2024 Interim Report

for the

Saskatchewan Pulse Crop Development Board

Mitigating Yield Losses Due to Pea Leaf Weevil in Field Pea and Faba Bean

(Project #AP-2409a)

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2. **Project Title:** Mitigating Yield Losses Due to Pea Leaf Weevil Feeding in Field Peas and Faba Beans

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5. **Introduction** (background and rationale, include references to original research projects where necessary)

The pea leaf weevil (PLW; *Sitona lineatus*) is one of relatively few insect pests affecting field peas (*Pisum sativum*) in western Canada. This insect also affects faba bean (*Vicia faba*) and, anecdotally, may even feed preferentially on this crop. In Saskatchewan, the distinct leaf damage caused by feeding adults was first documented in 2007 (Hartley 2007). The pest was initially observed in the southwest corner of the province, presumably having migrated from Southern Alberta; however, PLW has since expanded throughout Saskatchewan and into Manitoba. In 2023, pressure was highest in the northwest and east side of Saskatchewan, with essentially no PLW observed in the southwest and south-central regions (Government of Saskatchewan 2023), presumably due to the lack of field peas in these areas. The most obvious damage caused by PLW is the feeding of adults on foliage, which results in a distinct U-shaped notching on the leaf margins. Damage to the newest terminal leaves, sometimes referred to as clam leaves, is an indication that the insects are still actively feeding. While this feeding can reduce stands if pressure is extremely high as the field peas are just emerging, the greatest economic losses typically come from larval feeding on *Rhizobium* root nodules; thus, reducing N fixation and potentially leading to N deficiencies. Although adult PLW will feed on several wild or tame legume hosts, including alfalfa, clover, soybeans, etc., only field peas and faba beans are suitable hosts for their reproduction and, therefore, these are the crops that are most vulnerable in the spring and suffer the greatest damage and potential for yield loss (i.e., Landon et al. 1995; Carcamo and Vankosky 2011; Bogdan 2023).

Seed-applied systemic insecticides are generally recognized as the most effective chemical control for reducing yield losses due to PLW, largely because foliar insecticide applications are difficult to time and have no impact on eggs or larvae (i.e., Carcamo and Vankosky 2011; Carcamo et al. 2018; Bogdan 2023). Examples of seed treatments currently registered for control of pea leaf weevil in field pea include Cruiser 5FS (thiamethoxam), Stress Sheild 600 (imidacloprid), and Lumivia CPL (chlorantraniliprole). Vankosky et al. (2011), observed significant reductions in terminal leaf damage with thiamethoxam at the three and five node stage of field pea, but not at the eight-node stage. Yield responses, however, were inconsistent and even trended negative in one year. In faba bean plot trials at Lethbridge and Lacombe, Wijerathna et al. (2021), observed fewer plants with terminal leaf damage with a seed treatment (thiamethoxam) but not a foliar insecticide (lambda-cyhalothrin) at the five-node stage (three leaves unfolded) while both seed-applied and foliar applications resulted in a reduction at the seven-node (five leaves unfolded). Importantly, yields were approximately 700-800 kg/ha higher (21-24%) with the seed treatments; however, there was no yield benefit to either single or dual foliar insecticide applications. Further to this, faba bean yield was related to the proportion of plants with terminal leaf damage at the three-leaf stage but not at the five-leaf stage.

Because the yield loss associated with PLW infestations is often due to nodule feeding as opposed to above-ground defoliation, a reasonable practice to reduce yield loss might be planting field peas on high nitrogen (N) soils, or perhaps even applying N fertilizer to compensate for the reduction in N_2 fixation. Corre-Hellou and Crozat (2005) observed that the contribution of N fixation to total N uptake in field pea fell from 72% to 49% as the observed feeding on leaves became increasingly severe. While, under heavy PLW pressure, Vankosky et al. only improved pea yields with N fertilizer in one of three years, they consistently reduced nodulation with the addition of 60 kg N/ha. As such, N fertilized plants were still attractive for adult feeding, but less suitable for supporting larvae and reproduction.

While crop rotation is not always beneficial, due to the ability of the adults to disperse long distances in the early spring, multiple studies have shown that delaying field pea seeding until later in May can reduce PLW leaf and nodule feeding (i.e., Carcamo et al. 2018; Bogdan 2023); however, there is a high risk that later seeded field peas will yield less under normal environmental conditions. While detailed measurements were not completed, this was anecdotally observed in faba plots seeded at the beginning versus end of May at Indian Head in 2023 (Chris Holzapfel, personal communication). While beyond the scope of this demonstration, but for similar reasons that delayed seeding can be beneficial, trap crops of winter peas combined with targeted foliar insecticide applications have also been shown to be effective in reduced feeding in the main field pea crop (i.e., Carcamo and Vankosky 2011).

Literature Cited

Bogdan, J. 2023. Saskatchewan Pulse Growers: Pea Leaf Weevil. Online [Available]: https://saskpulse.com/resources/pea-leaf-weevii/?download-pdf (March 10, 2025).

Carcamo, H., and Vankosky, M. 2011. Managing the Pea Leaf Weevil in Field Peas. Prairie Soils and Crops Journal. **4:** 77-85.

Corre-Hellou G and Crozat, Y. 2005. N_2 fixation and N supply in organic pea (*Pisum sativum L.*) cropping systems as affected by weeds and pea weevil (*Sitona lineatus* L.) Europ. J. Agron. **22:** 449-458.

Hartley, S., 2007. Saskatchewan Insect pest report. Minutes of the 2007 Western Committee on Crop Pests, Penticton, British Columbia, 18 Oct. 2007. Online [Available]: https://www.westernforum.org/Documents/WCCP/WCCP%20Minutes/WCCP%20MInutes%20-%2020071.pdf (March 10, 2025).

Landon, F., Levieux, J., Huignard, J., Rougon, D., and Taupin, P. 1995. Feeding activity of Sifona lineatus L. (Col., Curculionidae) on Pisum safivum L. (Leguminosae) during its imaginal life. J. Appl. Ent. **119:** 515-522.

Vankosky, M., Hector, C., McKenzie, R., and Dosdoll, L. 2011. Integrated Management of *Sitona lineatus* with Nitrogen Fertilizer, *Rhizobium*, and Thiamethoxam Insecticide. **103:** 565-571.

Wijerathna, A., Evenden, M., Reid, P., Tideman, B., and Caramo, H. 2021. Management of Pea Leaf Weevil (Coleoptera: Curculionidae) and Development of a Nominal Threshold in Faba Beans. J. Econ. Ent. **114:** 1597-1606. doi: 10.1093/jee/toab086.

Government of Saskatchewan. 2023. Pea Leaf Weevil Survey Map. Online [Available]: https://publications.saskatchewan.ca/api/v1/products/118865/formats/141823/download (March 10, 2025).

6. **Objective(s) or purpose of the project**

The objectives of the project are to demonstrate and investigate, for both field pea and faba bean:

1) What is the relative efficacy of insecticide seed treatments for reducing pea leaf weevil (PLW) feeding and subsequent impacts on seed yield.
2) Is delaying seeding an effective management practice for reducing PLW feeding, albeit recognizing that delays in seeding can also result in lower seed yields?
3) When PLW pressure is high, can yield losses be reduced by applying supplemental nitrogen (N) at the time of seeding?
4) Recognizing that seed-applied insecticides are unlikely to provide complete control, will combining a seed treatment with supplemental N fertilizer be beneficial over either of these inputs on their own?

7. **Materials and Methods** (experimental design, methods used, details of growing the crop(s), materials used, sites, statistical analyses, etc.)

Field trials were established at four Saskatchewan locations to demonstrate and investigate the relative effectiveness of chemical and cultural strategies to reduce the impact of pea leaf weevil (PLW; *Sitona lineatus*) on field pea (*Pisum sativum*) and faba bean (*Vicia fava*) yield. The locations were Indian Head (R.M. #156), Melfort (R.M. #428), Scott (R.M. #380), and Yorkton (R.M. #244), strategically selected based on observed PLW feeding pressure in recent years. Due to space limitations, only the field pea trial was conducted at Yorkton in 2024. The treatments were a factorial combination of two seeding dates (early versus delayed), two seed-applied insecticide treatments (fungicide only versus fungicide plus insecticide), and two fertility treatments (Standard versus Extra N). The treatments were arranged in a four-replicate split-plot design with seeding date as the main plot and seed-applied insecticide and fertility treatments as the sub-plots. The initial seeding date was intended to be as early possible (late April / early May) while the delayed seeding date was targeted for 10-14 days after the first. The seed treatments were either Trilex EverGol (fungicide only) or Trilex EverGol SHIELD (fungicide plus insecticide) applied at the label recommended rates, with the higher rate of insecticide used in the field peas. The fertilizer treatments were defined as either Standard (N provided from required PKS fertilizers) or Extra N (required PKS fertilizers plus side-banded urea to bring the total fertilizer N rate to 110 kg N/ha). A granular rhizobial inoculant was always applied in-furrow at the label recommended rate. The treatments are detailed in Table 1.

Plot sites varied by location but, to minimize potential edge effects, each plot was three drill passes wide with all data collection foccused on the centre pass. All factors other than those being evaluated were intended to be non-limiting. All crop protection product applications were to be tailored to the individual seeding dates wherever possible. Weeds were managed using registered pre-emergent and in-crop herbicides with supplemental hand weeding as required. At least one preventative foliar fungicide application was required by protocol, with timing tailored to each individual seeding date, regardless of disease pressure. Although early-season foliar insecticide applications were prohibited (due to the potential impacts on PLW), foliar insecticides were permitted from the R1 stage onwards (i.e., to protect against pests such as grasshoppers, blister beetles, and aphids) and utilized as required based on the actual insect pressure. Pre-harvest herbicides and/or desiccants were used at the discretion of site managers and the centre plot was harvested with a small plot combine as soon as possible after it was fit to do so based on crop dry down and weather. Harvest dates were tailored to each seeding date wherever possible. Pertinent agronomic information, including dates of select field operations and data collection activities, are provided in Tables 9 and 10 of the Appendices.

