



## MATERIALS AND METHODS

Field studies were conducted in Fargo, ND in 2016 and 2017 and at a location near Mooreton, ND in 2017. For Fargo experiments, seed of Crystal ACH 817 was planted using a randomized complete block design with 4 replicates. In 2016, treatments included (1) an untreated control, (2) an early season MeJA treatment, (3) a late season MeJA treatment, (4) an early season SA treatment, (5) a late season Headline treatment, (6) an early season MeJA treatment + a late season Headline treatment, (7) a late season MeJA treatment + a late season Headline treatment, (8) an early season SA treatment + a late season Headline treatment, (9) a postharvest Stadium treatment, and (10) a late season Headline treatment + a postharvest Stadium treatment. MeJA, SA, Headline, and Stadium were applied at rates of 0.01  $\mu$ M, 10  $\mu$ M, 9 oz/acre, and 1.6% (v/v), respectively. MeJA and SA solutions contained 10 ppm (v/v) Tween 20 and were applied as foliar sprays. For the Fargo, ND 2017 experiment, treatments included (1) an untreated control, (2) a late season Headline treatment, (3) an early season MeJA treatment of 0.01  $\mu$ M, (4) an early season MeJA treatment of 1.0  $\mu$ M, (5) a late season MeJA treatment of 0.01  $\mu$ M, (6) a late season MeJA treatment of 1.0  $\mu$ M, (7) an early season MeJA treatment of 0.01  $\mu$ M + a late season Headline treatment, (8) an early season MeJA treatment of 1.0  $\mu$ M + a late season Headline treatment, (9) a late season MeJA treatment of 0.01  $\mu$ M + a late season Headline treatment, and (10) a postharvest Stadium treatment. Headline and Stadium were applied using the same rates as in 2016. Planting, treatment, and harvest dates for 2016 and 2017 are reported in Table 1.

The 2017 Mooreton, ND experiment was planted to two varieties, Hilleshög 4062 and Betaseed 73MN, as a split plot design with 6 replications, using varieties as the main plots. Treatments included (1) an untreated control, (2) a late season Headline treatment, (3) an early June MeJA treatment of 0.01  $\mu$ M, (4) an early June MeJA treatment of 10  $\mu$ M, (5) a mid-July MeJA treatment of 0.01  $\mu$ M, (6) a mid-July MeJA treatment of 10  $\mu$ M, (7) an early June MeJA treatment of 0.01  $\mu$ M + a late season Headline treatment, (8) an early June MeJA treatment of 10  $\mu$ M + a late season Headline treatment, (9) a mid-July MeJA treatment of 0.01  $\mu$ M + a late season Headline treatment, and (10) a mid-July MeJA treatment of 10  $\mu$ M + a late season Headline treatment. MeJA and Headline were applied as described above, and planting, treatment, and harvest dates are reported in Table 1.

**Table 1.** Planting, treatment, and harvest dates for the 2016 and 2017 field studies conducted in Fargo, ND and the 2017 study near Mooreton, ND. In 2016, methyl jasmonate (MeJA) was applied as an early season or late season treatment, and salicylic acid was applied as an early season treatment. In 2017, only MeJA was applied.

	2016, Fargo	2017, Fargo	2017, Mooreton
Planting date	4 May	6 June	9 May
Early season treatments			
date	29 June	13 July	8 Jun; 14 July
days after sowing	56	37	30; 66
Headline & late season treatments			
date	26 Aug	30 Aug	21 Aug
days before harvest	33	30	46
Harvest date	28 Sept	29 Sept	6 Oct

For all experiments (Fargo in 2016; Fargo and Mooreton in 2017), plants were mechanically defoliated and the roots were hand-harvested, washed, and stored at 5°C (41°F) and 95% relative humidity for up to 100 days. Respiration rate, sucrose content, loss to molasses, recoverable sugar yield, and invert sugar concentration were determined after 30 and 100 days in storage using established protocols (Campbell et al., 2012).

Data were analyzed using the GLM procedure of SAS (ver. 9.1, SAS Institute, Inc., Cary, NC) with  $\alpha = 0.05$ . Fisher's LSD was used to identify significant differences between treatment means.

