Cornell Cooperative Extension

VEGETABLE FACT SHEET

Integrated Pest Management

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NEW Crop Rotation Recommendations for Swede Midge

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A spatiotemporal rotation of 500 feet for 2.5 to 3 months can be highly effective for managing swede midge

INTRODUCTION

Swede midge is difficult to control on small farms

Swede midge (*Contarinia nasturtii*) is an invasive insect that can seriously damage plants in the family Brassicaceae, which includes broccoli, cauliflower, cabbage, kohlrabi, and kale. Larval feeding on brassica crops results in distorted plant growth, corky scarring, and/or blind heads, which can reduce marketable yield and quality (Fig. 1). Swede midge control is challenging on small-scale and organic farms, where season-long production of brassica crops in close proximity is common. This continuous supply of host plants allows swede midge populations to explode. Research shows that economic damage to crops can be avoided by "crashing" the swede midge population. New crop rotation recommendations provide a feasible population management strategy for some small farms.

Life cycle

In New York, swede midge has 4-5 overlapping generations that are active from mid-May to late-October. Each spring, the tiny (2 mm) gnat-like adult flies emerge from overwintered pupae in the soil. Females have 3 days to find a mate and then a suitable host on which to lay their microscopic eggs. Eggs hatch within 2-8 days and then the larvae (2-3 mm) feed deep within the growing tips of brassica plants for 7-26 days before dropping to the soil, where they pupate for 7-49 days or overwinter. About 2% of overwintering pupae remain in the soil for at least 2 years.

Figure 1. Damage caused by swede midge larval feeding: leaf puckering and brown scarring along leaf margins in broccoli (left), and brown corky scarring deeming kohlrabi head unmarketable (right). Photos: C. Hoepting, CCE Cornell Vegetable Program

FAR AND LONG CROP ROTATION OPTIONS

Preliminary crop rotation recommendations

Preliminary crop rotation recommendations advised growers to rotate away from brassica crops by **at least 3,000 feet for a minimum of 3 years**. This was a conservative recommendation based on the knowledge that swede midge are weak fliers and can persist in soil for at least 2 years. Implementing such far and long spatiotemporal rotations is impractical for most small farms.

To examine whether a reduced spatiotemporal rotation scheme could effectively mitigate swede midge damage, Cornell Vegetable Program researchers conducted an extensive project, which monitored swede midge populations and crop damage on seven small-scale organic farms in New York from 2015 to 2017. **This work resulted in new, less restrictive crop rotation recommendations** that center on reducing economic damage by depriving adult swede midge of susceptible host plants during peak periods of activity.

New spatial (far) crop rotation recommendations

In the monitoring project, **~500 feet between secluded fields was enough** to prevent swede midge that emerged from an infested field from finding brassicas in an uninfested field. Swede midge generally cannot fly long distances or cross over large physical barriers, so it is important that fields are separated by barriers such as wooded strips. Hedgerows and fences are not an adequate physical barrier. Note that in an open field (e.g. 8-12 acre), 500 feet between an infested site and a new brassica planting is not enough to prevent infestation of the new planting.

CROP ROTATION	RECOMMENDATIONS	
	OLD (for non-secluded fields)	**NEW (for secluded fields)**
Far	**Minimum: 3,000 feet** between brassica crops	**~500 feet Caveat: Fields must be separated by a substantial barrier such as woods**
Long	**Minimum: 3 years** between brassica crops	**Minimum: 2.5 to 3 months** (= no brassicas from May to mid-July)

New temporal (long) crop rotation recommendations

In New York, peak emergence of adult swede midge from overwintered pupae occurs from mid-May to late June. Population monitoring indicates that there are usually two emergence peaks, after which only very low levels of overwintering adults will continue to emerge (Fig. 2a & b). Therefore, a **minimum 2.5 to 3 month gap in brassica crop production from May through July can be highly effective**. This means that the same field may be cropped to brassicas in consecutive years, but enough time must be given to crash the swede midge population in the spring. **Wait until mid-July when swede midge spring emergence has subsided to plant a brassica crop in such a field**.

Largest spring emergence is expected following a brassica crop that was infested with swede midge during the previous fall. Heavy spring emergence may also occur following a brassica planting that was infested with swede midge during the previous summer. Extent of spring emergence following an infested planting during the previous spring is unknown, but it is expected to be minimal, because swede midge would likely have left the site in search of another brassica crop.

