Organic Transplant Media and Tomato Performance 2007

Betsy Leonard and Anu Rangarajan
Dept. of Horticulture, Cornell University, Ithaca, NY 14853
bai1@cornell.edu

Successful transplant production begins with good growing media. Healthy vigorous transplants will be less susceptible to insects, diseases and transplant shock leading to better crop performance. Formulating organic potting mixes is especially challenging. Organic sources of nitrogen such as compost can be inconsistent. Compost can change over time with storage and release nutrients unpredictably. Many organic potting mixes are supplemented with organic nitrogen sources such as alfalfa meal, soybean meal and blood meal. Another alternative N source is vermicompost, which often has more nitrate than the compost starting material. We compared dairy based thermogenic, dairy based vermicompost and hog based vermicompost along with plant based nitrogen sources for their impacts on tomato transplant growth.

When evaluating a potting mix for tomato transplant production, consider the following properties:

Physical Properties
- Particle size appropriate to container
- Density will hold up plants
- Good aeration and water holding capacity
- 10-20% air space, water (40-60% common)

Chemical Properties
- Nutrients levels low to moderate
- Salts and EC: 4-8 dS/m (saturated paste extraction)
- pH near 7

Biological Properties
- No plant pathogens
- Decomposition rate should be low

Need adequate supply of organic nutrients for growth
- Organic sources often inconsistent
- Compost based media-select a well-cured compost
- Some soluble fertilizer sources are available, such as fish meals

Release of nutrients from organic sources difficult to predict
- Some will result in 'composting'
- Others increase salts

In 2007, we compared twenty one potting media including an industry standard SunGro and a peat, perlite, lime and vermiculite mix with no added nutrients (control). The control media was the base mix for other mixes. This mix was amended with thermogenically composted dairy manure, the same dairy manure feedstock but vermicomposted, hog based vermicompost, alfalfa meal (Eagle Mix 3-1-5 Alfalfa Meal, Bradfield, Inc, Springfield, Missouri and organic alfalfa meal, (Lakeview Organic, Penn Yan, NY), sesame meal (produced by the sesame oil industry), blood meal mixture and organic soybean meal (Lakeview Organic, Penn Yan, NY). In some cases, amendments were combined, to assess the additive effects to the media. The plant-based amendments were ground to a 2 mm mesh size prior to incorporating into the base mix. All mixing occurred one week prior to seeding.

Media Treatment

Base (control)	70 peat moss: 15 vermiculite: 15 perlite (v/v) and lime (5 lbs. per yd.).
Base plus Blood meal mix	Base mix with blood meal, green sand and rock phosphate (5 lbs/yd^3)
Alfalfa meal 1, 2.5 and 5% (v/v)	Base mix plus Organic alfalfa meal
Bradfield Alfalfa meal 1, 2.5 and 5% (v/v)	Base mix plus Bradfield alfalfa meal (Eagle mix 3-1-5) which includes meat meal
Sesame meal 1 and 2.5% (v/v)	Base plus sesame meal
Soybean meal 1 and 2.5% (v/v)	Base plus organic soybean meal
Thermogenic compost 20% (v/v)	Base plus dairy thermogenic compost
Thermogenic compost 20% (v/v) plus Bradfield Alfalfa meal 1% (v/v)	Base plus dairy thermogenic compost and alfalfa meal
Thermogenic compost 20% (v/v) plus Blood meal mix	Base plus dairy thermogenic compost and blood meal, green sand and rock phosphate
Hog Vermicompost 20% (v/v)	Base plus hog vermicompost
Hog Vermicompost 20% (v/v) plus Blood meal	Base plus hog vermicompost plus blood meal, green sand and rock phosphate
Dairy vermicompost 20% (v/v)	Base plus dairy vermicompost
Dairy vermicompost 20% (v/v) plus Bradfield Alfalfa meal 1% (v/v)	Base plus dairy vermicompost and alfalfa meal
Dairy vermicompost 20% (v/v) plus Blood meal	Base plus dairy vermicompost and blood meal, green sand and rock phosphate
Sun Gro	Commercial organic peatlite mix from Sunshine

Cornell University now has an organically managed greenhouse at the Guterman Research Facility that is being operated to comply with all the NOFA-NY (local certifier) requirements. This greenhouse space was used for all mixing and transplant experiments.

