositions of modern and ancient taxa were completely separated for both the soil seed bank and neophytes, with the latter showing few specific associations with the major weeds.

The authors attributed the high weed-control ability of ancient durum wheat lines to cross-competition allelopathy effect.

2.3. Cropping Cover

Among the well-recognized ecosystem services provided by cover crops (i.e., unharvested crops grown in addition to the primary cash crop with the goal of improving soil fertility and enhancing yield), weed reduction is receiving increasing attention from the scientific community and stakeholders as shown in figure.4. Recently, [15] studied the effect of 5-year subterranean clover *Trifolium subterraneum* L. and spontaneous plants, with or without burial of dead mulch in the soil, on weed abundance and diversity in a Mediterranean apricot orchard. They found that weed biomass was significantly reduced by subterranean clover, especially as dead mulch was buried in the soil, with cover crop biomass being negatively associated with weed biomass. Furthermore, compared to conventional apricot management, subterranean clover reduced soil seed bank size by 57%. [16] studied the role of conservation agriculture and living mulch in a small olive grove in the Mediterranean. The authors report that using sagebrush *Salvia officinalis* L. *and lemongrass Cymbopogon citratus* L. as compact living cover reduces soil disturbance, reduces the need for weed management, and enhances the complexity of the arthropod fauna in terms of both species number and taxonomic complexity.

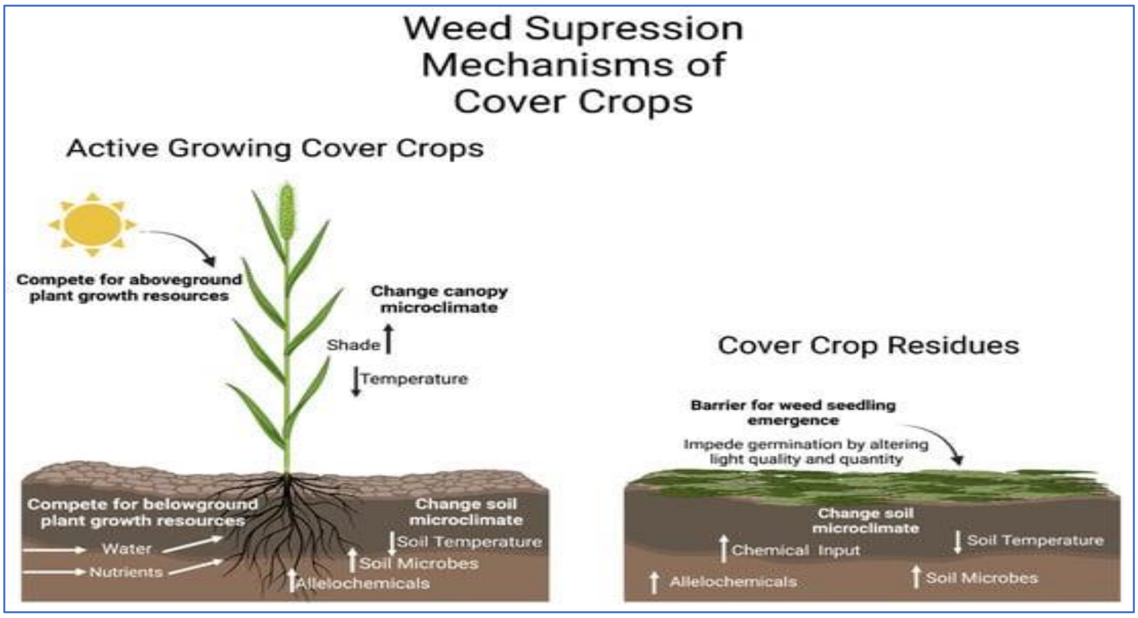


Figure.4 Conceptual diagram of a summary of possible interactions during the actively growing phase of the cover crop (left) and after the cover crop is terminated and left as a surface residue on the soil (right) [17].

