Bayer CropScience

Bayer CropScience AG
Communications
40789 Monheim
Germany
phone: +49 2173 38-3034
www.press.
bayercropscience.com

Bayer's Integrated Weed Management Program – Frequently Asked Questions

---

1. What is Integrated Weed Management all about?

Integrated Weed Management is an important component of Integrated Pest Management, which is a holistic approach to sustainable agriculture focusing on managing insects, weeds and diseases through a combination of physical, cultural, biological and chemical measures that are cost effective, environmentally sound, and socially acceptable.

2. Why is Integrated Weed Management so important, and what are the main objectives?

Weeds are the single most important reason for crop losses globally, causing high management costs and threatening food security. As a result of an increasing gap in new weed control solutions, resistance is on the rise, forcing farmers to diversify their strategies. Consequently, it is necessary to monitor vigilantly and use a variety of chemical and non-chemical strategies to control weed populations before they get out of hand. The use of different control methods reduces the risk that weed species will adapt to them. The inclusion of non-chemical weed control measures helps to reduce weed populations, making the job of the herbicides easier and thus diminishing the selection pressure for resistance. For example, if the same herbicide is used repeatedly over a longer period of time, a weed species can build up resistance to the chemical. A long-term approach to integrated weed management should reduce the extent of weeds as well as the weed seed stock in the soil. Moreover, it should consider how to achieve this goal without degrading the quality of the soil, e.g. its native ecology, or the crops themselves.

3. Why aren't enough effective weed control solutions available today?

Since the late 1990s, many crop science companies have significantly reduced or even stopped their herbicide research following the massive success of Glyphosate-based herbicides and Glyphosate-tolerant crops. The risk of resistance was underestimated and research reticence prevalent throughout the industry. This is illustrated by the sharp decline in patent applications for herbicide active ingredients from 250 per year in 1990 to little more than 50 applications a few years ago. To date, there are only a few multinational companies with major investments in herbicide research. This significant gap in R&D has to be bridged, and no new mode of action of significance to the global market has been launched in over 20 years. Since development timelines of 10+ years prevail from discovery to market introduction of a new compound, no new herbicide mode of action will be launched in at least the next eight years.

4. Why do weeds become resistant?

In every weed population there is a certain range of natural diversity in the genetic makeup of the plants, which is one of the basic principles of evolution. After application of an herbicide with a specific mode of action to any size of field, there will always be a selection chance for a small number of weed survivors that will continue to grow and produce seeds, or in the case of perennial species, rhizomes or other structures that allow vegetative propagation. If the same herbicidal mode of action is applied to the same field again and again with no other complementary non-chemical weed-control measures, the selection pressure for resistance to the herbicide is high. Resistant weeds survive, produce seeds or rhizomes, and increase in numbers until they take over entire fields – if nothing is changed.

5. What elements is Bayer's Integrated Weed Management program based on?

Bayer CropScience takes a truly holistic approach to Integrated Weed Management. We offer effective solutions (including seeds, crop protection products and services), promote best weed management practices, and constantly strive for innovation – alone or in partnership with leading universities and institutes. A fundamental pillar of our scientific approach to Integrated Weed Management is the Weed Resistance Competence Center in Frankfurt, Germany, where we test and develop new solutions to manage resistance both ourselves and in cooperation with our external partners, and share our knowledge with the entire international agricultural community.

6. How is Integrated Weed Management implemented on a daily basis?

Integrated weed control solutions are implemented via local Bayer initiatives such as "Diversity can't wait" (Australia), "Respect the Rotation" (USA), "Mix it up" (Canada), "Vielfalt ist Zukunft (Germany) and others. These country-specific initiatives focus on best weed management practices that follow Bayer guidelines and state-of-the-art stewardship measures. Their common goal is to ensure product integrity and utility, protect human health, and preserve the environment.

With no new resistance-breaking solutions in sight, our top priority is proactive weed management: aiming to prevent resistance from happening in the first place and preventing early-stage resistance from getting out of control. This goal is difficult to achieve in reality because when a particular weed management practice is working well and is economically attractive, it is tempting to continue with it despite knowing deep down that over-reliance on a

single measure can significantly increase selection pressure, which leads to resistance and the eventual loss of an entire class of herbicides in a field.

7. How do farmers benefit from Bayer's Integrated Weed Management program?

The loss of control caused by resistant weeds may result in the loss of a particular production system or even jeopardize the ability to grow a specific crop in a specific field. Incorporating Integrated Weed Management measures can help prevent or delay the onset of resistance and thus reduce costs for the farmer in only a few years. It may also lead to decreases in the density of a resistant population in a field. This requires, of course, that the problem is recognized, studied in detail, and properly addressed with a dedicated program over a longer period of time. Integrated Weed Management is not a one-time, quick and lasting fix. We actively pursue and promote Integrated Weed Management options, including mixtures, rotations and sequences of herbicides with alternate modes of action, pre-emergence treatments, crop rotations, field hygiene measures, and cultivation measures that fit into local production practices and are economically viable. Our goal is to simplify solutions as much as possible without diluting their effectiveness in order to assist their adoption and contribute towards the greater goal of developing sustainable agricultural practices. Bayer CropScience also invests a significant amount of money and expertise in order to inform and train our own employees, customers and other stakeholders so that they can develop sustainable programs to manage both their resistant and susceptible weed populations. In the end, the decision rests with the individual farmer. For this reason Bayer CropScience strives to communicate as transparently as possible on the risks of resistance and helps to convince farmers of the value of adopting Integrated Weed Management practices.

8. How is Bayer's Integrated Weed Management strategy moving forward?

Bayer CropScience plans to further broaden farmer training as well as partnerships and dialog with external partners. In terms of innovation, Bayer CropScience is strongly committed to discovery research. Besides, Bayer CropScience is the only company worldwide to cover the entire spectrum of herbicide tolerance technologies, including GM and non-GM solutions as well as safener chemistry. Our existing product portfolio includes high-performing seeds with built-in herbicide control technology (e.g. LibertyLink®), innovative crop protection products and

renowned brands such as Atlantis®, Huskie® and Adengo®, as well as tailored services and stewardship measures.

9. Why are collaborations and partnerships so important in this context?

The challenges to increasing productivity in crop production require a wide range of technologies and approaches that are difficult for one company alone to handle. We require a network of expertise to combine and maximize their external experience and resources with ours, so that more innovative solutions can be put into the hands of the world's farmers more quickly. Our research agreement with the Grains Research & Development Corporation (GRDC) in Australia is a good example: In this partnership, GRDC and Bayer CropScience join forces for the discovery and development of innovative weed management solutions. Bayer CropScience will adapt testing, evaluation and optimisation of new chemistry on major Australian weeds, including resistant weeds, and will field-evaluate all advanced herbicide classes in Australia under Australian conditions. This greatly increases the probability of success, and ensures that new weed control solutions adapted to Australian agriculture will be available to local farmers one to two years earlier on average.

Monheim, August 2015