Plant Population Key Driver of Maximum Pea Yields

An extensive, three-year agronomic study of pea inputs on their own and in combination suggests that skimping on seeding rates caps yield from the start

Lyndsey Smith

Is there a magic recipe of inputs for maximum pea yields? A recently-completed three-year, five-site study that varied five inputs alone and in different combinations provides some solid data to support a recipe, at least in part.

The pea input study, spearheaded by the Western Applied Research Corporation (WARC) at Scott, Saskatchewan, with funding provided by Saskatchewan Pulse Growers and Manitoba Pulse and Soybean Growers, totalled a formidable 22 treatments in five locations — Scott, Melfort, Swift Current, and Indian Head in Saskatchewan, and one Manitoba location at Minto — for a total of 12 site-years of data.

Sherrilyn Phelps, Agronomy and Seed Program Manager with Saskatchewan Pulse Growers, explains that the success of the canola and barley input studies headed up by Agriculture and Agri-Food Canada inspired the group to dig deeper into pea yield potential.

"The idea was to compare what individual inputs have the most impact on yield and then how the inputs act in combination. The low input treatment was called the 'empty package' and the treatment where all inputs were used in combination was called the 'full package'. We wanted to determine what the additive impact was of adding individual inputs, to see which inputs were the biggest drivers of yield," Phelps says. The individual inputs were tested by themselves, then in combinations of two, three, four, and then as all five which was considered the 'full package'.

The five inputs studied were:

- Seeding rate — 60 seeds/metre squared (m²) vs. 120 seeds/m² (roughly 1.8 bushels per acre (bu/ac) vs 3.8 bu/ac)
- Seed treatment — no seed treatment vs. Apron Maxx
- Inoculant — liquid vs. granular (at recommended rates of each)
- Starter fertilizer — none vs. 34 pounds (lbs) actual nitrogen (N)
- Foliar fungicide — none vs. a two-pass system (Headline EC and Priaxor DS)

When environment is limiting

What was immediately apparent from the results of the study, Phelps says, is that three sites — Melfort, Scott, and Minto — had much higher yields, whereas the Indian Head and Swift Current sites were lower yielding due to being limited by some factor other than the inputs the study looked at.

"There was an obvious split around the 45 bu/ac mark. Three sites above that became the high yielding locations, and the two below it low yielding sites, and we separated the data accordingly," Phelps says. "The environment — too much water, not enough, root rots, heat in July, whatever it was — was limiting in those areas."

Once settled out into high and low yield zones, Phelps says there were interesting findings within each grouping of sites.

High yielding site findings

"In the high yielding sites, there was one combination that was consistently the clear winner — the higher seeding rate, with the double fungicide application, and seeded with the granular inoculant," says Phelps.

Figure 1. Chart of Yield Response to Various Inputs and Combination of Inputs at the Yielding Site

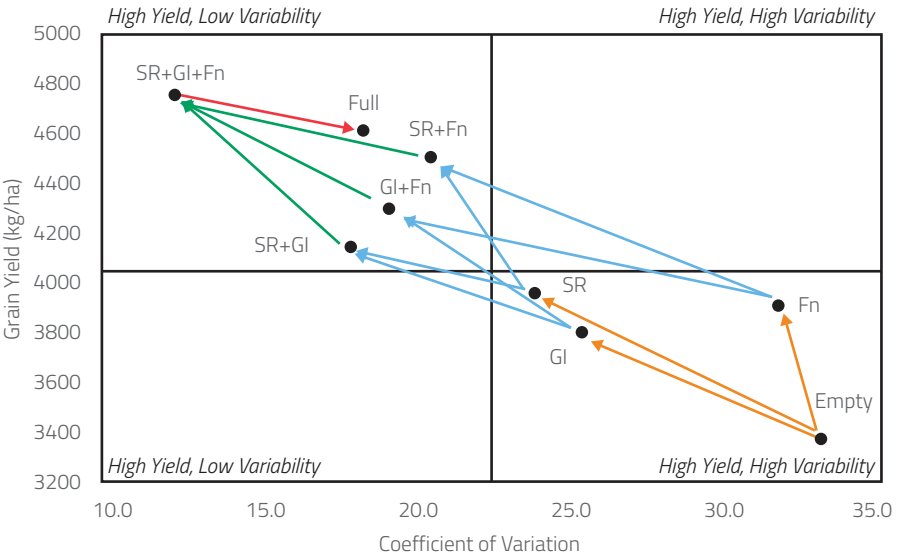

Figure 1. Chart of yield response to various inputs and combination of inputs at the high yielding sites. Only the individual inputs that showed significant responses and their corresponding combinations are shown. Coefficient of variation is a measure of the variability within that treatment. The more variable or inconsistent the yield response to that input, the higher the coefficient of variation, and the less predictable the response. Moving from the bottom right to the top left, you see that the addition of single inputs (SR, GI, Fn) increase yield and are less variable. Combining those individual inputs into combinations of two and then three, the yield continues to increase and the variability or risk continues to decline. The ultimate combination of all three inputs shows highest yield and lowest risk. In other words, it has the greatest yield potential and is more consistent at reaching higher yields than individual inputs. Comparing the three-way combination of inputs to the full input package that has all five inputs, or the empty package, you can see that the variability increases and the yield declines slightly. This suggests that the combination of five inputs or one of the five inputs is having a negative effect on yield and is causing more variability in response.

