Evaluation of Minecto Pro and Delegate for full-season Colorado potato beetle management in potato, Wisconsin, 2021

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Experimental design: This trial was conducted at the University of Wisconsin's Hancock Agricultural Research Station, located 1.1 miles west of Hancock, Wisconsin, in field K-8 (44.115803, -89.548258) on a loamy sand soil in 2021. Four replicates of two treatment programs were arranged in a randomized complete block design. Plots measured 8 rows wide by 30 ft. long with rows spaced on 3 ft. centers. Potato, *Solanum tuberosum* cv. 'Goldrush' B-size uncut tubers were machine-planted on Apr 23. Seed was placed approximately 12 in. apart along rows. Plots were separated by 6 ft. of unplanted space on all sides. The entire trial measured 48 ft. wide by 280 ft. long. Plots were maintained according to standard commercial practices including fertilizer, herbicide, and fungicide applications.

Treatments: See **Table 1** for complete treatment details. Treatment 1 included two applications of Minecto Pro at 13.5 fl oz/ac for first generation control and two applications of Delegate at 14 fl oz/ac for second generation control. Treatment 2 included the same rates but used Delegate for first generation control and Minecto Pro for second generation control. All plots additionally received a Platinum at-plant application at a rate of 2.7 oz wt/ac. Treatments were applied using a CO_2-pressurized backpack sprayer equipped with a 6 ft. boom, operating at 30 psi and delivering 20 gal/ac through 4 flat-fan nozzles (Tee Jet XR 8002-VS) spaced 18 in. apart while travelling at 3.5 ft./sec. First generation treatments were applied on Jun 18 and 25, and second generation treatments were applied on Jul 13 and 20.

Insect counts: Colorado Potato Beetle (CPB), *Leptinotarsa decemlineata*, populations were assessed on 10 randomly selected plants in the center of each plot for the following life stages: adults, egg masses, small larvae (1^{st}-2^{nd} instars), and large larvae (3^{rd}-4^{th} instars). Insect counts were performed weekly from Jun 21 (3 days after first treatment) through Aug 23 (34 days after last treatment). Plants began to senesce by Aug 11 so insect counts from Aug 11 – 23 are not included in this report. One pre-count was performed on Jun 10.

Plant health: All plots achieved high levels of emergence and no signs of treatment-related phytotoxicity or reduced plant vigor were observed. See **Table 2** for a record of field maintenance activities.

Yield. A single 30 ft.-long row from each plot was harvested on Sep 2 to determine yield and tuber quality. Tubers were graded using an AgRay Vision X-Ray grading machine which generated electronic measurements of tuber size and weight. The second-largest value of a tuber's dimension in the X, Y, and Z directions was considered its "diameter" and compared against the following USDA classification scheme: A-size tubers are larger than or equal to 1.875 in. diameter, B-size tubers fall between 1.875 in. and 1.5 in., and C-size tubers fall below 1.5 in. diameter.

Data analysis: Data analysis was performed in R. Insect counts were log(x+1) transformed prior to statistical analysis to satisfy assumptions of normality. Defoliation percentages were arcsine square root transformed. Yields required no transformation prior to statistical analysis. Treatment main effects were determined using analysis of variance. Means separation letter codes were generated using Tukey's HSD procedure (α=.05, R package 'agricolae').

Results. Numerical results and statistical analyses are presented in tabular and graphical format on the following pages.

Table 1. Treatment details

Trt No	Trt Type	Trt Product	Form Conc	Form Unit	Form Type	Rate Amt	Rate Unit	Appl Code	Appl Notes
1	INSE	Minecto Pro	1.67	LB/GAL	SC	13.5	FL OZ/A	AB	foliar application
1	ADJ	MSO	100	%	EC	0.25	% V/V	AB	foliar application
1	INSE	Delegate	1.67	LB/GAL	SC	14	FL OZ/A	CD	foliar application
1	ADJ	Induce	100	%	EC	0.25	% V/V	CD	foliar application
2	INSE	Delegate	1.67	LB/GAL	SC	14	FL OZ/A	AB	foliar application
2	ADJ	Induce	100	%	EC	0.25	% V/V	AB	foliar application
2	INSE	Minecto Pro	1.67	LB/GAL	SC	13.5	FL OZ/A	CD	foliar application
2	ADJ	MSO	100	%	EC	0.25	% V/V	CD	foliar application

