

AGRONOMIC ALERT



INTERACTION BETWEEN HERBICIDES AND INSECTICIDES IN CORN

The current demand for corn has increased the number of continuous corn acres. Breaking the corn/soybean rotation with two or more years of continuous corn has resulted in higher than normal corn rootworm (CRW) infestations on a small percentage of planted acres. Corn rootworm species are one of the most destructive and resilient pests of corn. CRW has been a challenge to manage since the late 1950's and have adapted to various soil and foliar applied insecticides (1). Northern and western CRW have been able to circumvent crop rotation tactics, with the potential for high levels of CRW. Best management practices for continuous corn acres include the use of soil-applied insecticides to manage CRW larvae to prevent root damage (2). Several soil-applied insecticides are available for use in corn but some restrict the use of herbicides to avoid crop tolerance problems.

Causes and Symptoms

Organophosphate (OP) insecticides, amino acid synthesis (ALS) and pigment (HPPD) inhibitor herbicides are metabolized by the cytochrome P450 enzyme system. All three pesticide groups are systemic in the corn plant, accumulating in areas with active cell division. The presence of an OP insecticide in corn at or near the time of herbicide application can reduce the rate of degradation of the herbicide, causing crop injury.

Terbufos, the active ingredient in Counter[®] insecticide products, has been found in the soil and corn 40 days after application, with residues declining through harvest (3). Individual insecticide or herbicide products may interact differently in regard to crop tolerance, even though they share a similar degradation pathway. The risk of an interaction between the herbicide and insecticide varies among OP insecticides. Counter[®] is considered to be the highest risk OP insecticide due to greater translocation and distribution within the corn plant. Crop injury symptoms resulting from the interaction of OP insecticides and herbicides include chlorosis in the corn whorl, chlorosis or bleached bands on leaves, and stunted plants.

Management Considerations

Crop injury resulting from the interaction of OP insecticides and ALS/HPPD herbicides can be exacerbated by several factors. Research with both ALS and HPPD herbicides and OP insecticides indicates that the type of insecticide, application method, formulation, soil type, and rainfall can have an effect on crop injury (3, 4, 5). OP insecticides vary within the group in regard to risk for crop injury and non-OP soil insecticides do not interact negatively with herbicides. In-furrow insecticide applications present a greater risk than T-band or banded applications.



Controlled release formulations (Counter CR) are designed to meter out the insecticide into the soil solution in a more uniform concentration which decreases the availability of terbufos, reducing the risk for crop injury. Increasing amounts of soil organic matter adsorb more of the insecticide from the soil solution making it less available for root uptake. Rainfall at or around the application of the insecticide or herbicide can increase the potential for crop injury as more of each pesticide

is available for absorption by the plant. Conversely, as soils dry out, less insecticide is in the soil solution and is bound to soil particles making it less available for uptake. Stress from environmental or pest conditions that reduce crop vigor can compound the potential for crop injury caused by herbicide/insecticide interactions (6). Soil compaction or related soil factors can amplify the effects of crop injury. Risk of crop injury or yield loss may also be increased by other pre- or tank mix herbicides and adjuvants that have crop tolerance issues. It is important to understand how all of the active ingredients in a pre- or tank mix may interact to compromise crop tolerance. ALS and HPPD herbicides registered for use in corn are summarized in Table 1. Pesticide labels for ALS, HPPD and OP insecticides used in corn have precautions or restrictions for managing interactions that affect crop tolerance (Table 1). Always consult individual product labels, technical bulletins or related information to ensure complete understanding of corn response to pesticide interactions. Although state, local or company recommendations may address crop injury potential, variable biological and environmental conditions change unexpectedly and may alter the crop tolerance equation. Labels and recommendations may vary between individual product manufacturer guidelines, particularly with multiple companies or generic formulations using similar herbicide or insecticide components.
ALWAYS READ AND FOLLOW LABEL DIRECTIONS.

Table 1. Herbicide recommendations for use with soil applied organophosphate insecticides.

