

## **Integrated Weed Management is Needed Now More Than Ever.**

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Nature abhors a vacuum and given the chance will fill the space. Agriculture is an ordered low stress environment designed to maximize crop production and profitability. Maintenance of this ordered low stress environment in a crop field requires work (energy) to maintain because the field is not at equilibrium with its environment. The work that goes into maintaining this weed free field is familiar to us, and consists of weed control tools like crop rotation, prevention of weed seed production, stale seedbeds, physical weed control like cultivation and hand weeding, and herbicides. Used in combination, these tools will reliably manage most weeds.

There are several challenges to weed management that we are faced with: 1. Permanent crops like trees and vines are not rotated from year to year so crop rotation is not feasible; 2. New herbicides are few in number today compared with the 1960s' 70s and 80s, so we must make the best use of existing products; 3. Costs are high and profit margins are narrow requiring efficient cost-effective weed management methods; 4. Labor costs are increasing and supply is shrinking thus hand weeding is becoming less feasible as time goes by.

The more variation and flexibility in our weed management system the more likely that it will always work. By rotating crops, preventing weeds from going to seed, performing mechanical cultivation, hand weeding and varying our herbicide program we will probably have a successful weed management program. If we always use the same herbicide because it is cheap and easy, if we start dropping tools from our weed management program like cultivation and hand weeding, if we let weeds go to seed because we don't have the time or money to control them, then we will most likely not have a successful weed control program. There is a limit as to how many shortcuts we can take with weed management programs. If we keep using the same herbicides repeatedly, and use a spray only program, then weed resistance to the herbicides will likely result. New herbicide mechanisms would help avoid weed resistance, but no new mechanism of action has been introduced in over 25 years.

We need to develop new weed management programs that utilize as many of our existing tools as possible in an integrated fashion. We also need to pay attention to new technology – specifically robotics. There are already robotic cultivators commercially available that mimic the activities of hand weeding crews by removing weeds with cultivator knives or spray solutions. These new robotic tools can be combined with existing tools to create a successful weed management system. There is no one answer to creating a successful integrated weed management system for all crops and environments. We will need to evaluate each situation separately and find the best IWM system for that situation. We need to respect the need for variation in our choice of weed management tools. Weeds are very adaptable and if we give them an opening there will be a weed

species or biotype that can successfully exploit the opening. Nature abhors a vacuum and if there is a leak in the system, weeds will exploit it.