An Empirical Approach for Estimating Seeding Dates for Winter Canola in Iowa

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BACKGROUND:

- ✓ Integrating winter canola (*Brassica napus*) into Iowa rotations could provide winter cover crop benefits while having the potential to produce a marketable crop in mid-summer.
- ✓ Crop establishment and winter survival represent a challenge in the cooler climates of the Upper Midwest.
- ✓ Time of seeding greatly affects winter canola's potential for winter survival, thus determining reliable seeding dates for this crop in Iowa is needed.
- ✓ Most North American and European studies have concluded that the fall rosette should develop between five to eight leaves to maximize potential winter hardiness.
- ✓ We investigated an empirical approach for estimating reliable seeding dates based on historical weather data and growth data from experimental plots.

KEY ASSUMPTIONS:

1. Winter Canola needs to develop **at least five leaves** to survive the winter.
2. Fall growth ceases shortly after **the first < 24 °F frost**

Winter canola research plots during Fall 2012 (top left) and Spring 2013 (top right) in Ames, Iowa. Winter canola fall seeded in early September 2012 had achieved more than six leaves by early November (bottom right).

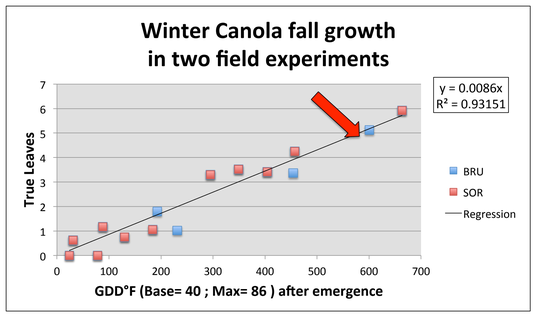
MODEL INPUTS:

1. Growth data from two field experiments (variety "Baldur" seeded at four dates):
   - Sorenson Farm (SOR) [2012]
   - Bruner Farm (BRU) [2013]

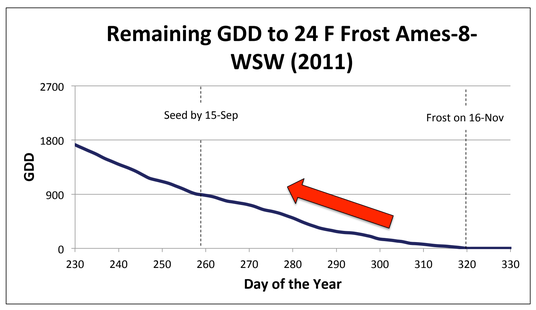
$$GDD_w = GDD_E + GDD_V = 320 + 580 = \mathbf{900}$$

Emergence of Treatments at two field experiments

Site	Seeding	Emergence	Seeding to Emergence Days	Seeding to Emergence GDD °F (Base=40 ; Max=86)
BRU	3-Sep	25-Sep	22	591
	13-Sep	25-Sep	12	362
	1-Oct	14-Oct	13	264
SOR	31-Aug	13-Sep	13	340
	17-Sep	3-Oct	16	292
	1-Oct	17-Oct	16	206
	12-Oct	24-Oct	12	182
		Average	15	320



2. Daily observations of daily growing degree-days (GDD°F)[Base=40, Max=86] and date of first 24°F frost, at **110 weather stations**, from 230 to 360 Day of the year (DOY) between **1972 to 2011**, retrieved from the Iowa Environmental Mesonet online database (http://mesonet.agron.iastate.edu/)



APPROACH:

- ✓ Determine the growth requirements of winter canola using empirical data collected from experimental plots.

$$GDD_W = GDD_E + GDD_V$$

GDD_W: Growing Degree Days (GDD °F [Base=40; Max=86]) required for overwintering; GDD_E: GDD required for emergence; GDD_E: GDD required from emergence to the development of the fifth leaf.

