Impact of Temperature on Performance of Vermicompost Amended Transplant Media for Growth of Vegetable Seedlings

Introduction

Successful transplant production begins with selecting good growing media. Healthy vigorous transplants will be less susceptible to insects, diseases and transplant shock, leading to improved overall crop performance. Formulating organic potting mixes is especially challenging. Organic sources of nitrogen, such as compost, can be inconsistent. Compost chemical, biological and physical characteristics can change over time with storage; as a result, nitrogen (N) mineralization and availability to plants can be unpredictable. An alternative to traditional thermophillic compost is vermicompost. Vermicompost has more soluble nitrogen than thermophillic compost. Past research in the Rangarajan lab has shown improved transplant growth and crop yields with vermicompost compared to thermophillic compost.

To optimize the microbially-mediated release of plant nutrients from organic amendments such as vermicompost, the temperature of the growing environment must be controlled. Warmer temperatures will increase both the nutrient release and plant growth. Evaluation of a vermicompost-amended potting media in a grower transplant facility found that the greenhouse temperature had a significant impact on media performance. This project examines the performance of vermicompost-based potting media under different temperature regimes to identify ideal ranges for use of this type of media.

Methods

The base potting mix was made of sphagnum peat moss, coarse grade perlite, vermiculite and dolomitic lime (1.1 lbs/yd^3). Sphagnum peat moss was first broken up in a soil mixer (Sprout Waldron, Model B-28, Muncy, PA) and then vermiculite and perlite were added at a ratio of 70% peat, 15% vermiculite and 15% perlite mix. Once the components were mixed, lime was added. Vermicompost (Worm Power, Avon, NY) and blood meal mix (Fertrell, Bainbridge, PA) were added to the base mix (Table 1). A media with only bloodmeal supplementation was not included based upon poor performance in past experiments.

Treatment mixes were placed into 200-cell flats one week prior to seeding and watered. 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 2). Cabbage cv 'Farao' or pepper cv 'New Ace' were seeded in these mixes and then flats placed into one of four greenhouse temperature regimes: 90º F day / 80º F night; 80/70; 70/60; or 60/50 (cabbage only). Plants were watered as required and no additional nutrients were added. Plants were grown in these temperature regimes to marketable size or up to 8 weeks if growth was slow. Final transplant above ground dry weight (g), length to growing tip (cm) and harvest index (dry wt/length) were recorded. The experiment was repeated twice and results combined for statistical analysis. Run was treated as a replicate, since the greenhouse temperature regimes could not be replicated except through time.

Table 1. Organic transplant media evaluated for the production of cabbage and peppers.

Treatment	Formulation
Base Mix	70% Sphagnum Peat Moss, 15% vermiculite, 15% perlite.
Base mix plus dairy vermicompost 10% (v/v)	Cornell base mix plus dairy vermicompost
Cornell base mix plus Dairy vermicompost 10% (v/v) plus Blood meal mix	Cornell base mix plus dairy vermicompost and blood meal, green sand and rock phosphate (7 lbs/yd^3)

Table 2. Nutrient analysis of potting media.

					mg/kg			
Run	media	pH	EC (ds/M)	Total N (%)	Nitrate-N	Ammonium-N	Soluble N	Carbon / N ratio
1	Base	4.9	0.19	0.7	15	89	104	54
1	Base + 10% Vermicompost	5.5	2.28	1.3	672	137	809	28
1	Base + 10% Vermicompost + Blood meal	6.6	2.55	1.6	13	1083	1096	21
2	Base	6.1	0.29	0.7	47	157	204	52
2	Base + 10% Vermicompost	6.1	4.4	1.8	1483	148	1631	20
2	Base + 10% Vermicompost + Blood meal	6.8	2.54	1.7	37	1107	1144	20

Results and discussion

Growth of cabbage and pepper transplants varied by the run, the potting media and the temperature regime (Table 3, 4). Dry wts were similar among the two runs of the experiment, and a marketable cabbage transplant averaged 0.2 g dry wt and for peppers averaged 0.1 g. Plant lengths were shorter in the second experiment, which started approximately two weeks later than the first. Light levels were significantly higher by the end of the experiment which would reduce plant elongation in the 200 cell trays.

