ABSTRACTS

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was due to the selection pressure by continuous use of quinclorac, a highly efficient herbicide on this weed, during eight consecutive seasons. The objective of this study was to evaluate the efficiency of alternative herbicides for the control of quinclorac resistant biotypes of ECHCG. Seeds were collected from rice fields with reported herbicide failure for the last two seasons. Seeds of resistant biotypes, as well as of a susceptible one were sown in pots in a greenhouse experiment. When the seedlings presented three-leaves, the herbicides were applied, except for clomazone that was used in pre-emergence. The herbicides used were bispyribac-sodium (50 g ha^{-1}), clefloxidim (170 g ha^{-1}), clomazone (400 g ha^{-1}), fenoxaprop-p-ethyl (41 g ha^{-1}), propanil (2 880 g ha^{-1}) and quinclorac (375 g ha^{-1}). Except for quinclorac, all other herbicides provided 100% control of the resistant biotypes. The susceptible biotype was controlled by all herbicides. The herbicides tested are efficient alternative products for use to control quinclorac resistant biotypes of ECHCG in flooded rice.

Chemical control of *Euphorbia heterophylla* L. biotypes resistant to acetolactate synthase (ALS/AHAS) inhibitors (325)

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The resistance of wild pointsettia (*Euphorbia heterophylla* L.) to ALS-inhibitors leads to the need to investigate the response of the resistant genotypes to herbicides with different action mechanisms. The objective of this study was to evaluate alternative herbicides for the control of *Euphorbia heterophylla* L. biotypes resistant to ALS-inhibitors. The herbicide treatments consisted of imazaquin (120 and 150g ha^{-1}), imazethapyr (7 and 100g ha^{-1}), flumetsulan (60 and 120g ha^{-1}), flumioxazin (45 and 60g ha^{-1}) and sulfentrazone (300 and 600g ha^{-1}), which were applied pre-emergence, and imazetapyr (80 and 100g ha-1), imazamox (30 and 40g ha^{-1}), imazapyr (20 and 250g ha^{-1}), lactofen (48 and 156g ha^{-1}), fomesafen (136 and 250g ha^{-1}) and glyphosate (600 and 720g ha^{-1}), applied after emergence in isolated as well as in combined form, on both an ALS- inhibitor-resistant and a susceptible biotype of *E. heterophylla*. For each biotype, there was an additional control without herbicide treatment. The ALS-inhibitor herbicides controlled the susceptible biotype efficiently, except for flumetsulan, whereas the resistant biotype could only be controlled by imazapyr at high doses. Herbicides with other action mechanisms proved to be highly efficient for the control of susceptible and resistant biotypes when applied in isolated or mixed form. Resistant *E. heterophylla* biotypes are therefore efficiently controlled by other action mechanisms than ALS-inhibitors.

Risk factors that impact resistant weed selection (326)

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Prior to 1970, weed scientists generally were not concerned with the possibility of weeds developing resistance to herbicides. Products such as atrazine and 2,4-D had been widely used for a long period of time with no large-scale failures that affected agriculture. During the 1970's, as cases of herbicide resistant weeds began to increase, growers and weed scientist began to study the phenomenon of herbicide resistant weeds and their impact on agriculture. Certain risk factors for development of herbicide resistance have been explored and described. These include the mode of action of the herbicide, persistence in the environment, effective kill rate, rotations with other herbicides, and the frequency of use. More subtle risk factors have not been as carefully studied or documented. Reacting to economic pressures, some growers may reduce herbicide rates to the point that resistant weeds may develop more quickly. This possibility is being studied with the use of glyphosate in RR crops. In the case of dicamba, the lower labeled use rate in small grains may have accelerated development of tolerant kochia biotypes relative to the higher use rates in corn. Further complicating the picture is the fact that some weeds are inherently more tolerant than others to a given herbicide. Rarely is the field use rate based on a precise analysis of the dose response of all weeds in a field to a given herbicide. Future herbicide resistance research will need to account for these additional factors if the true nature of herbicide resistant weeds is to be understood. A side benefit of herbicide resistant weeds has been the increased study of basic weed physiology and biochemistry, as well as the use of novel resistance traits in biotechnology to develop crops with new herbicide resistance traits.

Risk analysis of development of herbicide resistant weed biotypes to ACCase and ALS inhibitors in conventional and no-tillage soybean production systems in Brazil (327)

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Herbicide resistant weed biotypes have been reported in soybean fields in Brazil since 1993. Biotypes of *Bidens pilosa/Bidens subalternans* and *Euphorbia heterophylla* have developed resistance to ALS inhibitor herbicides, especially in conventional tillage areas and *Brachiaria plantaginea* to ACCase inhibitor herbicides in no tillage areas. *Bidens pilosa/Bidens subalternans* and *Euphorbia heterophylla*, under field conditions and greenhouse experiments have shown cross-resistance to sufonylureas, imidazolinones, triazolopyrimidines and pyrimidyl-oxi-benzoates. To prevent or manage resistance of these weeds, soybean growers can use herbicides, which have alternative mechanisms of action such as photosystem II and PROTOX inhibitors, sprayed in pre or post-emergence conditions. *B. plantaginea* found in soybean fields of Parana State is cross-resistant to aryloxyphenoxypropionic acids and cyclohexanediones. However, there is no other herbicide available with alternative mechanisms of action other than ACCase inhibitors. This is because the areas where *B. plantaginea* biotypes have been selected to resistance are restricted to no-tillage systems, where grasses are controlled only by ACCase inhibitor herbicides sprayed post-emergence. In Brazil, there is no survey to register the number of sites with resistant weeds, however they have increased in the last years. Integrated weed management systems should be used to reduce the risk of the increasing the number of sites with resistant weeds. Herbicides are widely used in soybean production systems in Brazil, and there is a great deal of herbicide expertise among farmers. Because of the success of chemical weed control, practitioners, farmers and several researchers have concentrated their efforts on the herbicide technology and have sometimes lost sight of the biology of the plants and integration of weed control methods.

What risks do herbicide resistant weeds present to chemical companies? (328)

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The cost of discovering, developing, and marketing a novel herbicide is approximately $100 million dollars in 2000. With such sizeable investments in new products, chemical companies hope for sizeable market share in several crops over a number of years to obtain a desirable return on investment. Short of being replaced by some other product in the market, herbicide resistant weeds can represent one of the biggest threats to return on investment for a chemical company. In several well documented examples, use of a class of chemistry by one company can create resistant weed populations which create serious problems for other companies seeking to develop herbicides with the same mode of action. Although rotation of herbicide mode-of-action is promoted as a way to reduce development of herbicide resistant weeds, the pressures of short-term profits make it difficult for companies to always actively promote such product stewardship. The reality of herbicide resistant weeds is that resistant weed populations must be viewed