Application dates: A=Jun 18, B=Jun 25, C=Jul 13, D=Jul 20

Table 2. Field management record

Date	Equipment	Products	Rate	Unit
09/02/2021	Potato Digger, Blue			
08/23/2021	Spray Coupe	Diquat 2L AG	2	pints / acre
08/23/2021	Spray Coupe	Non Ionic Surfactant 80/20	1	pints / acre
08/20/2021	Spray Coupe	Fortuna 75WDG	1.5	lb (pound) / acre
08/20/2021	Spray Coupe	Non Ionic Surfactant 80/20	1	pints / acre
08/20/2021	Spray Coupe	Revus Top	7	fluid oz / acre
08/12/2021	Spray Coupe	Bravo Weather Stik	1.5	pints / acre
08/12/2021	Spray Coupe	Tanos	8	dry oz. / acre
08/06/2021	Spray Coupe	Bravo Weather Stik	1.5	pints / acre
08/06/2021	Spray Coupe	Non Ionic Surfactant 80/20	1	pints / acre
08/06/2021	Spray Coupe	Revus Top	7	fluid oz / acre
07/30/2021	Spray Coupe	Fortuna 75WDG	1.5	lb (pound) / acre
07/30/2021	Spray Coupe	Zampro	14	fluid oz / acre
07/22/2021	Spray Coupe	Bravo Weather Stik	1.5	pints / acre
07/22/2021	Spray Coupe	Headline SC	12	fluid oz / acre
07/20/2021	**Backpack Sprayer**	**Foliar Appl. D**		
07/16/2021	Spray Coupe	Bravo Weather Stik	1.5	pints / acre
07/16/2021	Airflow Fertilizer Applicator	34-0-0 Ammonium Nitrate	110	lb (pound) / acre
07/13/2021	**Backpack Sprayer**	**Foliar Appl. C**		
07/09/2021	Spray Coupe	Bravo Weather Stik	1.5	pints / acre
07/09/2021	Spray Coupe	Tanos	8	dry oz. / acre
07/08/2021	Spray Coupe	Asana XL	4	fluid oz / acre
07/02/2021	Spray Coupe	Bravo Weather Stik	1.5	pints / acre
06/30/2021	Airflow Fertilizer Applicator	34-0-0 Ammonium Nitrate	110	lb (pound) / acre
06/25/2021	**Backpack Sprayer**	**Foliar Appl. B**		
06/23/2021	Spray Coupe	Fortuna 75WDG	1.5	lb (pound) / acre
06/18/2021	**Backpack Sprayer**	**Foliar Appl. A**		
06/10/2021	Spray Coupe	Matrix SG	1.5	dry oz. / acre
06/10/2021	Spray Coupe	Non Ionic Surfactant 80/20	1	pints / acre
06/04/2021	Airflow Fertilizer Applicator	34-0-0 Ammonium Nitrate	350	lb (pound) / acre
05/12/2021	Spray Coupe	Me-Too-Lachlor	1	pints / acre
05/12/2021	Spray Coupe	Metribuzin 75 DF	0.5	lb (pound) / acre
05/11/2021	Airflow Fertilizer Applicator	21-0-0-24S Ammonium Sulfate	360	lb (pound) / acre
05/11/2021	Hiller, 2 row			
05/06/2021	Spray Coupe	AMS - Sprayable	16	fluid oz / acre
05/06/2021	Spray Coupe	Credit Xtreme	1	pints / acre
04/23/2021	Soil Finisher, Brillion			
04/23/2021	Potato Planter - Kverneland	6-30-22-4S+micros with Platinum	550	lb (pound) / acre
04/09/2021	Airflow Fertilizer Applicator	0-0-0-17S-21Ca, Calcium Sulfate	500	lb (pound) / acre
04/09/2021	Airflow Fertilizer Applicator	0-0-60 Potash	450	lb (pound) / acre
01/01/2021	Disk Chisel, Landoll	Rye	60	lb (pound) / acre
01/01/2021	Airflow Fertilizer Applicator	Vapam HL	40	gallon / acre

