Synthetic Auxin Resistance in Wild Mustard

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HERBICIDE RESISTANCE ACTION COMMITTEE

Auxin Resistant Wild Mustard

Wild mustard is a common and serious weed of cereal production throughout the world. Populations of synthetic auxin resistant wild mustard were first found in cereal production in Manitoba, Canada in 1990. These populations were selected by repeated use of 2,4-D, dicamba, MCPA and mecoprop over more than 20 years. In addition a population of wild mustard with dicamba and ALS inhibitor resistance was identified in Turkey in 2008.

Levels of Resistance and Cross-Resistance

The levels of resistance of wild mustard from Canada to MCPA, 2,4-D, and dicamba are 10, 18, and 104-fold, respectively, relative to sensitive biotypes.

Dicamba-resistant Wild Mustard in wheat. Dicamba 0.25 lb ai/A

Synthetic auxin resistant wild mustard two months after treatment with the recommended rate of dicamba.

Susceptible and resistant wild mustard 21 days after treatment with MCPA.

Mechanism of Resistance

Studies on synthetic auxin resistant wild mustard have shown that resistance is not due to altered uptake, translocation, or metabolism. Although not completely understood, it appears that synthetic auxin resistance in wild mustard is due to changes in the auxin binding site.

Inheritance of Resistance

Genetic studies on wild mustard resistance to dicamba, picloram, and 2,4-D show that resistance is controlled by a single dominant gene.

Rate of Spread

The infestation of synthetic auxin resistant wild mustard is limited to a small cropping area in Manitoba, Canada. Populations were found on 9 farms in close proximity, and because these farmers shared equipment it is thought that the resistant populations all originated from a single founding population. Over the last 25 years there have not been any other populations detected in North America. Synthetic auxin resistant wild mustard has been shown to be less fit than susceptible biotypes, which may explain it's limited occurrence.

Resistance to Other MOA's

Wild mustard first evolved resistance to PSII inhibitors in Canada in 1983 and to ALS inhibitors in Canada in 1992. ALS inhibitor resistant wild mustard is found in Australia, Canada, Italy, Iran, Spain, Turkey, and the United States.

Whilst most populations that have evolved resistance to ALS inhibitors are due to an altered target site, a wild mustard population found in Alberta in 1993 with resistance to the ethametsulfuron-methyl (an ALS inhibitor) was found to be due to enhanced metabolism.

Multiple Resistance

The only reported case of multiple resistance in wild mustard is to the ALS inhibitors and synthetic auxins in cereal production in Turkey. These are two key herbicide groups for control of wild mustard in cereals, complicating control strategies.

Best Management Practices

Integrated weed management including herbicide rotation, mixtures, and cultural/ mechanical controls should be practiced to delay the selection of synthetic auxin resistant wild mustard.

Wild mustard seedling at an appropriate size for post-emergence herbicide application.

Additional information on herbicide resistance can be found at weedscience.org

Barley is more competitive with wild mustard than wheat, and may be a useful rotational crop for management of herbicide-resistant wild mustard.

Cultivation can be effective in reducing wild mustard populations however it is not often possible because wild mustard emerges at about the same time as spring planted cereals. Harrowing with spring-tine harrows after seeding but before crop emergence has been an effective method to control wild mustard. Grazing is not effective and can cause gastric problems for stock if eaten in excess. Delayed seeding combined with cultivation or a non-selective herbicide to kill wild mustard seedlings has been shown to reduce populations.

The fact sheet “Synthetic Auxin Resistant Weeds” provides more detail on how to delay and mitigate resistance.

Facts about Wild Mustard

SCIENTIFIC NAME

Sinapis arvensis

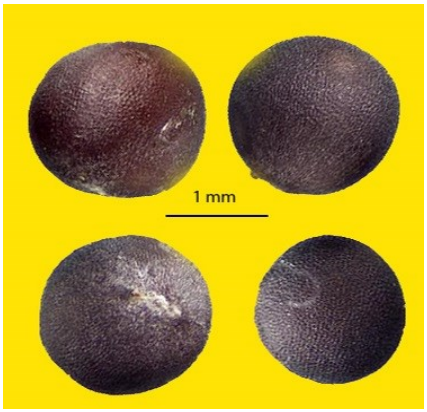
SYNONYM

Brassica kaber

OTHER COMMON NAMES

charlock, crunch-weed, field mustard, field kale, mustard, kedlock

Wild mustard is an annual broadleaf weed that originates from Europe, the Middle East and western Asia and is now widespread throughout the temperate regions of the world. Prior to the introduction of modern herbicides, like 2,4-D and MCPA, wild mustard was one of the most economically important weeds in spring sown cereal production throughout the world. It’s highly competitive growth habit along with high seed production and long seed survival are keys to it’s success as a weed. Studies have shown that if left uncontrolled in cereals wild mustard can cause between 30% to 75% yield reduction. Wild mustard thrives under high nitrogen and high light intensity on alkaline to neutral soils.



SEED LONGEVITY AND EMERGENCE

Typically 70% of freshly harvested wild mustard seed are dormant. In cereal production seeds ploughed to a depth of 8” had a mean annual decline of 23% and it took 14 years to obtain 95% seed loss. A small percentage of deeply buried seed may remain viable in the soil for up to 60 years. When stored as a contaminant of cereal grain wild mustard seed can remain viable for over 100 years.

HIGH LEVEL OF GENETIC VARIABILITY

Wild mustard is self incompatible and insect pollinated. DNA analysis has shown that wild mustard has a high degree of genetic variation which makes it prone to the development of herbicide resistance.

SEED PRODUCTION AND DISPERSAL

Wild mustard plants can produce up to 3,500 seeds per plant under crop competition. Seed is readily dispersed in soil on machinery and through contamination of seed.

REFERENCES

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