DON'T SQUEEZE IT IN:

The crop rotation break interval effect in Manitoba

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Effective use of crop rotation is known to have a dramatic positive influence on the yields of many crops. One contribution to this rotation effect is that the provision of a break interval between different host crop types allows time for the decline in carry-over problem biological organisms (e.g. disease pathogens, weeds, soil microorganisms) during the interval when unrelated crops are grown.

In theory, the longer the break interval is, the greater the reduction should be in the population of problem biological organisms, leading to improved yields.

Squeezing crops

Surveys show that the most important factors used by farmers to establish what crop to grow are not crop rotation sequence considerations but instead, the current anticipated commodity price and herbicide history.

Farmers pursuing the best short-term revenue potential are increasingly willing to take the risk of a minor yield penalty or resort to technology, such as fungicides, to make up for their decision to squeeze crop intervals.

There is very little published information on the actual on-farm impact of various crop rotation break intervals on actual average yields of various crops.

Fortunately, as the production insurance provider in the province, Manitoba Agricultural Services Corporation (MASC) has annually been collecting information from its clients on what crops are planted on each insured field and their annual yields.

MASC has been collecting client information for decades and the acreage of crops insured by MASC in most years is over 85 per cent of all annual crop acres grown in Manitoba, making the database very representative and useful. This database has been analyzed to provide insight into how various crop rotation break intervals influence the actual field yields of crops grown in Manitoba.

Summary results in this article are based on MASC database field histories from fields 120 acres or larger tracked over the 11 years between 2000 to 2010. Analysis was limited to larger fields as MASC does not track field positions within quarter sections.

The frequency of occurrence and yields from nine crops (red spring wheat, canola, corn, barley, oat, field pea, soybean, flax, and non-oil sunflower) were tracked in relation to the break intervals between plantings of the same crop.

There were five crop break intervals categories studied: zero break (no break interval), one-year break, two-year break, three-year break, and a four-year (and greater) break. Note that field history was tracked, not individual farmer history; if two different farmers grew the same crop on the same field with a two-year break that was considered a two-year break interval result.

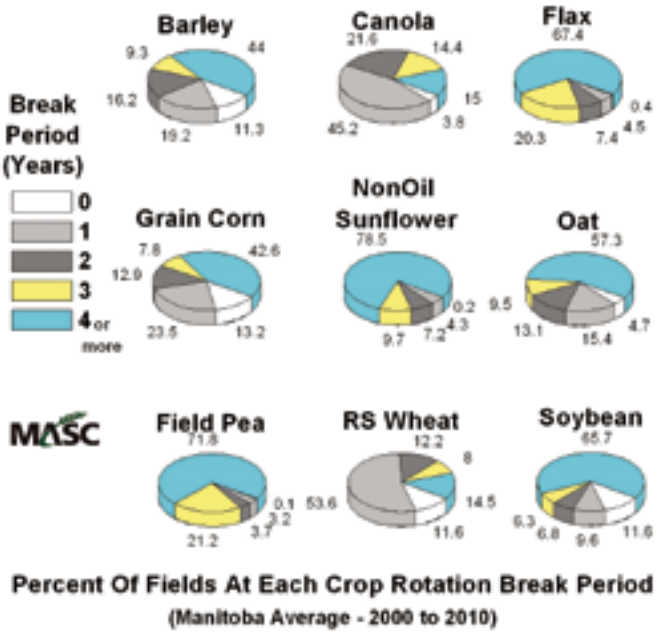

Figure 1. Pie charts illustrating the average percentage of fields sown at five crop rotation break intervals for nine major crops in Manitoba over the interval 2000 to 2010 from the MASC database.

Common break intervals

Figure 1 illustrates which crops Manitoba producers tend to be squeezing rotations on, and which crops they don't. This data is also a benchmark record of what break intervals farmers in Manitoba have been using over the past decade.

Of the intervals studied, there were several crops which had greater than 50 per cent of fields planted on fields not in that crop for at least four years between plantings. The crops were flax (67 per cent), non-oil sunflower (79 per cent), oat (57 per cent), field pea (72 per cent) and soybean (66 per cent). For these crops, it appears that most Manitoba farmers recognize that a multi-year crop rotation break interval is important.

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Figure 1 also illustrates that there were crops which had evidence of tight rotations. If a tight rotation crop is defined as any crop in which a zero-break interval occurs on more than 10 per cent of fields, then the tight rotation crops include barley (11 per cent), grain corn (13 per cent), red spring wheat (12 per cent) and soybean (12 per cent). Additionally, roughly half the fields in Manitoba are planted after a one-year break in canola (45 per cent) and red spring wheat (54 per cent). Clearly, for these crops, farmers are indicating their desire to squeeze rotation break intervals to a minimum.