Table 1. Treatments evaluated in pea leaf weevil (PLW) management demonstrations conducted with field pea and faba bean at various Saskatchewan locations in 2024 and 2025.

Trt #	Seeding Date[Z] (main plot)	Seed Treatment	Nitrogen Treatment[W]
1	Early	Fungicide[Y] only	Standard Fertility
2	Early	Fungicide only	Standard Fertility + Nitrogen
3	Early	Fungicide + Insecticide[X]	Standard Fertility
4	Early	Fungicide + Insecticide	Standard Fertility + Nitrogen
5	Delayed	Fungicide only	Standard Fertility
6	Delayed	Fungicide only	Standard Fertility + Nitrogen
7	Delayed	Fungicide + Insecticide	Standard Fertility
8	Delayed	Fungicide + Insecticide	Standard Fertility + Nitrogen

[Z] Early seeding occurs as early as possible (late April / early May), target 10-14 days later for delayed seeding
[Y] Fungicide is Trilix EverGol (3.85 g penflufen, 3.85 g trifloxystrobin, and 5.1 g metalaxyl/100 kg seed
[X] Insecticide is Stress Shield 600 (62.4 g imidacloprid/100 kg for faba bean and 124.8 g imidacloprid/100 kg for field pea)
[W] Rates may vary across sites but recommend 77 kg MAP/ha in Trts 1,3,5,7 (8-40-0-0 kg/ha) and 77 kg MAP/ha + 221 kg urea/ha in Trts 2,4,6,8 (110-40-0-0). MAP should be side-banded while urea may be side- or mid-row banded

Various data were collected during the growing season and from the harvested seed samples. A composite, two-depth (0-15 cm, 15-60 cm) soil sample was collected from each site with, in most cases, separate samples for each crop type, and submitted to AgVise laboratories for determination of residual nutrients and other properties. After emergence was complete, plant densities for each plot were estimated by counting seedlings in a minimum of 2 x 1 m sections of crop row and converting the averaged values to plants/m^2. Pea leaf weevil feeding pressure was quantified at the 4-5 node stage by counting leaf notches on 40 plants per plot and calculating both the average number of notches/plant and the percentage of plants with at least one leaf notch (incidence). These counts were focussed on the clam leaf in peas and the most recently unfolded pair of leaves in faba bean. The julian date when each plot reached physiological maturity was recorded and days from seeding to maturity were calculated. Maturity was defined as when 70% of pods turned or are turning brown in peas and when approximately 80% of pods had started to turn colour and 33% had completely turned for faba bean. Seed yields (expressed as kg/ha) were calculated from the harvested grain samples and are adjusted for dockage and to 16% seed moisture content, by mass. For consistency, IHARF completed the protein analyses on behalf of all sites using a FOSS Infratech NIR analyser and protein is expressed on a dry seed basis. Daily minimum and maximum temperatures and precipitation amounts were recorded at the nearest Environment and Climate Change Canada weather stations.

At this stage, response data for each crop were analyzed individually for each location. The data were analyzed using generalized linear mixed model (GLIMMIX) procedure of SAS Studio. The effects of seeding date (D), seed-applied insecticide (I), and N fertility (N), along with all possible interactions, were considered fixed while replicate and D x replicate effects were included as random effects. Fisher's protected LSD test was used to separate treatment effects; however, letter groupings for the two- and three-way interactions were only provided when the corresponding F-test was significant. Treatment effects and differences between means were considered significant at $P \leq 0.05$.

8. **Results and Discussion** (results presented and discussed in the context of existing knowledge and relevant literature or comparison to existing recommendations, detail any major concerns or sources of error, provide proper statistical significance)

Soil Test Results and Growing Season Weather
Soil test results for all locations are provided in Tables 11 and 12 of the Appendices for field pea and faba beans, respectively. At Scott, the trials were near each other and a single composite soil sample was submitted for both crops. Overall residual N levels (0-60 cm) were relatively high for the field peas at Yorkton and faba beans at Melfort (54-71 kg NO_3-N/ha), but reasonably low (24-32 kg NO_3-N/ha) in all other cases. Residual phosphorus (P), potassium (K), and sulfur (S) levels were not of specific interest and were intended to be non-limiting across sites and treatments. Soil pH, organic matter, and cation exchange capacities (CEC) ranged widely but were considered representative of the regions which each location was intended to represent.

Weather details are also reserved for the appendices, with mean monthly temperatures for May through August provided in Table 13 and precipitation amounts in Table 14, both relative to the long-term (1981-2010) averages. Following a dry fall and winter, all sites started the 2024 season with initially low soil moisture; however, the weather in May and June was cool and wet to the point that excess moisture was occasionally detrimental in some cases (i.e., field peas at Indian Head 2024). Heading into July, however, the weather patterns changed with temperatures shifting to well above normal at all sites and precipitation totals for the month ranging from approximately 30-60% of average. August weather was variable, with temperatures remaining above-average but to a lesser extent and precipitation totals ranging from very dry (i.e., Melfort) to well above-average (Indian Head). The August precipitation, however, at Indian Head, was generally too late to be of much benefit and mostly came in the form of thunderstorms, often with heavy rainfall and extreme winds. While peas are generally tolerant to drier conditions and heat during flowering, excess moisture earlier in the season can reduce root health and, by August, the plants were approaching maturity. Faba beans generally do better in high moisture environments, but high temperatures during flowering and pod fill can reduce pod retention and seed set, especially when coupled with drought stress.

Field Pea – Indian Head 2024
At this stage, we will review results for each site and crop individually, drawing preliminary overall conclusions where appropriate after all the data has been considered. Main effect means for field peas at Indian Head are provided in Table 2 below while the two- and three-way interactions are in Tables 15 and 16, respectively. Plant densities were only affected by seeding date (P = 0.005) with no other significant main effects or interactions (P = 0.376-0.672). The seeding date effect indicated that plant densities were higher with later seeding than with early seeding (107 versus 85 plants/m^2), presumably due to better seeding conditions at the later date. Damage due to PLW was negligible and not affected by any treatments or interactions (P = 0.117-0.764), with fewer than 1% of plants having any notches whatsoever and the overall average number of notches per plant being close to zero. Maturity was affected by both seeding date (P < 0.001) and N fertility (P < 0.001) but not seed treatment (P = 1.000) nor any interactions (P = 0.065-0.747). The seeding date effect was typical, with the later seeded plots reaching maturity in 83 days compared to 90 days with early seeding. Extra N delayed maturity just slightly, by 1.4 days, compared to standard fertility. Seed yields were only affected by N with a 934 kg/ha, or 29%, yield increase observed with extra N. Such a strong response was unexpected, especially given the lack of PLW feeding, but may have been due to overall root health and biological N fixation being negatively affected by the frequently excessive moisture in June through the beginning of July. While we did not do objective or intensive ratings, any plants that were inspected on the site appeared to have healthy root nodules; however, root disease was a substantial issue in the surrounding field pea fill crop and lentils plots. While the current pea plots may have been impacted by root disease to some extent, any symptoms were minor, and the plots were

quite uniform within and across replicates. Like yield, only the main effect of N was significant for seed protein (*P* < 0.001); however, a D x N interaction was also detected (*P* = 0.035). The main N response showed protein increasing from 20.1% to 22.0% with extra N fertilizer. The interaction revealed that protein was lower with delayed versus early seeding with standard fertility (19.5% versus 20.6%), but more similar between seeding dates (21.8-22.2%) with extra N (Table 15). While not significant at the desired probability level (*P* = 0.077), a similar trend was observed with yield whereby the gap between N treatments tended to be greater with delayed seeding.

Table 2. Treatment means and tests of fixed effects for seeding date, seed-applied insecticide, and nitrogen fertility effects on field pea response variables at Indian Head 2024.