Table 3. Colorado potato beetle adult counts per 10 plants

Trt No	Trt Description	21-Jun Mean ± SD	HSD	28-Jun Mean ± SD	HSD	06-Jul Mean ± SD	HSD	12-Jul Mean ± SD	HSD	19-Jul Mean ± SD	HSD	26-Jul Mean ± SD	HSD	02-Aug Mean ± SD	HSD
1	Minecto Pro | Delegate	0.50 ± 1.00	a	1.50 ± 2.38	a	2.50 ± 1.00	a	0.75 ± 0.50	a	2.75 ± 4.86	a	0.00 ± 0.00	a	2.50 ± 1.91	a
2	Delegate | Minecto Pro	0.25 ± 0.50	a	1.25 ± 0.96	a	2.50 ± 1.91	a	1.75 ± 0.96	a	4.50 ± 0.58	a	0.25 ± 0.50	a	3.25 ± 1.26	a
		P = 0.68		**P = 0.86**		**P = 0.8**		**P = 0.089**		**P = 0.19**		**P = 0.32**		**P = 0.45**	

Means followed by same letter code(s) are not significantly different (Tukey's HSD, α=.05). Treatment main effect p-values are shown in table footer (ANOVA).

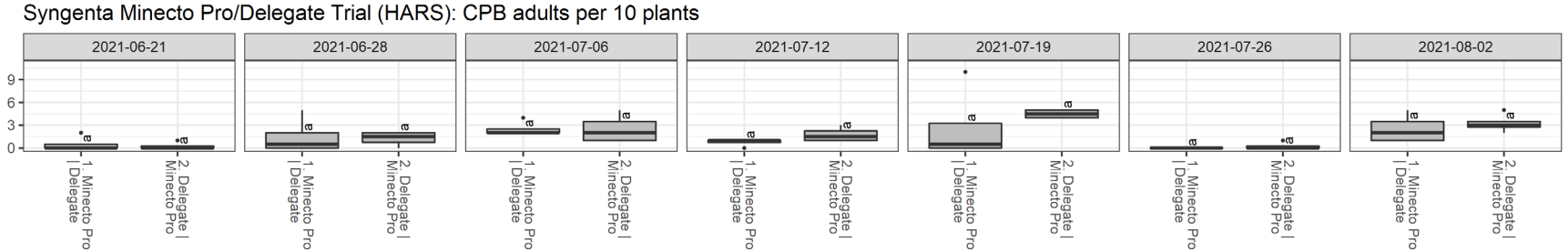


Table 4. Colorado potato beetle egg mass counts per 10 plants

Trt No	Trt Description	21-Jun Mean ± SD	HSD	28-Jun Mean ± SD	HSD	06-Jul Mean ± SD	HSD	12-Jul Mean ± SD	HSD	19-Jul Mean ± SD	HSD	26-Jul Mean ± SD	HSD	02-Aug Mean ± SD	HSD
1	Minecto Pro | Delegate	1.25 ± 1.50	a	0.25 ± 0.50	a	0.25 ± 0.50	a	0.75 ± 0.96	a	0.00 ± 0.00	a	0.00 ± 0.00	a	0.00 ± 0.00	a
2	Delegate | Minecto Pro	1.00 ± 0.00	a	0.50 ± 0.58	a	0.00 ± 0.00	a	0.50 ± 1.00	a	0.75 ± 0.50	b	0.00 ± 0.00	a	0.00 ± 0.00	a
		P = 0.85		**P = 0.57**		**P = 0.4**		**P = 0.7**		**P = 0.039**		**P = 1**		**P = 1**	

Means followed by same letter code(s) are not significantly different (Tukey's HSD, α=.05). Treatment main effect p-values are shown in table footer (ANOVA).

