OREGON PROCESSED VEGETABLE COMMISSION

RESEARCH REPORTS
2024-2025

Research/Extension Progress Report for 2024-2025 Funded Projects
Progress Report for the Agricultural Research Foundation
Oregon Processed Vegetable Commission

Title: Precision Ag Tools: Seeding, Weeding, and Application Systems Demonstration and Evaluation

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Cooperator(s): FarmDoid, LLC has loaned the equipment for the trial.

Funding History: 2024-2025 funding $16,500

Abstract: The reliance on labor-intensive and costly hand weeding persists due to constraints in herbicide options (lack of labeled products, export restrictions, etc.). Labor costs continue to increase along with overtime costs for farm workers. To overcome these limitations and enhance yields while minimizing management expenses, there is a pressing need for innovative technologies. The primary objective of this project is to evaluate one method of advanced technology weed control using a precision seeding and weeding machine developed by FarmDroid. FarmDroid is a company based in Denmark that developed robot precision seeding (RTK) and weeding system (https://farmdroid.com). In 2024, we gained familiarity with the equipment and software, tested seeding and weeding techniques and demonstrated the technology to over 100 growers. Additionally, this first trial year was a key catalyst in a successful Specialty Crop Block Grant submission to evaluate new technology to reduce pesticide use on farms from 2024-2027.

Key Words: mechanical weeding, precision seeding, autonomous, robot, weed control

Objectives: Our hypothesis is that the Farm droid system will provide weed control comparable to a grower standard weed management system with the additional bonus of reduced labor inputs. To test this hypothesis, we have developed the following objectives:

> **Objective 1:** Test efficacy of robot seeding and weeding for reducing weed pressure and labor inputs.
>
> **Objective 2:** Demonstrate robot precision seeding and weeding as well as advanced drone systems (spray and monitoring systems) to stakeholders.

Procedures:

Two technicians traveled to Denmark to learn the Farm Dorid system in spring 2024. Following training, the FarmDroid system was shipped to Oregon in late May 2024. Field operations were accomplished at OSU's NWREC and Hyslop Farm. Fields at NWREC were planted with beets and turnip crops, while fields at Hyslop were planted with turnip and clover.

Field prep consisted of discing and power harrow passes to establish a seedbed. Fields were pre-irrigated (or received rain) to force a flush of weeds that was then power-harrowed again to kill weeds before planting. Crops were planted with a row spacing of 38 cm with plants spaced every 14 cm within the row. Irrigation was applied for emergence and growth through August. No hand weeding or herbicide application was accomplished in any plot. Standard field spacing will often have double rows, however FarmDroid weeding operations are limited with this configuration. After discussion with commercial growers, we decided to plant single rows which reduced plant populations. The rationale was if the labor input cost is reduced with an autonomous system, then it would be acceptable to have lower yields.

Field days were advertised through grower groups, email lists, and most impactfully, through word of mouth from collaborating growers and researchers.

Accomplishments:

Objective 1: Test efficacy of robot seeding and weeding for reducing weed pressure and labor inputs.

Figure 1. Farm crew (Marc Anderson, left; Joe Battilega, right) at NWREC programming the FarmDroid for seeding operations.

We planned to plant replicated trials of beets (at NWREC) and turnip (Hyslop) in 2024. Our first planting of beets at NWREC suffered poor stand establishment due to seeding errors as a result of incorrect seed discs and seeding depth. After a few weeks of working closely with the FarmDroid company, correct discs were available for both beets and turnips for subsequent trials. This learning period greatly slowed the progress of the trials in 2024 and resulted in no replicated trials at NWREC. See Objective two for further details on field accomplishments at NWREC. As one measure of labor inputs, a grower-cooperator accomplished all seeding and weeding operations with a single person operating the FarmDroid system on a ½ acre organically managed field. The field required no hand labor and was harvested successfully. Trials such as this will be accomplished with replications suitable for statistical analysis in the next 2 years under the newly awarded Specialty Crop Block Grant.

At Hyslop Farm, the FarmDroid was used to plant a fall seeding of turnip for seed and clover for seed. The equipment is still in place and will be used to attempt weeding under fall conditions. We intend to collect data around weed densities in each treatment and can share results when completed.

Objective 2: Demonstrate robot precision seeding and weeding as well as advanced drone systems (spray and monitoring systems) to stakeholders.

While we were hampered on completing the objectives within our projected timeline due to becoming familiar with the equipment, we did find success by the end of the summer in seeding and weeding operations. At NWREC, we partnered with a local grower on 3 plantings at a commercial scale. Those three fields were used as weeding demonstrations in outreach events.

We hosted two field days at NWREC (June 17th and August 21st) and hosted media to FarmDroid at Hyslop Farm in November.

On the June 17th Field Day, topics included smart spray technology integrated with drone detection, and FarmDroid seeding operations. We hosted around 60 growers, industry representatives, and researchers. Additional field visits to demonstrate drone systems is planned over the winter and will be a critical part of field days next year as well.

Figure 2. Field day at NWREC in June 2024 demonstrating FarmDroid seeding operations (left) and weeding in August 2024 (right).

<u>Impacts:</u>

By the end of August 2024, we were able to partner successfully with a local farm to trial production at field scale with the FarmDroid. The grower learned and operated equipment in a manner suitable to his production system such that the field was harvestable without any hand weeding crews in an organic production field. This cooperation and example can be a great starting point for others to learn and trial new technologies as well. Based on this example, building partnerships across multiple farms coupled with field days could be very effective.

In future years of research, we plan to have more robust numbers on labor inputs and what impact plant population accommodations have on overall yield and profit for farms.

We were able to reach many others through online videos at You Tube @BeaverFarmTech-fz9xx (11,400 views), presentations (3 events with 180 attendees), and press releases. Experiences have been presented at multiple grower meetings in the Willamette Valley and Eastern Oregon to farmers, industry members, and other researchers including the PNVA Conference, upcoming issue of Onion World, and OSU Extension announcements. We think that hands-on experience with emerging technology is valuable, especially when it is deployed in local cropping systems. We intend to continue the outreach with even more information sharing next season.

Relation to Other Research:

This first year of work and collaboration resulted in the successful funding of a USDA Oregon Department of Agriculture Specialty Crop Block Grant for 2024-2027. The goals of the block grant include:

> Objective 1: Evaluate efficacy of robot weeding systems and aerial applied fungicide as compared with grower standards. Conduct a multi-site, multi-year evaluation of the technology for cost savings in herbicide, efficacy of fungicide based on application type and timing, total yields compared to grower standards.
>
> Objective 2: Teach and demonstrate enhanced pest control systems to Oregon specialty crop growers. Conduct a systematic evaluation of new technology and the potential adoption for improved pest management for Oregon fresh vegetable and vegetable seed producers that include a fully autonomous planting and weeding robot, fungicide applications with a drone, and crop biomass and health indication with drone imagery.

The project started in 2024 with OPVC and Specialty Seed Growers of Western Oregon will continue seamlessly with the new grant. We look forward to bringing the results of this work back to the OPVC throughout the next few years.

Research/Extension Progress Report for 2024-2025 Funded Projects
Progress Report for the Agricultural Research Foundation Oregon Processed Vegetable Commission

Title: Nitrogen fertility requirements of new sweet corn hybrids

Project Leader(s): Identify project leader(s) and their location(s).

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Cooperator(s): N/A

Funding History: $14,928 (2nd year)

Abstract: Cost of inputs for sweet corn production have risen dramatically in recent years, making the crop unattractive to growers for production and processing. One input for which prices have been especially high is nitrogen fertilizer. If nitrogen use could be reduced without loss of yield, then sweet corn contracts for processing would be more competitive with other crop options. Newer hybrids currently in use by processors have not been evaluated for nitrogen use efficiency. We conducted the second year of a trial of contemporary hybrids using different nitrogen fertilizer sidedress treatments to determine if existing recommendations still apply or if these might be adjusted to increase profitability for growers. The objective of this research was to evaluate nitrogen sidedress requirements for supersweet corn hybrids currently used in processing in the Willamette Valley and Columbia Basin. A yield and quality trial was established at the OSU Vegetable Research Farm in 2024 with six hybrids grown at five levels (0, 50, 100, 150 and 200 lb/A) of sidedressed nitrogen. A preplant soil test revealed that residual N was 28 lb/A (nitrate and ammonium N), and 40 lb/A N as 16-16-16 (applied at 250 lb/A) was banded in row prior to planting. At V4, sidedress N treatments were applied in the form of liquid N. Plant height was recorded at V6 stage and 50% silking date was used to estimate time of harvest, which was refined using moisture testing as harvest neared. Data was recorded on yield parameters, yield and some quality characteristics. Hybrids showed a linear to curvilinear response for net T/A yield to increasing levels of N. In 2024, overall N rates were higher than in 2023, and response to N by hybrids was not as strong. There was plateauing for several hybrids at 50 – 100 lb/A sidedress N, and in some cases, yields decreased at 200 lb/A. The data suggests that some hybrids could be grown at lower N rates of 100 lb/A whereas others were responsive to N and no threshold for maximum was identified even when rates were 200 lb/A. Type of response did not necessarily correlate with overall yield. While results are suggestive of trends, the study should be repeated to validate these results.

Key Words: Sweet corn, fertility trial, ammonium, nitrate, yield response

Objective: Determine nitrogen (N) requirements for new supersweet corn hybrids grown for processing.

Procedures:

The trial was conducted at the OSU Vegetable Research Farm. The field selected for this study had been fallowed during the summer of the previous year, with a cover crop of oats and clover planted in October, 2023 and mechanically terminated in April, 2024. A preplant soil test submitted on 10-June revealed that N levels were about 28 lb/A of nitrate and ammonium N combined remaining after winter rains (Table 1). Prior to planting, 40 lb/A N was banded in row using 16-16-16 (N-P-K) applied at the rate of 250 lb/A. The field was irrigated on a weekly basis with approximately an inch of water applied through solid-set sprinklers.

Sidedress fertilizer treatments were applied on 03-July at the V4 stage using urea ammonium nitrate solution UAN 32 (Simplot) between rows (Figure 1). Sidedress treatments consisted of 0, 50, 100, 150, 200 lb N/A applied to the field. The tractor moved at a constant speed through the field and adjustments in rate of flow were used to achieve the desired amount. Fertilizer was injected into the soil on both sides of the center data row. Seeds were treated with fungicide/insecticide mix as supplied by the seed company. Weeds were controlled through preemergent application of atrazine (1pt/acre), Outlook (18oz/acre), and Envy Six Max (1qt/acre).

Six supersweet corn hybrids representing those currently being grown in the Willamette Valley and Columbia Basin were planted 15-16-June. The hybrids included in the trial, their area of production and processing traits are shown in Table 2. 'Mint' grown in 2023, was not trialed in 2024 because the seed company had dropped this hybrid. Also, note that HMC302 trialed last year has been named 'Column' for this year's trial. These were seeded with a hand-propelled belt planter into 30-foot plots spaced at 30 inches between rows on 13-June. Initial population was about 80 seeds/plot, which was thinned to a seven inch within row spacing for a target population density of about 30,000 plants/A. Experiments were arranged as a split plot design with fertilizer treatments as whole strips through the field and hybrids as subplots within strips. Subplots consisted of three rows where the center row received the sidedress treatment and was harvested for yield and quality evaluation. The trial was replicated four times and had border rows top, bottom and sides in the field. The center 20 feet of each subplot was harvested by hand and brought to the grading room for husking and yield and quality measurements.

