

# Trends in Process and Application of Herbicides: A Mini Review

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## Abstract

*In agricultural and wilderness settings, herbicides are used to suppress the density of weeds and encourage the growth of beneficial species. Herbicide use in agro-ecosystems has the potential to alter the makeup of weed populations. Herbicides have the potential to improve native species diversity in wildlands. Herbicide use poses a significantly smaller danger to plant biodiversity than habitat degradation and invasive species. This article goes over the definition of weeds, weed management guidelines, preparation process and the types, effects, and disposal of herbicides. Herbicides' effects on target and nontarget species' biodiversity as well as the contribution of weed control to biodiversity preservation are also covered. Herbicides are the most commercially available class of pesticides, with around 267 active ingredients included in over 3000 commercial products worldwide which are mainly synthetic chemicals and recent years focus has been drawn by bio-herbicides. Bio herbicides will be sustainable for the future.*

**Keywords:** Herbicides, Weed killer, Selective and Non-selective, Herbicides advantages, Herbicides resistance, Glyphosate

## INTRODUCTION

Herbicides, sometimes referred to as weed killers, are chemicals used to suppress unwanted plants, or weeds. Chemicals called herbicides are applied to unwanted plants to alter or control it. The most common use of herbicides is in row crop farming when they are sprayed either before or during planting in order to minimize other vegetation and increase crop productivity. Herbicides are substances, usually chemical ones that are used to eradicate or suppress the growth of undesirable plants, such as invasive species and weeds in homes and farms. The simplicity of application of chemical herbicides, which frequently results in labor cost savings, is a significant benefit over mechanical weed control methods. Figure 1 shows the trend of spraying herbicides in fields. Although most herbicides are thought to be safe for use around humans and animals, they can seriously harm non-target plants and the insects that depend on them, particularly when applied aerially [2].

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Currently, herbicides are the most commercially available class of pesticides, with around 267 active ingredients included in over 3000 commercial products. According to the target crop, the herbicide market in 2001 was 20% for oilseeds and soybeans, 19% for corn, 17% for cereals, 8% for rice, 6% for fruits and nuts, and 5% for cotton. Geographically speaking, North America accounts for 40% of the herbicide market, followed by Europe, the Middle East, and Africa (25%), Pacific Asia (18%), and Latin America (17%).

The most widely used crop-protection chemicals worldwide are herbicides. The estimated global

herbicide consumption in 2007 was 951,000 MT. Using selective herbicides has drastically decreased the amount of work needed to control weeds in agricultural areas. Herbicides have also made it easier to implement tillageless and reduced tillage production systems, as well as to manage weeds inside rows in crops that are closely seeded. Currently, around 130 chemical compounds are employed as selective herbicides globally, and about 30 more are used as nonselective herbicides, with a total of about 16 different modes of action.

To comprehend herbicides, one must comprehend the significance of weed management. Long before herbicides were invented, weed control was an essential component of agriculture. Alongside your crops, you may find some unwanted plants known as weeds to be growing. Because these undesirable plants use the same resources as your intended crops—water, nutrients, sunlight, and insects and fungi—their presence can have a detrimental effect on their growth and productivity [3].



**Figure 1.** Spraying herbicide in field [1].

## HOW HERBICIDES WORK

Herbicides contain chemicals that can stop or slow the growth of weeds. Even at low concentrations, herbicides have a great deal of potential for effectiveness. Herbicides come in a wide variety of forms, and while they all function differently, they can be broadly divided into two categories based on how they act: non-systemic or contact herbicides and systemic or translocated herbicides [4].

Herbicides classified as systemic or translocated are ones that enter the plant through the vascular system and are absorbed by the plant, moving from the point of absorption to areas of action where the chemicals regulate the plant's growth. Herbicides that are not systemic, sometimes known as contact herbicides, destroy the plant components they come in contact with. Even while this function is faster than contact herbicides, they are less effective against perennial weeds and need to be used more frequently, particularly to control underground growth [4, 5]. Use of herbicide and its effect on weed population is summarized in Figure 2.