The new crop rotation recommendations will not eliminate swede midge from your farm, but can prevent swede midge populations from building up to economically damaging levels (Fig. 2b & c).

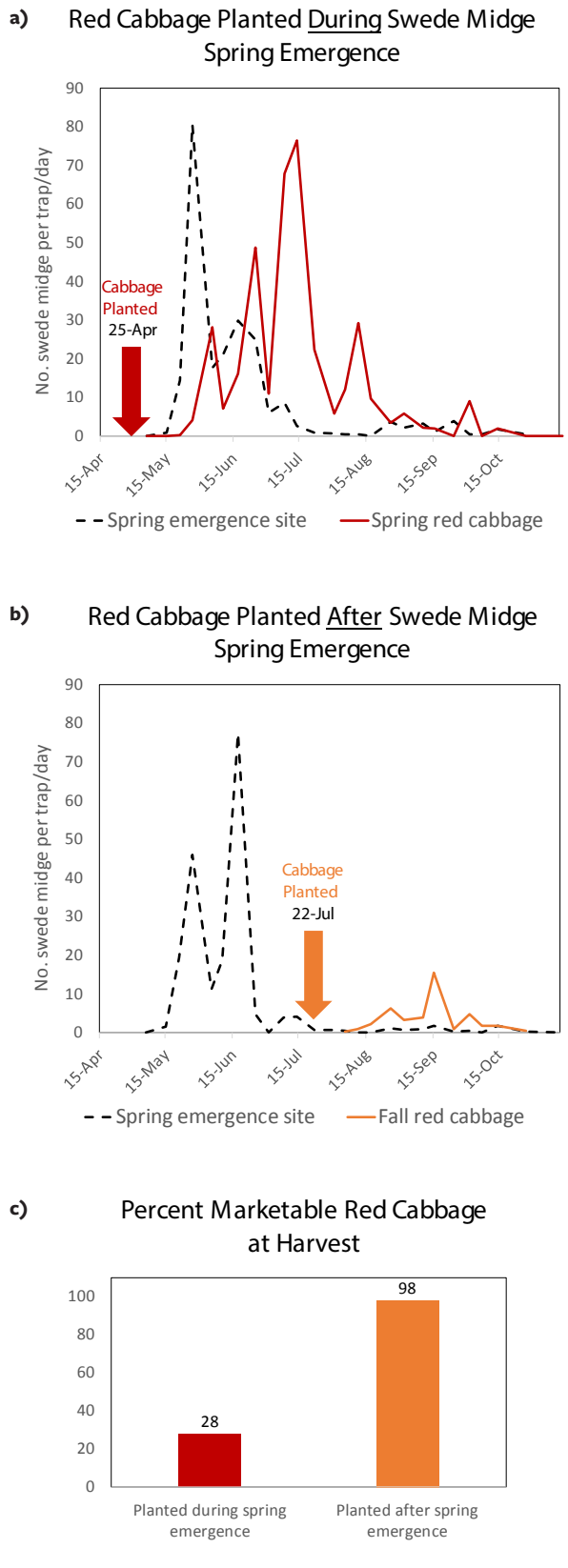


Figure 2. Effects of planting red cabbage during (a) and after (b) spring emergence of swede midge on swede midge population and subsequent marketability of the crop (c). Waiting to plant red cabbage until spring emergence had subsided improved marketability by 70%.

