# Investigation of Winter Wheat Seeding Dates, Seeding Rates, and Related Interactions

## Purpose:

Production methods to achieve more consistent winter wheat acreages have risen to the forefront, with wide acreage swings over the past number of years. Grower intentions to plant significant acreage each year has remained constant, but final planted acreage has ranged from record levels to less than one half of intentions, based on soybean harvest and accumulated precipitation through the fall planting period. The impact of ultra early and ultra late planting was investigated, as well as the impact of seeding rates at various planting dates.

## Methods:

Two replicate, randomized field scale trials were established during the fall of 2005 (4 sites) and 2006 (7 sites). Plots were planted using a John Deere 1560 drill with updated 1590 boots. Seeding rates ranged from 0.9 million seeds per acre to 2.1 million seeds per acre, and were maintained using a drill mounted population monitor. Treatments were repeated over several different planting dates, ranging from Oct 5$^{th}$ to Jan 24$^{th}$ in the fall of 2005 and from Sept. 2$^{nd}$ to Nov 10$^{th}$ in the fall of 2006. Winter survival was evaluated in the spring. Nitrogen rates were maintained at full rate across the trials. Other fertility was applied following the normal practice of the grower. Weed control was applied as needed, or as per the farms normal practice. Fungicides were applied as per the normal practice for that cooperator. Fields were monitored for disease, weed pressure, and head counts throughout the growing season. Yields, moisture, test weight, thousand kernel weight and protein measurements were taken from the wheat at harvest.

## Results:

Planting date results are shown in Table 1 (2006) and Table 2 (2007). It is clear that yields decline significantly as planting dates are delayed past the optimum date. This is consistent with earlier research. Actual yield loss from 2006 is shown in Table 3. Average yield loss of 1.07 bu/ac/day in the earliest time frame compares remarkably with previous data of 1.1 bu/ac/day. However, the scale of the decline is by far the greatest during this early time frame (considered “optimum”), and declines considerably as you move to later planting dates. Later yield loss at 0.14 and 0.24 would appear low, but is probably reflective of the rate of growing degree day (GDD) accumulation, and should not be used as a strict calendar date calculation.

Table 5 gives results for 2007. Yield loss in 2007 appears much lower than in 2006, averaging just 0.6 bu/ac/day. Interestingly, the two high yield sites (Perth and Middlesex) show close to the normal loss. The reduced, and in many cases more consistent level of yield loss despite calendar date, is likely a result of the cold wet October experienced, and a lack of GDD accumulation compared to normal.

Of great significance in these trials is the yield response at both early and late planting dates. Yields of both ultra early and ultra late planting dates were much better than anticipated.

Growers have often been reluctant to plant wheat past October 31st, considering it “too late”. Agricorp will not provide winterkill insurance beyond the October 31st deadline (in this region of Ontario). However, in both years of the trial, winter survival was not reduced as planting dates moved into November. This indicates that planting beyond the October 31st date can be an option, if planting was not able to be completed prior to this date.

There are limitations to how far growers are able to extend planting dates. When planting was continued into January, there was considerable impact on winter survival, especially at the Perth location, where the soil was frozen too hard to allow drill penetration and proper seed depth placement. A December planting into frost at the Middlesex location suffered a similar fate (data not shown).

These results show opportunity to seed well past calendar dates that have been considered in the past, but that there are management considerations. Soil conditions must either be fit for planting, or the grower must be able to seed into frost, and achieve a 1” planting depth minimum. The results clearly show that as planting dates move later and later, yield potential drops. Thus these later plantings must be considered with realistic yield objectives.

**Table 1: Planting Date Response 2006**

| Location | 5-Oct | 21-Oct | 15-Nov | 24-Jan |
|---|---|---|---|---|
| Huron | 83.4 | 74.6 | 67.8 | 57.8 |
| Middlesex | 105.3 | 72.7 | 72.1 | 59.9 |
| Perth | 69.8 | 58.2 | 50.2 | 31.2 |
| **Avg** | 86.2 | 68.5 | 63.4 | 49.6 |

**Table 2: Planting Date Response 2007**

| Location | Sept 2-7 | Sept 17-27 | Oct 7-27 | Nov 4-10 |
|---|---|---|---|---|
| Elgin | 87.8 | 80.8 | | 61.7 |
| Kent | 71.1 | 71.7 | 64.2 | |
| Halton | 68.2 | 72.4 | 65.5 | |
| Perth | | 118.2 | 106.4 | |
| Middlesex | | 100.3 | 89.9 | |
| Oxford 1 | | | 74.4 | 68.9 |
| Oxford 2 | | | 70.4 | 61.2 |
| **Avg 3 trials** | 75.7 | 75.0 | | |
| **Avg 4 trials** | | 90.7 | 81.5 | |
| **Avg 2 trials** | | | 72.4 | 65.1 |

Earlier planting dates have shown promise in the 2007 data. Wheat planted in early September, 21 to 28 days prior to the optimum date for these areas, did not show a yield decrease, but maintained the yield level of plantings in the optimum time frame (table 2).

While this data must be interpreted cautiously, with only one year of information, it is a positive result which encourages further investigation.