Herbicide Trade Name	Active Ingredients	Site of Action (Group)	Counter® 20G In-furrow or T-band	Lorsban®	Fortress®	Aztec®
Accent®/Accent® Q	nicosulfuron	ALS (2)	No	See label	Yes	Yes
Basis®	rimsulfuron, thifensulfuron	ALS (2)	No	See label	Yes	Yes
Beacon®	primisulfuron	ALS (2)	No	Risk	Risk	Risk
Balance® Pro/Flexx	isoxaflutole	HPPD (27)	Yes	Yes	Yes	Yes
Callisto®/Callisto® Xtra	mesotrione/mesotrione, atrazine	HPPD (27)	PRE only	No	Yes	Yes
Camix®	mesotrione, metolachlor	HPPD, Mitosis (27, 15)	PRE only	Risk	Risk	Risk
Capreno®	thiencarbazone, tembotrione	ALS, HPPD (2, 27)	No	No	Yes	Yes
Celebrity® Plus	nicosulfuron, dicamba	ALS, Synthetic auxin (2, 4)	No	Yes	Yes	Yes
Corvus™	thiencarbazone, isoxaflutole	ALS, HPPD (2, 27)	No	No	No	Yes
Halex™ GT	mesotrione, glyphosate, metolachlor	HPPD, EPSPS, Mitosis (27, 9, 15)	No	No	No	No
Hornet®	flumetsulam, clopyralid	ALS, Synthetic auxin (2, 4)	No	Risk	Risk	Risk
Impact®	topramezone	HPPD (27)	Yes	Yes	Yes	Yes
Laudis®	tembotrione	HPPD (27)	Yes	Yes	Yes	Yes
Lexar®	mesotrione, atrazine, metolachlor	HPPD, PsII, Mitosis (27, 5, 15)	PRE only	Risk	Risk	Risk
Lumax®	mesotrione, atrazine, metolachlor	HPPD, PsII, Mitosis (27, 5, 15)	PRE only	Risk	Risk	Risk
Northstar®	primisulfuron, dicamba	ALS, Synthetic auxin (2, 4)	No	Risk	Risk	Risk
Option®	foramsulfuron	ALS (2)	No	Risk	Yes	Yes
Prequel®	rimsulfuron, isoxaflutole	ALS, HPPD (2, 27)	No	See label	Yes	Yes
Python®	flumetsulam	ALS (2)	No	Risk	Risk	Risk
Realm™ Q	rimsulfuron, mesotrione	ALS, HPPD (2, 27)	No	No	Yes	Yes
Require® Q	rimsulfuron, dicamba	ALS, Synthetic auxin (2, 4)	No	See label	Yes	Yes
Resolve®/Resolve® Q	rimsulfuron, thifensulfuron	ALS (2)	No	See labels	Yes	Yes
Sharpen®	saflufenacil	PPO (14)	No	No	Yes*	Yes*
Spirit®	prosulfuron, primisulfuron	ALS (2)	No	Risk	Risk	Risk
Steadfast®/Steadfast® Q	nicosulfuron, rimsulfuron	ALS (2)	No	See label	Yes	Yes
Stout®	nicosulfuron, thifensulfuron	ALS (2)	No	See label	Yes	Yes
SureStart®	flumetsulam, clopyralid, acetochlor	ALS, Synthetic auxin, Mitosis (2, 4, 15)	No	See label	See label	See label
TripleFLEX®Herbicide	flumetsulam, clopyralid, acetochlor	ALS, Synthetic auxin, Mitosis (2, 4, 15)	No	See label	See label	See label
Verdict™	saflufenacil, dimethenamid	PPO, Mitosis (14, 15)	No	No	Yes*	Yes*

No = Do not apply herbicide if Counter will be or was applied at planting; Do not use/apply; Severe corn injury with yield loss; Unacceptable crop injury. PRE only = Herbicide can only be applied preemergence if Counter was applied at planting; Risk = Risk of temporary or greater crop injury. See labels = Consult precautionary statements on herbicide and insecticide labels. Yes = May be applied/used. *Restricted application method, see label for specific details.

CONSULT PRODUCT LABELS FOR SPECIFIC USE INSTRUCTIONS PRIOR TO USE.

Sources: 1. Counter 20G Technical Bulletin, Potential Herbicide Interactions with Counter 20G at Planting, 2012. AMVAC Chemical Corporation, <http://www.amvac-chemical.com/>. 2. Individual herbicide labels—<http://www.cdms.net> (verified)

References

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3. Morton, C. A, et. al. 1993. In-furrow terbufos reduces field and sweet corn (*Zea mays*) tolerance to nicosulfuron. *Weed Technol.* 7: 934-939.
4. Hartzler, B. and M. Owens. 2000. Interactions between ALS-herbicides and OP insecticides. *ISU Weed Science Online*. <http://www.weeds.iastate.edu/> (verified 1/26/2012).
5. Jewett, M. R. et. al. 2008. Corn response to mesotrione as affected by soil insecticide, application method, and rate. *Plant Management Network*.
6. White corn seedlings. 2011. *Agronomic Spotlight*
7. Corn and soybean herbicide chart. Glyphosate, Weeds, and Crops Series GWC-3. http://glyphosateweeds crops.org/Info/MOA_060807.pdf (verified 1/26/2012).
8. Herbicide package mixes. 2012 Herbicide Guide for Iowa Corn and Soybean Production. Iowa State University. <http://www.weeds.iastate.edu/reference/08wc94mixes.pdf> (verified 1/26/2012).

ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. **Tank mixtures:** The applicable labeling for each product must be in the possession of the user at the time of application. Follow applicable use instructions, including application rates, precautions and restrictions of each product used in the tank mixture. Monsanto has not tested all tank mix product formulations for compatibility or performance other than specifically listed by brand name. Always predetermine the compatibility of tank mixtures by mixing small proportional quantities in advance. TripleFLEX® Herbicide is not registered in all states. TripleFLEX® Herbicide may be subject to use restrictions in some states. The distribution, sale, or use of an unregistered pesticide is a violation of federal and/or state law and is strictly prohibited. Check with your local Monsanto dealer or representative for the product registration status in your state. Technology Development by Monsanto and Design® and TripleFLEX® are registered trademarks of Monsanto Technology LLC. Permit® and YUKON® are a registered trademark of, and used under license from, Nissan Chemical Industries, Ltd. Impact® is a registered trademark of Amvac Chemical Corporation. ©2012 Monsanto Company. All other trademarks are the property of their respective owners. ©2012 Monsanto Company. 01262012JSC.