Treatment mixes were placed into 72-cell flats and watered one week prior to seeding. Before planting, sub-samples of all potting mix treatments were sent to the University of Massachusetts Soil and Plant Tissue Testing Laboratory, Amherst, MA, for chemical analysis (Table 1). Tomato seedling production started on February 19, 2007. Untreated seed of fresh market tomato cv 'Mt. Fresh' (Harris Seeds, Rochester, NY) was planted in these mixes. Plants were watered daily and no additional nutrients were added. Seed germination, soil electrical conductivity and plant weights were measured to see what impacts the potting mixes had on transplant production. Media pH and EC were measured on February 19, 28 and March 7, 12, 19 and 26. Germination counts were recorded on February 26, 28, and March 2, 5, 7 and 9. Four plants from each treatment were cut at soil level, dried and weighed to determine aboveground biomass on March 12, 19, 26 and April 2.

Table 1. Compost analysis results from University of Massachusetts 2007.

media treatment	Bulk density (g/cm3)	coarse frag	pH	EC (ds/M)	% Total N	mg/kg Nitrate-N	mg/kg Ammonium-N	% OM	% Estimated Organic C	Carbon/ N ratio
Base	0.4	6.5	3.7	0.45	0.83	52	220	58.1	31.4	37.8
Base plus Blood meal	0.4	5.7	3.9	0.51	1.39	78	437	58.7	31.7	22.7
Bradfield 1%	0.3	6.9	3.7	0.97	1.06	49	98	60.9	32.9	31.1
Bradfield 2.5%	0.3	5.9	3.8	1.58	1.15	63	50	61.6	33.3	29.0
Bradfield 5%	0.3	5.5	3.9	2.77	1.36	95	95	63.5	34.3	25.3
Alfalfa 1%	0.3	9.6	3.9	0.52	1.1	49	198	62.5	33.8	30.7
Alfalfa 2.5%	0.3	7.8	4.1	0.66	1.4	94	176	65.9	35.6	25.4
Alfalfa 5%	0.3	5.5	4.2	0.93	1.48	78	190	66.0	35.6	24.1
Sesame 1%	0.2	10.7	3.8	0.39	1.42	40	120	64.1	34.6	24.4
Sesame 2.5%	0.3	12.5	3.9	0.47	1.93	39	91	66.2	35.7	18.5
Dairy Vermicompost 20%	0.2	7.5	5.1	3.02	1.77	771	154	63.9	34.5	19.5
Dairy Vermicompost 20% plus Blood meal	0.3	8.8	5.2	2.9	2.13	833	539	62.9	34	15.9
Dairy Vermicompost 20% plus Bradfield Alf 1%	0.3	9.2	5	2.52	1.7	853	110	62.6	33.8	19.9
DairyThermicompost 20%	0.4	9.0	5.5	2.47	1.62	318	169	65.1	35.2	21.8
DairyThermicompost 20% plus Blood meal	0.4	10.7	5.5	2.11	2.01	286	187	63.5	34.3	17.1
Dairy Thermicompost 20% plus Bradfield Alf 1%	0.3	9.3	5.4	2.09	1.66	972	278	63.3	34.2	20.6
Hog Vermicompost 20%	0.4	8.1	4.7	1.90	1.20	1034	122	47.3	25.5	21.3
Hog Vermicompost 20% plus Blood meal	0.5	8.4	4.8	2.05	1.48	1483	661	46.0	24.8	16.8
SunGro	0.3	7.9	5.7	1.12	0.77	1242	30	63.6	34.3	44.7
Soybean meal 1%	0.3	9.6	3.8	0.46	1.38	52	26	59.9	32.3	23.5
Soybean meal 2.5%	0.3	10.2	4.1	0.52	1.88	12	37	63.6	34.3	18.3
Bloodmeal mix	1.19		6.3	3.86	4.97	24	179	30.9	16.7	3.4

1 dS/m =1mmho/cm = 1 mS/cm = 1000 uS/cm

Results and Discussion

Most organic potting mixes tested supported good tomato transplant plant growth. All transplant mixes had similar physical structure, as indicated by bulk density values (Table 1). Compost amended mixes had much higher initial Nitrate-N content compared to plant amended mixes. Plants grown in Dairy Vermicompost with blood meal, Dairy Thermicompost with blood meal and Hog Vermicompost with blood meal were significantly larger than plants in other mixes (Table 2). Initial ammonium-N levels were 2-3 times higher in mixes with blood meal added. The addition of the blood meal mix increased fresh and dry weights of plants grown in these manure based composts (Table 2 and Figure 1). Although, blood meal did not enhance growth as dramatically when added to the peat base mix only compost based mixes. Adding blood meal seems to stimulate microbial activity in these mixes especially around March 9 (Figure 2). EC peaks higher in mixes with blood meal compared to the same mix without it. Bradfield alfalfa 5% produced a significantly larger plant than Alfalfa 5% which

can be explained by Bradfield's additional ingredients (meat meal, molasses and sulfate of potash). Alfalfa 5% mix started with 0.93 ds/M EC while Bradfield 5% mix was nearly triple (Table 1). Germination rates varied among the different treatments (p=0.0001) and were above 90% for all treatments except for Soybean meal 1 and 2.5%, which had final rates of 85 and 66% (Table 2). Both mixes had very low initial levels of nitrate-N and ammonium-N (Table 1).