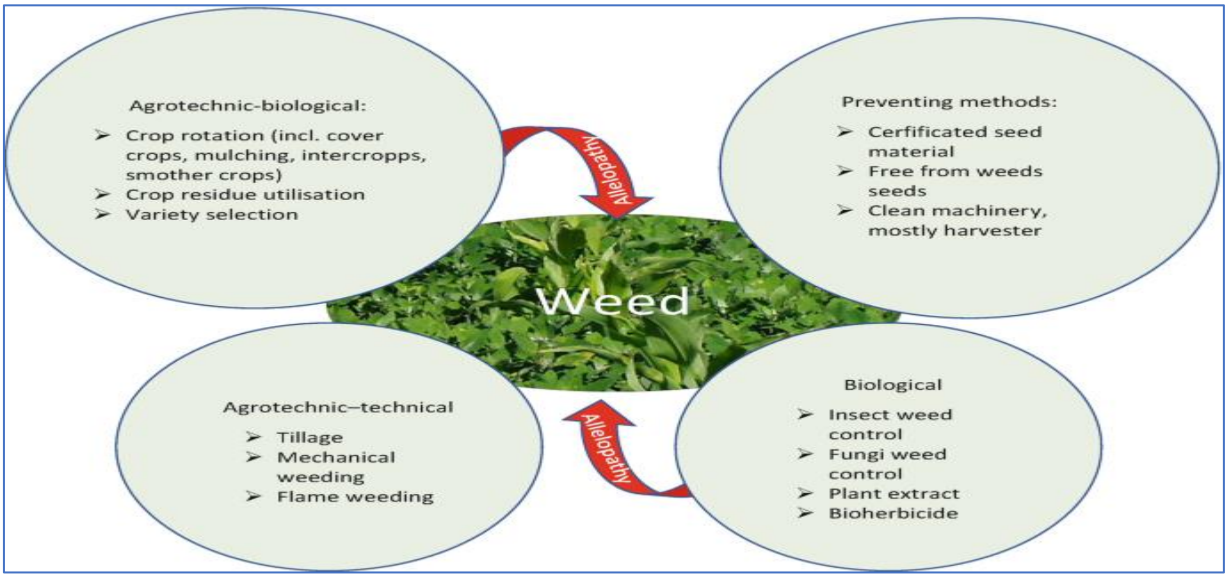
Another technique related to cover crops, i.e. mulching, is studied in this special issue by [18] in winter wheat grown in central New York (USA). By evaluating the biomass gradient of mulch consisting mainly of perennial species such as orchard *Dactylis glomerata* L., *Phleum pratense* .L and *T. pretense* they found that wheat seedling density showed a close relationship with mulch biomass. (no effect at low rates and gradual decrease from medium to high rates of mulch and that the highest level of mulch (9000 kg ha-1) selectively suppressed weed biomass without reducing wheat grain yield.

*2.4. **New Developments in Chemical Weed Control***

Herbicides remain the most common tool for weed control, especially in developing countries. However, the study by [19] inIndian subtropical setting highlighted that chemical control using the herbicides pensulfuron, pretilachlor and bespiripak sodium negatively affected soil microbial and enzymatic activity, whereas improvement of microbial populations and enzyme activities was observed in under cultivated rice *Oryza sativa* L . under organic herbal management. Another negative effect associated with irrational use of herbicides is the spread of invasive or resistant weed species. Study by [20] noted that resistance of acetyl A carboxylase (ACCase) inhibitory herbicides in three resistant Phalaris species: *P. brachystachys, P. minor and P. paradoxa,* the study showed , it turns out that cross-resistance in Phalaris species is conferred by specific point mutations, with resistance in *P. brachystachys* being due to target site and non-target site resistance mechanisms, while variable target site was found only in *P. minor* and *P. Paradox*.

2.5. Use of Allelopathy for Weed Management

Allelopathic species can be manipulated for sustainable weed management in various ways such as introducing an allelopathic crop into crop rotation schemes [21] using an allelopathic cover crop, or identifying, isolating and extracting plant allelochemicals for potential bioherbicide production. Potential of essential oils extracted from members of the *Mediterranean lamiaceae*.L as a bioherbicide is reviewed by [22]. In addition, [23] studied the allelopathic potential of *Parthenium hysterophorus* L. methanolic extracts at different concentrations under laboratory and greenhouse conditions. They noted eight amino acids, seven phenolic compounds, three terpenoids and other minor organic compounds such as *P. hysterophorus* L. allelochemicals in the methanolic extract. The *P. hysterophorus* L. extract was also able to inhibit the germination and growth of *Cyperus iria* L. to a similar extent as the synthetic herbicides glyphosate and ammonium glufosinate.



Figuer.5 Effect of allelopathy with different methods on weed activity [24]

The allelopathic potential of plants is known to be influenced by genotype, partly due to differences in the concentration of allelochemicals. After returning to local durum wheat strains in demand by the market, [25] conducted an investigation on the allelopathic effects of extracts from three durum wheat lines :Temilia, Rossello and modern cultivar (Mongibello), obtained from three different plant parts (ears, stems and roots), on the weeds *Portulaca oleracea* L. and *Stellaria. Media* L. Phil. It was found that ancient landraces :particularly, Temilia and Rossello showed higher allelopathic activity and that ear extracts were the most active.

3. CONCLUSION

In conclusion, a complete smart strategy can be developed based on smart agriculture As alternative methods of weed management in the future. With taking into consideration the increased resistance of weeds, their adaptation, and the speed of their spread. In long-term experiments, future studies should also focus on climate change to gain more in depth clarity on weed behavior and dynamics.

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