## TYPES OF HERBICIDES

There are several categories for herbicides. Herbicide composition, application technique, location of action, and application time are the basis for this classification. The following is a list of some of these herbicide classifications:

### **Herbicide Types According to Specificity**

#### ***Selective Herbicides***

These herbicides can stop the growth of certain plant species without affecting crops. Because they can be applied without harming crops, these are the herbicide varieties that are most frequently employed in agriculture.

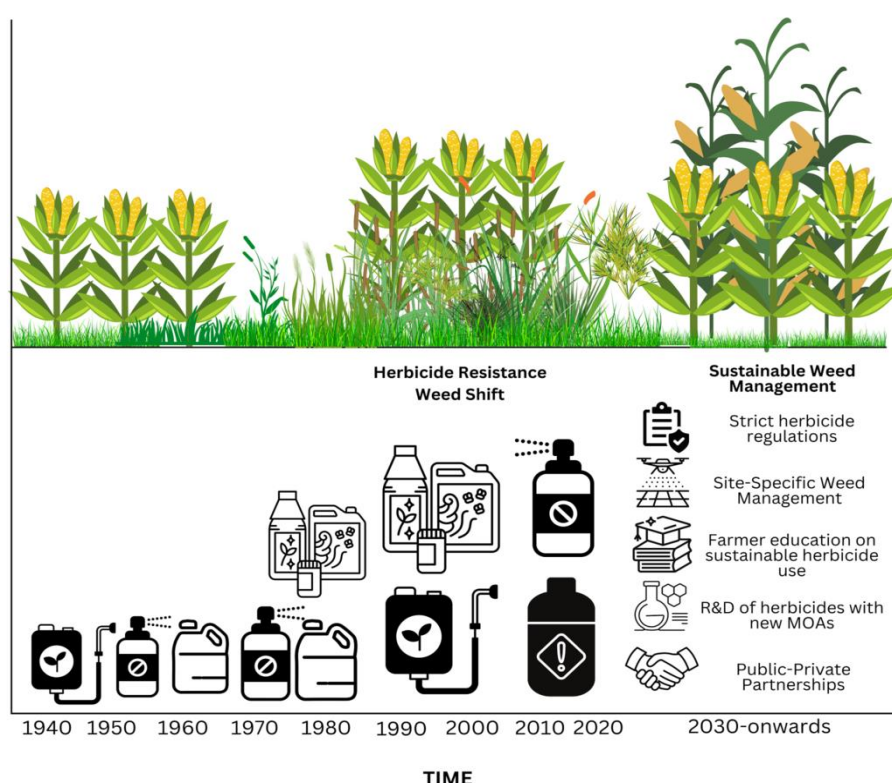
### ***Non-Selective Herbicides***

These herbicides have a broad spectrum of action and will harm any plant they come in contact with. Non-selective herbicides are mostly employed in chemical follow-up, pre- and post-sowing burn down, plantations, and industrial applications when a large area of land needs to be cleared of all vegetation [4, 7].

### **Types of Herbicides Based on the Method of Application**

#### ***Herbicides Applied to the Soil***

These herbicides are sprayed on the soil and taken up by the weed's roots or emerging seedlings' shoots. These herbicides must be administered to the right soil layer and have enough soil moisture for them to work as intended.



**Figure 2.** Use of herbicide and its effect on weed population [6].

#### ***Herbicides Applied Foliar***

These herbicides are sprayed on the weeds' foliar portions above the soil, where they are subsequently absorbed by the exposed weed tissues.

Herbicide types according to application timing.

#### ***Pre-Plant Herbicides***

These herbicides are sprayed on the soil before to planting in order to suppress weeds before crops are planted. Usually, these herbicides are both non-selective and selective. Crops can then be grown on the herbicide-treated ground for agricultural purposes.