Break interval influences yield

Figure 2 illustrates the relationship between crop-on-crop break interval and relative yield. The nine crops studied seem to fall into three categories. For the purposes of discussion I have labelled these categories – "textbook," "almost-textbook," and "asymmetric."

The first crop category consists of crops showing a "textbook" response to crop rotation break intervals, where crop average yields continuously increase over the entire range of break intervals plotted.

Figure 2 illustrates that the crops in the textbook response category are flax, field peas and oats. To give a measure of the magnitude of yield difference between the break intervals for these three crops, the actual yield difference between these textbook crops at the zero break interval and the four- or more-year-break interval is six bu./ac. for flax, eight bu./ac. for field peas, and 18 bu./ac. for oats.

Clearly, the rotation effect is happening with these crops. These results justify the decision of the majority of Manitoba farmers to sow these "textbook" crops on fields with a four-year or greater break interval between the same crop (Figure 1).

The second crop category consists of crops showing an "almost-textbook" response to crop rotation break intervals, where the crop average yields generally increase continuously over the entire range of the plotted break intervals.

Figure 2 illustrates that the crops in the almost-textbook response category are barley, grain corn, canola and red spring wheat. To measure the magnitude of yield difference between the break intervals for these four crops, the actual yield difference between these textbook crops at the zero-break period and the three-year break interval is nine bu./ac. for barley, 19 bu./ac. for grain corn, five bu./ac. for canola and six bu./ac. for red spring wheat.

The rotation effect observed in the almost-textbook crops is not as clean of a trend as the textbook crops. In particular, there seems to be a decline in yields for these crops when the break interval is four or more years. These results illustrate why most Manitoba farmers elect to sow these "almost-textbook" crops on fields with less than a four-year break interval between the same crop (Figure 1).

The reasons for the yield decline in the four-year and greater break interval in the "almost-textbook" crops have not been determined. One could speculate that the decline could be due to natural data variability or confounding unidentified variables. Perhaps if farmers are choosing to grow these crops infrequently on these fields, that these fields are less suitable for those crops, or that the farmer has less experience or interest in those crops and in turn they put less management into those crops. Any explanation is speculative at this time as no analysis has been done.

Break interval effect not consistent

The third crop category consists of crops showing an "asymmetric" response to crop rotation break intervals, where the crop average yields bounce around over the entire range of break intervals plotted.

Figure 2 illustrates that the crops in the asymmetric response category are non-oil sunflowers and soybeans. Although the yields vary for the two asymmetric crops, they both have their highest yields when the break interval is three years between the same crop.

There is a slight positive response in non-oil sunflowers for the zero-break interval, though that response could be an artifact of relatively few acres being planted in that category over the intervals studied (Figure 1). With soybeans, there is a slight yield decline at the four-year and greater interval, which could be potentially due to the same speculative reasons as the "almost-textbook" crops described previously. Overall, with the exception of the two asymmetric crops, a zero-break interval between crops always yielded inferior than a longer break period.