Main Effect	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
Seeding Date	- plants/m^2 -	--- #/plant ---	-- % plants --	----- days -----	---- kg/ha ----	------ % ------
Early	84.5 b	0.0 a	1.4 a	89.6 a	3661 a	21.4 a
Delayed	107.3 a	0.0 a	0.0 a	83.4 b	3690 a	20.7 a
S.E.M.	2.43	0.01	0.46	0.21	63.5	0.255
Pr > F (p-value)	0.005	0.215	0.117	<0.001	0.721	0.136
Insecticide						
Untreated	95.1 a	0.0 a	0.8 a	86.5 a	3687 a	21.2 a
Treated	96.8 a	0.0 a	0.6 a	86.5 a	3664 a	20.9 a
S.E.M.	2.43	0.01	0.41	0.18	57.6	0.20
Pr > F (p-value)	0.578	0.556	0.764	1.000	0.673	0.309
Nitrogen						
Standard	96.9 a	0.0 a	0.8 a	85.8 b	3208 b	20.1 b
Extra N	94.9 a	0.0 a	0.6 a	87.2 a	4142 a	22.0 a
S.E.M.	2.43	0.01	0.41	0.18	57.6	0.20
Pr > F (p-value)	0.530	0.556	0.764	<0.001	<0.001	<0.001

Field Pea – Melfort 2024

Main effect means for field peas at Melfort are presented in Table 3 below with two- and three-way interactions deferred to Tables 16 and 17 of the Appendices, respectively. Emergence at this site was affected by N fertilizer (*P* = 0.004) but no other main effects (*P* = 0.165-0.250) or interactions (*P* = 0.364-0.935). The N rate effect was a small reduction in emergence from 73.3 to 68.7 plants/m^2 with the extra N. While relatively small, inspection of individual treatment means revealed that this response was quite consistent. Peas are known to be sensitive to seedling injury and it may be that separation between the seed and fertilizer was insufficient to eliminate ammonium toxicity from the side-banded urea. Like Indian Head, the observed PLW feeding with field peas at Melfort was negligible with fewer than 1% of plants having any leaf notches and no significant treatment effects or interactions for either leaf notches per plant or the incidence of affected plants (*P* = 0.331-531). Maturity was affected by seeding date and N in a similar manner as at Indian Head; however, an I x N interaction suggested that the delay in maturity with N was more pronounced in the absence of seed-applied insecticide. Seed yield was only affected by seeding date at Melfort (*P* < 0.001) and the response was as expected whereby yields were higher with early seeding. Early (May 6) seeding resulted in 833 kg/ha, or 17% higher seed yield than delayed (May 27) seeding. Seed protein was higher with early seeding (*P* = 0.007) and extra N fertilizer (*P* < 0.001); however, there was an interaction between these two factors (*P* = 0.002) where the extra N only increased protein when seeding was delayed (Table 17). The D x I x N interaction was also significant (*P* = 0.016) and showed that no I or N treatments affected protein with the early seeding, but extra N always increased protein with delayed seeding, but to a greater extent when no insecticide was applied to the seed (Table 18). The reason for this three-way interaction is not clear.

Table 3. Treatment means and tests of fixed effects for seeding date, seed-applied insecticide, and nitrogen fertility effects on field pea response variables at Melfort 2024.

Main Effect	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
<u>Seeding Date</u>	- plants/m^2 -	--- #/plant ---	-- % plants --	----- days -----	---- kg/ha ----	------ % ------
Early	74.5 a	0.0 a	0.6 a	90.1 a	5648 a	21.8 a
Delayed	67.5 a	0.0 a	0.3 a	87.4 b	4815 b	19.3 b
S.E.M.	2.74	0.00	0.31	0.54	130.4	0.27
Pr > F (p-value)	0.165	0.391	0.531	0.011	0.020	0.007
<u>Insecticide</u>						
Untreated	73.3 a	0.0 a	0.6 a	88.9 a	5247 a	20.6 a
Treated	68.7 a	0.0 a	0.3 a	88.6 a	5216 a	20.5 a
S.E.M.	2.74	0.00	0.31	0.51	106.2	0.22
Pr > F (p-value)	0.250	0.331	0.489	0.290	0.768	0.503
<u>Nitrogen</u>						
Standard	77.3 a	0.0 a	0.3 a	88.1 b	5264 a	20.0 b
Extra N	64.7 b	0.0 a	0.6 a	89.4 a	5199 a	21.1 a
S.E.M.	2.74	0.00	0.31	0.51	106.2	0.217
Pr > F (p-value)	0.004	0.331	0.489	<0.001	0.548	<0.001

<u>Field Pea – Scott 2024</u>

Main effect means for field peas at Scott are presented in Table 4 below with two- and three-way interactions appearing in Tables 19 and 20 of the Appendices. No main effects were significant for plant density (*P* = 0.143-0.734) but a D x N interaction (*P* = 0.017) revealed that extra N reduced emergence with early but not delayed seeding. This may have been due to poorer seeding conditions reducing the separation for between seed and fertilizer at the earlier date or soil and weather conditions after seeding reducing the potential for ammonia toxicity (i.e., better soil moisture and timely precipitation). Pea leaf weevil feeding was also low at Scott with average leaf notch numbers per plant being close to zero and only 4% of plants having at least 1 leaf notch. There were strong trends for PLW feeding to be slightly worse with delayed seeding and no insecticide seed treatment; however, the tests of fixed effects were never quite significant at *P* ≤ 0.05, with such low feeding pressure, the trend may not have been of much agronomic importance. Field pea maturity at Scott was affected by seeding date (*P* < 0.001) and insecticide (*P* = 0.012) but not N fertilizer or any interactions (*P* = 0.276-0.782). The seeding date effect was like the previous sites whereby the peas matured in fewer days with delayed seeding. The insecticide effect revealed a small but significant, 1.2-day delay in maturity with the seed treatment. Seed yield was also affected by both seeding date (*P* = 0.001) and seed treatment (*P* = 0.004), but not N (*P* = 0.421) or any interactions (*P* = 0.102-0.780). The seeding date effect was as expected and like what occurred at Melfort, with early (May 5) seeding resulting in a 905 kg/ha (22%) advantage over delayed (May 22) seeding. Despite seemingly low feeding pressure, the seed-applied insecticide improved field pea yields by 327 kg/ha or 7% at Scott in 2024. Inspection of the corresponding interactions and individual treatment means suggested that the insecticide response was reasonably consistent. While the D x I interaction was not significant (*P* = 0.102), the magnitude of the insecticide responses did appear to be slightly greater with delayed seeding where there was also a trend for increased PLW feeding. Seed protein concentrations were only affected by N at Scott (*P* = 0.018) whereby protein with standard fertility was 19.3% compared to 19.7% with extra N. No other main effects or interactions showed any signs of additional effects on protein (*P* = 0.249-90.540).

Table 4. Treatment means and tests of fixed effects for seeding date, seed-applied insecticide, and nitrogen fertility effects on field pea response variables at Scott 2024.

Main Effect	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
<u>Seeding Date</u>	- plants/m^2 -	--- #/plant ---	-- % plants --	----- days -----	---- kg/ha ----	------ % ------
Early	62.2 a	0.0 a	2.0 a	89.9 a	5070 a	20.0 a
Delayed	61.0 a	0.1 a	5.9 a	82.4 b	4165 b	19.0 b
S.E.M.	2.84	0.02	1.18	0.31	69.5	0.31
Pr > F (p-value)	0.734	0.127	0.056	<0.001	0.003	0.007
<u>Insecticide</u>						
Untreated	62.3 a	0.1 a	5.3 a	85.6 b	4454 b	19.6 a
Treated	60.8 a	0.0 a	2.7 a	86.8 a	4781 a	19.5 a
S.E.M.	2.69	0.02	1.18	0.31	69.5	0.31
Pr > F (p-value)	0.602	0.050	0.054	0.012	0.004	0.426
<u>Nitrogen</u>						
Standard	63.7 a	0.1 a	4.4 a	86.0 a	4658 a	19.3 b
Extra N	59.4 a	0.1 a	3.6 a	86.4 a	4577 a	19.7 a
S.E.M.	2.69	0.02	1.18	0.31	69.5	
Pr > F (p-value)	0.143	1.000	0.552	0.410	0.421	0.033

<u>Field Pea – Yorkton 2024</u>

Main effect means and tests of fixed effects for field peas at Yorkton are presented in Table 5 below with results for the two- and three-way interactions appearing in Tables 21 and 22 of the Appendices, respectively. Only seeding date affected emergence (*P* = 0.041) and the response was like Indian Head, with better establishment when seeding was delayed. Consistent with general observations from recent years, Yorkton had much higher PLW feeding than the other locations. Both notches/plant and incidence were affected by seeding date (*P* < 0.001-0.004) and seed-applied insecticide (*P* < 0.001) while the D x I interaction was also significant for incidence (*P* = 0.002). The seeding date effect was due to much higher pressure with delayed seeding whereby the average number of notches increased from 0.1/plant to 1.8/plant and the percentage of plants with notches increased from 7% to 73%. Seed-applied insecticide reduced overall average notches from 1.5/plant to 0.5/plant and incidence from 51% to 29%. Neither N fertilizer nor any other interactions affected PLW feeding at Yorkton (2024), despite the high pressure (*P* = 0.551-0.865). The D x I interaction for incidence was due to the seed treatment effect only being statistically significant with delayed seeding; however, it appeared that the seed treatment benefit with early seeding was simply masked by the combination of high overall variability and lower feeding pressure at this time. With delayed seeding, the incidence of plants with PLW notches was reduced from 90% to 56% while, with early seeding, there was a trend for incidence to be reduced from 11% to 3% (Table 21). Allowing heterogenous variance estimates between seeding dates or, potentially, data transformations may have eliminated this seemingly trivial interaction; however, this will be difficult to accommodate with future combined analyses. Field pea maturity at Yorkton was only affected by seeding date (*P* = 0.009) and the effect was consistent with the other sites whereby delayed seeding significantly reduced the number of days from seeding to maturity. Yield variability was relatively high and only the seeding date effect was significant (*P* = 0.049). The seeding date effect was like Melfort and Scott, with a 699 kg/ha or 17% yield advantage to early seeding. Despite the lack of significance, there was a trend for 5% (210 kg/ha) higher yields with both insecticide (210 kg/ha; *P* = 0.101) and extra N (228 kg/ha; *P* = 0.080). Inspection of individual D x I, I x N (Table 21) and D x I x N (Table

22) shows that these trends were consistent, and the highest mean yields were achieved with a combination of early seeding, seed-applied insecticide, and extra N fertilizer. Seed protein was only affected by N (*P* = 0.018) with values increasing from 21.3% to 22.6% when supplemental urea was applied.

Table 5. Treatment means and tests of fixed effects for seeding date, seed-applied insecticide, and nitrogen fertility effects on field pea response variables at Yorkton 2024.