Conclusion

Compost based mixes enhanced with blood meal, rock phosphate and greensand produced stocky healthy tomato plants. Adding blood meal seems to accelerate nutrient release in compost based potting mixes. Alfalfa based mixes also produced smaller acceptable transplants. The commercial mix SunGro seemed to run out of nutrients more quickly than other mixes.

Amendment Sources

Alfalfa meal and Soybean meal	Lakeview Organic Grain, Penn Yan, NY 14527, 315-531-1038
Dairy based Vermicompost	RT Solutions (dba Worm Power) www.wormpower.net
Hog based Vermicompost	www.natureworksorganics.com
Bradfield Alfalfa meal	www.bradfieldorganics.com
Sun Gro	Sun Gro Horticulture , www.sungro.com

Table 2. Final plant weights, medium pH, EC and germination rates of 21 potting mixes.

	Per plant				Final					
media treatment	fresh wt(g)		dry wt(g)		pH		EC(uS/cm)		% germination	
Base	0.58	i[z]	0.11	j	4.8	j	139	g	95	ab
Base plus Blood meal	0.86	hi	0.10	j	6.0	f	184	defg	94	ab
Bradfield 1%	2.12	fg	0.34	fgh	5.0	ij	168	efg	94	ab
Bradfield 2.5%	3.61	de	0.47	de	5.0	ij	193	defg	94	ab
Bradfield 5%	5.41	c	0.65	c	5.3	gh	224	cde	90	bc
Alfalfa 1%	1.58	gh	0.28	fghi	5.0	ij	167	efg	93	ab
Alfalfa 2.5%	3.32	de	0.46	de	5.2	hi	191	defg	93	ab
Alfalfa 5%	3.84	d	0.52	d	5.6	g	197	defg	91	ab
Sesame 1%	2.78	ef	0.39	efg	4.8	j	147	fg	93	ab
Sesame 2.5%	3.53	de	0.39	ef	5.6	g	199	defg	94	ab
Dairy Vermicompost 20%	3.33	de	0.49	de	6.7	cd	250	bcd	93	ab
Dairy Vermicompost 20% plus Blood meal	9.68	a	1.19	a	6.0	f	250	bcd	93	ab
Dairy Vermicompost 20% plus Bradfield Alf 1%	3.58	de	0.53	cd	6.6	de	272	bc	93	ab
Dairy Thermicompost 20%	0.78	hi	0.11	j	7.3	a	302	ab	94	ab
DairyThermicompost 20% plus Blood meal	6.98	b	0.78	b	6.4	e	356	a	95	a
Dairy Thermicompost 20% plus Bradfield Alf 1%	2.66	ef	0.39	ef	7.0	bc	356	a	96	a
Hog Vermicompost 20%	3.74	d	0.58	cd	7.0	bc	216	cdef	94	ab
Hog Vermicompost 20% plus Blood meal	8.93	a	1.08	a	6.9	c	199	defg	95	ab
SunGro	1.59	gh	0.27	ghi	7.2	ab	185	defg	95	a
Soybean meal 1%	2.73	ef	0.27	hi	5.4	gh	251	bcd	85	c
Soybean meal 2.5%	1.64	gh	0.16	ij	6.3	e	358	a	66	d

[z] Values in the same column followed by the same letter are not significantly different at $p<0.05$.