This pea input study was funded by Saskatchewan Pulse Growers and Manitoba Pulse and Soybean Growers.

With the individual inputs, the biggest yield advantage came from the first of these two inputs — the higher seeding rate and the foliar fungicide applications. When all individual inputs, as well as all the combinations of inputs were compared, granular inoculant also increased yields, Phelps says. "Not only were the input responses consistent, they were additive, too." In other words, the yield increase from the combination of adding input A plus input B equalled the total yield gain when the individual responses from treatment A were added to the individual treatment responses from treatment B.

Stu Brandt, manager of the North East Agricultural Research Foundation (NARF) at Melfort, says that the predictability observed in the data is great news for farmers, as it means not only can they be confident in what the numbers suggest, but also the consistency of the findings means that as they add inputs, the risks decrease.

"Under high yield conditions, the inputs work in an additive fashion — those that contributed to yield, could be combined to build that yield," Brandt says. "But in the low yielding sites, the

Table 1. Economic gain with inputs compared to empty package at high yielding site

Treatment Ranking	Gain $/ac
SR+GI+Fn	72
SR+GI	53
SR+Fn	50
GI+Fn	45
GI	37
SR	37
Full	31
Fn	10
Empty	0

SR = seeding rate
GI = granular inoculant
Fn = foliar fungicide
Full = full package
Empty = empty package

Table 2. Economic gain or loss with inputs compared to empty package at low yielding sites

Treatment Ranking	Gain $/ac
SR	44
SR+GI	5
GI	1
Empty	0
SR+GI+Fn	-8
GI+Fn	-24
Full	-25
Fn	-25
SR+Fn	-28

SR = seeding rate
GI = granular inoculant
Fn = foliar fungicide
Full = full package
Empty = empty package

responses were not additive, and in fact, the contribution to yield of each input was reduced."

Were there any inputs that did not appear to contribute to yield? Phelps says that, as the study was laid out, seeding happened in mid-to late May — hardly early — and that may have been why the seed treatment did not seem to offer any advantage. Peas, however, typically go in quite early, in cold or wet soil, making a seed treatment much more likely to protect plant populations, which, the data shows is a key driver of yield potential.

Running the numbers

Those that love numbers are likely waiting to hear about the economic breakdown of the different treatments — as achieving higher yields sometimes comes with a price tag too high to be economical.

That is not the case, though, according to Phelps, who says that the consistently higher yielding combinations also resulted in the highest net profit per acre. "In the high yielding sites, the combination of the higher seeding rate, two-pass fungicide, and granular inoculant resulted in a net gain of $72/acre versus the empty input package," she says. "Any of those two inputs in combination resulted in $45 to $53/acre above the empty input package. Not using all three basically costs you $20 an acre in potential income."

Low yield site lessons: Invest in seed

The input results at Indian Head and Swift Current are still very important, even if the possible yield potential never did reach the levels of the other three sites.

Whether plagued by root rots, too much moisture, or some other environmental factor (the analysis into that answer is still ongoing, but excess moisture was a factor at Indian Head), there was still a consistent advantage to investing in the higher seeding rate at the designated low yield sites.

In the high yielding sites, the combination of the higher seeding rate, two-pass fungicide, and granular inoculant resulted in a net gain of $72/acre versus the empty input package.

"At these two sites, the higher seeding rate was the only input that increased yield and margin consistently," Phelps says. "If you are going to invest in anything and you are not sure what your environment is going to be, or if you have a risky situation, do not skimp on seeding rates because you are shooting yourself in the foot right off the bat."

There was no observed advantage between the inoculant types, Phelps explains, but there was not a comparison to no inoculant. As for fungicides, that is a call to make in-season, Phelps says, as the payback on the application is likely only going to occur if the growing season favours disease development.

"There was still a profit advantage to inputs at the low yielding sites," Phelps says. "The higher seeding rate resulted in a gain of $44/acre versus the empty package, making it a clear driver of yield and profitability even when the environment is not ideal."

Lessons learned

Brandt says that the real value of this research is that when margins are tight, farmers can be confident in knowing where their input dollars are best spent, and which costs may be trimmed without significantly hurting yield. As well, when prices are good and you know you have high yield potential, you can have confidence, in input investments paying off.

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