The performance of the potting media varied by the greenhouse temperature regime (Table 3,4; Figures 1, 2). The base mix did not produce marketable transplants for either crop, at any temperature, within the treatment period. Inadequate plant nutrients were provided by the base mix (Table 2).

Adding vermicompost to the media improved growth slightly, but not significantly, for both crops, at all temperature regimes (Figure 1,2). A temperature of 80/70 F produced cabbage transplants in this media close to the desired marketable size (0.2 g) within 6 weeks. In the case of peppers, however, the greenhouse temperature 90/80 was required to produce a marketable transplant within six weeks.

When bloodmeal was added to each the base + 10% vermicompost mix, crop dry weight was nearly doubled at all temperature regimes (Figures 1,2) . A very high quality cabbage transplant was produced at the 60/50 regime and at the 70/60 regime for peppers (Figure 3). These represent the coolest temperature regimes tested in the experiments, hence the most economical for growers.

These studies suggest that growers interested in using vermicompost in potting media should supplement with additional nutrients to produce a healthy transplant. The nitrogen available from vermicompost was inadequate to produce a high quality transplant within six to eight weeks. The highest temperature (90/80 F) was included to determine if very warm temperatures would improve the release of nutrients from the vermicompost. Total plant dry weight was not improved, and dry matter accumulation was likely inhibited at this high temperature.

Amending the vermicompost media with blood meal resulted in a doubling of dry weights from the low to high temperature as well as within any particular temperature regime. No additional nutrient supplementation was necessary. This represents a highly cost effective strategy to improve vermicompost performance, reduce transplant production time, and insure high transplant quality. This media would be suitable for use in organic or conventional transplant production.

Table 3. Growth of cabbage tranplants in various potting media under different greenhouse day/night temperatures.

Factor	Dry wt (g)	Length (cm)	Harvest index
Experiment			
1	0.19	7.8	0.033
2	0.17	4.9	0.037
Greenhouse Temp (F)			
60/50	0.13	3.1	0.040
70/60	0.17	3.2	0.050
80/70	0.24	9.1	0.028
90/80	0.18	9.9	0.019
Potting Media [z]			
Base	0.10	3.9	0.031
Base10v	0.15	6.4	0.031
Base10vbm	0.30	8.8	0.042
P>F [y]			
Experiment	ns	**	ns
Greenhouse Temp	**	**	**
Potting Media	**	**	**
Temp*Media	*	**	ns

[z] Base media amended with 10% vermicompost (10v) and blood meal (bm).

[y] Significant at 5% (*), 1% (**) or non-significant (ns).

Table 4. Growth of pepper tranplants in various potting media under different greenhouse day/night temperatures.

Factor	Dry wt (g)	Length (cm)	Harvest index
Experiment			
1	0.09	9.9	0.008
2	0.09	7.7	0.011
Greenhouse Temp			
70/60	0.05	4.6	0.010
80/70	0.10	9.7	0.009
90/80	0.12	12.2	0.009
Potting Media [z]			
Base	0.03	5.2	0.007
Base10v	0.07	8.5	0.009
Base10vbm	0.16	12.8	0.013
P>F [y]			
Experiment	ns	**	**
Greenhouse Temp	**	**	ns
Potting Media	**	**	**
Temp*Media	*	**	ns

[z] Base media amended with 10% vermicompost (10v) and blood meal (bm).

[y] Significant at 5% (*), 1% (**) or non-significant (ns).

