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DIGGING INTO RESEARCH

Winter wheat stand establishment strategies

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Two research studies investigated best management practices for winter wheat stand establishment at 26 sites over three years across western Canada. A strong, integrated agronomic system with high seed rate near 40 plants per square foot, a dual fungicide/insecticide seed treatment, and vigorous seed provided the greatest yield stability and returns.

The first study looked at how seed treatment, seed lot vigor (seed size), and seeding rate influenced winter wheat stand establishment, yield, and seed quality. Seed of CDC Buteo was treated with Raxil MD (tebuconazole + metalxyl) plus Stress Shield (imidacloprid), or left untreated. Seeding density was either 20 or 40 seeds per square foot (200 or 400 seeds/m^2). Small, medium, and large seed sizes were used to represent seed vigor.

Seeding rate had an obvious effect on fall and spring plant density. At the lower seeding rate, fall plant stand density was 13.4 plants per square foot (134 plants/m^2) compared to 22 plants per square foot (220 plants/m^2) at the high seeding rate of 40 seeds per square foot.

Seed size also slightly affected plant density. Fall and spring plant densities were about 1 plant per square foot (10 plants/m^2) higher for heavy seed versus light seed.

The dual seed treatment provided the greatest yield and test weight benefit with light seed. For example, with the seeding rate of 20 seeds per square foot, yield of untreated light seed was 63 bushels per acre (4.26 tonnes/ha) compared to 66 bushels per acre with light seed treated with the dual fungicide/insecticide seed treatment. There was less of a response to seed treatment with heavier seed at the lower seeding rate.

Net returns were calculated for the seed rate and seed treatment interaction. At both seeding rates, the dual fungicide/insecticide seed treatment provided the highest gross returns. However, the additional cost of seed and seed treatment at the high seeding rate resulted in lower net returns than the low seeding rate with or without a seed treatment.

From a purely economic perspective, the researchers found that a low seeding rate combined with the dual seed treatment provided the best net returns at $75 per acre ($186/ha). However, the thinner plant stand would likely require additional herbicide applications because of reduced crop competition with weeds. If an additional herbicide application of $15 per acre was factored in to the low seeding rate, the higher seeding rate produced a higher net return.

Economic analysis of mean winter wheat responses to seeding rate by seed treatment interaction for data collected at environments in Manitoba, Saskatchewan, and Alberta, Canada, from the fall of 2010 to the summer of 2013.

Sowing density	Seed treatment	Gross returns†	Total costs	Net returns	Weed control: Cost of additional herbicide	Net returns (Revised)
		$ ha^{-1}				
200 seeds m^{-2}	Check	833	670	164	37	126
200 seeds m^{-2}	Dual fungicide/Insecticide	864	678	186	37	148
400 seeds m^{-2}	Check	849	695	154	0	154
400 seeds m^{-2}	Dual fungicide/Insecticide	855	712	143	0	143

† Source for variable and fixed costs: Saskatchewan Ministry of Agriculture Guide to Crop Planning.

Weakest agronomic system most variable

A stability analysis also found that the weakest agronomic system of low seeding rate and untreated, light seed was often the poorest performing with highly variability. At low seeding rates, seed treatments helped to partially compensate for stand establishment and provided yields similar to high seeding rates. However the variability across site years with the weak agronomic system couldn't always be overcome with a seed treatment.

Additionally, because greater instability was observed in the systems with low seeding rate and lower seed vigour, the researchers concluded that a stronger agronomic system with seeding rate around 40 seeds per square foot and a dual fungicide/insecticide seed treatment was recommended

across all environments. This type of agronomic system reduces risk and brings benefits of better stand establishment, improved over winter survival, reduced weed competition, and more stable yields.

Seeding system treatment examples showing a weak agronomic system of low sowing density and light seed with (upper left photo) no seed treatment or (upper right photo) with dual fungicide/insecticide (Raxil WW). Lower photos depict a strong agronomic system of high sowing density and heavy seed (lower left photo) with no seed treatment or (lower right photo) with dual fungicide/insecticide (Raxil WW).

Dual insecticide/fungicide seed treatment most profitable

The second study looked at winter wheat seed treatments and a fall foliar fungicide application at the 26 site years across western Canada. CDC Buteo was sown at a rate of 45 seeds per square foot ($450/m^2$).

Untreated seed was compared to fungicide seed treatments of Raxil 250 FL (tebuconazole) and Allegiance FL (metaxyl), an insecticidal seed treatment with Stress Shield (imidacloprid), and a dual fungicide/insecticide seed treatment of Raxil MD (tebuconazole + metalxyl) + Stress Shield (imidacloprid).

Additionally, a fall foliar fungicide treatment of Proline 480 SC (prothioconazole) applied at the three to four leaf stage was compared to a non-foliar application check.

The dual fungicide/insecticide seed treatment yielded the highest at 64.5 bushels per acre (4.33 tonnes/ha) and the highest net return at $42 per acre ($104/ha). The check and the fungicide seed treatment, metalxyl, produced lower grain yield of around 62 bushels per acre (4.17 tonne/ha) resulting in low net returns of around $35 per acre ($86/ha). The imidacloprid only seed treatments and the fungicide seed treatment tebuconazole had intermediate yields and net returns.

Fall foliar application also improved yield, but by slightly less than 1 bushel per acre (0.06 tonne/ha), resulting in a decreased net return of $4.85 per acre ($12/ha). There was no apparent synergistic or antagonistic relationship noted between seed treatments and a fall foliar application.

A cropping system stability analysis was also conducted. Fall-applied foliar fungicide applications provided greater plant stand stability and higher yield, but with lower overall net returns. However, because fall foliar fungicide application provided greater stability, the researchers felt further research is required to see if a foliar fungicide is justified as an added input or as an alternative to a spring application.

The two studies found that a seeding rate of around 40 seeds per square foot and a dual insecticide/fungicide seed treatment provide the highest and most stable yields and net returns.

Beres, B. L., T. K. Turkington, H. R. Kutcher, B. Irvine, E. N. Johnson, J. T. O'Donovan, K. N. Harker, C. B. Holzapfel, R. Mohr, G. Peng, and D. M. Spaner. 2016. Winter Wheat Cropping System Response to Seed Treatments, Seed Size, and Sowing Density. Agron. J. 108:1101-1111.

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