Main Effect	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
<u>Seeding Date</u>	- plants/m^2 -	--- #/plant ---	-- % plants --	----- days -----	---- kg/ha ----	------ % ------
Early	85.3 b	0.1 b	7.0 b	92.1 a	4759 a	22.2 a
Delayed	96.6 a	1.8 a	73.0 a	86.5 b	4060 b	21.7 a
S.E.M.	2.30	0.15	2.57	0.64	184.5	0.42
Pr > F (p-value)	0.041	0.004	<0.001	0.009	0.049	0.338
<u>Insecticide</u>						
Untreated	93.9 a	1.5 a	50.8 a	89.0 a	4305 a	21.8 a
Treated	88.0 a	0.5 b	29.2 b	89.7 a	4515 a	22.1 a
S.E.M.	2.30	0.15	2.57	0.59	161.2	0.42
Pr > F (p-value)	0.084	<0.001	<0.001	0.394	0.101	0.540
<u>Nitrogen</u>						
Standard	90.7 a	1.0 a	40.3 a	88.9 a	4295 a	21.3 b
Extra N	91.2 a	0.9 a	39.7 a	89.8 a	4523 a	22.6 a
S.E.M.	2.30	0.15	2.57	0.59	161.2	0.42
Pr > F (p-value)	0.900	0.629	0.865	0.229	0.080	0.018

<u>Faba bean – Indian Head 2024</u>

Main effect means and tests of fixed effects for the faba beans at Indian Head are presented in Table 6 below with those for the two- and three-way interactions are in Tables 23 and 24, respectively. Faba bean establishment was not affected by any of the main effects or interactions (*P* = 0.316-0.974). Despite minimal evidence of PLW feeding in the peas, for faba beans we saw an overall average of 0.5 notches/plant and 27% incidence of plants with at least one notch. For both variables, only seed treatment significantly affected PLW feeding (*P* < 0.001), essentially cutting the overall number of notches in half and reducing incidence from 34% to 20%. Days from seeding to maturity was affected by seeding date (*P* = 0.001) and N rate (*P* < 0.001) with later seeding hastening crop development by 3.1 days and, somewhat unexpectedly, N fertilizer hastening maturity by 0.7 days. Any time the N effect on field pea maturity was significant it showed a slight delay with extra N. Faba bean yields at Indian Head were relatively low overall but affected by seeding date (*P* = 0.006), insecticide (*P* < 0.001), and N (*P* < 0.001) with a significant D x I interaction (*P* < 0.001) detected. The N effect was such that yields were 278 kg/ha (15%) higher when supplemental urea was applied. There was a 403 kg/ha (22%) yield advantage to early seeding and yields were 454 kg/ha (25%) higher with insecticide; however, the D x I interaction revealed the response to insecticide was much greater when combined with delayed seeding (Table 23). Focussing only on these two factors, the lowest yields, by far, occurred with the combination of delayed seeding no seed-applied insecticide (1491 kg/ha) while the highest yields were with early seeding and an insecticide (2347 kg/ha). Despite the D x I interaction, the seed-applied insecticide significantly increased yields at both seeding dates. Faba bean protein at Indian Head was affected by seeding date (*P* = 0.047), insecticide (*P* = 0.006), and N fertility (*P* = 0.011); however, the D x N interaction was also significant. Although extra N fertilizer simultaneously increased yield and protein, the main effects of seeding date and seed-applied insecticide were such that protein was inversely related to yield (i.e., lower protein but higher yields with early seeding and seed-applied insecticide). The D x

N interaction showed that extra N only affected protein when seeding was delayed, and overall yields were lower (Table 23).

Table 6. Treatment means and tests of fixed effects for seeding date, seed-applied insecticide, and nitrogen fertility effects on faba bean response variables at Indian Head 2024.

Main Effect	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
Seeding Date	- plants/m^2 -	--- #/plant ---	-- % plants --	----- days -----	---- kg/ha ----	------ % ------
Early	37.4 a	0.5 a	26.4 a	102.0 a	2236 a	27.1 b
Delayed	37.9 a	0.5 a	26.9 a	98.9 b	1833 b	28.0 a
S.E.M.	0.81	0.05	2.17	0.26	96.4	0.23
Pr > F (p-value)	0.712	0.875	0.889	0.001	0.006	0.047
Insecticide						
Untreated	37.7 a	0.6 a	33.8 a	100.3 a	1807 b	27.9 a
Treated	37.6 a	0.3 b	19.5 b	100.6 a	2261 a	27.3 b
S.E.M.	0.81	0.05	2.17	0.24	96.4	0.21
Pr > F (p-value)	0.967	<0.001	<0.001	0.072	<0.001	0.006
Nitrogen						
Standard	37.4 a	0.5 a	27.0 a	100.8 a	1895 b	27.3 b
Extra N	37.9 a	0.4 a	26.3 a	100.1 b	2173 a	27.9 a
S.E.M.	0.81	0.05	2.17	0.24	96.4	0.21
Pr > F (p-value)	0.690	0.428	0.802	<0.001	<0.001	0.011

Faba bean – Melfort 2024

Main effect means and tests of fixed effects for faba beans at Melfort are in Table 7 below while those for the two- and three-way interactions are in Table 25 and 26 of the Appendices. Plant densities were only affected by seed-treatment, with significantly fewer plants observed with the seed-applied insecticide (28 plants/m^2) than without (34 plants/m^2). This response was unexpected, but depending on how exactly the treating was completed, potentially could have been due to seed damage resulting from extra handling when adding the insecticide. Pea leaf weevil feeding was more prevalent with early seeding for both notches per plant (P = 0.002; 0.7/plant versus 0.2/plant) and incidence of plants with damage (P = 0.004; 40% versus 15%). For notches/plant, a D x N interaction (P = 0.023) revealed slightly lower numbers with extra N with early seeding but no N effect with delayed seeding, where feeding was negligible regardless (Table 25). For incidence, an I x N interaction (P = 0.031) showed that extra N slightly reduced PLW feeding when no seed-applied insecticide was applied, but had no effect when combined with insecticide. This interaction was difficult to explain considering that seed-applied insecticide alone did not appear to affect PLW feeding. While not significant at the desired probability (P = 0.072), the D x N means for incidence showed a similar trend to what occurred for notches/plant. Faba bean maturity at Melfort was affected by seeding date (P = 0.001) with a D x N interaction (P = 0.022). While the overall date response was as expected with the crop developing more rapidly when seeding is delayed, the D x N interaction showed that maturity was hastened by 1.3 days with extra N when combined with early seeding, but not with delayed seeding (Table 25). Faba bean yields at Melfort were not affected by any main effects on their own (P = 0.066-0.488), however, D x I (P = 0.047) and D x N (P = 0.035) interactions were detected (Table 25). The D x I interaction showed opposite trends for seed-applied insecticide effects on yield depending on the seeding date; however, the I effect was never significant within a seeding date. The D x N effect was difficult to explain, showing a negative response to extra N when paired with early seeding (3977 versus 3573 kg/ha), where PLW pressure was also higher, but no N effect with delayed seeding (3994-4025 kg/ha). Seed protein concentrations were only impacted by seed-applied insecticide (*P* = 0.028), where values were reduced from 28.0% to 27.7% with a seed-applied insecticide. While this would not necessarily be expected if the insecticide reduced PLW larvae feeding on nodules, the protein values were inversely related to yield, despite the insecticide effects on yield not being significant.

Table 7. Treatment means and tests of fixed effects for seeding date, seed-applied insecticide, and nitrogen fertility effects on faba bean response variables at Melfort 2024.

Main Effect	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
Seeding Date	- plants/m^2 -	--- #/plant ---	-- % plants --	----- days -----	---- kg/ha ----	------ % ------
Early	31.6 a	0.7 a	40.0 a	106.1 a	3775 a	27.7 a
Delayed	30.4 a	0.2 b	14.7 b	102.0 b	4009 a	28.0 a
S.E.M.	1.67	0.03	2.18	0.27	107.1	0.21
Pr > F (p-value)	0.633	0.002	0.004	0.001	0.148	0.283
Insecticide						
Untreated	33.8 a	0.4 a	25.6 a	104.2 a	3859 a	28.0 a
Treated	28.2 b	0.5 a	29.1 a	103.9 a	3926 a	27.7 b
S.E.M.	1.67	0.03	2.13	0.27	100.5	0.18
Pr > F (p-value)	0.016	0.419	0.258	0.482	0.488	0.028
Nitrogen						
Standard	30.1 a	0.5 a	28.9 a	104.3 a	3986 a	27.8 a
Extra N	31.9 a	0.4 b	25.8 a	103.9 a	3799 a	27.9 a
S.E.M.	1.67	0.03	2.13	0.27	100.5	0.18
Pr > F (p-value)	0.423	0.023	0.303	0.296	0.066	0.751

