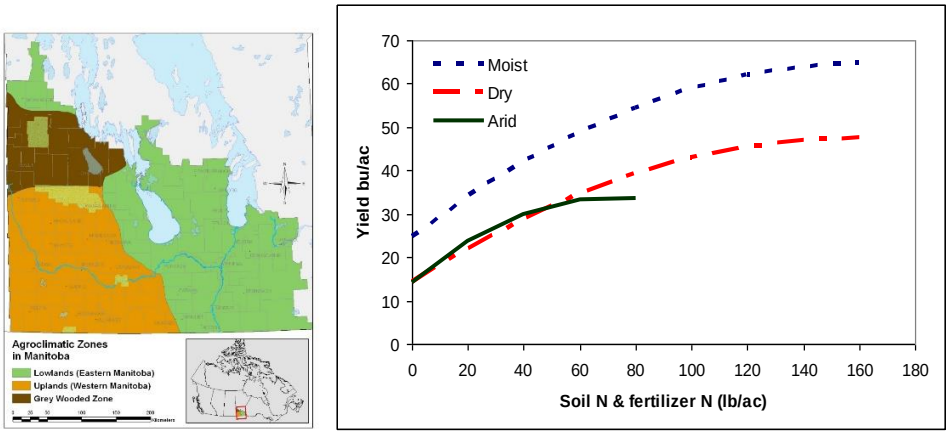
Nitrogen rate and timing strategies for dry springs

With current dry soil conditions and uncertain precipitation, some wheat and barley growers may be seeking options to reduce the economic risk of applying high rates of nitrogen (N) to a moisture-limited, lower yielding crop. Past and current research may offer some options.

Traditionally, Manitoba nitrogen recommendations for spring wheat (and barley) were developed according to soil moisture conditions (Figures 1 and 2, and Table 1[1]). Under very limited moisture conditions (ARID) on well drained, sandy, coarse textured soils, yields were low and nitrogen rates modest. DRY recommendations were for modest yields and targeted for coarse soils in the east and northwest, and moderately to poorly drained soils in the west. MOIST recommendations were for heavier texture, more poorly drained soils.

Based on extensive field studies, economically optimum N rates were developed based on N cost, soil test and crop price and are posted at: https://www.gov.mb.ca/agriculture/crops/soil-fertility/nitrogen-rate-calculator.html




Figures 1 and 2. Location of moisture zones and wheat yield response to N supply.

Table 1. Available moisture supply by location and soil characteristics in Manitoba.

| Moisture | Location | Texture/Drainage |
|---|---|---|
| Moist | Lowlands | Any texture, poorly drained |
| | Uplands | Heavy textured |
| | | Grey wooded soils |
| Dry | Lowlands | Coarse textured, moderately drained |
| | Uplands | Coarse textured wooded soils |
| | | Other textures moderately to poorly drained |
| Arid | Lowlands and Uplands | Coarse textured, well drained soils |

Under current production practices and with newer varieties, yield potential is considerably higher than what is provided by these guidelines above. Recent research with wheat, found that under high yield practices and varieties, a nitrogen supply (fertilizer and soil N) of about 2.25 lb N/bu was economically optimum[2]. For an 80 bu/ac crop that would be 180 lb N/ac.

This study also investigated split nitrogen timing options, finding that applying a base N rate of 80 lb N/ac at seeding followed by either 30 or 60 lb N/ac at stem elongation or flagleaf emergence produced equal to higher yields and higher protein than applying all of the N at seeding[2]. What made this so effective was that rainfall was received within days of application.

Risk averse growers may wish to use a strategy such as applying a base fertility program according to the Soil Moisture criteria, and then later supplementing to the higher rate based on 2.25 lb N/bu IF moisture conditions improve and yield potential is increased.

Now this approach is contingent upon rainfall to move the split N into the soil. Past studies led by Guy Lafond at Indian Head demonstrated this inherent risk, where in 1 of 3 years delayed N was stranded at the surface under dry conditions and yielded 30% less than all N applied at seeding time[3]. However, his subsequent studies showed that as long as a large portion of the required N was applied at seeding (50%+), dribble UAN applications could be delayed for wheat and canola[4] (Tables 2-3).

Table 2. Effect of N timing split on spring wheat yield in bu/ac (mean of 7 sites)[4].

| Portion of total N at seeding | At seeding | 1-1.5 leaf | 3-3.5 leaf | 5-5.5 leaf (stem elongation) |
|---|---|---|---|---|
| | ---------- Yield (bu/acre) ---------- | | | |
| Check – no N | 31 | | | |
| 100% | 37 | | | |
| 67% | | 36 | 36 | 37 |
| 50% | | 36 | 36 | 35 |
| 33% | | 37 | 36 | 35 |
| 0% | | 34 | 36 | 34 |

Table 3. Effect of N timing split on canola yield in bu/ac (mean of 5 sites)[4].

| Portion of total N at seeding | At seeding | 5-6 leaf | Start bolting | Start flowering |
|---|---|---|---|---|
| | ---------- Yield (bu/acre) ---------- | | | |
| Check – no N | 31 | | | |
| 100% | 45 | 43 | 42 | 39 |
| 67% | | 42 | 39 | 36 |
| 50% | | 40 | 39 | 36 |
| 33% | | 39 | 38 | 35 |
| 0% | | 39 | 34 | 32 |

If farmers choose to use a split application of N as a management strategy, they should be aware of the risks. When N is placed at the soil surface, volatilization loss or stranding is more likely.

References:

1 https://www.gov.mb.ca/agriculture/crops/soil-fertility/revised-nitrogen-fertilizer-guidelines-for-wheat-barley-and-canola-in-manitoba.html

2 https://www.mbcropalliance.ca/assets/uploads/images/MCA_factsheet3_nitrogen_FINAL2.pdf

3 https://cdnsciencepub.com/doi/pdf/10.4141/CJPS07169

4 https://cdnsciencepub.com/doi/pdf/10.4141/CJPS07169