Data was collected plant height at V6 and on 50% silking date at approximately 60 days after planting. A 28 day interval from silking was used to predict harvest, with moisture testing used to determine actual harvest date (target of 75-77% for supersweet hybrids) (Table 3). Final moisture was not taken in 2024 on harvested ears, but estimated moisture at harvest was calculated based on a 0.5% drop per day in moisture content.

At harvest, total ear number and weight, net ear number and weight, and cull ear number and weight were recorded. Individual ear measurements included length and diameter, row number, tip fill, kernel depth, and weight per ear. A soil test of residual ammonium and nitrate N was obtained after harvest for each hybrid-treatment combination (combined across replicates) to determine if any plant-available N remained.

Accomplishments:

Trial in 2024

Hybrids showed a similar range in 50% silking date and maturities (Tables 3 and 4). Fertilizer treatment did not significantly affect growth rates as individual hybrids matured at a similar rate across treatments

(Table 4). Estimated moistures at harvest were generally within the desired range of 75 – 77% except for Column, whose estimated moisture was about 78% (Table 3). Total (unhusked) weight of sweet corn hybrids ranged from 14 to 18 T/A in 2024, but was reduced by 30 to 40% when husks and culls were removed (Table 4). Overall yields were higher than observed in 2023. Hybrids produced economic yields (net T/A) in the range of 8.8 to 11.8 T/A (Table 4). In terms of overall ranking, Driver had highest average yield across all treatment, followed by Column, 007R, Kopa, Coronado, and GSS1477.

Lowest yields were observed with the 0 lb/A N sidedress rate, and increased by 0.3 to 1.1 T/A for the higher fertilizer rates (Table 4, Figure 2). Yields were somewhat variable at increasing levels of N, and in some cases, showed a drop at the highest sidedress treatment. Kopa, Column and GSS1477 all showed a decrease in yield at 100 lb/A N relative to the other three hybrids. Kopa and GSS1477 had the highest cull percentages at this treatment, while Column showed very little variation in percent culls across fertility treatments. Driver, Kopa and Column exhibited highest yields at 150 lb/A N, and significantly lower yields at 200 lb/A. Those hybrids that showed more or less linear increases in N across treatments included GS1477, 007R and Coronado. The clearest differences in response were apparent for Total T/A, but the same relative differences were observed for Net ears T/A (Table 4, Figure 2). Weight (3.5 to 16%) and number (3.5 to 21%) of cull ears were relatively variable such that few statistically significant differences among hybrids were observed. There did not appear to be any association of culls with N treatment. Weight per ear varied among hybrids with Driver and Column producing the heaviest and GSS1477 the lightest ears (Table 5). Ear parameters also varied among hybrids, with heaviest ears having the greatest length, but not necessarily the greatest diameter, row number, and kernel depth (Table 5 and 6). Ear length, diameter and row number were positively correlated with net T/A. Only Total Husked T/A was weakly and positively correlated with sidedress N rates (Table 6).

Post-harvest plant-available residual N amounts were relatively low except for the 200 lb/A sidedress treatment, and isolated hybrid-treatment combinations (Table 7). These included GSS1477 with 100 lb/A and Kopa with the 50 lb/A N treatment. A corresponding dip in yield is apparent for the GSS1477 treatment but not for Kopa (Figure 2). Table 8 and Figure 3 show the total N provided to the plants over the season. With an occasional exception, hybrids showed the same uptake response across the varying amounts of N supplied. At the highest N treatment, several hybrids deviated from the linear response seen at other levels of N (Figure 3).

Trial summary over two years

In 2023, two linear patterns of response to N were observed with the various hybrids. Three (Coronado, Mint and Kopa) showed increases in yield up to the 100 lb/A N sidedress treatment, after which yields plateaued or even decreased at higher N treatments. The other four hybrids showed a continuous linear response across treatments, with highest yields achieved at highest rates of N. In 2024, overall N rates appeared to be higher which was associated with higher yields than in 2023 (Figure 4). In 2024, most hybrids plateaued at 50 or 100 lb/A sidedress N, the exception being 007R, which showed a continuous increase. The mean of two years was analyzed for the six hybrids common to both years (Tables 9 and 10, Figure 5). In general, the hybrids all showed continuous increase across sidedress N treatments, with only Kopa showing a drop-off in yield at 200 lb/A (Figure 5).Plateauing is apparent at the 100 lb/A treatment, with only minor increase at higher rates for Driver, Coronado and Kopa. As with the single year data, ear weight, length and number of rows is positively associated with yield, but not ear diameter, tip fill or kernel depth.

Impacts:

With a second year, these continue to support the hypothesis that some contemporary supersweet corn hybrids may produce optimum yields at lower sidedress N rates than others. Because of the variability of the trials, a third year of study in 2025 would help to verify these results.

Relation to Other Research:

Some of the same hybrids were included in our commercial supersweet corn yield and quality trial. This trial is supported entirely by fees from commercial companies and data are provided to companies and processors as well as conducting a sample display of frozen ears and kernels at the PNVA meetings held in Kennewick WA in November 2024. This report is available upon request.

Table 1. Preplant nutrient status of a field used for a supersweet sweet corn nitrogen fertility trial grown at the OSU Vegetable Research Farm in 2024.

	%			pH units		ppm (mg nutrient/kg soil)		
Lab ID	**C**	**N**	**OM**	**pH**	**BpH**	**PO_4-P**	**NO_3-N**	**NH_4-N**
1	1.18	0.10	2.36	6.62	6.76	103	13.3	0.77
	ppm (mg nutrient/kg soil)							
Lab ID	**Ca**	**Mg**	**K**	**B**	**Cu**	**Fe**	**Mn**	**Zn**
1	3,600	794	444	0.16	2.8	83	5.5	2.7

Table 2. Supersweet corn hybrids source and production information, grown in a sidedress N fertility trial at the OSU Vegetable Research Farm in 2024.

Hybrid	**Source**	**Kernel color**	**Area of production**
Driver	HM Clause	yellow	Willamette Valley
Kopa	HM Clause	yellow	Willamette Valley
Coronado	HM Clause	white	Columbia Basin
Column (HMC302)	HM Clause	yellow	Columbia Basin
GSS1477	Syngenta	yellow	Willamette Valley
007R	Syngenta	yellow	Willamette Valley

Table 3. Supersweet corn kernel moisture percentages at harvest of a nitrogen fertility trial grown at the OSU Vegetable Research Farm in 2024. Trial was planted 13-June.

	Test moistures				
Hybrid	Date	Percent	Day of Harvest	Days to Harvest	Est. moisture[z]
007R	9-Sep	74.70	10-Sep	89	74.20
Column	6-Sep	79.48	9-Sep	88	77.98
Coronado	9-Sep	75.50	10-Sep	89	75.00
Driver	9-Sep	77.72	13-Sep	92	75.72
GSS1477	9-Sep	76.90	11-Sep	90	75.90
Kopa	9-Sep	77.50	13-Sep	92	75.50

[z]Final moistures were not calculated in 2024. Estimated final moisture at harvest is based on 0.5% drop per day from initial moisture.

Table 4. Yield, yield components, days to silking, and maturity of supersweet corn hybrids grown in a fertility trial at the OSU Vegetable Research Farm in 2024.

Entry	Sidedress N)lb/A)	Days to 50% silking	Days to harvest	V6 plot height (cm)	Plants/A	Total T/A	Total husked T/A	Net ear T/A	Cull ear T/A	% culls (by wt)	Net ears/A	Cull ears/A	% cull (by Area)
007R	**0**	60	89	117	36,300	14.2	10.2	9.5	0.8	7.3	29,911	4,356	12.1
007R	**50**	59	89	108	33,977	14.5	10.3	9.7	0.6	6.1	30,782	3,194	9.0
007R	**100**	59	89	121	34,267	14.9	10.9	10.6	0.3	3.4	31,363	1,452	4.7
007R	**150**	59	89	104	37,452	16.5	11.9	10.6	1.1	9.2	32,525	6,970	16.7
007R	**200**	59	89	112	34,558	16.0	11.5	10.9	0.6	5.1	32,525	2,904	8.2
Column	**0**	57	88	115	35,138	16.2	11.5	11.0	0.5	4.0	33,106	2,614	6.9
Column	**50**	57	88	114	33,106	17.5	11.8	11.4	0.5	4.1	33,106	2,614	6.9
Column	**100**	57	88	113	35,138	16.3	11.2	10.7	0.4	3.9	32,525	2,614	7.1
Column	**150**	57	88	114	38,623	17.9	12.3	11.7	0.6	4.8	34,848	2,904	7.7
Column	**200**	57	88	112	37,752	17.7	11.9	11.2	0.7	6.3	34,848	3,194	8.5
Coronado	**0**	59	89	106	32,525	14.0	9.4	8.8	0.6	6.4	28,750	4,646	13.7
Coronado	**50**	60	89	102	38,623	15.1	10.6	10.1	0.5	4.5	33,106	3,485	8.6
Coronado	**100**	59	89	101	35,429	14.9	10.8	10.4	0.4	3.9	33,106	2,323	6.5
Coronado	**150**	59	89	99	33,396	14.6	10.4	10.1	0.2	2.2	32,525	1,162	3.5
Coronado	**200**	59	89	101	34,558	15.1	10.7	10.4	0.3	2.6	32,815	1,742	5.0
Driver	**0**	59	92	110	38,623	16.5	11.8	11.0	0.8	7.0	32,525	3,485	9.7
Driver	**50**	59	92	117	36,881	17.8	12.5	11.8	0.7	4.9	34,267	2,614	6.4
Driver	**100**	59	92	116	37,752	18.4	12.8	11.8	0.9	7.3	33,396	3,194	8.8
Driver	**150**	59	92	113	37,752	18.4	12.6	11.8	0.8	6.7	34,267	3,775	10.1
Driver	**200**	59	92	111	36,300	17.9	12.3	11.1	1.2	9.1	31,654	4,646	11.7
GSS1477	**0**	62	90	108	37,171	13.8	10.2	9.1	1.1	10.5	31,944	5,227	14.0
GSS1477	**50**	62	90	104	37,171	15.0	11.1	9.9	1.2	10.5	33,977	6,098	14.8
GSS1477	**100**	61	90	98	38,623	14.7	10.9	9.2	1.7	15.9	31,073	8,422	21.1
GSS1477	**150**	62	90	97	33,396	15.0	10.9	9.5	1.4	13.0	31,363	6,970	18.1
GSS1477	**200**	61	90	103	37,752	15.4	11.4	9.6	1.7	15.1	32,525	8,422	20.3
Kopa	**0**	62	92	113	36,300	16.6	10.6	9.5	1.1	10.9	29,911	4,937	14.8
Kopa	**50**	61	92	97	36,590	17.0	11.1	10.3	0.8	7.0	31,073	4,356	11.2
Kopa	**100**	62	92	109	38,333	17.1	11.2	9.7	1.5	13.7	30,782	6,970	18.7
Kopa	**150**	61	92	108	37,752	18.1	11.8	11.0	0.8	6.6	35,719	3,485	8.7
Kopa	**200**	62	92	102	35,719	16.7	11.0	9.9	1.1	9.6	30,782	4,937	12.7
LSD 0.05[z]		0	0	5	2,541	0.9	0.7	0.7	0.4	3.8	2,161	2,086	5.2

[z]If difference in a pair of means in a column is less than the LSD value, they are not significantly different at P ≤ 0.05 by Fisher's Least Significant Difference test.