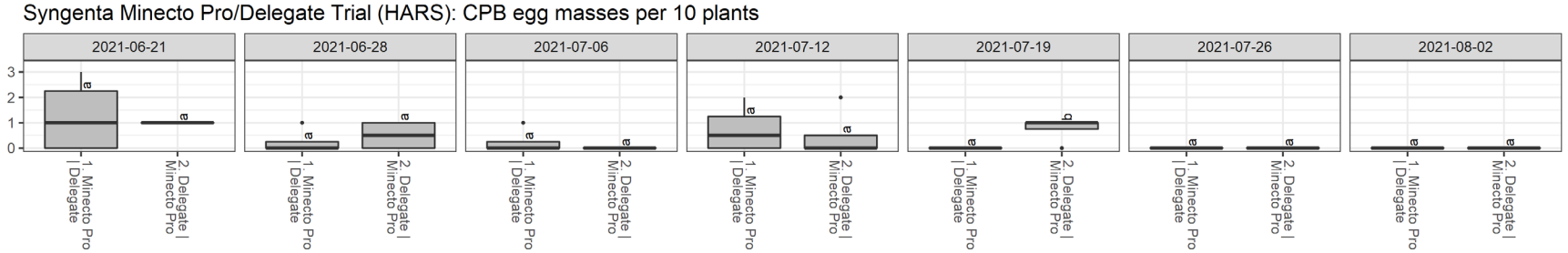


Table 5. Colorado potato beetle small larvae counts per 10 plants

Trt No	Trt Description	21-Jun Mean ± SD	HSD	28-Jun Mean ± SD	HSD	06-Jul Mean ± SD	HSD	12-Jul Mean ± SD	HSD	19-Jul Mean ± SD	HSD	26-Jul Mean ± SD	HSD	02-Aug Mean ± SD	HSD
1	Minecto Pro | Delegate	5.00 ± 10.00	a	0.00 ± 0.00	a	0.75 ± 1.50	a	0.00 ± 0.00	a	0.00 ± 0.00	a	0.00 ± 0.00	a	1.00 ± 1.41	a
2	Delegate | Minecto Pro	6.25 ± 4.79	a	3.75 ± 4.79	a	1.25 ± 2.50	a	3.75 ± 7.50	a	3.75 ± 4.79	a	0.00 ± 0.00	a	0.00 ± 0.00	a
		P = 0.43		**P = 0.093**		**P = 0.85**		**P = 0.32**		**P = 0.18**		**P = 1**		**P = 0.16**	

Means followed by same letter code(s) are not significantly different (Tukey's HSD, α=.05). Treatment main effect p-values are shown in table footer (ANOVA).

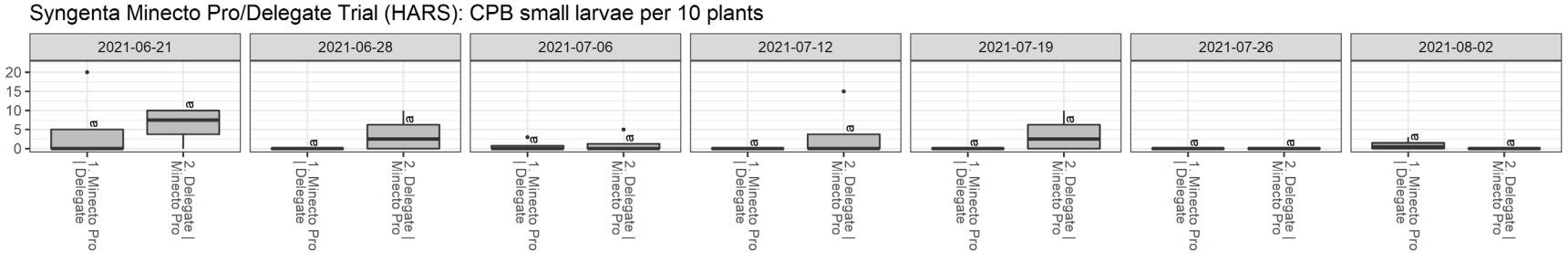


Table 6. Colorado potato beetle large larvae counts per 10 plants

Trt No	Trt Description	21-Jun Mean ± SD	HSD	28-Jun Mean ± SD	HSD	06-Jul Mean ± SD	HSD	12-Jul Mean ± SD	HSD	19-Jul Mean ± SD	HSD	26-Jul Mean ± SD	HSD	02-Aug Mean ± SD	HSD
1	Minecto Pro | Delegate	5.00 ± 4.08	a	3.75 ± 4.79	a	1.50 ± 2.38	a	5.00 ± 4.08	a	0.00 ± 0.00	a	0.00 ± 0.00	a	0.75 ± 0.96	a
2	Delegate | Minecto Pro	16.25 ± 7.50	a	16.25 ± 16.01	b	3.75 ± 4.79	a	26.25 ± 27.80	a	7.00 ± 8.91	b	0.00 ± 0.00	a	0.00 ± 0.00	a
		P = 0.088		**P = 0.018**		**P = 0.6**		**P = 0.45**		**P = 0.048**		**P = 1**		**P = 0.18**	

Means followed by same letter code(s) are not significantly different (Tukey's HSD, α=.05). Treatment main effect p-values are shown in table footer (ANOVA).