Faba bean – Scott 2024

Main effect means and tests of fixed effects for faba beans at Scott appear in Table 8 below with results for the two- and three-way interactions summarized in Tables 27 and 28 of the Appendices, respectively. Plant densities at this site were not affected by any of the main effects or interactions (*P* = 0.160-0.943). Like Indian Head and Melfort, PLW seemed to feed preferentially on faba beans over field peas at Scott; however, treatment effects were rare for both the average number of notches per plant and incidence of plants with notches. For notch numbers, only the main effect of N was significant with slightly lower values when supplemental urea was applied. For incidence, no main effects or interactions were significant at the desired probability (*P* = 0.071-0.954); however, the D x N means showed a trend for less feeding with extra N specifically when combined with delayed seeding (*P* = 0.071). Once again, the seeding date effect on faba bean maturity was highly significant (*P* = 0.003) with the early seeded crop taking an additional 8 days to mature relative to the late seeded crop. An N effect was also detected (*P* = 0.005) whereby maturity was delayed by approximately 1 day when supplemental urea was applied. This N effect on maturity was consistent with what frequently occurred in field peas and was generally expected, but inconsistent with the faba bean response at Indian Head and with early seeding at Melfort. Faba bean yields at Scott were affected by seeding date (*P* = 0.002) and insecticide (*P* = 0.014), but not N (*P* = 0.858) or any interactions (*P* = 0.586-0.873). The seeding date effect was strong, with a 1250 kg/ha, or 79% yield advantage to seeding early. Despite not having a measurable impact on PLW feeding, seed-applied insecticide increased yields by 222 kg/ha, or 11%, on average. Inspection of the D x I, I x N, and D x I x N means (Tables 27 and 28) showed that the seed-treatment effects on yield were consistent. Faba bean seed protein concentrations at Scott were affected by seeding date (*P* = 0.005), insecticide (*P* = 0.034), and N (*P* < 0.001), with a significant D x I interaction (*P* = 0.011). First, the N response was such that protein increased from 27.3% to 28.2% with supplemental urea and the lack of any interactions with N suggested that the response was consistent across seeding dates and seed treatments. Not unexpected, the main effects of seeding date and insecticide were opposite of what occurred for yield with protein being lower with early seeding and with an insecticide. The D x I interaction, however, showed the seed treatment effect to only be significant when seeding was delayed, yields were lower, and overall protein levels were higher (Table 27).

Table 8. Treatment means and tests of fixed effects for seeding date, seed-applied insecticide, and nitrogen fertility effects on faba bean response variables at Scott 2024.

Main Effect	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
Seeding Date	- plants/m^2 -	--- #/plant ---	-- % plants --	----- days -----	---- kg/ha ----	------ % ------
Early	32.2 a	0.3 a	18.1 a	106.8 a	2823 a	27.0 b
Delayed	35.2 a	0.4 a	23.0 a	98.4 b	1573 b	28.5 a
S.E.M.	1.24	0.04	2.08	0.64	122.9	0.14
Pr > F (p-value)	0.160	0.082	0.169	0.003	0.002	0.005
Insecticide						
Untreated	33.1 a	0.4 a	22.0 a	102.5 a	2087 b	28.0 a
Treated	34.3 a	0.3 a	19.1 a	102.6 a	2309 a	27.6 b
S.E.M.	1.24	0.04	2.08	0.48	115.6	0.13
Pr > F (p-value)	0.468	0.163	0.284	0.691	0.014	0.034
Nitrogen						
Standard	33.2 a	0.4 a	22.5 a	103.1 a	2206 a	27.3 b
Extra N	34.2 a	0.3 b	18.6 a	102.1 b	2191 a	28.2 a
S.E.M.	1.24	0.04	2.08	0.48	115.6	0.13
Pr > F (p-value)	0.558	0.012	0.163	0.005	0.858	<0.001

9. Economic and Practical Implications for Growers

Detailed economic analyses are beyond the scope of this project since marginal profits could vary widely with the assumptions used for field pea and faba bean prices, seed treatment product prices, seeding rates (due to the implications for seed treatment costs), and N fertilizer. Each of these can vary dramatically depending on broader market conditions and political considerations, field pea and faba bean market class, and overall grain quality.

Overall, seeding date effects on pea leaf weevil (PLW) feeding were inconsistent, with instances of higher damage when seeding was delayed in several cases and some where the opposite occurred. Delayed seeding resulted in substantial yield losses in 5 of 7 possible cases and, as such, should be avoided as much as possible.

While measurable or statistically significant benefits did not always occur, seed treatments were generally quite effective for reducing PLW feeding and, in many cases, improving yields when the insect was present. For field peas, seed-applied insecticide significantly improved yields at Scott and there was a relative strong trend for such at Yorkton. For faba beans, seed-applied insecticide improved yields at Indian Head and Scott, but had inconsistent effects at Melfort.

Nitrogen fertility effects were inconsistent. At Indian Head in 2024, we saw yield and protein improvement with extra N for both crops. The N effect on yield was especially strong for field peas at this site; however, with such low PLW pressure it was difficult to attribute this benefit to larval feeding on root nodules and we can only speculate as to why it may have occurred. The main effect of N on yield was not significant at any other locations and we had one case where, depending on seeding date, extra N reduced yield. Although extra N frequently improved grain protein, this benefit would not economically justify such high N rates in pulse crops where farmers are unlikely to receive a direct price premium for protein. Furthermore, the greatest public good and environmental advantages to field peas and faba beans in rotation are due to these crops being capable of fixing most of their N requirements from the atmosphere under most conditions.

10. Conclusions & Recommendations (how do results relate to objectives or original research that project is based on; is there a need to refine current recommendation based on the results from this project?)

Our preliminary results are broadly consistent with past research in that the most reliable method for reducing the impact of pea leaf weevil (PLW) feeding on the yield of susceptible pulse crops (field pea and faba bean) was a seed-applied insecticide. Delaying seeding increased PLW feeding at least as often as it decreased it and, in many cases, came with a substantial yield penalty. Extra nitrogen (N) fertilizer substantially increased yields at Indian Head, especially with field pea; however, with relatively low pressure, we cannot correlate this response specifically to PLW feeding with any confidence.

At this stage, field pea and faba bean growers who are concerned about PLW are strongly recommended to plan on using a registered, seed-applied insecticide to reduce the potential impacts of this pest. Seeding early will generally produce the healthiest, highest yielding crop across a broad range of conditions and based on these preliminary results, is at least as likely to reduce PLW pressure as it is to increase it. In theory, extra N fertilizer should buffer against reduced N fixation due to PLW feeding on root nodules; however, the actual benefits realized were inconsistent and difficult to predict. Furthermore, high rates of N fertilizer will substantially increase production costs of field peas and faba beans while also reducing the rotational and environmental benefits that these crops are often praised for. Foliar spraying, while beyond the scope of this project, is not always effective but is an option to consider for farmers who observe heavy feeding, if they are able to spray while the adults are still actively feeding and have not finished laying eggs. Crop rotations alone may not be especially effective, but feeding pressure may be highest along field boundaries or in fields near previous year host crops; therefore, these are good areas to focus on for early spring scouting.

These conclusions and recommendations will be updated upon the conclusion of the project.

11. Future Research (did the project identify a need for future research or further work)

These results are still preliminary and, as such, so are any recommendations for future research.

We observed preferential feeding in faba beans relative to field peas. This raises questions regarding thresholds specific to this crop and whether the pea leaf weevil (PLW) maps generated exclusively from field pea surveys will accurately predict the pressure that faba bean growers may face, or even regional pressure where both crops are grown in proximity to one another.

Our results from Indian Head (2024) raise questions regarding the potential ability of N fertilizer to improve the ability of field peas to tolerate wet, clay soils where root health and, potentially, N fixation, has been negatively impacted. While we will not make blanket recommendations to apply N to field peas, this concept may be worth investigating, particularly where growers have struggled with root health in the past and are questioning the viability of this crop on their farms. While past work has looked at lower rates of starter N (i.e., ~55 kg N/ha), the rate used in the current project was closer to what might be applied in cereal crops. Unfortunately, results might be very specific to the environmental conditions encountered at Indian Head 2024 which creates challenges for researching the matter; however, the observed benefits were undeniable.

Finally, this project utilized a single insecticide product (Imidacloprid, Group 4) for managing PLW in susceptible crops; however, other registered options also exist (i.e., Chlorantraniliprole, Group 28; Thiamethoxam, Group 4) and farmers may have questions about their relative efficacy.

12. Technology Transfer Activities (include presentations, extension material, field days, articles published, etc.)

At Indian Head in 2024 the trials were shown during the Crop Management Field Day (July 16, 145 participants) and a National Circle for Indigenous Agriculture and Food (August 7, 40 participants). Chris Holzapfel presented preliminary results from Indian Head 2024 during the IHARF Soil & Crop Management Meeting in Melfort (Feb. 5, 2025; 97 participants). At Melfort, the trial was not a formal stop during the field day; however, sponsor and treatments signs were in place and the plots were shown in passing (July 18, 100 participants). At Yorkton, the trial was shown during the annual field day (July 23, 100 participants). Additionally, Mike Hall prepared a YouTube video summarizing the 2024 results for field pea (https://www.youtube.com/watch?v=qTa5bjB4Cgo). No tech transfer was conducted at Scott in 2024.

13. Funding Contributions (acknowledge partners and contributors to the project)

Financial support for this demonstration was provided by the Saskatchewan Pulse Crop Development Board (SaskPulse). Signs were in-place for any plot tours to acknowledge the funding sources and appropriate acknowledgements will be made in all written communications, oral presentations, or other printed materials pertaining to the project. We would like to acknowledge the Boards of Directors for the participating organizations in addition to the many technical and support staff who worked on the project. Bayer CropScience provided the seed treatment products used in the field trials as an in-kind contribution and several of the other inputs and crop protection products utilized were also donated. IHARF, NARF, and WARC have strong working relationships and memorandum of understanding with Agriculture and Agri-Food Canada and all participating organizations have received funding for infrastructure and basic operating expenses from the Saskatchewan Ministry of Agriculture and several other producer/commodity groups, all of which has helped to make work like this possible.

14. Appendices (detailed data tables, maps, photos, etc.)

Table 9. Selected agronomic information and dates of operations from pea leaf weevil (PLW) management demonstrations completed with field pea at Indian Head (IH), Melfort (ME), Scott (SC), and Yorkton (YK) in 2024 (24) and 2025 (25).