Table 5. Ear characteristics of supersweet corn hybrids grown in a fertility trial at the OSU Vegetable Research Farm in 2024.

Hybrid	Sidedress N (lb/A)	Wt/ear (lb)	Ear length (in)	Ear diameter (in)	No rows	Tip fill[z]	Kernel depth (mm)
007R	**0**	0.63	8.1	2.0	19.0	6.3	13.0
007R	**50**	0.63	8.3	2.0	17.5	6.8	12.3
007R	**100**	0.67	8.2	2.1	19.0	7.5	13.0
007R	**150**	0.65	8.3	2.0	17.0	6.0	12.8
007R	**200**	0.67	8.2	2.1	18.5	6.8	12.8
Column	**0**	0.67	8.5	2.0	18.0	6.3	13.0
Column	**50**	0.69	8.9	2.0	17.5	6.3	12.5
Column	**100**	0.66	8.5	2.0	18.3	6.5	12.8
Column	**150**	0.67	8.6	2.1	18.0	6.3	12.8
Column	**200**	0.64	8.5	2.1	18.5	6.3	13.0
Coronado	**0**	0.62	7.6	2.0	17.5	9.0	12.5
Coronado	**50**	0.61	7.8	2.0	17.5	9.0	12.3
Coronado	**100**	0.63	7.9	2.1	18.3	9.0	12.8
Coronado	**150**	0.62	7.9	2.1	18.0	7.8	12.3
Coronado	**200**	0.64	7.8	2.0	19.3	9.0	12.3
Driver	**0**	0.67	8.9	2.0	18.5	6.5	12.0
Driver	**50**	0.69	8.7	2.0	19.0	5.5	12.0
Driver	**100**	0.71	8.8	2.0	19.0	6.5	12.5
Driver	**150**	0.69	8.8	2.0	18.5	6.5	12.0
Driver	**200**	0.71	8.7	2.0	18.5	6.0	12.5
GSS1477	**0**	0.57	7.9	1.9	17.0	3.5	12.8
GSS1477	**50**	0.59	7.9	1.9	17.5	3.8	13.0
GSS1477	**100**	0.59	7.9	1.9	16.5	4.0	12.8
GSS1477	**150**	0.61	7.9	1.9	16.0	4.3	13.0
GSS1477	**200**	0.59	8.0	1.9	16.0	3.5	12.5
Kopa	**0**	0.64	7.8	2.0	18.5	5.8	11.8
Kopa	**50**	0.66	7.9	2.2	17.5	5.3	12.0
Kopa	**100**	0.63	7.7	2.0	17.5	5.0	12.0
Kopa	**150**	0.62	7.7	2.0	17.5	5.5	11.8
Kopa	**200**	0.65	8.0	2.0	17.5	6.0	11.3
LSD 0.05[y]		0.02	0.1	0.0	0.9	0.6	0.5

[z]Scale of 1 – 9 where 9 is complete tip fill. [y]If difference in a pair of means in a column is less than the LSD value, they are not significantly different at P ≤ 0.05 by Fisher's Least Significant Difference test.

Table 6. Pearson multiple correlation of sidedress nitrogen treatments and various yield components, yield and quality traits of a supersweet corn trial conducted at the OSU Vegetable Research Farm in 2024. For each parameter, the first row contains the correlation coefficient (*r*) and the second row has the probability of obtaining a greater absolute value of *r* under the hypothesis of *r* = 0. The value of *r* may vary between -1 and +1. Probabilities ≤ 0.05 are highlighted.

	Days 50 % silking	Days to harvest	V6 plot ht cm	Plant pop/A	Total T/A	Total husked T/A	Net ear T/A	Cull ear T/A	% cull wt	Net ears/A	Cull ears/A	% cull/A	Wt ear	Ear ln	Ear dia	No rows	Tip fill	Kernel depth
Sidedress N	-0.07	0.00	-0.24	0.04	0.31	0.38	0.28	0.13	0.06	0.34	0.05	-0.01	0.12	0.01	0.09	-0.06	0.00	-0.05
	0.71	1.00	0.20	0.83	0.09	0.04	0.14	0.51	0.75	0.07	0.79	0.97	0.54	0.94	0.64	0.77	0.98	0.78
Days 50 % silking	1.00	0.64	-0.51	0.25	-0.24	-0.31	-0.62	0.69	0.74	-0.36	0.67	0.69	-0.57	-0.65	-0.54	-0.49	-0.52	-0.40
		0.00	0.00	0.18	0.21	0.09	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.03
Days to harvest		1.00	-0.05	0.40	0.43	0.31	0.08	0.46	0.41	-0.08	0.28	0.30	0.19	-0.01	-0.22	0.05	-0.33	-0.69
			0.80	0.03	0.02	0.09	0.68	0.01	0.02	0.69	0.13	0.11	0.32	0.97	0.24	0.79	0.07	0.00
V6 plot ht cm			1.00	0.05	0.39	0.39	0.51	-0.30	-0.32	0.17	-0.41	-0.38	0.59	0.62	0.14	0.62	0.07	0.16
				0.80	0.04	0.03	0.00	0.10	0.08	0.38	0.02	0.04	0.00	0.00	0.45	0.00	0.73	0.41
Plant pop/A				1.00	0.40	0.46	0.20	0.46	0.40	0.39	0.37	0.33	-0.05	0.13	-0.20	-0.05	-0.38	-0.15
					0.03	0.01	0.28	0.01	0.03	0.03	0.04	0.08	0.81	0.50	0.29	0.79	0.04	0.41
Total T/A					1.00	0.88	0.80	0.04	-0.08	0.54	-0.14	-0.18	0.70	0.58	0.25	0.29	-0.12	-0.36
						0.00	0.00	0.83	0.66	0.00	0.45	0.35	0.00	0.00	0.18	0.11	0.54	0.05
Total husked T/A						1.00	0.88	0.10	-0.04	0.68	-0.09	-0.15	0.68	0.73	0.10	0.24	-0.21	-0.08
							0.00	0.62	0.82	0.00	0.65	0.41	0.00	0.00	0.61	0.20	0.26	0.67
Net ear T/A							1.00	-0.39	-0.51	0.74	-0.54	-0.60	0.81	0.77	0.42	0.54	0.18	-0.05
								0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.35	0.78
Cull ear T/A								1.00	0.99	-0.23	0.95	0.94	-0.37	-0.21	-0.70	-0.63	-0.79	-0.05
									0.00	0.22	0.00	0.00	0.04	0.28	0.00	0.00	0.00	0.78
% cull wt									1.00	-0.32	0.96	0.96	-0.47	-0.30	-0.74	-0.65	-0.76	-0.04
										0.08	0.00	0.00	0.01	0.11	0.00	0.00	0.00	0.84
Net ears/A										1.00	-0.32	-0.41	0.21	0.39	0.09	0.16	-0.04	0.07
											0.08	0.02	0.27	0.03	0.64	0.39	0.84	0.71
Cull ears/A											1.00	0.99	-0.51	-0.34	-0.68	-0.74	-0.69	0.03
												0.00	0.00	0.07	0.00	0.00	0.00	0.86

	Days 50 % silking	Days to harvest	V6 plot ht cm	Plant pop/A	Total T/A	Total husked T/A	Net ear T/A	Cull ear T/A	% cull wt	Net ears/A	Cull ears/A	% cull/A	Wt ear	Ear ln	Ear dia	No rows	Tip fill	Kernel depth
% cull/A													-0.52	-0.37	-0.69	-0.70	-0.66	0.02
													0.00	0.05	0.00	0.00	0.00	0.92
Wt ear													1.00	0.77	0.55	0.64	0.29	-0.14
														0.00	0.00	0.00	0.12	0.45
Ear ln														1.00	0.18	0.41	0.00	0.11
															0.34	0.03	0.98	0.55
Ear dia															1.00	0.52	0.63	-0.11
																0.00	0.00	0.57
No rows																1.00	0.54	-0.06
																	0.00	0.74
Tip fill																	1.00	-0.07
																		0.70

Table 7. Residual nitrogen following a supersweet corn trial of six hybrids grown with five sidedress N treatments at the OSU Vegetable Research Farm in 2024.

		Lb/A sidedress N treatment				
Hybrid	**N test**	**0**	**50**	**100**	**150**	**200**
		lb/A				
0079R	NO3-N	2.6	3.8	17.0	10.2	9.2
0079R	NH4-N	0.5	0.6	3.1	0.7	0.9
Column	NO3-N	5.6	6.3	8.5	5.8	26.0
Column	NH4-N	0.5	0.4	0.6	0.4	1.0
Coronado	NO3-N	4.4	5.2	11.3	2.9	28.3
Coronado	NH4-N	0.7	0.8	0.6	0.4	2.2
Driver	NO3-N	4.1	5.0	4.1	7.8	24.6
Driver	NH4-N	1.0	0.8	0.4	0.6	25.7
GSS1477	NO3-N	8.0	8.7	29.9	5.8	20.2
GSS1477	NH4-N	0.3	0.6	5.4	3.5	2.1
Kopa	NO3-N	9.3	28.2	4.6	14.2	10.1
Kopa	NH4-N	0.6	2.7	0.5	1.2	0.5
Mean	NO3-N	5.7	9.5	12.6	7.8	19.7
Mean	NH4-N	0.6	1.0	1.8	1.1	5.4

Table 8. Total nitrogen of that supplied (preplant N + starter N + sidedress N - residual N) utilized by sweet corn hybrids in a sidedress N fertility trial conducted at the OSU Vegetable Research Farm in 2024.

	Nitrogen supplied (lb/A)				
	68	**118**	**168**	**218**	**268**
0079R	65	114	148	207	258
Column	62	111	159	212	241
Coronado	63	112	156	215	238
Driver	63	112	164	210	218
GSS1477	60	109	133	209	246
Kopa	58	87	163	203	258
Mean	51	108	154	209	243

Table 9. Mean of two years (2023 and 2024) of yield, yield components, days to silking, and maturity of supersweet corn hybrids grown in a fertility trial at the OSU Vegetable Research Farm.