#### ***Pre-Emergence Herbicides***

These are herbicides that can be used prior to the emergence of weed seedlings from the ground. These herbicides work by suppressing weed growth when it emerges from the soil; they have no effect

on established weeds. Herbicides known as "post-emergence" are sprayed on weeds after they have already begun to develop. Depending on the requirements, they can be applied topically or through the leaves. They can also be non-selective. Rain lowers their efficiency, therefore they are best avoided while using them. Usually, many treatments are needed for effective control [3, 8].

### **Use of Herbicides**

Herbicides eliminate weeds that would otherwise compete with crops for light, moisture, and nutrients, lowering crop quality and yield. They can also contaminate water resources, harbor pests and viruses, interfere with and destroy harvesting equipment, and even have poisonous qualities that lead to health problems.

Although its primary application is in agriculture, herbicides are often utilized in other industries where the removal of unwanted plants is important. Herbicides are helpful in agriculture because they allow crop growers flexibility by controlling weeds at nearly any stage of growth. Different weed species affect different crops, and thus, different herbicides will be required.

Herbicides can be used in preparation for seed planting in order to guarantee that no herbicide residue remains after seeding. When growing crops coexist with weeds, it may be necessary to apply a selective herbicide to control the weeds without endangering the crops. Since they can drastically affect productivity and stop dangerous weeds from growing and being processed alongside crops, pesticide use will always be crucial [9].

### **Importance of Herbicides**

By cleverly serving as molecular probes, these herbicides not only significantly improved agricultural weed control but also contributed significantly to the advancement of knowledge regarding basic plant processes [10]. Following this route, several research teams from the US and Europe investigated the molecular profiles of herbicides or employed them to investigate plant metabolism. In the 1950s, research on targeted herbicides got underway. Herbicide candidates used to advance from screens only if their biology would meet farmers' needs in the early stages. Groundwater was shown to contain traces of agrochemicals thanks to improvements in analytical instrument sensitivity during the 1970s and 1980s. These investigations also revealed that certain chemicals were environmentally persistent [11]. Consequently, there was a need for agrochemical businesses to conduct tests and quantify the rates of compound breakdown in soil and water under both aerobic and anaerobic circumstances, which resulted in strengthened regulatory requirements. Nowadays, more complex toxicological testing is done prior to field testing, and regular measurements of physicochemical parameters like vapor pressure and the octanol-water partition coefficients of novel compounds are made.

### **Advantages**

Because herbicides may be applied in so many various ways, they have significant advantages over conventional weed control techniques. The following benefits demonstrate the significance of herbicides:

#### ***Herbicides can be Applied Before the Weeds Grow***

Unlike other weed control techniques, herbicides can be sprayed during the pre-plant and pre-emergence stages of the weed life cycle. This allows the crops, even in their early phases of development, to flourish in an environment free of weeds and without competition for nutrients. Herbicides work well in a variety of crop configurations.

#### ***Herbicides can be Effectively Used Indifferent Crop Arrangements***

While mechanical weed management methods have their uses, they are unable to completely eradicate all weeds from a field, something herbicides can readily accomplish when it comes to crops that are broadcast seeded or narrowly spaced. Herbicides are also effective at getting to weeds inside the rows.

### ***Deep-rooted Weeds can be Eradicated with Herbicides***

Mechanical methods may not always be effective in eliminating weeds with deeply ingrained roots because, even after the top portion of the weed is removed, it may regenerate from the roots. For these, successful weed control may require a combination of chemical and mechanical herbicides.

### ***Herbicides Stop Weeds from Developing for an Extended Period of Time***

Herbicides have the tendency to be effective for extended periods of time and stop weeds from coming back quickly after application.