Site	Prev. Crop	Row Spacing	Inoculant	kg N-P_2O_5-K_2O-S/ha [Z]	Seeding Dates	Plant Counts	PLW Notch Counts	Harvest Dates
IH-24	Wheat	30 cm	3.1 kg/ha TagTeam P/L	8-40-0-0	May-6 (D1) May-24 (D2)	Jun-3 (D1) Jun-18 (D2)	Jun-3 (D1) Jun-18 (D2)	Aug-13 (D1) Aug-23 (D2)
IH-25	—	—	—	—	—	—	—	—
ME-24	Wheat	30 cm	4.3 kg/ha Cell Tech P/L	8-40-0-0	May-6 (D1) May-27 (D2)	Jun-12 (D1) Jun-21 (D2)	Jun-12 (D1) Jun-26 (D2)	Aug-20 (D1) Sep-11 (D2)
ME-25	—		—	—	—	—	—	—
SC-24	Wheat	25 cm	3.7 kg/ha Nodulator Duo P/L	8-40-0-0	May-5 (D1) May-22 (D2)	May-29 (D1) Jun-14 (D2)	May-29 (D1) Jun-14 (D2)	Aug-23 (all)
SC-25	—	—	—	—	—	—	—	—
YK-24	Canola	30 cm	2.5 kg/ha LALFIX Start	8-40-0-0	May-6 (D1) May-21 (D2)	May-28 (D1) Jun-14 (D2)	May-28 (D1) Jun-14 (D2)	Aug-19 (D1) Aug-23 (D2)
YK-25	—	—	—	—	—	—	—	—

[Z] Fertility for all treatments whereby 'Extra N' treatments had total N rates topped up to 110 kg N/ha (not including soil N)

Table 10. Selected agronomic information and dates of operations from pea leaf weevil (PLW) management demonstrations completed with field pea at Indian Head (IH), Melfort (ME), Scott (SC), and Yorkton (YK) in 2024 (24) and 2025 (25).

Site	Prev. Crop	Row Spacing	Inoculant	kg N-P_2O_5-K_2O-S/ha [Z]	Seeding Dates	Plant Counts	PLW Notch Counts	Harvest Dates
IH-24	Wheat	30 cm	3.1 kg/ha TagTeam BioniQ	8-40-0-0	May-6 (D1) May-24 (D2)	Jun-3 (D1) Jun-18 (D2)	Jun-3 (D1) Jun-18 (D2)	Sep-6 (D1) Sep-16 (D2)
IH-25	—	—	—	—	—	—	—	—
ME-24	Wheat	30 cm	3.0 kg/ha TagTeam BioniQ	8-40-0-0	May-8 (D1) May-27 (D2)	Jun-12 (D1) Jun-24 (D2)	Jun-18 (D1) Jun-26 (D2)	Sep-24 (all)
ME-25	—	—	—	—	—	—	—	—
SC-24	Wheat	25 cm	4.5 kg/ha TagTeam BioniQ	8-40-0-0	May-5, May-22	May-30, Jun-14	May-30, Jun-14	Aug-23 (all)
SC-25	—	—	—	—	—	—	—	—
YK-24	—	—	—	—	—	—	—	—
YK-25	—	—	—	—	—	—	—	—

[Z] Fertility for all treatments whereby 'Extra N' treatments had total N rates topped up to 110 kg N/ha (not including soil N)

Table 11. Selected soil test results for pea leaf weevil (PLW) management in field pea demonstration trials conducted at Indian Head (IH), Melfort (ME), Scott (SC), and Yorkton (YK) in 2024 (24) and 2025 (25). Unless otherwise indicated, all measurements are for the 0-15 cm soil profile.

Parameter	IH-24	IH-25	ME-24	ME-25	SC-24	SC-25	YK-24	YK-25
pH	7.5	—	6.2	—	6.5	—	6.8	—
Organic Matter (%)	5.6	—	8.5	—	4.0	—	5.3	—
CEC (meq)	43.8	—	35.4	—	14.6	—	22.6	—
NO_3-N (kg/ha) [Z]	27	—	24	—	32	—	71 [Y]	—
Olsen-P (ppm)	12	—	18	—	16	—	15	—
K (ppm)	628	—	562	—	219	—	370	—
kg S/ha (kg/ha) [Z]	43	—	63	—	139	—	69	—

[Z] Values for residual NO_3-N and S are for the 0-60 cm soil profile
[Y] Values estimated from a 30 cm soil sample by multiplying values by 1.5

Table 12. Selected soil test results for pea leaf weevil (PLW) management in faba bean demonstration trials conducted at Indian Head (IH), Melfort (ME), Scott (SC), and Yorkton (YK) in 2024 (24) and 2025 (25). Unless otherwise indicated, all measurements are for the 0-15 cm soil profile.

Parameter	IH-24	IH-25	ME-24	ME-25	SC-24	SC-25	YK-24	YK-25
pH	7.5	—	5.9	—	6.5	—	—	—
Organic Matter (%)	5.9	—	11.7	—	4.0	—	—	—
CEC (meq)	51.1	—	35.4	—	14.6	—	—	—
NO_3-N (kg/ha) [Z]	31	—	54	—	32	—	—	—
Olsen-P (ppm)	10	—	15	—	16	—	—	—
K (ppm)	721	—	437	—	219	—	—	—
kg S/ha (kg/ha) [Z]	31	—	60	—	139	—	—	—

[Z] Values for residual NO_3-N and S are for the 0-60 cm soil profile
[Y] Values estimated from a 30 cm soil sample by multiplying values by 1.5

Table 13. Mean monthly temperatures along with long-term (1981-2010) averages for the 2024 and 2025 growing seasons at Indian Head, Melfort, Scott, and Yorkton, Saskatchewan.

Location	Year	May	Jun	Jul	Aug	Avg.
		------ Mean Temperature (°C) ------				
Indian Head	2024	10.6	13.6	19.5	17.9	15.4 (-0.2)
	2025	—	—	—	—	—
	Long-term	10.8	15.8	18.2	17.4	15.6
Melfort	2024	10.1	13.2	19.4	17.4	15.0 (-0.2)
	2025	—	—	—	—	—
	Long-term	10.7	15.9	17.5	16.8	15.2
Scott	2024	9.8	13.3	18.9	17.4	14.9 (+0.1)
	2025	—	—	—	—	—
	Long-term	10.8	14.8	17.3	16.3	14.8
Yorkton	2024	10.5	14.2	20.3	17.7	15.7 (+0.5)
	2025	—	—	—	—	—
	Long-term	10.4	15.5	17.9	17.1	15.2

Table 14. Total monthly precipitation amounts along with long-term (1981-2010) for the applicable growing seasons at Indian Head, Melfort, Outlook, Prince Albert, Swift Current, and Yorkton, Saskatchewan.

Location	Year	May	Jun	Jul	Aug	Total
		------ Precipitation (mm) ------				
Indian Head	2024	63.7	74.9	37.4	71.2	248 (102%)
	2025	—	—	—	—	—
	Long-term	51.7	77.4	63.8	51.2	244
Melfort	2024	73.0	84.0	36.1	16.9	210 (93%)
	2025	—	—	—	—	—
	Long-term	42.9	54.3	76.7	52.4	226
Scott	2024	74.2	112.0	26.7	42.8	256 (113%)
	2025	—	—	—	—	—
	Long-term	38.9	69.7	69.4	48.7	227
Yorkton	2024	56.0	120.4	22.9	42.3	242 (89%)
	2025	—	—	—	—	—
	Long-term	51.3	80.1	78.2	62.2	272

Table 15. Two-way interaction treatment means and tests of fixed effects for seeding date (D), seed-applied insecticide (I), and nitrogen fertility (N) effects on field pea response variables at Indian Head 2024.

2-Way Interaction	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
D x I	-- plants/m² --	---- #/plant ----	--- % plants ---	----- days -----	----- kg/ha -----	------- % -------
Early - Untreated	84.3	0.0	1.6	89.8	3661	21.4
Early - Treated	84.7	0.0	1.3	89.4	3660	21.4
Delay - Untreated	105.8	0.0	0.0	83.2	3713	20.9
Delay - Treated	108.9	0.0	0.0	83.6	3668	20.4
S.E.M.	3.25	0.01	0.58	0.25	73.8	0.29
Pr > F (p-value)	0.672	0.556	0.764	0.065	0.685	0.157
D x N						
Early - Standard	84.1	0.0	1.6	88.9	3243	20.6 b
Early - Extra N	84.9	0.0	1.3	90.4	4078	22.2 a
Delay - Standard	109.7	0.0	0.0	82.7	3173	19.5 c
Delay - Extra N	105.0	0.0	0.0	84.1	4207	21.9 a
S.E.M.	3.25	0.01	0.58	0.25	73.8	0.29
Pr > F (p-value)	0.376	0.556	0.764	0.747	0.077	0.035
I x N						
Untr - Standard	97.0	0.0	0.6	85.8	3242	20.1
Untr - Extra N	93.1	0.0	0.9	87.2	4131	22.2
Trt - Standard	96.8	0.0	0.9	85.8	3175	20.0
Trt - Extra N	96.8	0.0	0.4	87.3	4153	21.8
S.E.M.	3.25	0.01	0.55	0.22	68.7	0.25
Pr > F (p-value)	0.533	0.556	0.373	0.747	0.413	0.396

Table 16. Three-way interaction treatment means and tests of fixed effects for seeding date, seed-applied insecticide, and nitrogen fertility effects on field pea response variables at Indian Head 2024.