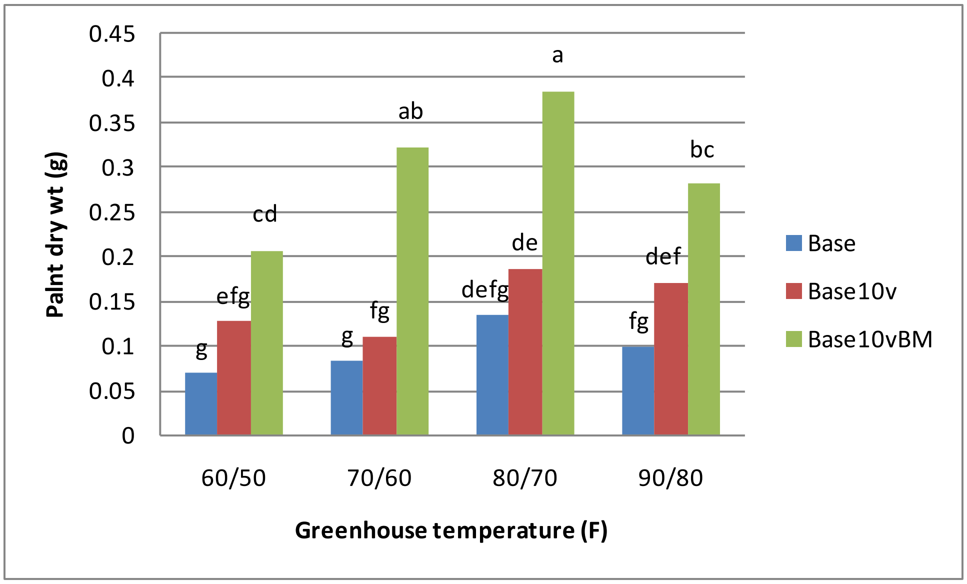

Figure 1. Final average dry weight of cabbage transplants grown in three potting media and at four greenhouse temperatures. Means with the same letter are not significantly different.

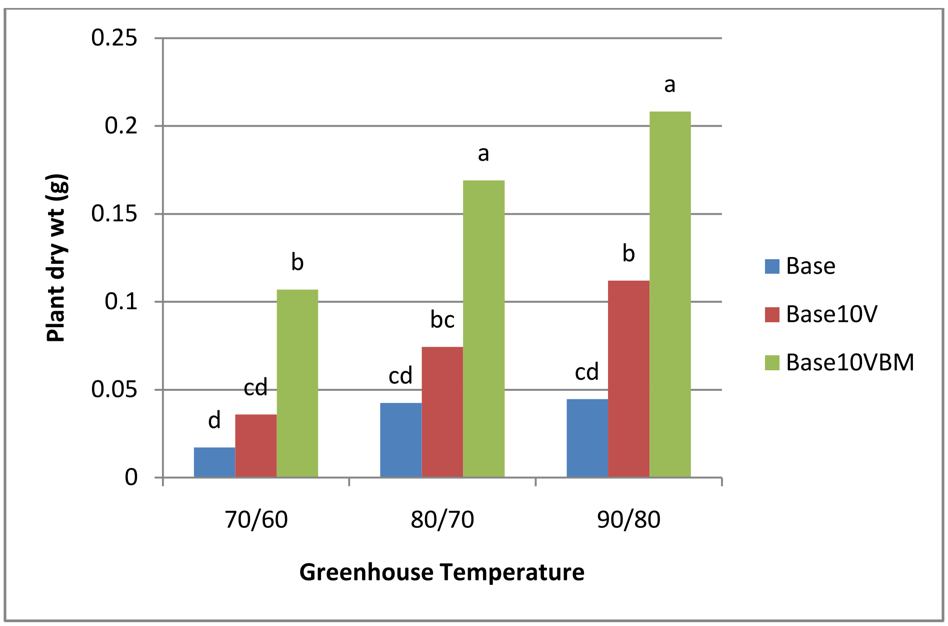

Figure 2. Final average dry weight of pepper transplants grown in three potting media and at four greenhouse temperatures. Means with the same letter are not significantly different.