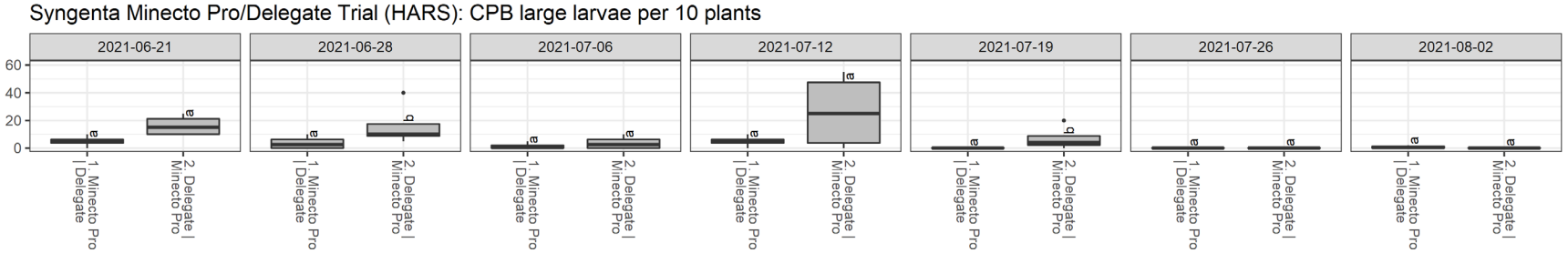
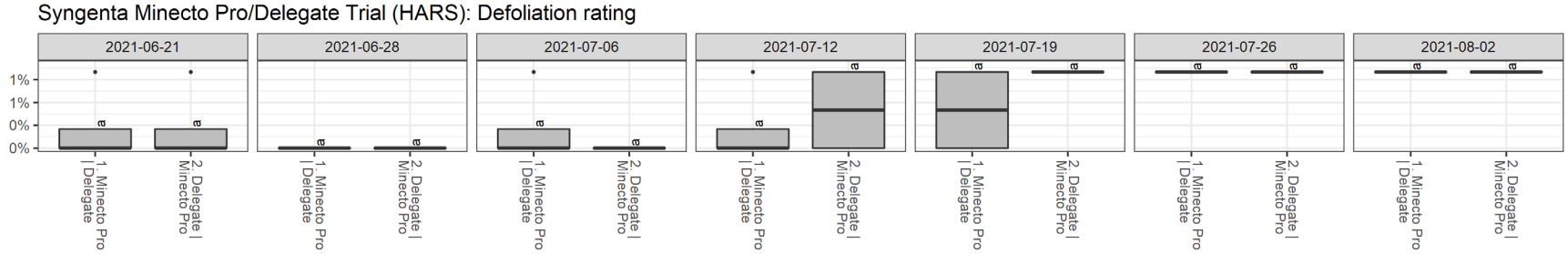


Table 7. Whole-plot defoliation estimates

Trt No	Trt Description	21-Jun Mean ± SD	HSD	28-Jun Mean ± SD	HSD	06-Jul Mean ± SD	HSD	12-Jul Mean ± SD	HSD	19-Jul Mean ± SD	HSD	26-Jul Mean ± SD	HSD	02-Aug Mean ± SD	HSD
1	Minecto Pro | Delegate	0% ± 1%	a	0% ± 0%	a	0% ± 1%	a	0% ± 1%	a	1% ± 1%	a	1% ± 0%	a	1% ± 0%	a
2	Delegate | Minecto Pro	0% ± 1%	a	0% ± 0%	a	0% ± 0%	a	1% ± 1%	a	1% ± 0%	a	1% ± 0%	a	1% ± 0%	a
		P = 1		**P = 1**		**P = 0.32**		**P = 0.55**		**P = 0.17**		**P = 1**		**P = 1**	

Means followed by same letter code(s) are not significantly different (Tukey's HSD, α=.05). Treatment main effect p-values are shown in table footer (ANOVA).