Entry	Sidedress N)lb/A)	Days to 50% silking	Days to harvest	Total T/A	Total husked T/A	Net ear T/A	Cull ear T/A	% culls (by wt)	Net ears/A	Cull ears/A	% cull (by Area)
007R	**0**	60	89	12.5	8.8	8.2	0.6	6.1	25,555	3,049	9.6
007R	**50**	60	89	12.7	9.0	8.4	0.6	6.1	26,862	2,468	7.6
007R	**100**	60	89	12.9	9.3	8.9	0.4	4.8	26,572	2,033	7.0
007R	**150**	60	89	13.8	9.9	9.2	0.6	5.6	28,169	3,775	9.7
007R	**200**	59	89	14.1	10.1	9.6	0.5	4.4	29,040	1,597	4.7
Column	**0**	59	90	14.1	9.8	9.3	0.5	4.5	26,862	1,888	6.0
Column	**50**	59	90	15.2	10.3	9.8	0.5	5.2	27,443	2,323	7.6
Column	**100**	59	90	14.1	9.4	9.1	0.4	3.8	26,136	1,888	6.3
Column	**150**	59	90	15.7	10.7	10.1	0.6	5.5	28,750	2,614	7.9
Column	**200**	59	90	16.9	11.1	10.5	0.7	5.9	30,492	2,614	7.9
Coronado	**0**	60	90	12.4	8.2	7.8	0.4	4.7	24,684	2,904	9.0
Coronado	**50**	61	90	13.8	9.3	9.0	0.3	3.5	28,314	2,178	6.2
Coronado	**100**	61	90	15.0	10.4	9.6	0.8	7.6	30,056	3,920	11.6
Coronado	**150**	60	90	14.5	9.9	9.4	0.5	4.6	29,476	1,888	6.1
Coronado	**200**	60	90	15.2	10.2	9.7	0.6	5.3	29,476	2,759	8.3
Driver	**0**	61	92	14.5	10.1	9.2	0.9	8.7	26,136	3,630	12.3
Driver	**50**	61	92	15.4	10.6	10.0	0.6	5.9	27,878	2,468	8.0
Driver	**100**	61	92	15.9	10.9	10.3	0.6	5.3	28,024	2,178	6.8
Driver	**150**	61	92	15.7	10.8	10.3	0.4	3.8	28,459	2,033	5.7
Driver	**200**	61	92	17.2	11.7	10.6	1.1	8.5	29,330	4,646	12.2
GSS1477	**0**	62	91	12.6	9.0	8.1	0.8	9.3	27,298	3,775	12.0
GSS1477	**50**	62	91	13.4	9.2	8.5	0.7	6.6	27,152	3,485	9.4
GSS1477	**100**	62	91	13.1	9.3	8.0	1.2	12.2	25,991	5,808	15.9
GSS1477	**150**	62	91	13.5	9.6	8.3	1.3	13.3	26,281	5,953	18.1
GSS1477	**200**	62	91	14.5	10.4	9.0	1.4	12.9	28,750	6,244	17.0
Kopa	**0**	62	93	14.2	9.1	8.5	0.6	6.4	24,684	2,759	8.9
Kopa	**50**	62	93	14.7	9.5	9.1	0.4	3.5	25,846	2,178	5.6
Kopa	**100**	62	93	15.2	9.9	9.0	0.9	8.1	26,136	3,920	11.2
Kopa	**150**	62	93	15.6	10.0	9.5	0.5	4.8	28,024	2,178	6.4
Kopa	**200**	62	93	15.2	9.9	9.2	0.6	5.6	26,426	2,759	7.5
LSD 0.05		0	0	0.7	0.5	0.5	0.3	2.5	1,398	1,240	3.4

[z]If difference in a pair of means in a column is less than the LSD value, they are not significantly different at P ≤ 0.05 by Fisher's Least Significant Difference test.

Table 10. Mean over two years (2023 and 2024) for ear characteristics of supersweet corn hybrids grown in a fertility trial at the OSU Vegetable Research Farm in 2024.

Entry	Sidedress N)lb/A)	Wt/ear (lb)	Ear length (in)	Ear diameter (in)	No rows	Tip fill[z]	Kernel depth (mm)
007R	**0**	0.65	8.3	2.0	19.3	7.0	12.6
007R	**50**	0.63	8.5	2.0	18.0	7.4	12.0
007R	**100**	0.67	8.4	2.1	19.0	7.8	12.8
007R	**150**	0.65	8.4	2.0	18.3	7.1	12.6
007R	**200**	0.67	8.4	2.1	18.3	7.3	12.4
Column	**0**	0.70	8.9	2.1	18.0	7.0	13.1
Column	**50**	0.72	9.1	2.1	18.3	6.8	12.9
Column	**100**	0.70	8.8	2.1	18.6	7.1	13.3
Column	**150**	0.71	8.9	2.1	18.5	6.8	13.3
Column	**200**	0.70	8.9	2.1	18.5	6.9	13.1
Coronado	**0**	0.64	7.9	2.0	18.4	8.8	12.1
Coronado	**50**	0.64	7.9	2.1	18.3	8.3	11.8
Coronado	**100**	0.64	7.9	2.1	19.3	8.6	12.1
Coronado	**150**	0.64	7.9	2.1	18.6	7.9	11.9
Coronado	**200**	0.66	7.9	2.1	19.5	8.6	12.0
Driver	**0**	0.71	9.1	2.0	18.5	6.9	12.8
Driver	**50**	0.73	9.0	2.0	19.0	5.9	12.6
Driver	**100**	0.74	9.1	2.0	19.0	6.6	12.9
Driver	**150**	0.73	9.0	2.0	19.0	6.8	12.8
Driver	**200**	0.73	9.0	2.0	18.8	6.3	13.0
GSS1477	**0**	0.60	8.2	1.9	16.5	4.8	12.8
GSS1477	**50**	0.64	8.3	2.0	17.5	5.5	13.1
GSS1477	**100**	0.63	8.2	1.9	16.8	5.3	13.1
GSS1477	**150**	0.64	8.2	1.9	16.3	5.0	13.3
GSS1477	**200**	0.63	8.2	1.9	16.3	4.8	12.9
Kopa	**0**	0.70	8.4	2.0	17.8	6.4	12.8
Kopa	**50**	0.72	8.4	2.1	18.0	6.8	12.8
Kopa	**100**	0.71	8.3	2.0	18.0	6.4	12.8
Kopa	**150**	0.70	8.2	2.0	17.8	7.0	12.5
Kopa	**200**	0.71	8.3	2.1	17.5	6.4	12.4
LSD 0.05[y]		0.01	0.1	0.0	0.6	0.4	0.3

[z]Scale of 1 – 9 where 9 is complete tip fill. [y]If difference in a pair of means in a column is less than the LSD value, they are not significantly different at P ≤ 0.05 by Fisher's Least Significant Difference test.

Figure 1. Applying liquid N sidedress at V4 in a supersweet corn fertility trial grown at the OSU Vegetable Research Farm in 2024.

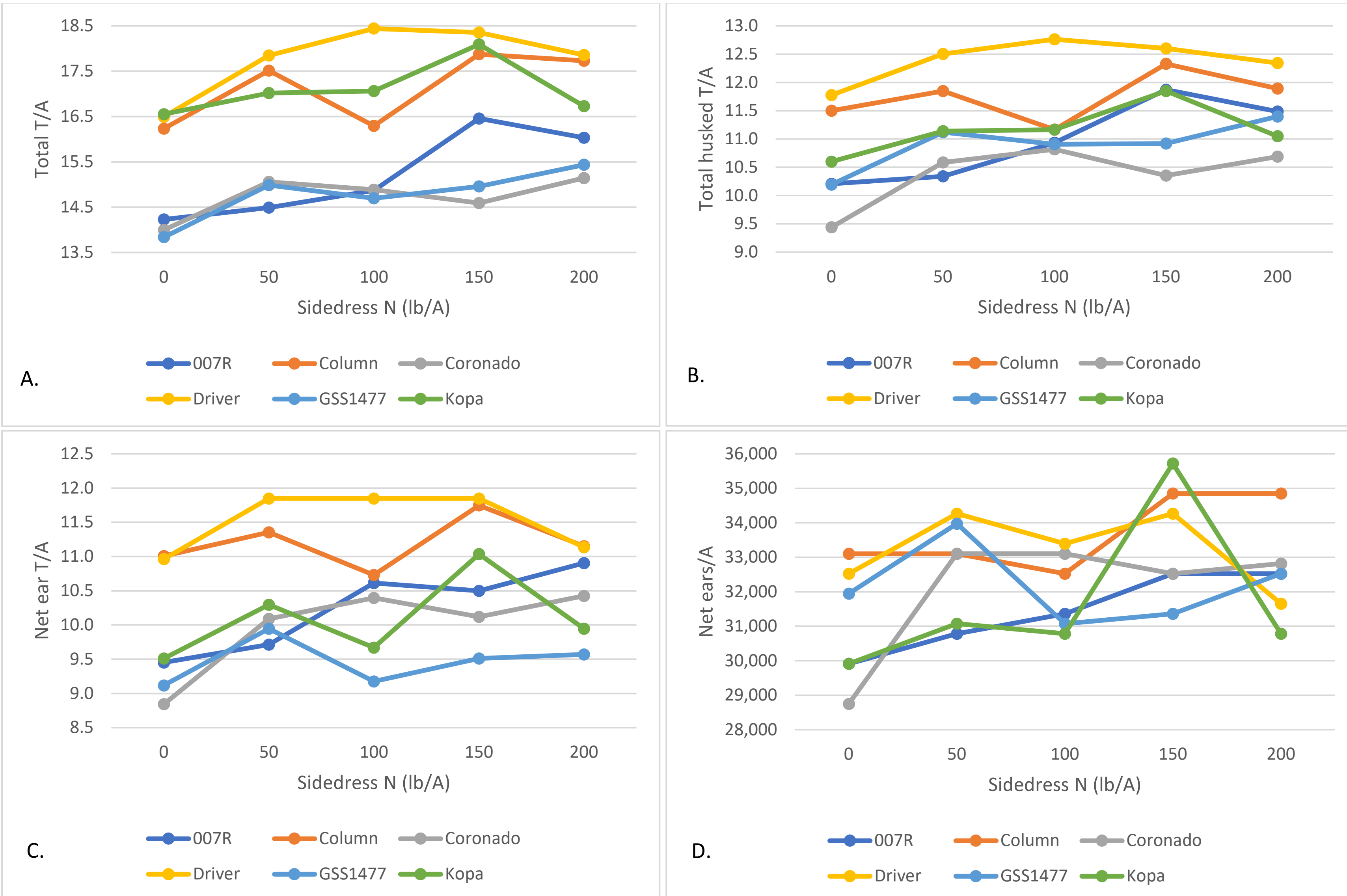


Figure 2. Yield response for six supersweet corn hybrids grown at five sidedress N levels at the OSU Vegetable Research Farm in 2024. A. Total T/A yield (husk + ear weight), B. Husked T/A, C. Net T/A and D. Net ears/A.

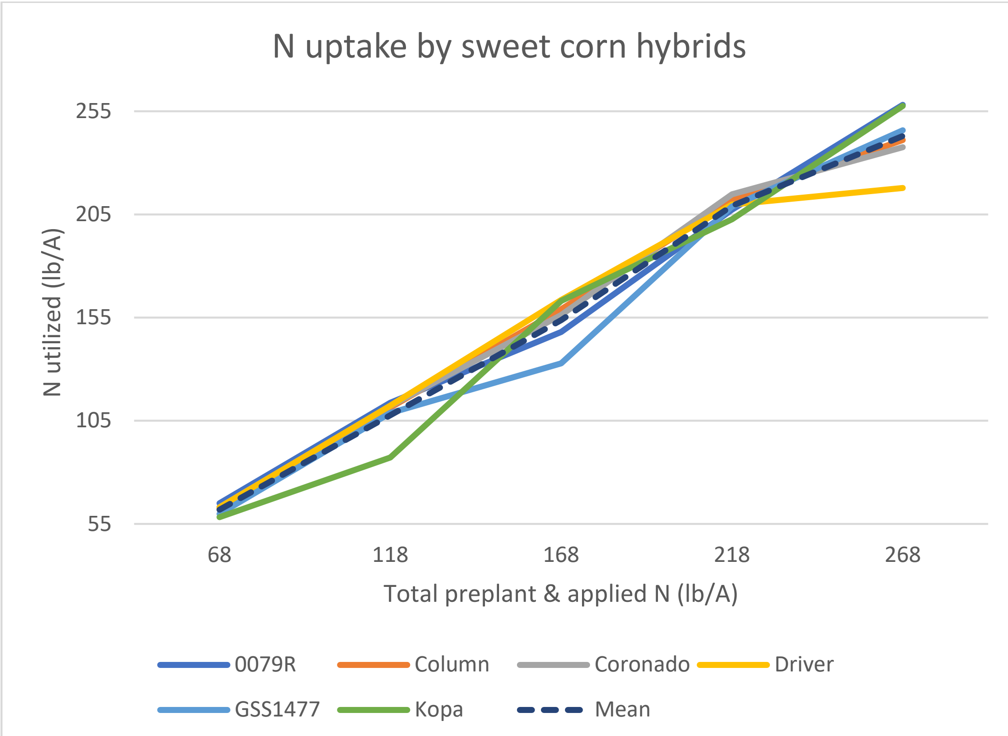


Figure 3. Total nitrogen utilized (preplant N + starter N + sidedress N - residual N) by supersweet corn hybrids grown in a yield and quality trial with five sidedress N rates at the OSU Vegetable Research Farm in 2024.

