Spring Wheat Seeding Dates that Reduce Infestation Risk by Wheat Blossom Midge, *Sitodiplosis mosellana* [Diptera:Cecidomyiidae]

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SITUATION

Management of the wheat blossom midge currently depends on foliar-applied insecticides to kill adults before they oviposit on flowering wheat heads. Chlorpyrifos is the sole registered insecticide for midge control. Insecticide application timing is critical. Once larvae begin to feed on wheat kernels, control efficacy declines because the glume protects larvae from insecticide contact.

Wheat only is susceptible to larval feeding when eggs are laid on flowering heads; larvae cannot complete development if oviposition occurs earlier or later than flowering. Economic infestations seldom develop in winter wheat because the crop flowers before midge ovipositional flights. In contrast, severe infestations often develop in spring wheat because flowering exactly coincides with midge emergence and oviposition.

During 2000 we derived and validated a degree-day model that predicts when overwintering larvae emerge from the soil as egg-laying adults. We developed the model by trapping adults at commercial spring wheat fields along a 20-mile south-to-north transect from Bonner's Ferry, Idaho; we then described seasonal midge captures as a function of degree-days above 5˚C since 1 January by fitting a probit model to our data. The model predicts that midge flights begin at 735 DD 5˚C, reach seasonal peaks at 820 DD 5˚C and end at 915 DD 5˚C.

Probit model predictions: $DD_{5^{\circ}C}$ since 1 January required for seasonal midge capture

event	mean DD5˚C	lower 95% C.I.	upper 95% C.I.
10% midge capture	735	720	747
50% midge capture	820	811	829
90% midge capture	915	901	932

The midge probit model by itself can enhance IPM decisions by helping growers schedule optimal times for field scouting. But it would be even more useful to couple the midge model to a spring wheat plant degree-day model that forecasts the timing of flowering. Together the insect and plant models could allow growers to reduce infestation risk by identifying "midge-free" spring wheat seeding dates such that plants could escape midge oviposition – by identifying seeding dates so that plant flowering did not coincide with peak midge flights.

METHODS

I developed 3 predictive scenarios by using 30-year (1970-2000) max:min air temperatures from a standard weather station 2-km SW Bonner's Ferry, Idaho:

(1) "normal year" average expected temperatures
= 30-year mean daily max:min

(2) "warm year" 1 year in 5 warmer-than-average temperatures
= 30-year mean daily temperature + [(sd)(p)(z)]

(3) "cold year" 1 year in 5 colder-than-average temperatures
= 30-year mean daily temperature - [(sd)(1-p)(z)]

where sd = standard deviation (computed for each day)
p = probability exceedence value, the probability that temperature on a given day equals or exceeds specified value; p = 0.2
z = standard normal variate

I then used these historical weather data to compute midge degree-days and predict expected dates of 10%, 50% and 90% seasonal flight activity during normal, warm and cold years. I likewise used these data to compute spring wheat degree-days (Cook & Veseth 1991) during normal, warm and cold years. Parameters for the spring wheat plant model were as follows:

Spring wheat degree-day requirements (32 ˚f base)

wheat variety	from germination (seeding) until plant emergence	from plant emergence until head emergence	total $DD_{32°F}$
early-maturing	180	1365	1545
standard	180	1500	1680

Crop seeding dates that allow wheat plants to grow beyond the susceptible flowering stage before midge activity reaches seasonal peaks were identified by back-computing either 1545 or 1680 spring wheat DD (for early-maturing and standard wheat varieties, respectively) from the date of expected 10% midge capture, 50% capture or 90% capture.

RESULTS

— *model predicts midge flight activity mid-June through early August*

Predicted dates of initial (10%) midge flight activity ranged from 14 June during "warm" years to 25 July during cold years. The model forecasts that peak flight activity typically can be expected at the end of June, with peaks predicted 10 days earlier during warm years and 1 month later in cold years. The model further predicts that midge activity ends during the first week in July in typical years but extends an additional month during cold years.

PREDICTED DATES OF MIDGE FLIGHT ACTIVITY
30-yr temperature data

flight event	cold year	normal year	warm year
10% capture	25 July	22 June	14 June
50% capture	31 July	29 June	20 June
90% capture	7 August	6 July	26 June

— ***seed before mid-April to avoid midge flights during wheat flowering***

DD models predict that seeding earlier than 11-20 April during "normal" years will allow the wheat crop to grow beyond the susceptible flowering stage before midge activity reaches seasonal peaks. The worst seeding dates are late April through early May; adult midge emergence and ovipositional flights most likely will coincide with flowering in these crops.

Relative risk of midge infestation vs spring wheat seeding date during "normal years"
30-yr temperature data

wheat variety	**low risk** flowers before 10% midge activity	**increasing risk** flowers after 10% midge activity	**highest risk** flowers during 50% (peak) midge activity	**decreasing risk** flowers before 90% midge activity	**low risk** flowers after 90% midge activity
early maturing	before 20 April	after 20 April	2 May	13 May	after 13 May
standard maturity	before 11 April	after 11 April	25 April	7 May	after 7 May

These seeding-date recommendations are yet untested in field.

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REFERENCES
Cook, R.J. & R.J. Veseth. 1991. Wheat Health Management. APS Press.