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DIGGING INTO RESEARCH

Economic optimum soybean plant density for irrigated soybean

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The economic optimum seeding rate for irrigated soybeans in southern Alberta was calculated to be 58 seeds/m^2 at 80% emergence, which is equivalent to 5.8 seeds/ft^2 or 252,000 seeds/acre.

In southern Alberta, the development of very early maturing varieties in the MG 00 and MG 000 maturity groupings made soybean production under irrigation possible. However, very little research has been conducted on target plant populations and row spacing in southern Alberta's cool climate.

Research was conducted to investigate several objectives, which were profiled in two Canadian Journal of Plant Sciences articles. One study compared agronomic practices for soybean investigating the relationships between plant density and soybean yield for different genotypes, row spacing, and growing environments. The other study looked at these factors to estimate the Economic Optimum Plant Density (EOPD; stand establishment), for irrigated, early-maturity soybean in southern Alberta.

The research was conducted at Bow Island and Lethbridge, Alberta from 2014 through 2016 under irrigation using two glyphosate resistant varieties rated as MG 00.4 with a CHU rating of 2400 (NSC Tilston RR2Y) and MG 00.8 with a CHU rating of 2525 (Podaga R2). The varieties were seeded on either narrow row spacing of 7 inches (17.5 cm) or wide row spacing of 14 inches (35 cm). Seeding

rate was 30, 50 or 80 seeds/m^2 (3, 5 or 8 seeds/ft^2). This translates into approximately 130,000, 218,000, and 350,000 seeds per acre. The Lethbridge 2016 site was lost due to hail, leaving five site-years for analysis.

Average plant emergence was 74% for the MG 00.4 and 80% for the MG 00.8 variety. Overall plant emergence ranged from 75 to 79% , but was 82 to 84% when 2016 Bow Island was excluded due to soil crusting issues. These are typical emergence percentages for soybean under good soil moisture and temperature conditions.

As a result, plant density at establishment was slightly greater for MG00.8 at 4.3 plants/ft^2 compared to 3.9 plants for MG00.4. There was a slight but significant increase in plant density with wider row spacing. As expected, plant density increased as seeding rate increased with an average of 2.3 plants/ft^2 at 3 seeds/ft^2, 3.8 plants at 5 seeds, and 6.2 plants at 8 seeds/ft^2. The recommended target plant stand in Manitoba is 140,000 to 160,000 live plants per acre, or about 3.2 to 3.7 plants/ft^2.

Days to 95% maturity ranged from 114 to 132 days, and 1 out of six site-years (Lethbridge 2014) experienced a killing frost prior to maturity.

Increasing seeding rate from 3 to 8 seeds/ft^2 resulted in an increase in grain yield from 31.4 bu/ac (2107 kg/ha) at the lowest rate, increasing to 36 bu/ac (2416 kg/ha) at the medium rate and 41.6 bu/ac (2793 kg/ha) at the highest seeding rate. Wide row spacing yielded 37 bu/ac (2494 kg/ha), which was 1.7 bu/ac (111 kg/ha) higher than the narrow row spacing at 35.5 bu/ac (2383 kg/ha). Overall, wide row spacing increased grain yield 5% to 20% in 4 out of 6 environments compared with narrow rows.

Optimum seeding rate calculated

The Economic Optimum Plant Density (stand establishment) was calculated to determine the optimum seeding rate that delivers the best economic returns. This takes seed costs, yield, and commodity price into consideration as they relate to seeding rate and row spacing. For example, the highest seeding rate might result in the highest yield, but the added seed cost might be more than the added revenue from the higher yield.

The EOPDs for genotype varied by location, with 2 of 4 sites having a higher EOPD for MG 00.4 compared to MG 00.8, but lower at 2 other sites, and similar at the 5th site. When compared across environments and row spacings, the EOPD difference between varieties was almost identical at 4.6

plants/ft^2 for MG 00.4 and 4.7 plants/ft^2 for MG 00.8. This suggests that seeding rate may be the same for different early season soybean varieties, specifically for 00 MG soybeans .

The EPODs for row spacing also varied between sites, with wide rows having a higher, similar and lower EPOD than narrow rows depending on sites. When combining variety and sites, the EOPD gap between row spacings was small, with the EOPD for narrow rows at 4.5 plants/ft^2 and 4.8 plants/ft^2 for wide rows. Similarly, grain yields and revenue at the EOPD were very similar, with wide rows having a $483/ac ($1195/ha) return compared to $477/ac ($1180/ha) for narrow rows.

Overall, the gaps in EPOD were minimal between environments, genotypes, and row spacing. This gap was only 0.1 to 0.3 plants/ft^2, and only resulted in 1.3% to 2.0% higher grain yield, and an increase in gross revenue of $6.47/ac to $9.72/ac ($16 to $24/ha). The overall EOPD was estimated at 4.6 plants/ft^2 regardless of environment, genotype and row spacing.

As a result, the Economic Optimum Seeding Rate was estimated to be 58 seeds/m^2 or 5.8 seeds/ft^2, assuming 80% plant emergence. This is equivalent to 252,000 seeds/acre seeding rate – substantially higher than Manitoba seeding rate recommendations of 175,000 to 180,000 seeds/acre, which targets 140,000 to 160,000 stand establishment assuming 80% plant emergence.

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Tram T.N.Thai, Danny G.Le Roy, Manjula S.Bandara, James E.Thomas, and Francis J.Larney. Economic optimum plant density of irrigated early-maturity soybean in southern Alberta. *Canadian Journal of Plant Science*. **102**(1): 234-245. https://doi.org/10.1139/cjps-2021-0026

Tram T.N.Thai, Francis J.Larney, James E.Thomas, Manjula S.Bandara, and Doon G.Pauly. Westward expansion of soybean: adaptability of maturity group 00 genotypes to row spacing and seeding density under irrigation in southern Alberta. *Canadian Journal of Plant Science*. **99**(5): 715-733. https://doi.org/10.1139/cjps-2019-0016