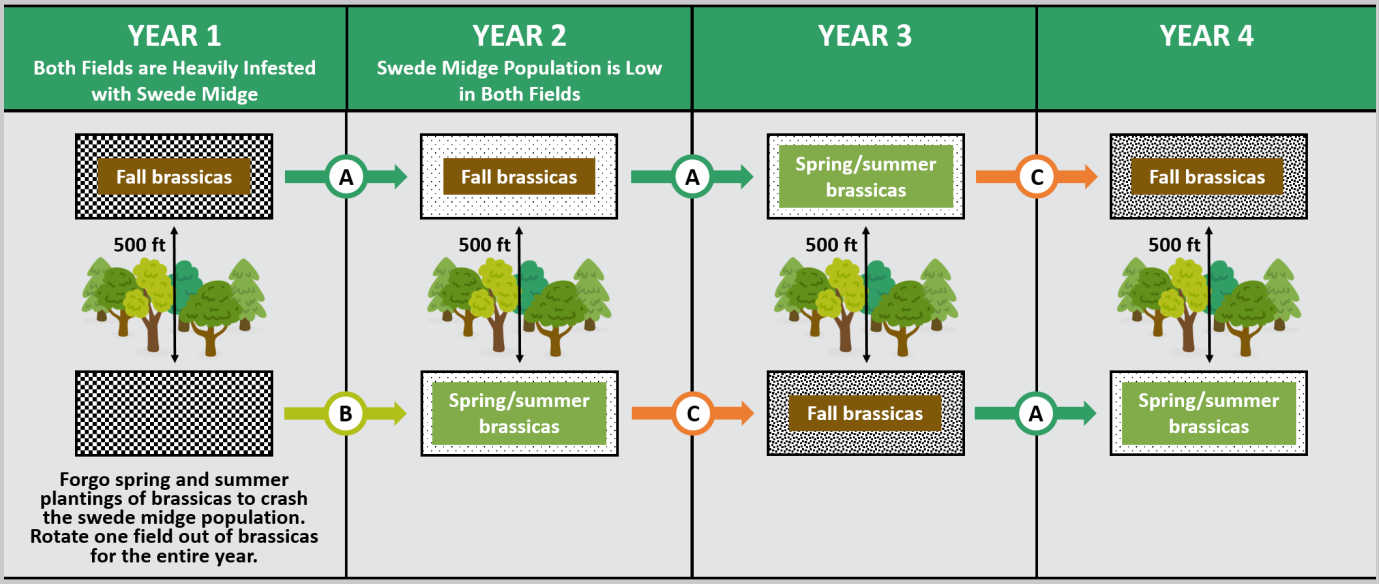
Conditions for new crop rotation recommendations

- Have multiple secluded fields, ideally separated by wooded areas. 500 feet is not far enough in an open area (e.g. 8-12 acre field)
- Ensure brassica transplants are free from swede midge infestation.
- Combine crop rotation with timely post-harvest crop destruction to prevent swede midge populations from building.
- Avoid brassica cover crops such as mustard when rotating away from brassicas.

EXAMPLE CROP ROTATION USING NEW RECOMMENDATIONS

In this example, we begin with a farm that has **two secluded fields separated by a 500 foot wooded area**, both of which are heavily infested with swede midge. Heavy spring emergence is expected in both fields. After rotating away from spring and summer brassica plantings for one year, the farm may resume season-long brassica production by rotating between spring and summer plantings in one field and fall plantings in the other.

If two secluded sites are not available, two farms could consider collaborating by swapping ground in order to implement rotation of brassica plantings. If susceptible brassicas must be planted in a heavily infested site, insect exclusion netting may be an option. More information on insect exclusion netting can be found in the online reports listed at the end of this factsheet.



Key

Field with high swede midge pressure (major crop losses occur in susceptible brassicas)

Field with moderate swede midge pressure (some crop losses occur in susceptible brassicas)

Field with low swede midge pressure (no damage or minor damage occurs)

Wait until after spring emergence subsides to plant fall brassicas no earlier than mid-July, and monitor your fall plantings in case unexpected damage does occur.

Plant spring and summer brassicas in field with lowest swede midge pressure.

A — Swede midge pressure is expected to be low following fall brassicas that were planted after spring emergence.

B — In absence of brassicas, swede midge population crashes to low levels.

C — Planting spring and summer brassicas in the same field will allow the swede midge population to build to moderate levels. Do not plant brassicas in the same field season-long.

WHEN CROP ROTATION IS NOT AN OPTION

The new crop rotation recommendations will not work for every farm. However, there are still other management strategies to consider. Even if you do not have secluded fields separated by 500 feet, **growing only fall brassicas** on your farm can reduce pest pressure by disrupting the swede midge population cycle (see crop rotation example). **Insect exclusion netting** is extremely effective and economically viable when swede midge pressure is high in a high-value brassica crop. Additionally, swede midge has **relative preferences among brassica crops**, and less-preferred crops consistently suffer lower levels of damage (Fig. 3).