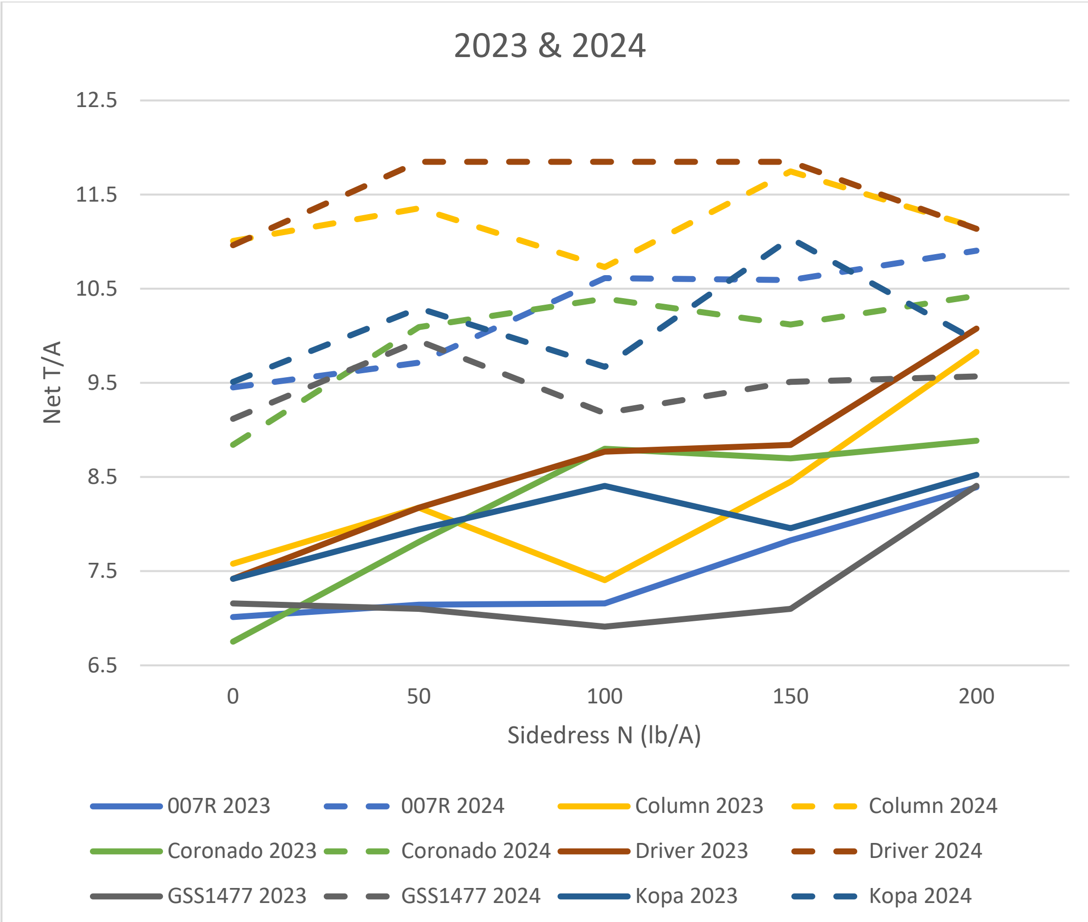


Figure 4. Net T/A for six supersweet corn hybrids grown at five sidedress N levels at the OSU Vegetable Research Farm in t2023 (solid lines) and 2024 (dashed lines).

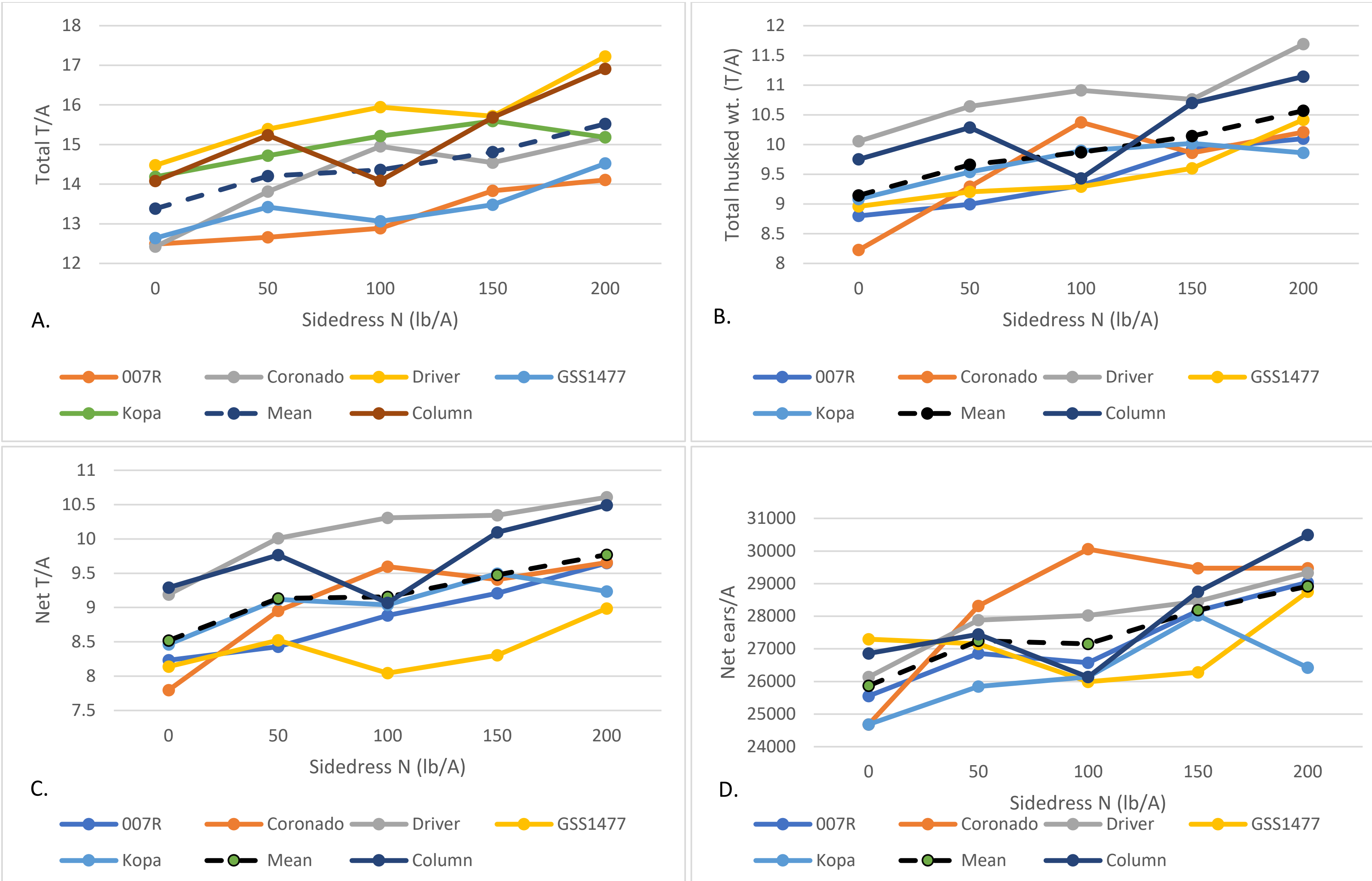


Figure 5. Mean of two years (2023 and 2024) yield response for six supersweet corn hybrids grown at five sidedress N levels at the OSU Vegetable Research Farm. A. Total T/A yield (husk + ear weight), B. Husked T/A, C. Net T/A and D. Net ears/A.

Research/Extension Progress Report for 2024-2025 Funded Projects
Progress Report for the Agricultural Research Foundation
Oregon Processed Vegetable Commission

Title: Evaluating Nitryx® SP for Sweet Corn in Eastern Oregon

Project Leader(s): Ruijun Qin, Associate Professor and Extension Agronomist, 2121 S 1st St, Hermiston, OR 97838, (541) 567-8321 x 134, ruijun.qin@oregonstate.edu

Cooperator(s):

Funding History: $9,078 for this project. Previous year, there was another project "Evaluating Drone Imagery Applications for Sweet Corn Nitrogen Fertilization" with the funding of $15,989.

Abstract:
As the most important nutrient, N is intensively applied to sweet corn to secure the optimal yield target. However, environmental concerns and the increasing fertilizer cost are forcing growers to adopt practices to improve N use efficiency (NUE) while reducing N input, especially in the Columbia basin with the dominant soil types of coarse-textured soils. An organic bio-fertilizer, named "Nitryx® SP" showed the advantage of improving crop NUE with the proprietary strain of a beneficial bacteria (Paenibacillus polymyxa strain P2b-2R). In a field trial conducted from May to August in Hermiston, OR, six sweet corn varieties were tested under 6 levels of nitrogen (from 0 to 275 lbs N/ac) plus Nitryx® SP application. The results showed that the optimal N rate for the corn yield and marketable ear number should be around 220 lbs/ac across all the tested varieties, suggesting that the previous N recommendation on sweet corn in the region is valid. Among the varieties, #3 (Driver R) and #4 (Sorel) had the highest yield, most marketable ears, and relatively longer sizes, while #5 (Turbine) had the lowest yield. #6 (Megaton) had the highest non-marketable yield, which may affect its marketable value, but it has the longest cob. The Nitryx® SP application was found to benefit plant numbers and total ear numbers but had a limited effect on sweet corn yields. To make the conclusive remark, multiple-year data collection is needed.

Keywords: Split-fertilization, corn yield, leaf greenness, corn quality, nitrogen

Objective(s):
We hypothesize that 1) Nitryx® SP might benefit sweet corn by improving NUE, and 2) the effect of Nitryx® SP might depend on variety and N rate. To test the hypothesis, our objectives are 1) identifying the effect of the product on various sweet corn varieties, 2) exploring the interaction of this product and N application, and 3) conducting extension activities for growers to deliver the research findings.