Even the textbook crops do not exhibit a textbook response in all years. Flax is

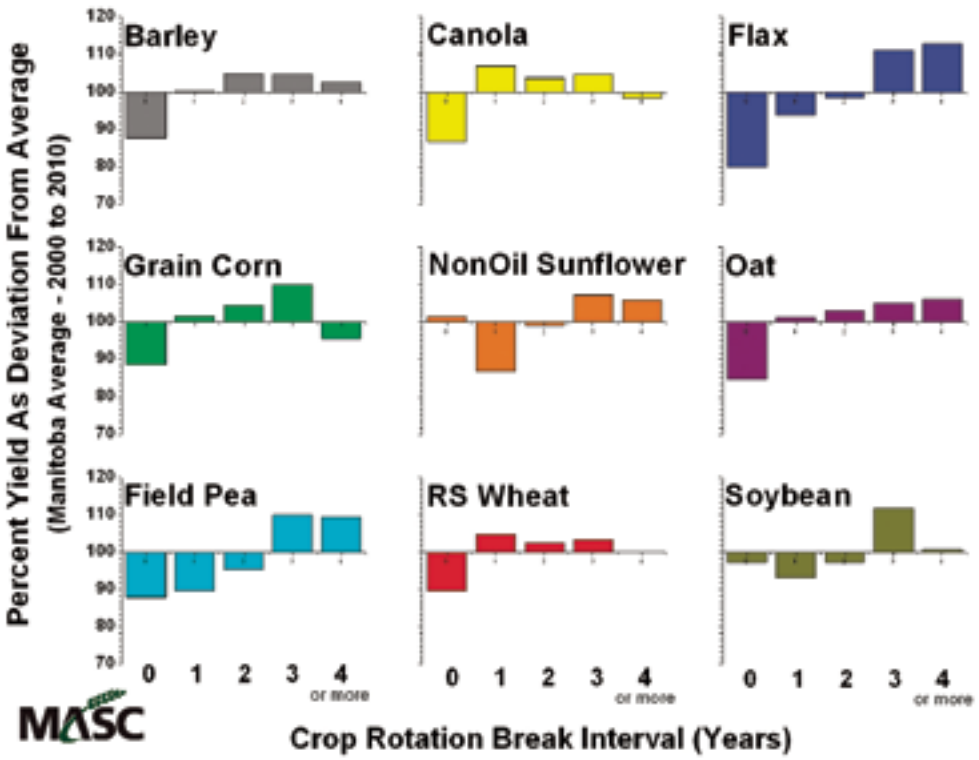

Figure 2. Average relative yield (per cent) deviation charts for nine major crops sown in five crop rotation break intervals in Manitoba over the interval 2000 to 2010 from the MASC database.

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one of the best examples of a textbook crop (Figure 2).

Figure 3 illustrates that when the flax yield response is broken out year by year, the textbook-break interval response varies depending on the year. In fact, for flax in 2004, the break interval trend is in the opposite direction to the 11-year average trend, with the zero-break interval flax crops having the highest yields.

Although not presented in this article, this kind of year-to-year variation was observed in all the crops studied.

Manitoba farmers are faced with the challenge of using these MASC database summaries to help with reviewing their own crop break interval options.

MASC records demonstrate that for many Manitoba crops, there is a positive yield response trend that is associated with increasing break intervals, although this can vary by crop, break interval, and year. For most crops, the potential average yield advantage alone should make it desirable for farmers to give consideration to extending crop rotation break intervals.

However, it also needs to be recognized that relative yield differences should only be one of the considerations in any field break interval selection decision. Other considerations should be the potential differences in fertility improvements, weed and disease control issues, and cash flow variability. These other considerations may justify extending crop rotation break intervals even if yield benefits are not present.

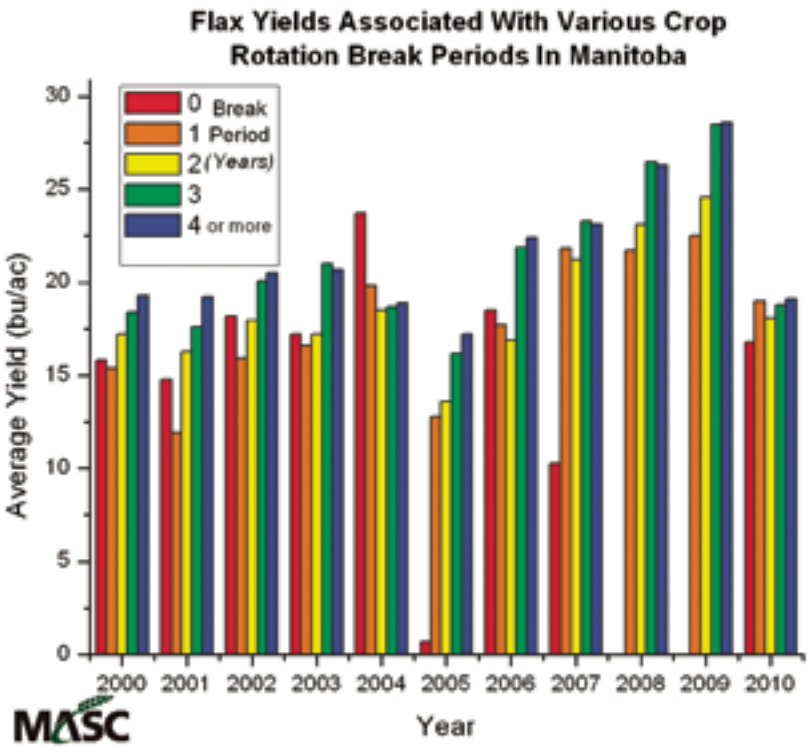

Figure 3. Average annual yields (bu./ac.) of flax associated with five crop rotation break intervals in Manitoba over the period 2000 to 2010 from the MASC database.