## RESULTS

In 2016, MeJA and SA treatments had little effect on root yield or sucrose yield at harvest, or storage properties at 30 or 100 days after harvest (Tables 2, 3, and 4). Relative to the untreated control, no statistical differences were noted

except for an increase in root respiration rate after 30 days in storage for roots that received the early MeJA treatment (Table 3) and an increase in recoverable sugar per ton after 100 days in storage for roots that received a late MeJA treatment + Headline (Table 4). Stadium had no statistically significant effects on any storage property after 30 or 100 days storage (Tables 3 and 4).

In 2017, poor germination for the Fargo, ND field experiment required that the field be replanted. The Fargo field was replanted on 6 June and no treatments were applied until mid-July to allow plants sufficient time to become established. At harvest, no significant differences in root yield, sucrose content, recoverable sugar per ton, recoverable sugar per acre, or sucrose loss to molasses were found for any treatments (Table 5). In the 2017 Mooreton, ND experiment, all treatments had similar root yield, sucrose content, recoverable sugar per ton, and sucrose loss to molasses at time of harvest (Table 6). A significant 1149 lbs/acre increase in recoverable sugar per acre, however, was found for plants receiving a mid-June treatment of 0.01  $\mu$ M MeJA + a late August Headline treatment. Storage studies for roots from both locations are ongoing.

**Table 2.** Harvest data from 2016 Fargo, ND field experiment. Means within a column followed by different letters are significantly different based upon Fisher's LSD, with  $\alpha = 0.05$ .

Treatment	yield (tons/acre)		root weight (g/root)		sucrose (%)		loss to molasses (%)		Recoverable sugar			
									per ton (lbs/ton)		per acre (lbs/acre)	
control--untreated	17.4	a	609	a	16.8	ab	1.66	a	303	ab	5287	a
early MeJA	17.5	a	712	a	16.7	ab	1.73	a	299	ab	5212	a
late MeJA	20.1	a	667	a	16.6	ab	1.68	a	298	ab	6011	a
early SA	18.0	a	701	a	16.1	b	1.88	a	285	b	5049	a
late Headline	19.5	a	690	a	17.2	ab	1.62	a	311	ab	6082	a
early MeJA + Headline	18.1	a	784	a	17.0	ab	1.41	a	311	ab	5643	a
late MeJA + Headline	18.1	a	619	a	17.6	a	1.63	a	318	a	5723	a
early SA + Headline	18.7	a	667	a	16.5	ab	1.84	a	294	ab	5491	a

**Table 3.** Respiration rate and invert sugar concentration 30 and 100 days after harvest (DAH) for the 2016 Fargo, ND field experiment. Means within a column followed by different letters are significantly different based upon Fisher's LSD, with  $\alpha = 0.05$ . Treatment means that are significantly different from the control are highlighted in red.

Treatment	respiration (mg CO <sub>2</sub> /kg/h)				inverts (g/100 g sucrose)			
	30 DAH		100 DAH		30 DAH		100 DAH	
	control--untreated	3.67	a	3.88	b	0.75	ab	0.48
early MeJA	3.49	a	4.82	a	0.93	ab	0.55	a
late MeJA	3.90	a	3.93	ab	0.84	ab	0.53	a
early SA	3.71	a	4.25	ab	1.02	ab	0.52	a
late Headline	3.60	a	4.18	ab	0.84	ab	0.56	a
early MeJA + Headline	3.75	a	3.80	b	0.80	ab	0.43	a
late MeJA + Headline	4.01	a	4.17	ab	0.58	b	0.53	a
early SA + Headline	3.66	a	3.96	ab	0.66	ab	0.73	a
Stadium	3.85	a	4.43	ab	1.06	a	0.54	a
Stadium + Headline	3.59	a	3.94	ab	0.67	ab	0.56	a

**Table 4.** Sucrose content, loss to molasses and recoverable sugar per ton 30 and 100 days after harvest (DAH) for the 2016 Fargo, ND field experiment. Means within a column followed by different letters are significantly different based upon Fisher's LSD, with  $\alpha = 0.05$ . Treatment means that are significantly different from the control are highlighted in red.