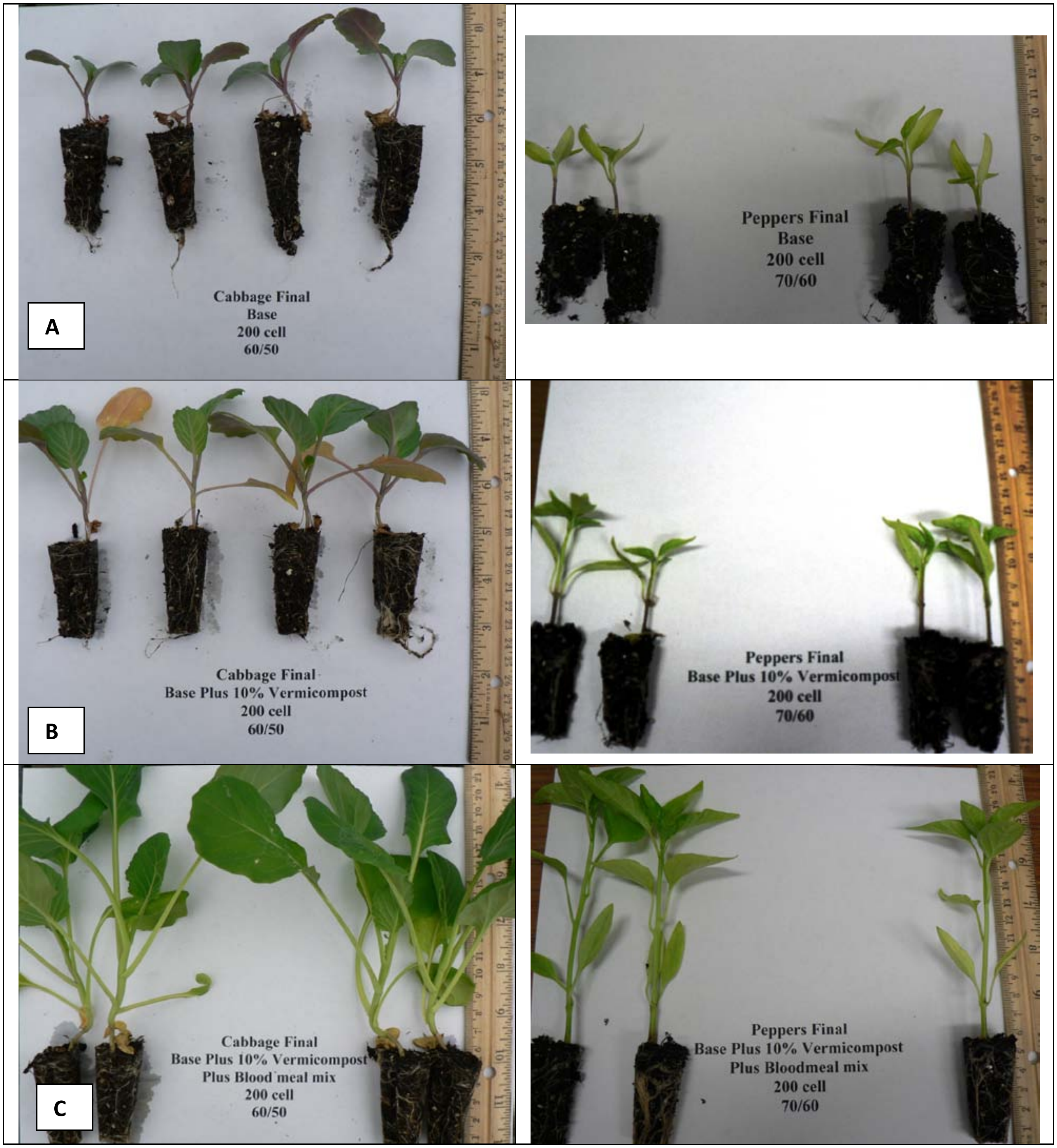

Figure 3. Cabbage and pepper transplant final size after production in either base, base plus 10% vermicompost or base + 10% vermicompost and bloodmeal mix. Greenhouse temperatures for cabbage were 60/50 F day/night, and for pepper were 70/60 F day/night.

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