QUESTIONS FREQUENTLY ASKED BY FARMERS

MIDGE TOLERANT WHEAT
Plant · Protect · Preserve

When will the midge tolerant wheat varieties be commercially available?

AC® Unity VB, AC® Goodeve VB and AC® Glencross VB were commercially available in spring 2010.
AC® Fieldstar VB will be available in spring 2011.
AC® Shaw VB, CDC Utmost VB and AC® Conquer VB will be available in spring 2012.
AC® Vesper VB will be available in spring 2013.

Who funded the development of these varieties?

These varieties were developed using funds from the Western Grains Research Foundation check-off program, AAFC, CDC and variety distributors. AC® Unity VB, AC® Goodeve VB, AC® Glencross VB, AC® Fieldstar VB, AC® Shaw VB, AC® Conquer VB and AC® Vesper VB were developed through the work of Agriculture & Agri-Food Canada wheat breeders at Winnipeg and Swift Current. CDC Utmost VB was developed at the Crop Development Centre at the University of Saskatchewan.

Do all midge tolerant wheat varieties use the same form of tolerance?

Yes, all varieties contain the *Sm1* gene which provides midge tolerance.

How does the *Sm1* gene work?

When the insect begins to feed on the seed, the *Sm1* gene causes the level of phenolic compounds (naturally occurring organic acids in wheat kernels) to elevate more rapidly than in wheat kernels without the *Sm1* gene. The higher levels of phenolic acids cause the midge larvae to stop feeding and the larvae starve to death.

The mechanism that triggers the production of phenolic acids does not operate if midge larvae are not feeding on the seed, and in addition, these acids are reduced to normal levels by the time wheat reaches maturity — thus not affecting the quality or food value of the harvested grain.

Is this a GMO?

No. The *Sm1* gene is a naturally occurring gene in wheat. *Sm1* was incorporated into CWRS through crossing with a winter wheat variety from the U.S. This used traditional plant breeding techniques, not biotechnology.

Why is the *Sm1* gene likely to break down?

The *Sm1* gene does not change or "break down". However, the *Sm1* gene is single gene insect resistance, which has a history of becoming ineffective over time as insect populations change. Since a small number of midge carry a mutation allowing them to attack varieties carrying the *Sm1* gene and survive (referred to as virulent midge), these can mate with other virulent midge and quickly build up a large population that can feed on wheat varieties with the *Sm1* gene. The objective of the interspersed refuge is to slow down the potential shift in the midge population towards the virulent biotype.

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What is the difference between virulent and non-virulent midge?

Virulent wheat midge are those resistant to the effects of the *Sm1* gene. They carry a mutation that allows them to attack wheat plants with the *Sm1* gene and survive. A very low level of virulent midge exists within the natural midge population.

Non-virulent wheat midge cannot survive the *Sm1* gene contained in midge tolerant wheat. If non-virulent midge mate with virulent midge, the progeny of this cross will be non-virulent since this is usually the dominant gene.

What is a refuge?

Refuge refers to the 10% susceptible variety in the varietal blend (VB). The blend is 90% tolerant and 10% susceptible. For example:

AC® Unity VB — refuge (susceptible) variety is AC® Waskada
AC® Goodeve VB — refuge (susceptible) variety is AC Intrepid
AC® Glencross VB — refuge (susceptible) variety is AC® Burnside
AC® Fieldstar VB — refuge (susceptible) variety is AC® Waskada
AC® Shaw VB — refuge (susceptible) variety is AC Domain
CDC Utmost VB — refuge (susceptible) variety is Harvest
AC® Conquer VB — refuge (susceptible) variety is 5701PR
AC® Vesper VB — refuge (susceptible) variety is AC® Waskada

What is an interspersed refuge system?

An interspersed refuge system means that the refuge variety is evenly distributed (inter-seeded) throughout the field. This is different to the *Bt* corn refuge management system where the refuge is grown as a block beside or within the same field.

How does the interspersed refuge system work?

In an interspersed refuge system, non-virulent midge survive on the 10% susceptible plants interspersed throughout the wheat field. The non-virulent midge would inter-mate with virulent (resistant) midge. The progeny of this cross would be non-virulent. This prevents a build up of virulent midge, and could extend the life of midge tolerance to 90 years or longer.

What happens if midge tolerant wheat is grown in a pure stand?

If midge tolerant wheat is grown in a pure stand, only virulent (resistant) midge will survive. The virulent midge would mate only with other virulent midge. A large virulent population quickly builds and feeds on tolerant varieties. Without an interspersed refuge system, midge tolerance could break down within 10 years.

Could 10 percent of the crop (the refuge variety) be really damaged by the pest?

Yes, it is possible that the refuge variety will suffer severe damage under a heavy midge infestation.

Has this midge tolerant system proven to be as effective as spraying Lorsban?

We have very little experience comparing field scale use of insecticides versus field scale production of varieties carrying the *Sm1* gene. However, it appears that the *Sm1* gene is effective in protecting the crop from large scale losses in yield due to wheat midge. There may be some down-grading in varieties carrying the *Sm1* gene since the midge larvae need to nibble on the wheat kernels before they die.

Why is it necessary to limit the use of farm-saved seed to one generation past Certified Seed?

This condition is critical because wheat midge may attack the refuge variety and the level of the refuge in farm-saved seed may change substantially over multiple generations. For example, under an extremely heavy midge infestation, the susceptible refuge variety could sustain up to 50 percent yield loss. To keep the refuge at the desired level of 10 percent of the plant population, it is necessary to limit the use of farm-saved seed to one generation past Certified Seed.

Why is it necessary to sign a stewardship agreement?

The stewardship agreement is necessary to make sure that the importance of the refuge is communicated to farmers and that the refuge is followed. We need to preserve midge tolerance so farmers can continue to benefit from this technology. The agreement ensures that all farmers will maintain the interspersed refuge system in midge tolerant wheat. This is necessary to preserve midge tolerance because:

- The tolerance is based on a single gene, which has a history of becoming ineffective over time. An interspersed refuge system could extend the life of midge tolerance from as little as 10 years to 90 years or longer.
- It took researchers more than 15 years to move this single gene into spring wheat varieties.
- No other known source of midge tolerance has been identified so we all need to work together to maintain this valuable trait for today and for generations to come.