**Table 3: Daily Actual Yield Loss 2006**

| Planting Delay | Yield Loss (Bu/ac/day) | | | | |
|---|---|---|---|---|---|
| | Huron | Middlesex | Perth | Strathroy | Avg |
| Oct 5-21 | 0.55 | 2.04 | 0.73 | 0.95 | 1.07 |
| Oct 21-Nov 15 | 0.26 | 0.02 | 0.31 | -0.03 | 0.14 |
| Nov 15-Jan 24 | 0.14 | 0.31 | 0.27 | | 0.24 |

**Table 4: Daily Percent Yield Loss 2006**

| Planting Delay | Yield Loss (Percent/day) | | | | |
|---|---|---|---|---|---|
| | Huron | Middlesex | Perth | Strathroy | Avg |
| Oct 5-21 | 0.66 | 1.93 | 1.04 | 1.77 | 1.35 |
| Oct 21-Nov 15 | 0.35 | 0.03 | 0.53 | -0.08 | 0.21 |
| Nov 15-Jan 24 | 0.21 | 0.24 | 0.53 | | 0.33 |

**Table 5: Actual and Percent Yield Loss 2007**

| Location | Yield (bu/ac) | | | Time | Loss | Percent |
|---|---|---|---|---|---|---|
| | Sept 17-27 | Oct 7-27 | Nov 4-10 | days | (bu/ac/day) | per day |
| Elgin | 80.8 | | 61.7 | 39 | 0.5 | 0.61 |
| Kent | 71.7 | 64.2 | | 24 | 0.3 | 0.43 |
| Halton | 72.4 | 65.5 | | 21 | 0.3 | 0.45 |
| Perth | 118.2 | 106.4 | | 10 | 1.2 | 1.00 |
| Middlesex | 100.3 | 89.9 | | 13 | 0.8 | 0.80 |
| Oxford 1 | | 74.4 | 68.9 | 13 | 0.4 | 0.57 |
| Oxford 2 | | 70.4 | 61.2 | 24 | 0.4 | 0.54 |
| **Avg** | | | | | 0.6 | 0.63 |

In other jurisdictions, seeding rate recommendations are tied to planting date. Table 6 shows the data from early planted seeding rate trials. There is essentially no difference in yield at any population at the early seeding date, and certainly no economic response. This supports the concept of lower seeding rates at early planting dates. At the “mid” or normal seeding time, there is a slight trend to higher yields at higher populations, although increased yield barely covers added seed costs. However, this trend supports the current recommendation of 1.5 million seeds per acre at normal seeding dates.

**Table 6: 2007 Seeding Rate Yields**

| Planting Date | Population (million plants/ac) | | |
|---|---|---|---|
| | 0.9 | 1.2 | 1.5 |
| Early | 74.2 | 74.7 | 75.6 |
| Mid | 70.1 | 71.9 | 74.3 |
| Late | | | 63.0 |

Another feature of early planting is the increased potential for lodging. Table 7 shows seeding rate by seeding date interactions with the variety AC Morley. AC Morley is prone to lodging, as evidenced in the data shown. It is clear that lodging decreases with reduced population, particularly at earlier planting dates. This trend has been noted in other trials, but the Halton location is the most graphic illustration of this outcome. In this situation, it is lodging which is totally responsible for yield loss at the earlier planting date. When corrected for harvest loss, the yield of the various seeding rates, at the two earliest planting dates, are essentially equal. This adds more reason to a recommendation for reduced seeding rates at early planting dates.

**Table 7: Yield and Standability of AC Morley, Halton Site**

| Planting Date | Population (million plants/ac) | | |
|---|---|---|---|
| | 0.9 | 1.2 | 1.5 |
| % lodged and unharvestable | | | |
| 2-Sep | 15% | 15% | 25% |
| 17-Sep | 3% | 10% | 15% |
| 9-Oct | Standing | 1% | 1% |
| | Yield (bu/ac) | | |
| 2-Sep | 58.0 | 58.1 | 50.9 |
| 17-Sep | 70.8 | 66.3 | 59.8 |
| 9-Oct | 64.1 | 68.7 | 62.5 |

## Summary:

Planting winter wheat very early or very late resulted in yields much better than anticipated. Management techniques were identified which may help growers to plant outside of the normal window, and still have success. Early plantings require a reduced seeding rate, or the use of varieties with excellent standability. Later seedings require sufficient depth of seeding, and reasonable yield objectives. Calculated yield loss from delayed seeding ranged from 0.6 to 1.1 bu/ac/day, dropping to about 0.2 bu/ac/day as planting dates were delayed well past the optimum date. This yield loss is likely more associated with GDD accumulation than calendar days. Highest yield loss appeared to be during the optimum planting window, and on the highest yielding fields.

Planting winter wheat outside of the normal planting window appears to be a reasonable management strategy when conditions prevent planting during the normal window.

## Next Steps:

Growers have been quick to adopt this information. Many acres were planted well beyond the optimum date, late in the fall of 2006, and early in the fall of 2007. Outcomes have generally been good. Further studies need to continue to validate these findings over more years and different environments, and to assess the impact of disease or insect concerns that did not manifest themselves in these trials.

**Acknowledgements:**

This project is funded in part through contributions by Canada and the Province of Ontario under the Canada-Ontario Research and Development (CORD) Program, an initiative of the federal-provincial-territorial Agricultural Policy Framework designed to position Canada's agri-food sector as a world leader. The Agricultural Adaptation Council administers the CORD Program on behalf of the province.
Many thanks to all our co-operators and sponsors: the Ontario Wheat Producers Marketing Board, the Middlesex Soil and Crop Improvement Association, OMAFRA and the University of Guelph. A special note of thanks to summer assistants Mike McFarlane, Nicole Van Ostaeyen, Jen Mullen, and Shane McClure for all their work on these trials!

**Project Contacts:**

Peter Johnson: OMAFRA, peter.johnson@ontario.ca , 519 271 8180, (fax) 519 273 5278

**Location of Project Final Report:**

Peter Johnson