After three years of monitoring swede midge populations on small organic farms, it became obvious that **broccoli and Red Russian kale are the most preferred hosts**. Repeatedly, swede midge sought out these crops over all other brassica crops within a contiguous 4 to 12 acre area. Also, swede midge tended to remain in broccoli and Red Russian kale as long as these crops were producing new growing points. Therefore, know that if you plant broccoli or Red Russian kale under moderate or high swede midge pressure, these crops will very likely suffer economic levels of damage.

Alternatively, **Chinese cabbage, savoy cabbage, and Bok choy consistently were not damaged in fields with high swede midge pressure**. Curly kales, Lacinato kales, turnips, radishes and rutabagas also appeared to be less preferred by swede midge, but could be infested when a more preferred crop was unavailable. More tolerant crops could potentially withstand higher levels of swede midge pressure than susceptible crops, reducing economic losses.

In general, red or purple varieties, such as red cabbage or purple kale, are more preferred by swede midge than green varieties. Also, once the growing points become inaccessible, such as when cabbage is heading, these crops become least preferred by swede midge.

For more information

Cornell University's website Swede Midge Information Center for the U.S. http://web.entomology.cornell.edu/shelton/swede-midge/

Hoepting, C.A. 2015. Optimizing management of a new invasive species, swede midge, on small-scale organic farms. Final Report for Northeast Sustainable Agriculture Research and Extension (NESARE) Partnership project ONE15-237. Online: https://projects.sare.org/project-reports/one15-237/.

Hoepting, C.A. 2016. Optimizing management of a new invasive species, swede midge, on small-scale organic farms, Part II. Final Report for Northeast Sustainable Agriculture Research and Extension (NESARE) Partnership project ONE16-262. Online: https://projects.sare.org/project-reports/one16-262/.

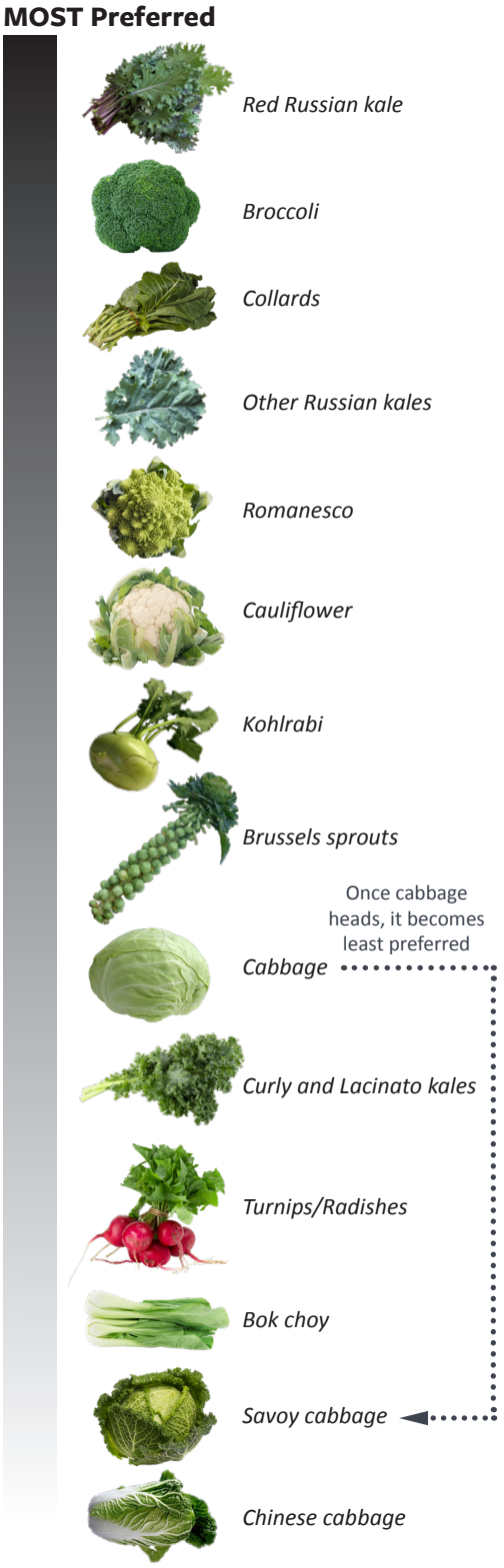


Figure 3. Relative preference of different brassica crops by swede midge in order from most preferred at top to least preferred at bottom.

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