Procedures:
A field trial was conducted at Hermiston Agricultural Research and Extension Center and six varieties were used based on the recommendation of a sweet corn seed company. The experiment followed a split-plot design with the Nitryx® SP application as the main factor and sweet corn variety as the subfactor with four replicates. The selected sweet corn varieties were from Harris Moran Seed Co. The detailed information is in Table 1. The sweet corn was planted on May 24 with a two-row planter with a seeding rate of 35,000 seeds per acre and a row space of 2.5 feet. Each plot was 22 ft long. All the seeds germinated one week later.

Table 1: The selected sweet corn varieties in the test

#	Name	Type	Seed Size	Maturity (days)	Seed weight (#/lb)
1	Bullion F1	Yellow SH2	MR	80	3108
2	COLUMN F1	Yellow SH2	LR	74	2766
3	DRIVER R F1	Yellow SH2	LR	79	2544
4	SOREL F1	Yellow SH2	LR	81	2579
5	TURBINE F1	Yellow SH2	LF	70	2740
6	MEGATON F1	Yellow SH2	LF	85	3600

This study included six nitrogen (N) rates including 0, 55, 110, 165, 220, and 275 lbs N/ac for identifying the N requirement for the sweet corn in the region although it was not funded. The Nitryx® SP application was conducted at the plots with the N rate of 0, 110, and 220 lbs N/ac. Each N plot consisted of two parts, i.e., with or without Nitryx® SP application. For the part with Nitryx® SP application, it was 10 ft long, while for the part without application, it was 12 ft long. As a result, there are six treatments included: 1) no-fertilizer control (CK), 2) CK+ Nitryx® SP, 3) low N rate (110 lbs/ac), 4) low N rate + Nitryx® SP, 5) normal N rate (220 lbs/ac), 6) normal N rate+ Nitryx® SP.
All the plots received sufficient amounts of phosphorus, potassium, and other nutrients as base/starter fertilizer based on the soil nutrient analysis. The N application occurred weekly from June 12 to August 2 with a varied amount. The detailed information on N fertilization is seen in Table 2.

Table 2: The nitrogen fertilization plan

Time	date	Nitrogen fertilization target rate (lbs/ac)					Growing stage
		55	110	165	220	275	
0	5/24						Sowing
0	6/1						Germination
1	6/12	30	30	30	30	30	V2
2	6/21	25	20	30	30	35	V4
3	6/28		10	15	25	35	V5
4	7/5		10	15	25	35	V5-6
5	7/12		15	20	30	40	V7-8
6	7/19		15	20	30	40	tassel
7	7/26		10	20	30	35	tassel/silk
8	8/2			15	20	25	silk

The Nitryx® SP application occurred on July 8 and 16, respectively when the crop was in a growing stage of V6-V8 at a rate of 6 oz/acre. The application time and rate followed the label of the product.

It should be noted that the tested field was in a circle with the silage corn planted, so the sweet corn was surrounded by silage corn. However, there was sufficient space between the sweet corn and silage corn, so there was no shadow impact from the silage corn. Throughout the growing season, the irrigation, field management, and pest management followed the experimental station' standards.

Before trial establishment, soil samples were taken to characterize soil fertility status and showed a residual N level of 66 lbs/ac. During the in-season fertilization period, sampling events were conducted to assess the nutrient changes in plants and soil, including the plant leaf samples and soil samples at 1 ft depth. Meanwhile, crop growth was observed and recorded. At maturity, the corn was harvested manually, the yield was measured and the corn quality was evaluated. The pest infestation was also measured. At the end of the growing season, post-harvest soil samples were taken to quantify the residual N status.

The research findings were presented at the Pacific Northwest Vegetable Association Conferences and will be presented at various extension meetings, and published as extension articles and/or peer-reviewed papers.

Accomplishments:

It should be noted that we included more N treatments to be able to achieve more findings from the field trial. In this report, all the data including N fertilization and Nitryx® SP application will be included.

1. The effect of N rate:

Data analysis was initially mainly focused on the effect of N rates and varieties on corn height, total yield, unmarketable yield, total ear number, marketable ear number, plant number, and cob length (Table 3). All the parameters are significantly impacted by varieties. The N application impacts total yield and marketable ear number. There was no interaction between variety and N application rate.

Table 3. The ANOVA results on the various parameters under the effect of variety and N rate

Source	Height	Total yield	Non marketable yield	Total ear #	Marketable ear #	Plant #	Cob length
Variety	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
N rate	NS	<0.0001	NS	NS	<0.0001	NS	NS
Variety*N rate	NS	NS	NS	NS	NS	NS	NS

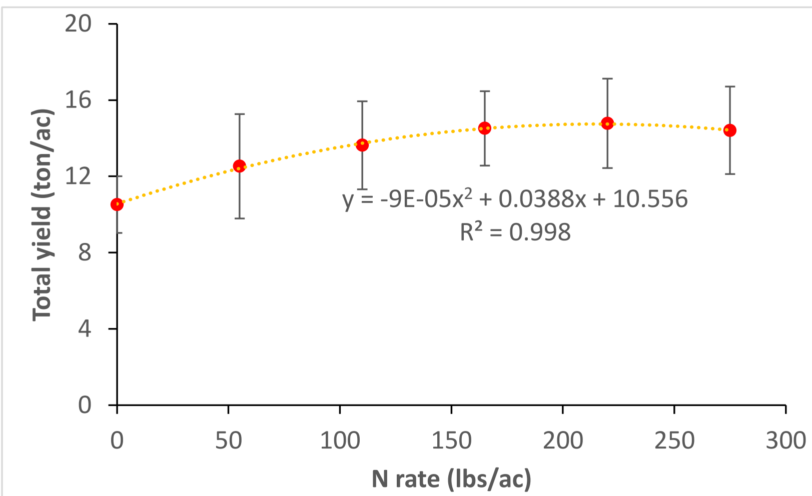


Figure 1. The total yield of sweet corn as affected by N application rates

Our results showed that the sweet corn yield increased with N application from 0 to 220 lbs.ac. Afterward, the yield tended to decrease, across all the varieties (Fig. 1).

The sweet corn grows very fast in July, indicating an important stage for N fertilization. However, no differences were observed in plant height among the N fertilization rates (Fig. 2). Similar observations were shown in the previous field trial. Between these two trials, the soil residue N was much less in this year. Our data suggest that the plant height can not be an indicator of sweet corn, different from other crops.

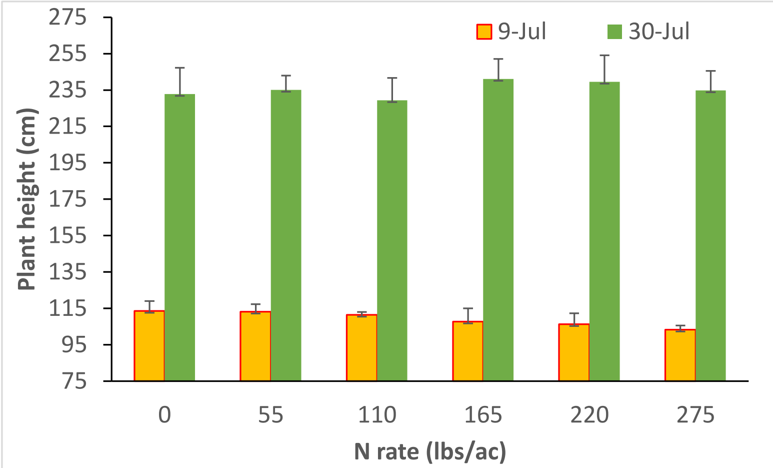


Figure 2. The plant height of sweet corn as affected by N application rates

A similar pattern for the sweet corn was also shown in the ear number (Fig. 3), consistent with the yield data.

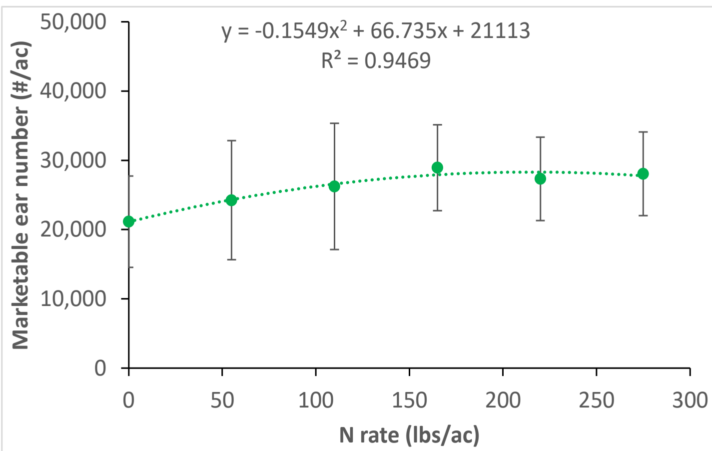


Figure 3. The marketable ear number of sweet corn as affected by N application rates

The quality of the tested sweet corn generally belongs to a good rating level. No N effect was shown in the sweet corn quality. For example, regardless of the N rate, the average cob length was in a range of 22-24 cm (Fig. 4).

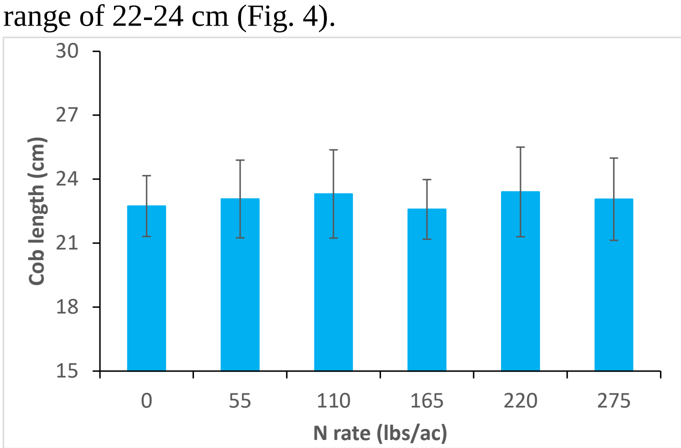
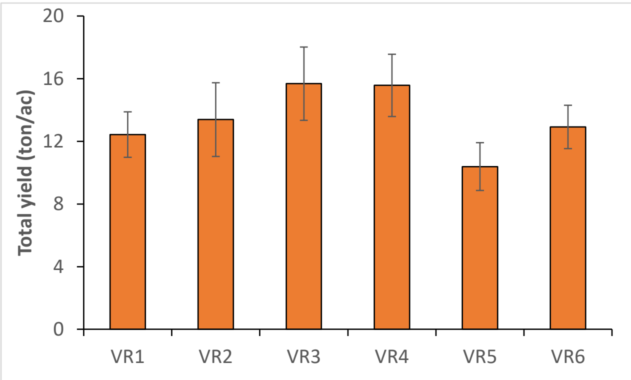


Figure 4. The cob length (cm) of sweet corn as affected by N application rates

2. The effect of variety:

The variety plays an important role in deciding the performance of sweet corn in the study. Among the six varieties, varieties 3 and 4 had the highest total yield, while variety 5 had the lowest (Fig. 5). Meanwhile, variety 6 had the highest non-marketable yield (Fig. 5).