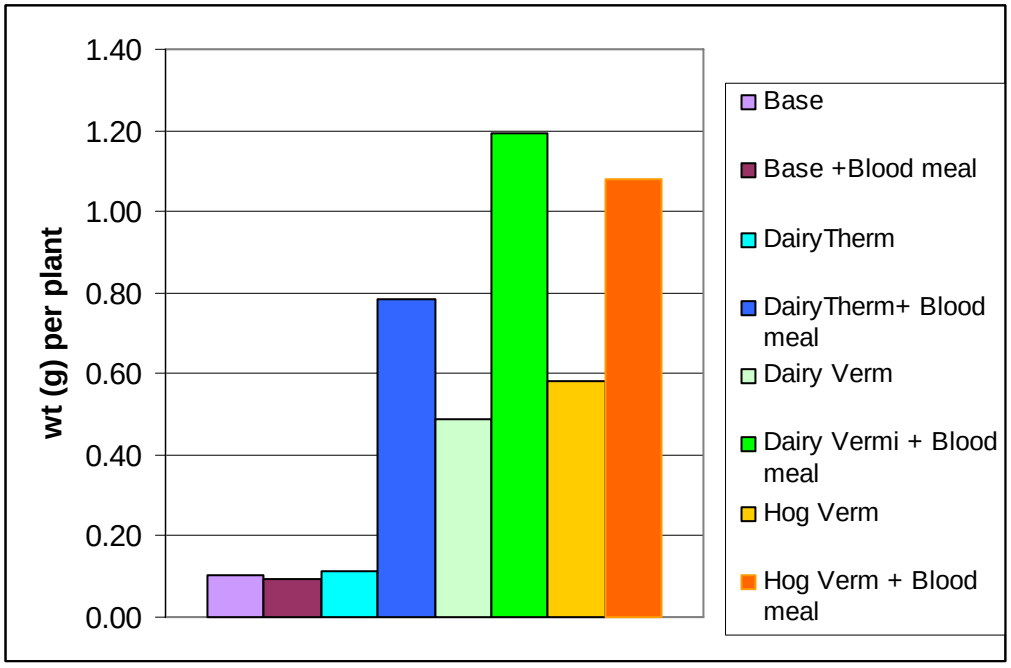

Figure 1. Final dry weights of plants grown in eight potting mixes in 2007.

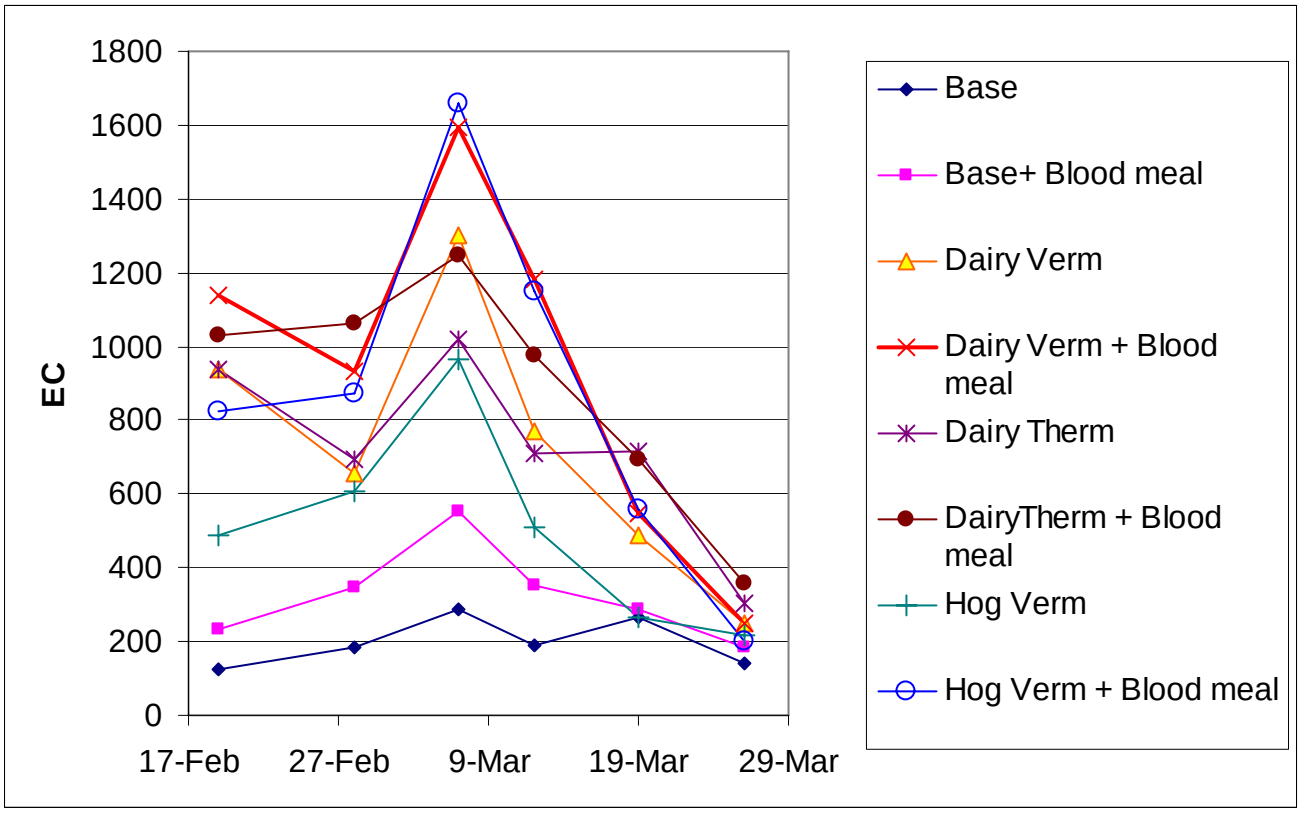

Figure 2. Electrical conductivity (EC) of eight potting mixes in 2007.