Treatment	sucrose (%)				loss to molasses (%)				recoverable sugar per ton (lbs/ton)			
	30 DAH		100 DAH		30 DAH		100 DAH		30 DAH		100 DAH	
control--untreated	17.4	a	17.2	ab	1.73	a	1.94	a	313	a	308	b
early MeJA	17.0	a	16.7	b	1.80	a	1.77	a	305	a	303	b
late MeJA	17.6	a	17.3	ab	1.71	a	2.04	a	317	a	308	b
early SA	17.0	a	16.7	b	1.82	a	2.01	a	304	a	301	b
late Headline	17.6	a	17.2	ab	1.76	a	1.92	a	316	a	311	ab
early MeJA + Headline	17.5	a	17.2	ab	1.84	a	1.91	a	314	a	310	ab
late MeJA + Headline	18.1	a	18.3	a	1.85	a	1.92	a	325	a	331	a
early SA + Headline	17.2	a	16.7	b	1.66	a	1.87	a	312	a	301	b
Stadium	16.8	a	16.7	b	1.85	a	2.00	a	301	a	300	b
Stadium + Headline	17.0	a	17.0	b	1.78	a	1.99	a	306	a	306	b

**Table 5.** Harvest and storage data for the 2017 Fargo, ND field experiment. Means within a column followed by different letters are significantly different based upon Fisher's LSD, with  $\alpha = 0.05$ . Determination of storage properties for these roots is in progress.

Treatment	yield tons/acre		recoverable sugar lbs/acre		recoverable sugar lbs/ton		loss to molasses %		sucrose content		respiration rate			
									0 DAH	30 DAH	30 DAH			
											mg CO <sub>2</sub> /kg/h			
control--untreated	16.8	abcd	5552	abc	330	a	1.42	a	17.9	a	18.7	a	4.24	ab
Headline (HDL)	16.1	bcd	5052	cd	316	a	1.90	a	17.5	a	18.8	a	3.80	b
Jul MeJA, 0.01 $\mu$ M	16.7	abcd	5534	abc	331	a	1.51	a	18.1	a	18.7	a	4.31	ab
Jul MeJA, 10 $\mu$ M	16.1	bcd	5150	bcd	319	a	1.65	a	17.6	a	19.3	a	4.40	ab
Jul MeJA, 0.01 $\mu$ M + HDL	17.5	abc	5703	ab	326	a	1.54	a	17.8	a	19.3	a	4.16	ab
Jul MeJA, 10 $\mu$ M + HDL	15.9	cd	5060	cd	318	a	1.59	a	17.5	a	19.0	a	4.38	ab

**Table 6:** Harvest and storage data for the 2017 Mooreton, ND field experiment. Means within a column followed by different letters are significantly different based upon Fisher's LSD, with  $\alpha = 0.05$ . Values that are statistically different from untreated controls are highlighted in red. Determination of storage properties for these roots is in progress.

Treatment	yield tons/acre		recoverable sugar lbs/acre		recoverable sugar lbs/ton		loss to molasses %		sucrose content		respiration rate			
									0 DAH	30 DAH	30 DAH			
											mg CO <sub>2</sub> /kg/h			
control--untreated	32.4	ab	7993	bc	293	a	1.58	a	16.2	ab	16.2	abc	4.32	a
Headline (HDL)	29.9	b	7454	c	285	a	1.66	a	15.9	ab	15.9	bc	4.21	a
Jun MeJA, 0.01 $\mu$ M	30.1	b	7497	c	292	a	1.62	a	16.2	ab	16.1	abc	4.14	a
Jun MeJA, 10 $\mu$ M	31.4	b	7644	bc	286	a	1.49	a	15.8	b	15.9	c	4.09	a
Jul MeJA, 0.01 $\mu$ M	32.4	ab	8520	ab	297	a	1.45	a	16.3	ab	16.6	a	4.03	a
Jul MeJA, 10 $\mu$ M	30.8	b	7646	bc	287	a	1.53	a	15.9	b	16.1	abc	4.09	a
Jun MeJA, 0.01 $\mu$ M + HDL	35.4	a	9142	a	299	a	1.18	a	16.4	a	16.5	ab	4.06	a
Jun MeJA, 10 $\mu$ M + HDL	33.4	ab	8438	abc	295	a	1.43	a	16.2	ab	16.3	abc	4.02	a
Jul MeJA, 0.01 $\mu$ M + HDL	31.8	ab	8045	bc	291	a	1.46	a	16.0	ab	16.3	abc	4.34	a
Jul MeJA, 10 $\mu$ M + HDL	30.8	b	7678	bc	291	a	1.53	a	16.1	ab	16.3	abc	4.19	a

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