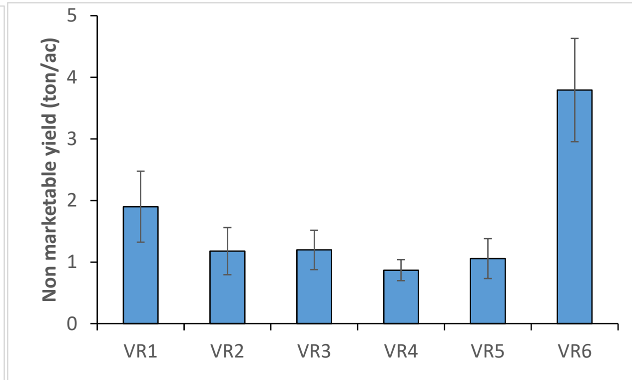
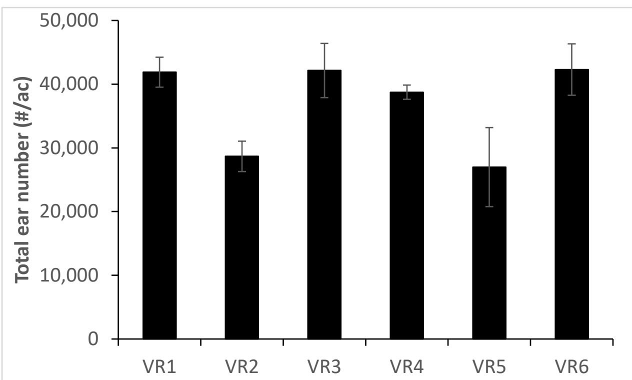


Figure 5. The total and non-marketable yields of sweet corn under the effect of various varieties

Among the varieties, the #1, 3, and 6 had the most ear number, but the #3 and 4 had the most marketable ear number (Fig. 6).



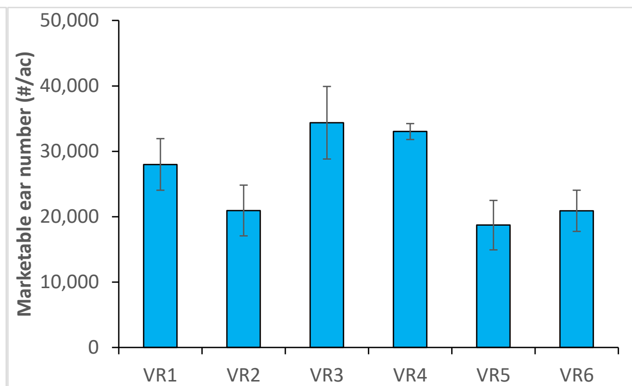


Figure 6. The total and marketable ear number of sweet corn under the effect of various varieties

Measured based on the tip filling, uniformity, and overall rating showed that all the varieties have good quality. However, the cob length was different among them, i.e., #6 had the longest cob, while #5 had the shortest cob.

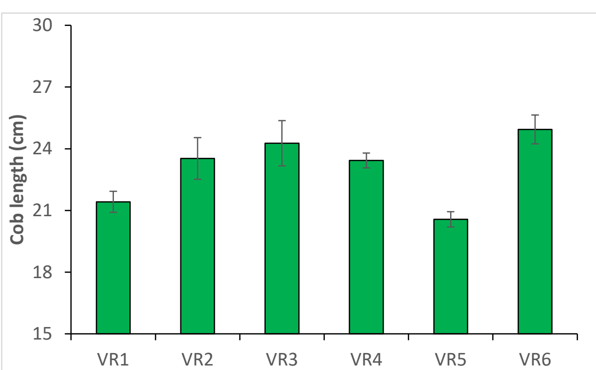


Figure 7. The cob length of sweet corn under the effect of various variety

3. The impact of Nitryx® SP application:
Data analysis is shown in Table 4. Our results showed that the Nitryx® SP application (micro) only impacted the total ear number and plant number both were increased with the Nitryx® SP application (Fig. 8). However, in regards to total yield, marketable yield, marketable ear numbers, limited differences were found with the Nitryx® SP application.

Table 4. The ANOVA results on the various parameters under the effect of variety, N rate, and Nitryx® SP application

Source	Total yield	Non-marke yield	Total ear #	Marketable ear #	Plant #	Cob length
Variety	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
N rate	<0.0001	NS	<0.0001	<0.0001	NS	NS
Micro	NS	NS	0.0123	NS	0.0309	NS
Variety*N rate	NS	NS	0.005	NS	NS	NS
Variety*Micro	NS	NS	NS	NS	NS	NS
N rate*Micro	NS	NS	NS	NS	NS	NS
Variety*N rate*Micro	NS	NS	NS	NS	NS	NS

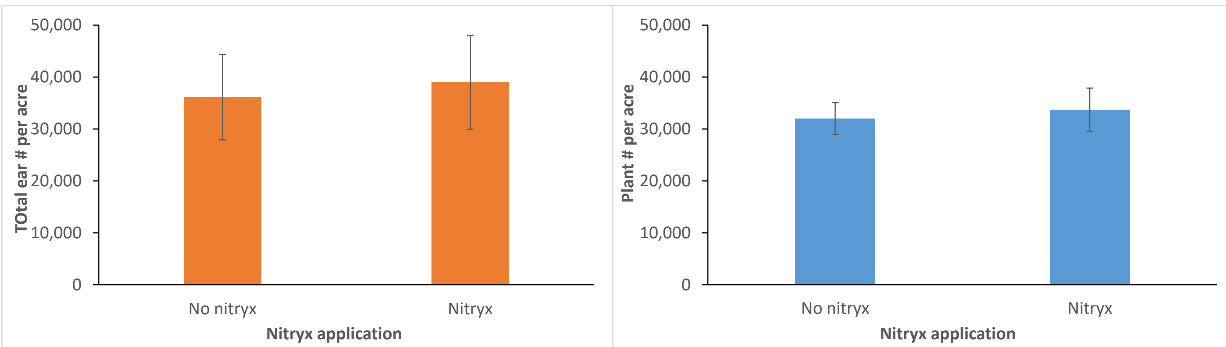


Figure 8. The total ear # and plant # of sweet corn under the effect of Nitryx® SP application

4. Ear worm:
Different from the previous field trial, no earworm was found in the field trial this year. It is not clear whether the surrounding crops (silage corn) contributed to the lower occurrence of the earworm or not.

Impacts: This project will benefit the Oregon Processed Vegetable industry. With the findings of this project, we will help growers make a decision to use the emerging product that was tested.

Relation to Other Research: This work will be an important part of my overall research/extension effort on N fertilization in eastern Oregon. It is the first study in the region and OPVC is the only sponsor. Besides this project, we expected to have more collaborations with other scientists at OSU (e.g., Professor Jim Myers) and WSU.

Research/Extension Progress Report for 2024-2025 Funded Projects
Progress Report for the Agricultural Research Foundation
Oregon Processed Vegetable Commission

Title: Evaluation of entomopathogenic fungi against seed corn maggot in sweet corn

Project Leader(s): Josephine Antwi. Hermiston Agricultural Research & Extension Center. Oregon State University.

Cooperator(s): Kenneth Frost. Hermiston Agricultural Research & Extension Center. Oregon State University. Assisted Josephine Antwi with the study design.

Funding History: 2024 funding; **$39,419**

Abstract (300 word limit):
The goal of this study was to test the efficacy of entomopathogenic fungi (EPF) in controlling seed corn maggot (SCM) (*Delia platura*). EPF work by adhering their spores to insect cuticle (skin), penetrate the cuticle, replicate inside the insect, and eventually kill the insect. Seed corn maggot attacks the seed germ or the underground portion of young sweet corn seedlings, making SCM a good target for EPF when applied at planting. In this study, I applied 3 commercial products of EPF to sweet corn seeds in different application patterns at planting. I included a fungicide in some of the treatments to test for its compatibility with EPF. I also included chemical insecticides (for seed and soil) as control. However, throughout the study, I did not observe any field pressure of SCM. Interestingly, plant count (i.e., number of germinated seeds) was low across some of the EPF treatments, which was not caused by SCM pressure. As a result, I could not determine the efficacy of the fungal products in controlling SCM in this study. I suspect that the low germination rate was due to the product application rate I used. For those EPF products that resulted in the lowest plant count, I used the highest label rate. To confirm this suspicion, I am currently conducting a greenhouse trial using different EPF rates (low, medium, and high) to test for their effect on sweet corn germination. Findings from this greenhouse study will provide relevant information needed to prepare for the 2025 field study. I also plan to increase SCM pressure in the field by introducing more organic matter into the field to attract SCM adults. My incorporating these anticipated changes in the 2025 field study, I hope to find answers to the effect of EPF on SCM.

Key Words: Entomopathogenic fungi, sweet corn, *Delia platura*, *Beauveria bassiana*, *Cordyceps javanicus*.

Objective(s): The objectives of the original proposed study were to (1) test the efficacy of 4 commercial strains of EPF containing *B. bassiana* and *M. anisopliae* as biopesticides against seed corn maggot, and (2) to determine if use pattern of these products (i.e., seed treatment, in-furrow, or a combination of both) affects product efficacy.

Procedures:
Objectives 1 and 2 are described together. Raw seeds of the sweet corn variety "Bull Moose®" from Bayer was used in this study was. The EPF products, insecticides, fungicide, and their rates used in this study are shown in table 1. For seed treatment, raw seeds were coated with suspensions of each product and allowed to dry before planting. Soil applications with prepared suspensions of each product were made at planting, post row closure, using a hand-held backpack sprayer. Field design consisted of

four 15 ft x 30 inches wide rows per treatment, with 4-6 inches between plants. Each plot consisted of 2 rows and each plot was replicated 4 times. Prepared seeds were planted with a 2-row corn planter. When germinated plants reached the V2 growth stage, plant stand was counted for all treatments. For data analysis, I used a one-way ANOVA to determine the effect of treatment on plant stand.

Table 1. List of proposed treatments and application rates for seedcorn maggot

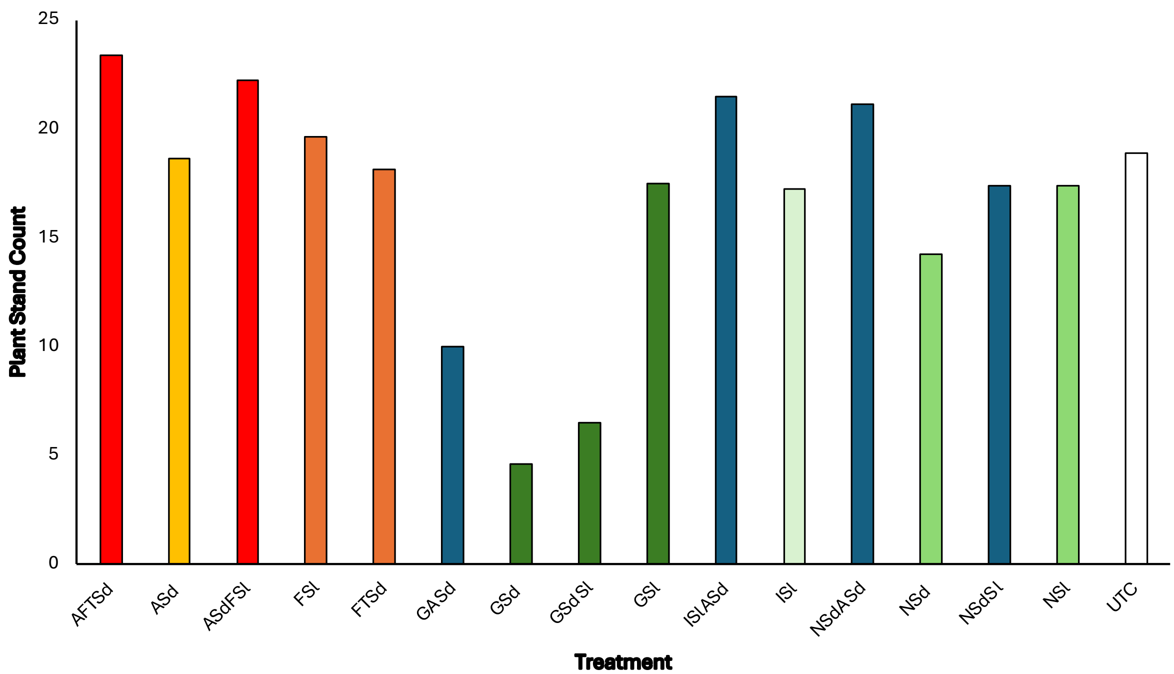
Application type	Product	EPF active ingredient	Rate used for this study	Label rate
Seed treatment	[a]BoteGHA ES®	Beauveria bassiana	4 fl oz/A	4 fl oz/A
	[a]NoFly 22WP®	Cordicypes javanicus	0.5 lb/A	2 lb/A
	Fortenza®	cyantraniliprole	5 fl oz per 100 lb	0.2 mg a.i./seed
Soil treatment				
	PFR97®	Cordicypes javanicus	1 lb/A	1-2 lb/acre
	Force Evo®	Tefluthrin	0.5 fl oz per 1000' row	0.46-0.57 fl oz/1000' row