3-Way Interaction	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
D x I x N	-- plants/m² --	--- #/plant ---	--- % plants ---	----- days -----	---- kg/ha ----	------- % -------
Early - Untr – Std	83.7	0.0	1.3	89.0	3217	20.6
Early - Untr – Ext N	84.9	0.0	1.9	90.6	4105	22.2
Early - Trt – Std	84.5	0.0	1.9	88.8	3270	20.7
Early - Trt – Ext N	84.9	0.0	0.6	90.1	4050	22.1
Delay - Untr – Std	110.3	0.0	0.0	82.6	3268	19.6
Delay - Untr – Ext N	101.3	0.0	0.0	83.8	4157	22.3
Delay - Trt – Std	109.1	0.0	0.0	82.8	3079	19.3
Delay - Trt – Ext N	108.7	0.0	0.0	84.4	4256	21.5
S.E.M.	4.45	0.02	0.78	0.31	90.9	0.35
Pr > F (p-value)	0.450	0.556	0.373	0.339	0.078	0.643

Table 17. Two-way interaction treatment means and tests of fixed effects for seeding date (D), seed-applied insecticide (I), and nitrogen fertility (N) effects on field pea response variables at Melfort 2024.

2-Way Interaction	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
D x I	-- plants/m² --	---- #/plant ----	--- % plants ---	----- days -----	----- kg/ha -----	------- % -------
Early - Untreated	76.7	0.0	0.9	90.1	5713	21.8
Early - Treated	72.4	0.0	0.3	90.0	5582	21.8
Delay - Untreated	69.9	0.0	0.3	87.6	4781	19.4
Delay - Treated	65.0	0.0	0.3	87.1	4849	19.1
S.E.M.	3.87	0.01	0.44	0.58	150.1	0.31
Pr > F (p-value)	0.935	0.331	0.489	0.521	0.356	0.514
D x N						
Early - Standard	80.0	0.0	0.6	89.6	5727	21.7 a
Early - Extra N	69.1	0.0	0.6	90.5	5568	22.0 a
Delay - Standard	74.7	0.0	0.0	86.5	4800	18.4 c
Delay - Extra N	60.3	0.0	0.0	88.3	4830	20.1 b
S.E.M.	3.87	0.01	0.44	0.58	150.1	0.31
Pr > F (p-value)	0.658	0.331	0.489	0.144	0.380	0.002
I x N						
Untr - Standard	79.4	0.0	0.6	87.9 c	5235	19.9
Untr - Extra N	67.3	0.0	0.6	89.9 a	5260	21.3
Trt - Standard	75.3	0.0	0.0	88.3 bc	5293	20.1
Trt - Extra N	62.1	0.0	0.6	88.9 b	5139	20.8
S.E.M.	3.87	0.01	0.44	0.54	129.6	0.26
Pr > F (p-value)	0.895	0.331	0.489	0.027	0.406	0.141

Table 18. Three-way interaction treatment means and tests of fixed effects for seeding date, seed-applied insecticide, and nitrogen fertility effects on field pea response variables at Melfort 2024.

3-Way Interaction	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
D x I x N	-- plants/m² --	--- #/plant ---	--- % plants ---	----- days -----	---- kg/ha ----	------- % -------
Early - Untr – Std	83.7	0.0	1.3	89.5	5848	21.8 a
Early - Untr – Ext N	69.7	0.0	0.6	90.8	5578	21.9 a
Early - Trt – Std	76.3	0.0	0.0	89.8	5606	21.6 ab
Early - Trt – Ext N	68.5	0.0	0.6	90.3	5558	22.1 a
Delay - Untr – Std	75.1	0.0	0.0	86.3	4621	18.1 d
Delay - Untr – Ext N	64.8	0.0	0.6	89.0	4941	20.7 b
Delay - Trt – Std	74.3	0.0	0.0	86.8	4979	18.7 d
Delay - Trt – Ext N	55.8	0.0	0.6	87.5	4719	19.6 c
S.E.M.	5.48	0.01	0.63	0.64	0.073	0.37
Pr > F (p-value)	0.364	0.331	0.489	0.073	183.3	0.016

Table 19. Two-way interaction treatment means and tests of fixed effects for seeding date (D), seed-applied insecticide (I), and nitrogen fertility (N) effects on field pea response variables at Scott 2024.

2-Way Interaction	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
D x I	-- plants/m^2 --	---- #/plant ----	--- % plants ---	----- days -----	----- kg/ha -----	------- % -------
Early - Untreated	65.8	0.1	3.1	89.3	4991	20.1
Early - Treated	58.6	0.0	0.9	90.6	5148	19.9
Delay - Untreated	58.8	0.1	7.5	81.9	3917	19.1
Delay - Treated	63.1	0.1	4.4	83.0	4413	19.0
S.E.M.	3.47	0.02	1.49	0.44	98.3	0.33
Pr > F (p-value)	0.055	0.494	0.720	0.782	0.102	0.713
D x N						
Early - Standard	68.1 a	0.0	1.9	89.5	5096	19.9
Early - Extra N	56.4 b	0.1	2.2	90.4	5043	20.1
Delay - Standard	59.4 ab	0.1	6.9	82.5	4219	18.8
Delay - Extra N	62.5 ab	0.1	5.0	82.4	4110	19.3
S.E.M.	3.47	0.02	1.49	0.44	98.3	0.33
Pr > F (p-value)	0.017	0.179	0.407	0.276	0.780	0.276
I x N						
Untr - Standard	63.6 a	0.1	5.0	85.1	4510	19.4
Untr - Extra N	61.0 a	0.1	5.6	86.0	4398	19.7
Trt - Standard	63.9 a	0.1	3.8	86.9	4806	19.3
Trt - Extra N	57.8 a	0.0	1.6	86.8	4756	19.6
S.E.M.	3.35	0.02	1.49	0.44	98.3	0.33
Pr > F (p-value)	0.549	0.179	0.290	0.276	0.755	0.955

Table 20. Three-way interaction treatment means and tests of fixed effects for seeding date, seed-applied insecticide, and nitrogen fertility effects on field pea response variables at Scott 2024.

3-Way Interaction	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
D x I x N	-- plants/m^2 --	--- #/plant ---	--- % plants ---	----- days -----	---- kg/ha ----	------- % -------
Early - Untr – Std	69.9	0.0	2.5	88.8	5047	20.0
Early - Untr – Ext N	61.8	0.1	3.8	89.8	4935	20.1
Early - Trt – Std	66.2	0.0	1.3	90.3	5145	19.8
Early - Trt – Ext N	50.9	0.0	0.6	91.0	5152	20.0
Delay - Untr – Std	57.4	0.1	7.5	81.5	3972	18.8
Delay - Untr – Ext N	60.3	0.1	7.5	82.3	3861	19.3
Delay - Trt – Std	61.5	0.1	6.3	83.5	4466	18.8
Delay - Trt – Ext N	64.7	0.0	2.5	82.5	4360	19.2
S.E.M.	4.47	0.03	1.97	0.63	139.0	0.36
Pr > F (p-value)	0.518	1.000	0.720	0.410	0.775	0.838

Table 21. Two-way interaction treatment means and tests of fixed effects for seeding date (D), seed-applied insecticide (I), and nitrogen fertility (N) effects on field pea response variables at Yorkton 2024.

2-Way Interaction	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
D x I	-- plants/m² --	---- #/plant ----	--- % plants ---	----- days -----	----- kg/ha -----	------- % -------
Early - Untreated	90.2	0.2 c	11.3 c	92.2	4609	21.8
Early - Treated	80.4	0.1 c	2.8 c	92.1	4908	22.7
Delay - Untreated	97.6	2.8 a	90.3 a	85.8	3998	21.8
Delay - Treated	95.6	0.9 b	55.6 b	87.3	4122	21.5
S.E.M.	3.25	0.22	3.63	0.83	203.8	0.55
Pr > F (p-value)	0.247	<0.001	0.002	0.319	0.484	0.249
D x N						
Early - Standard	86.7	0.1	6.3	91.9	4630	21.3
Early - Extra N	83.9	0.1	7.8	92.4	4887	23.2
Delay - Standard	94.7	2.0	74.4	85.9	3961	21.3
Delay - Extra N	98.4	1.7	71.6	87.2	4159	22.1
S.E.M.	3.25	0.22	3.63	0.83	203.8	0.55
Pr > F (p-value)	0.329	0.551	0.554	0.632	0.812	0.281
I x N						
Untr - Standard	96.2	1.6	50.3	88.7	4210	21.0
Untr - Extra N	91.7	1.4	51.3	89.3	4396	22.6
Trt - Standard	85.3	0.5	30.3	89.0	4380	21.6
Trt - Extra N	90.7	0.5	28.1	90.3	4650	22.6
S.E.M.	3.25	0.22	3.63	0.79	183.0	0.55
Pr > F (p-value)	0.146	0.669	0.672	0.655	0.737	0.495

Table 22. Three-way interaction treatment means and tests of fixed effects for seeding date, seed-applied insecticide, and nitrogen fertility effects on field pea response variables at Yorkton 2024.