Supplemental figures: Cumulative plots

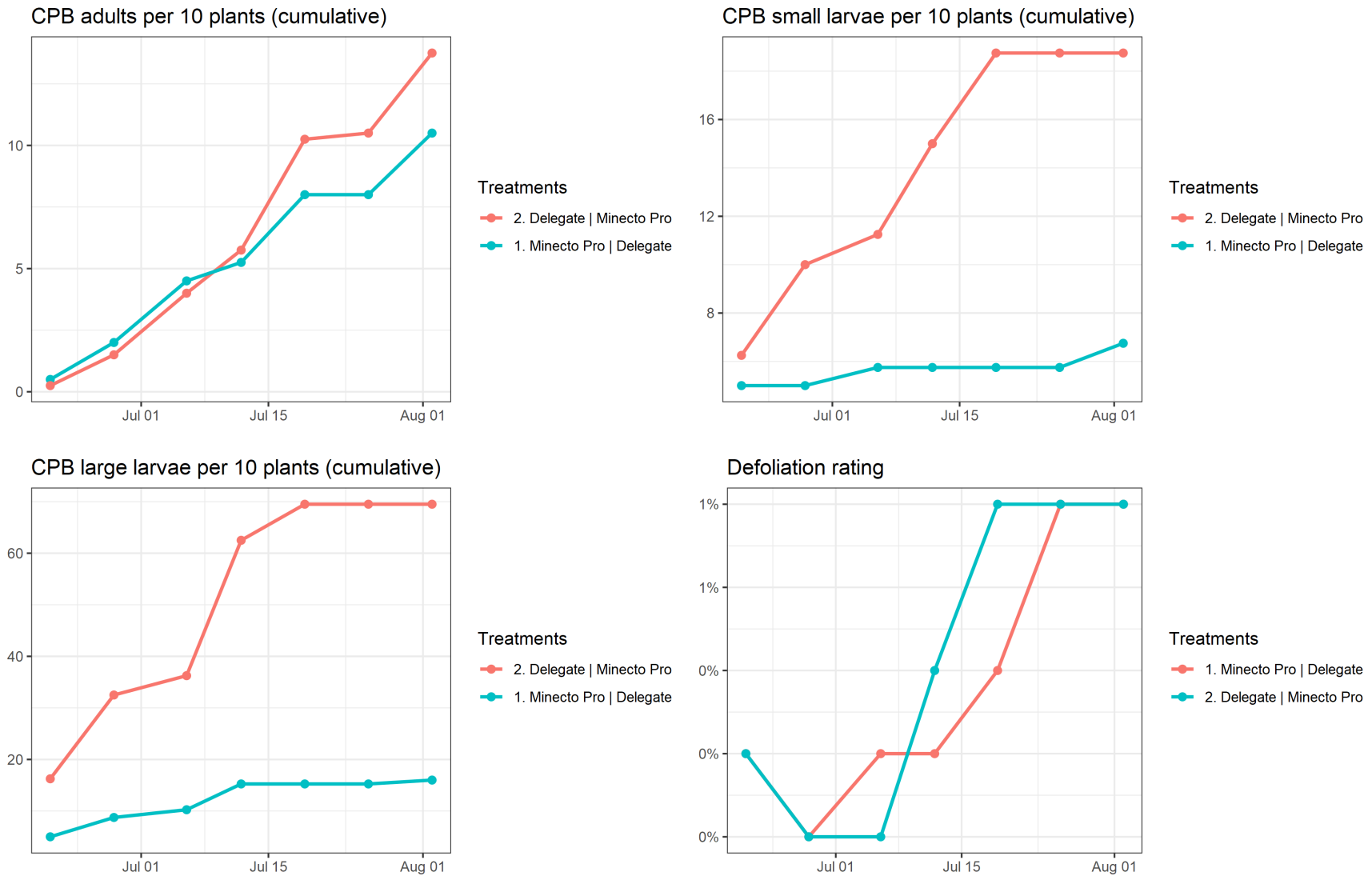


Table 8. Yield

Trt No	Trt Description	Total yield Mean ± SD	HSD	Yield A's Mean ± SD	HSD	Yield B's Mean ± SD	HSD	Yield culled Mean ± SD	HSD
1	Minecto Pro | Delegate	476.70 ± 8.43	a	444.50 ± 10.50	a	26.79 ± 2.77	a	0.24 ± 0.28	a
2	Delegate | Minecto Pro	436.30 ± 24.10	b	409.80 ± 23.38	a	22.36 ± 3.27	a	0.12 ± 0.24	a
		P = 0.034		**P = 0.055**		**P = 0.11**		**P = 0.32**	

Means followed by same letter code(s) are not significantly different (Tukey's HSD, α=.05). Treatment main effect p-values are shown in table footer (ANOVA). Yield show in units of 100 lbs per acre (cwt/ac). Yield determined by grading tubers dug from a single 30 ft. row from the center of each plot.