

MUSKMELON (*Cucumis melo* 'Sivan')
Manganese toxicity

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Field evaluation of rescue treatments for manganese toxicity in muskmelon production in Maryland, 2015.

Manganese toxicity is a frequent problem in muskmelon grown in low pH sandy soils, as commonly used starter solutions (i.e. ammonium nitrate, urea, or urea-ammonium nitrate) acidify the soil. Leaf symptoms usually appear when fruit begin to net and are often misdiagnosed as a foliar plant disease. Currently, little can be done to correct manganese toxicity during the season. The experiment was conducted at the University of Maryland's Lower Eastern Shore Research and Education Center, Salisbury. The field of Fort Mott loamy sand soil had been previously planted with corn and received no lime application after harvest. Soil pH was 6.0 on 11 Dec 2014. The experiment was conducted as a randomized complete block design with three replicates. Rescue treatments included: Botanicare's SilicaBlast, Growth Products' 0-0-25 solution, and General Hydroponics' pH Up. Non-treated plots served as a control. Plots consisted of single row raised beds, 90 feet long with 33 plants on 7-ft centers, with 1.25 mil black plastic mulch and drip irrigation. The field was fertilized with a 16-03-15 (N-P-K) (650 lb/A) starter solution before the plastic was laid on 27 May. Muskmelon seedlings (cultivar 'Sivan') were treated with AdmirePro (8 oz/A) on 9 Jun and transplanted into the field on 12 Jun; plants were 32 in. apart in the row. Weed management was accomplished by rototilling and hand-weeding. Insects were managed with: Entrust (6 oz/A) applied on 26 Jun, 29 Jul and 24 Aug; and PyGanic (32 oz/A) applied on 9 Jul, and 7 and 13 Aug. Foliar diseases were controlled with applications of copper fungicides (Champ at 22 oz/A on 29 Jul and 7 Aug; and Nordox at 1 lb/A on 6, 13 and 19 Aug). Soil pH was 4.4 on 29 Jun 2015. Rescue treatments for manganese toxicity were initiated after onset of foliar symptoms and were applied for 1 hr through the drip (0.67 gal/A) on 21 and 29 Jul, and 13 and 19 Aug. Muskmelon foliage from 11 plants per treatment per replicate was evaluated for symptoms of manganese toxicity using a 1-5 scale (anchored by 1=no symptoms and 5=severe symptoms). Foliar manganese concentration was calculated from samples consisting of 19 young, fully mature leaves (no petioles) per treatment per replicate; analysis by A&L Eastern Laboratories in Richmond, VA. Soil pH under the plastic mulch was measured with composite soil samples consisting of seven surface (0-8 inch) soil cores per treatment per replicate; analysis by the University of Delaware Soil Testing Laboratory in Newark. Mature fruit were weighed and assessed for soluble sugars on 3, 8, 12, 18 and 24 Aug. Foliar toxicity ratings, manganese concentration, soil pH, and harvest data were analyzed using JMP version 10, and means separated using Tukey's HSD test ($p=0.05$).

Rainfall in Jun, Jul and Aug was 9.1, 4.3 and 4.0 in., respectively. However, no precipitation was recorded within 24 hours of any treatment application. No rescue treatment significantly reduced foliar symptoms or improved soil pH under the plastic mulch. Although plants treated with SilicaBlast had significantly lower foliar concentrations of manganese at the end of the season than plants treated with the 0-0-25 solution or the non-treated control, the concentration exceeded the normal healthy range (50-250 ppm) for the vegetable crop. Plants treated with a rescue treatment had significantly larger average fruit weights, as compared to the non-treated control. However, soluble sugars were not significantly different among treatments. All plants (including the non-treated control) had total yields within two standard deviations of the mean (272 ± 20) (data not shown).

Treatment ^y	Manufacturer	Active ingredient ^x	Mn toxicity rating ^z				Weight (lb) ^y	Brix (%) ^u
			17 Jul	27 Jul	3 Aug	8 Aug		
Control			3.09	3.48	4.24	4.64	1.45 a	11.4 a
SilicaBlast	Botanicare	2% Si, 0.5% K ₂ SiO ₃	3.67	3.97	4.36	4.24	1.66 b	11.6 a
0-0-25 solution	Growth Products	25% K ₂ CO ₃	3.52	3.76	3.97	4.30	1.60 b	11.3 a
pH Up	General Hydroponics	10-30% K ₂ CO ₃	3.36	3.97	4.36	4.21	1.66 b	11.8 a

^z Data based on foliar ratings of 11 plants per treatment per replicate using a 1-5 scale, where 1=no symptoms, 2=minimal symptoms (less than 10%), 3=moderate symptoms (10-25%), 4=enhanced moderate symptoms (25-50%) and 5=severe symptoms (more than 50%).

^y Treatments did not differ by date (17 Jul $p=0.175$; 27 Jul $p=0.258$; 3 Aug $p=0.206$; and 8 Aug $p=0.160$).

^x Abbreviations: Mn = manganese; Si = silicon, K₂SiO₃ = potassium silicate; K₂CO₃ = potassium carbonate.

^v Up to six mature fruit weighed individually on each evaluation date per treatment per replicate. Average fruit weight was significantly different between the control and rescue treatments ($p=0.022$). Mean separation by Tukey's HSD test ($p=0.05$).

^u Brix (percent soluble sugars) determined for 19 fruit per treatment per replicate, staggered across harvest dates. Brix was not significantly different among treatments ($p=0.325$).

Treatment	Foliar Mn concentration (ppm) ^z			Soil pH ^w	
	20 Jul (0 applications)	3 Aug (2 applications)	26 Aug ^y (4 applications)	3 Aug (2 applications)	26 Aug (4 applications)
Control	1543	1029	454 a	4.3	4.1
SilicaBlast	1363	888	322 b	4.4	4.3
0-0-25 solution	1553	888	440 a	4.3	4.3
pH Up	1353	937	382 ab	4.2	4.3

Number in parentheses indicates number of rescue treatment applications prior to foliage or soil collection.

^z Data based on foliar samples of 19 young, fully mature leaves per treatment per replicate. Normal Mn range is 50-250 ppm.

^y Mn concentration was significantly different by treatment on 26 Aug ($p=0.009$), but not on 20 Jul ($p=0.741$) or 3 Aug ($p=0.790$). Mean separation by Tukey's HSD test ($p=0.05$).

^w Data based on composite samples of seven soil cores collected under the plastic mulch per treatment per replicate.

Recommended soil pH for muskmelon production is between 6.0 and 6.5. Soil pH was not significantly different by treatment ($p=0.130$) or date ($p=0.421$).