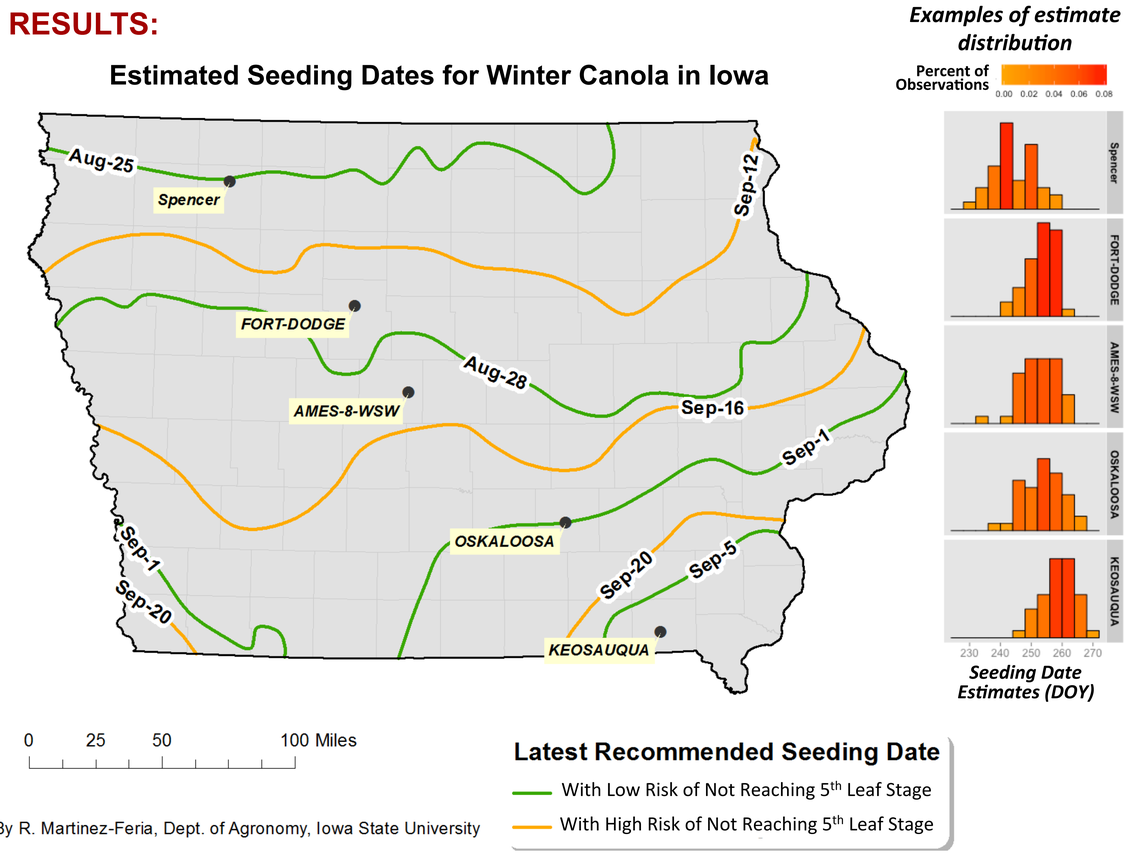
- ✓ Calculate the latest reliable seeding date (LRSD) for a given year-location using historical weather data.

$$LRSD_{(ij)} = F_{24°F} - DGR \ni \sum_{DGR}^{F_{24°F}} dGDD \geq GDD_W$$

DRG: days to growth requirement; dGGD: daily observations of GDD; $F_{24°F}$: day of first < 24 °F frost

- ✓ Calculate the 10th and 90th percentile for the distribution of the calculated LRSD, as the seeding date with low and high risk of frost damage, respectively
- ✓ Interpolate the geo-referenced data using an ordinary kriging method with a Gaussian semivariogram
- ✓ Translate the raster output into isolines for determined dates and plot the results in a map of Iowa format using ArcGIS 10.0

RESULTS:



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CONCLUSION:

During most years in Iowa, winter canola seeded by Aug-25 in the NW and by Sep-5 in the SE should have enough heat units available for developing at least five leaves. Seeding may be delayed up to Sep-12 in the NW and Sep- 20 in the SE, but the risk of frost damage and winterkill increases. Seeding after these dates is not recommended.

FUTURE WORK:

- ✓ Integrate soil temperature and moisture as factors into the model in order to predict emergence more accurately
- ✓ Include growth data from multiple canola varieties

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