3-Way Interaction	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
D x I x N	-- plants/m² --	--- #/plant ---	--- % plants ---	----- days -----	---- kg/ha ----	------- % -------
Early - Untr – Std	92.3	0.2	10.6	91.9	4528	20.4
Early - Untr – Ext N	88.2	0.2	11.9	92.5	4690	23.2
Early - Trt – Std	81.2	0.0	1.9	91.8	4732	22.2
Early - Trt – Ext N	79.6	0.1	3.8	92.4	5085	23.1
Delay - Untr – Std	100.1	3.0	90.0	85.5	3893	21.6
Delay - Untr – Ext N	95.1	2.6	90.6	86.2	4103	22.1
Delay - Trt – Std	89.4	0.9	58.8	86.3	4029	21.1
Delay - Trt – Ext N	101.7	0.9	52.5	88.2	4215	22.0
S.E.M.	4.60	0.31	5.13	1.12	237.8	0.74
Pr > F (p-value)	0.272	0.754	0.612	0.667	0.669	0.253

Table 23. Two-way interaction treatment means and tests of fixed effects for seeding date (D), seed-applied insecticide (I), and nitrogen fertility (N) effects on faba bean response variables at Indian Head 2024.

2-Way Interaction	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
D x I	-- plants/m² --	---- #/plant ----	--- % plants ---	----- days -----	----- kg/ha -----	------- % -------
Early - Untreated	38.0	0.7	35.6	101.6	2124 b	27.5
Early - Treated	36.8	0.3	17.2	102.3	2347 a	26.8
Delay - Untreated	37.3	0.6	31.9	98.9	1491 c	28.3
Delay - Treated	38.4	0.4	21.9	98.9	2174 b	27.8
S.E.M.	1.14	0.07	3.07	0.29	104.4	0.27
Pr > F (p-value)	0.316	0.122	0.187	0.072	<0.001	0.756
D x N						
Early - Standard	37.2	0.5	26.6	102.3	2124	26.6 b
Early - Extra N	37.6	0.5	26.3	101.6	2347	27.7 a
Delay - Standard	37.6	0.5	27.5	99.3	1666	28.0 a
Delay - Extra N	38.1	0.4	26.3	98.5	1999	28.1 a
S.E.M.	1.14	0.07	3.07	0.29	104.4	0.27
Pr > F (p-value)	0.974	0.690	0.881	0.864	0.338	0.022
I x N						
Untr - Standard	37.1	0.7	34.7	100.6	1665	27.5
Untr - Extra N	38.2	0.6	32.8	99.9	1950	28.3
Trt - Standard	37.7	0.3	19.4	100.9	2125	27.1
Trt - Extra N	37.5	0.3	19.7	100.3	2396	27.5
S.E.M.	1.14	0.06	3.07	0.27	104.4	0.25
Pr > F (p-value)	0561	0.324	0.726	0.864	0.906	0.273

Table 24. Three-way interaction treatment means and tests of fixed effects for seeding date, seed-applied insecticide, and nitrogen fertility effects on faba bean response variables at Indian Head 2024.

3-Way Interaction	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
D x I x N	-- plants/m² --	--- #/plant ---	--- % plants ---	----- days -----	---- kg/ha ----	------- % -------
Early - Untr – Std	37.5	0.7	35.6	102.0	2028	26.9
Early - Untr – Ext N	38.6	0.7	35.6	101.3	2219	28.1
Early - Trt – Std	36.9	0.3	17.5	102.6	2221	26.4
Early - Trt – Ext N	36.7	0.3	16.9	102.0	2474	27.2
Delay - Untr – Std	36.7	0.7	33.8	99.3	1302	28.2
Delay - Untr – Ext N	37.9	0.5	30.0	98.5	1680	28.4
Delay - Trt – Std	38.6	0.4	21.3	99.3	2030	27.8
Delay - Trt – Ext N	38.3	0.4	22.5	98.5	2318	27.7
S.E.M.	1.61	0.09	4.35	0.34	118.7	0.33
Pr > F (p-value)	0.966	0.815	0.653	0.864	0.510	0.987

Table 25. Two-way interaction treatment means and tests of fixed effects for seeding date (D), seed-applied insecticide (I), and nitrogen fertility (N) effects on faba bean response variables at Melfort 2024.

2-Way Interaction	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
D x I	-- plants/m² --	---- #/plant ----	--- % plants ---	----- days -----	----- kg/ha -----	------- % -------
Early - Untreated	35.5	0.7	40.6	106.4	3843 ab	27.8
Early - Treated	27.7	0.6	39.4	105.9	3707 b	27.5
Delay - Untreated	32.2	0.2	10.6	102.0	3874 ab	28.2
Delay - Treated	28.7	0.3	18.8	102.0	4145 a	27.8
S.E.M.	2.25	0.05	3.01	0.37	126.6	0.23
Pr > F (p-value)	0.321	0.116	0.129	0.482	0.047	0.592
D x N						
Early - Standard	31.8	0.8 a	44.4	106.8 a	3977 a	27.7
Early - Extra N	31.4	0.5 b	35.6	105.5 b	3573 b	27.6
Delay - Standard	28.5	0.2 c	13.4	101.8 c	3994 a	27.9
Delay - Extra N	32.4	0.2 c	15.9	102.3 c	4025 a	28.1
S.E.M.	2.25	0.05	3.01	0.37	126.6	0.23
Pr > F (p-value)	0.321	0.013	0.072	0.022	0.035	0.497
I x N						
Untr - Standard	33.4	0.5	30.6 a	104.5	3954	28.1
Untr - Extra N	34.2	0.3	20.6 b	103.9	3763	27.9
Trt - Standard	26.9	0.5	27.2 ab	104.0	4017	27.5
Trt - Extra N	29.5	0.4	30.9 a	103.9	3835	27.8
S.E.M.	2.25	0.05	2.98	0.37	121.0	0.20
Pr > F (p-value)	0.668	0.070	0.031	0.482	0.958	0.136

Table 26. Three-way interaction treatment means and tests of fixed effects for seeding date, seed-applied insecticide, and nitrogen fertility effects on faba bean response variables at Melfort 2024.

3-Way Interaction	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
D x I x N	-- plants/m² --	--- #/plant ---	--- % plants ---	----- days -----	---- kg/ha ----	------- % -------
Early - Untr – Std	36.5	0.8	48.1	107.0	4049	28.1
Early - Untr – Ext N	34.4	0.5	33.1	105.8	3638	27.5
Early - Trt – Std	27.1	0.7	40.6	106.5	3906	27.3
Early - Trt – Ext N	28.3	0.6	38.1	105.3	3509	27.8
Delay - Untr – Std	30.3	0.2	13.1	102.0	3860	28.1
Delay - Untr – Ext N	34.0	0.1	8.1	102.0	3887	28.3
Delay - Trt – Std	26.7	0.2	13.8	101.5	4127	27.8
Delay - Trt – Ext N	30.8	0.3	23.8	102.5	4162	27.9
S.E.M.	3.09	0.06	4.21	0.51	158.5	0.27
Pr > F (p-value)	0.736	0.588	0.934	0.482	0.988	0.078

Table 27. Two-way interaction treatment means and tests of fixed effects for seeding date (D), seed-applied insecticide (I), and nitrogen fertility (N) effects on faba bean response variables at Scott 2024.

2-Way Interaction	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
D x I	-- plants/m² --	---- #/plant ----	--- % plants ---	----- days -----	----- kg/ha -----	------- % -------
Early - Untreated	31.8	0.3	19.7	106.8	2735	27.0 c
Early - Treated	32.6	0.2	16.6	106.8	2911	27.1 c
Delay - Untreated	34.5	0.5	24.4	98.3	1440	28.9 a
Delay - Treated	36.0	0.4	21.6	98.5	1707	28.1 b
S.E.M.	1.70	0.06	2.82	0.68	135.7	0.18
Pr > F (p-value)	0.825	0.741	0.954	0.691	0.586	0.011
D x N						
Early - Standard	31.6	0.3	17.5	107.3	2847	26.6
Early - Extra N	32.7	0.2	18.8	106.3	2799	27.4
Delay - Standard	34.8	0.5	27.5	98.9	1564	28.0
Delay - Extra N	35.7	0.3	18.4	97.9	1582	29.0
S.E.M.	1.70	0.06	2.82	0.68	135.7	0.18
Pr > F (p-value)	0.943	0.110	0.071	1.000	0.690	0.480
I x N						
Untr - Standard	32.1	0.5	24.4	107.3	2075	27.5
Untr - Extra N	34.1	0.3	19.7	106.3	2100	28.4
Trt - Standard	34.3	0.3	20.6	98.9	2336	27.1
Trt - Extra N	34.3	0.3	17.5	97.9	2282	28.0
S.E.M.	1.70	0.06	24.4	0.68	129.1	0.18
Pr > F (p-value)	0.553	0.163	0.775	0.429	0.632	0.873

Table 28. Three-way interaction treatment means and tests of fixed effects for seeding date, seed-applied insecticide, and nitrogen fertility effects on faba bean response variables at Scott 2024.

3-Way Interaction	Plant Density	Leaf Notch Numbers	Leaf Notch Incidence	Maturity	Seed Yield	Seed Protein
D x I x N	-- plants/m² --	--- #/plant ---	--- % plants ---	----- days -----	---- kg/ha ----	------- % -------
Early - Untr – Std	30.3	0.4	20.6	107.5	2720	26.5
Early - Untr – Ext N	33.2	0.2	18.8	106.0	2749	27.4
Early - Trt – Std	33.0	0.2	14.4	107.0	2974	26.7
Early - Trt – Ext N	32.2	0.3	18.8	106.5	2849	27.4
Delay - Untr – Std	34.0	0.6	28.1	98.8	1430	28.4
Delay - Untr – Ext N	35.0	0.3	20.6	97.8	1450	29.5
Delay - Trt – Std	35.7	0.5	26.9	99.0	1699	27.5
Delay - Trt – Ext N	36.4	0.3	16.3	98.0	1715	28.6
S.E.M.	2.36	0.08	3.89	0.75	158.3	0.25
Pr > F (p-value)	0.609	0.912	0.394	0.429	0.654	0.607