### ***Structure-wise Comparable Weeds can be Eradicated with Herbicides***

When weeds are eliminated mechanically, it is possible to miss those that seem similar to crops since it is difficult to tell the difference between the two. Nevertheless, without endangering the crops, herbicides can be used to eradicate these weeds that may have a similar appearance but differ biologically [12].

## **HERBICIDE RESISTANCE**

Similar to herbicide destiny, herbicide resistance in weeds is a vast field of study concerning herbicides and is outside the purview of this article; yet it serves as the foundation for it. Weeds that have developed herbicide resistance are a serious worry because it nearly invariably leads to higher expenses, especially in developed countries that have accepted the use of pesticides and genetically engineered crops. Although cases of resistance to herbicides were known for much longer, resistance was first recorded in the 1970s. There are presently 218 herbicide-resistant plant species in the world and the actual number is probably greater because resistance reporting might vary and depends on ongoing weed science research projects that address resistance. As elucidated and reviewed by Powles and Yu, herbicide resistance is primarily an evolutionary process, and selection for herbicide resistance depends on a variety of factors including the genetic basis of the resistance, the biology of the weed species, the characteristics of the herbicide, and how it is used. Herbicide resistance has spurred a boom in herbicide discovery and could serve as the catalyst for future developments in new herbicide modes of action, especially given the prevalence of glyphosate resistance in North America [13].

## **Glyphosate**

Herbicide glyphosate is used to suppress broad-leaved weeds and grasses. Glyphosate is widely used in the production of fruits, cereals, nuts, and vegetables and is very successful at controlling noxious weeds. Various commercial weed-killing formulations, such as those marketed under the names Roundup, Rodeo, Eraser, Refuge, AquaMaster, and AquaPro, include this active component.

## **Development and Discovery**

Glyphosate was first created in 1950 as part of scientist Henri Martin's hunt for new medicinal substances at the Swiss business Cilag. However, the compound was abandoned since there was little proof that it had any medicinal use. Glyphosate was included to the Aldrich Library of Rare Chemicals in the 1960s after the American corporation Aldrich Chemical acquired Cilag. This resulted in its rediscovery and, in 1970, its re-synthesis by American scientists Phil Hamm and John Franz employed by the business Monsanto; their study identified glyphosate's herbicidal function. The first glyphosate-based herbicide, Roundup, was released by Monsanto in 1974 and swiftly rose to prominence as a global herbicide product.

## **Use of Glyphosate**

Since its debut, glyphosate has been essential to agriculture. It provided a boost to low-till and no-till farming in the late 1970s and early 1980s, for instance, enabling more timely crop establishment and higher crop yields; these methods also helped retain soil moisture and lessen soil erosion, especially in arid and semiarid regions. The introduction of genetically modified crops that were resistant to glyphosate, such as canola (rapeseed) and corn, cotton, and soybeans, in 1996 marked a significant

increase in the use of the herbicide in agriculture. Other bare-ground weed control applications for glyphosate include fence line treatment, fallow fields, lawns, gardens, and orchards and vineyards. It is also frequently used to control weeds in aquatic situations, especially common reed (*Phragmites*), purple loosestrife (*Lythrum salicaria*), reed canary grass (*Phalaris arundinacea*), and cattails (*Typha*), which grow near water and are regarded as invasive in many places [14].

## CONCLUSION

Herbicides have been used for many years to suppress undesirable vegetation in agro-ecosystems, but little research has been done on how they affect weed biodiversity and how that affects weed management, with the exception of how herbicide resistance develops. Herbicides are substances, mainly chemical ones, used to eradicate or suppress the growth of undesirable plants, including invasive species and weeds in homes and farms. Chemical herbicides provide a lot of advantages over mechanical weed control, including easier application that frequently results in lower labor cost. Herbicides are mainly synthetic chemicals which are being used by farmers and others but now attention required is towards green synthesis of herbicide or bioherbicides. In recent years focus has been drawn by bio-herbicides. Bio herbicides will be sustainable for the future.

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