[a] same rate used in-furrow

Accomplishments:

For the duration of this study, I did not observe any SCM pressure on the field. Due to this, the plant count data presented here does not reflect the impact of SCM. Overall, germination rate averaged 56% (i.e., ~17 out of 30 seeds), ranging from 15% - 78%. The effect of treatment, either as seed or soil application, on plant stand was statistically significant ($p = 2.2e-16$ at $\alpha = 0.05$). BoteGHA seed treatment significantly reduced plant count compared to soil applications with the same product (dark green bars of figure 1). In general, EPF products containing *Cordyceps javanicus* (i.e., PFR97 and NoFly; lighter green bars of figure 1) did not significantly reduce plant stand as did BoteGHA. Recall that I used the highest label rate of BoteGHA for both seed treatment and soil applications. BoteGHA is an emulsion suspension, and I suspect that the amount of oil contained in the suspension of the final application rate, especially for seed treatment, negatively affected seed germination. On the other hand, seeds treated with the fungicide and insecticides (as a mixed treatment) had relatively higher plant count (red bars of figure 1). However, this count was no different from seeds treated with a combo of the fungicide and either of the *C. javanicus* products (*ISlASd* and *NSdASd* labels of figure 1). However, without testing the combined effect of these products on SCM, I cannot conclude that the fungicide is compatible with either of the *C. javanicus* products.

Currently, I am conducting a greenhouse study to follow-up on the effect of EPF on germination rate. Specifically, I am testing the germination rate of sweet corn treated with low, medium, and high rates of each of the EPF products. At the end of this greenhouse trial, any treatment group that results in the lowest sweet corn germination rate will be removed from the field trial planned for summer 2025.



Sweet corn plant stand count after treatment with entomopathogenic fungi (EPF) separately or in combination with insecticides (Force Evo® (abbrev. "F") or Fortenza® (abbrev. "FT") and a fungicide (Apron®)). Bars in shades of green represent treatments with EPF products: BoteGHA® (abbrev. "G"), NoFly® (abbrev. "N"), and PFR97® (abbrev. "I"). Bars in blue represent EPF combined with insecticides and fungicide. Bars in red represent treatments with insecticides and fungicide. Bars in orange and yellow represent treatments with insecticides only and fungicide only, respectively. Sd and Sl indicate seed and soil treatments, respectively. UTC untreated control.

Another modification I plan to make to the field trial of summer 2025 is to enhance SCM pressure. To do this, I plan to increase organic matter content in the field by "working-in" green material from winter cover crops during soil preparation. Additionally, or when necessary, I will spread dog food and/or rotten potato on the prepared field. Suggestions from other entomologists who have expertise in field trials with SCM indicate that these practices attract SCM adults into fields.

Impacts:

In the short term, this project will generate new knowledge about the ability of EPF to control SCM in sweet corn in the Columbia Basin of Oregon. In the long term, the project will benefit sweet corn IPM by offering alternative (i.e., EPF) tools to growers in managing SCM. To my knowledge, this study is the first of its kind on sweet corn in the Columbia Basin of Oregon. To disseminate findings, I will present at OPVC meetings as needed and participate in Field Days and workshops that bring Oregon sweet corn growers and stakeholders together. I will also publish findings in peer reviewed articles to reach a wider audience.

Relation to Other Research:

The goal of my extension entomology program is to find alternatives (i.e., control methods besides synthetic chemistries) and develop sustainable IPM programs that will benefit Oregon growers. Growers are faced with increased cases of insect resistance, secondary pest outbreaks, and declines in field natural enemies due to sole reliance on synthetic chemistries for pest control. I hope to use studies such as the one described here to raise more grower awareness to alternatives, especially microbials, to insect management.

Research/Extension Progress Report for 2024-2025 Funded Projects
Progress Report for the Agricultural Research Foundation
Oregon Processed Vegetable Commission

Title: Expanding the Reach of Regional Insect Pest Monitoring

Project leaders: Jessica Green and Dr. Silvia Rondon, Oregon IPM Center 2710 SW Campus Way, room 2215, Corvallis, OR 97331

Cooperators: Kyleah Rabe (OSU student), Jessica Blakley, Megan Sturzen, Matt Cook, Thomas Barnett, Mike Christensen, Dan Haener, Max Jaeger, Ben Lyon (OSU Vegetable Research Farm), Josephine Antwi (OSU-HAREC), Govinda Shrestha (OSU-SOREC), Bradey Cope (Simplot, Umatilla)

Funding history:
2022-23: none requested
2023-24: $14,781
2024-25: $7,727 (match from PNVA)

ABSTRACT

Insect pest monitoring is a crucial component of crop production. Developmental estimates, also known as phenology models, exist for many common vegetable pests via forecasting tools like USPEST.org, but in order for them to be relevant and applicable, the models need to be 'ground-truthed' by regional data collection and research. VegNet, a regional trapping and reporting network, has been operating in the Willamette Valley, OR. for more than 25 years. It is a valued resource across industry, academia, state agencies, and more. Insect pest sampling data from vegetable fields is now directly fed into a new, digital platform called the Oregon Pest Monitoring Network (https://beav.es/iRT). The system collects the geospatial data and presents it in a visual, interactive map format, which allows for easy and immediate access. Expanding the reach of the system to serve other vegetable producing areas of the PNW is highly desired, and attainable with regional collaborators and financial support from the vegetable commodity industry.

KEYWORDS: insect, pest monitoring, IPM, sweet corn, broccoli, snap bean

OBJECTIVES

1. Continued operation of VegNet, an insect pest monitoring and reporting program in the Willamette Valley.
2. Geographically expand the reach of the program, using a network of collaborators in other parts of Oregon (Eastern, NE, and Southern).

PROCEDURES

Field sites were selected based on target crop, relative geographical location, and grower cooperation. At each location, 'Texas cone' wire mesh traps or plastic 'Unitraps' were placed at field edges and baited with pheromone lures to target moth species within Lepidoptera:Noctuidae. Other passive sampling efforts included yellow sticky cards and delta wing traps. Sticky traps were used to monitor cucumber beetles, Hemipteran pests, and smaller moths. Monitoring was conducted from 8 April to 1 October 2024. Pheromone lures were changed every 4 weeks. Technicians used "FieldMaps", a mobile application, to upload trap data into the Oregon Pest Monitoring Network. Direct sampling was conducted periodically and included sweep nets, leaf pulls, and root examination. Cooperators were asked to sample for rootworm beetles (Coleoptera:*Diabrotica* spp.) and beneficials using yellow sticky traps. Supplies and identification training materials were shipped to them in August 2024, and they were instructed to mail datasheets back to the Oregon IPM Center for analysis.

<u>ACCOMPLISHMENTS/FINDINGS</u>

OBJ. 1 - *Regional pest monitoring and reporting.*

- Early-season (8 Apr to 30 May) traps were placed at the vegetable research farm to serve as sentinel indicators of migratory moth activity. Black cutworm levels were normal, but there were elevated levels of cabbage looper early in the season.
- For the remainder of the season, the cabbage looper regional average counts were below normal.
- 12-spotted cucumber beetles (*Diabrotica undecimpunctata*) were abnormally high in late August, both at the research station and the 2 remaining commercial sweet corn fields.
- Winter cutworm had 2 distinct peaks of activity as monitored at Hylsop farm: 8 Jul and 29 Aug to 5 Sept)
- Corn earworm levels were low again this year.
- Black cutworm trap counts collected in 2023 & 2024 contributed to the development of a revised and more regional phenology model. The work has been submitted to the journal "Frontiers in Insect Science".

OBJ. 2 – *Statewide collaboration for rootworm monitoring*

- Western corn rootworm (*D.virgifera*) was detected in western Oregon. A total of 430 adult beetles were trapped from a fresh market sweet corn field in Albany; 1011 adult beetles were trapped from a silage corn field in Aurora; and 0 beetles were trapped in a snap bean field in Aurora.
- Southern corn rootworm (*D.undecimpunctata*) was detected in each of the 3 monitored fields in western Oregon. Note: these locations were in addition to the regular VegNet monitoring described above.
- Collaborators at OSU's Southern Oregon Research and Extension Center (SOREC) in Central Point, OR., monitored 1 locatios from 12 August to 19 September. They found 69 southern corn rootworm beetles and zero western corn rootworm beetles.
- The industry collaborator from Umatilla County, OR. monitored 6 locations from 14 August to 10 September and found 24 western corn rootworm beetles.
- Our team created a short instructional video on how to monitor for rootworm beetles. It can be found on YouTube.

<u>IMPACTS</u>

The geographic extension of a coordinated trapping network has the potential to provide a better understanding of pest dynamics throughout the PNW region. Many of the pests we sample for (e.g.

cutworms and armyworms) are not host-specific. Therefore, we can use data collected from other commodities like grass seed and forage to make a better estimate about overall pest activity levels. Having data automatically upload into a digital hub has huge benefits. It serves as a data repository, meaning that data can be retrieved, statistically analyzed, and shared if desired. As we continue to analyze data, we are able to provide quantitative values that help to ground truth phenology models.

RELATION TO OTHER RESEARCH / EXTENSION

The *Diabrotica* sampling was conducted in collaboration with a National Corn Rootworm IPM Working Group. They supply sticky cards but the workload of setting and checking traps is not funded. This is our 2nd year working with this group, and they have been gracious to include our data in their final report (2023 available here). We have literally put Oregon 'on the map' as a corn-producing region, and plan to continue rootworm sampling next year. Graduate students and technicians from the Oregon IPM Center are proposing research to better understand the impact of *D. virgifera*, the western corn rootworm, compared to our more commonly noted *D. undecimpunctata*, the southern corn rootworm, also known as 12-spotted cucumber beetle. More information about rootworm monitoring can be found on the Oregon IPM Center's website.

An interactive training on how to use the Oregon Pest Monitoring Network was offered at OSU's Extension Annual Conference in early December. It was well-attended, and some faculty that do pest monitoring across the state were engaged and interested in contributing.