Novel Development Option

Addition of Compost to Potting Media for Chilli Pepper Seedling Production

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Introduction

There has been a large growth in the local production of intensively grown organic vegetables. This is typically done on a small scale to provide for recognized high demand and willingness to pay for organic produce. The premiums that can be achieved for organic produce can make such small scale ventures economically sustainable but the production is not without challenges.

One of the roles of the ARGOS He Whenua Whakatipu team has been to identify solutions to impediments to farm diversification that would allow for a greater number of livelihoods to be produced in an area. Some of the case study farms have identified organic crop production as a means of achieving extra farm income. This research note covers one of the limitations identified for organic production of seasonal crops; the lack of nutrient provision in typical organic potting media especially for heavy feeding crops such as capsicums.

The Issue

Vegetable seedlings derive initial mineral, nitrogen and carbohydrate nutrition from the seed itself. After emergence photosynthesis begins to be the sole source of carbohydrate energy for the plant but it is still reliant on the soil or growing medium for provision of minerals and nitrogen. It is nitrogen that is often the most limiting nutrient. This element is required for all proteins including chlorophyll that is necessary for photosynthesis. Nitrogen deficient leaves are characteristically yellowed or chlorotic demonstrating the lack of chlorophyll that reduced the ability of the plant to gain energy and to grow.

The lack of availability can be due simply to a low level of nitrogen in the growing medium or to the balance between carbon and nitrogen. A high Carbon:Nitrogen ratio will generally reduce the availability of nitrogen. Nitrogen can also be locked up within organic matter that might take too long to breakdown for it to be useful during the time that seedlings are growing in the medium.

For many seasonal vegetable seedlings, they may be raised in the same pot for as long as two or three months. With typical organic potting media, seedlings will become nitrogen deficient within this time and be suboptimum for transplanting. In conventional potting media it is usual to supplement the medium with slow release chemical fertiliser that provides high levels of nitrogen and required minerals.

The research and associated observations were aimed at improving the quality of organically produced potting media.

Potting Media and Compost

Three types of commercially available potting media were first pilot trialled to identify the best available for seedling production. Dalton's Organic Potting Mix

(which contains the organic fertiliser NuFert) was selected as having good structure and nutrient fertility that produced the best growth rates of a range of vegetable seedlings. This potting mix was used in the subsequent experiment.

Compost is a rich source of nutrients including nitrogen and can be added to potting media. Depending on the ingredients and composting process, there can be a high carbon:nitrogen ratio which may make some composts unsuitable for potting media as they will start to decompose and actually sequester (rob) nitrogen from the rest of the media. On the other hand, composts made with a reasonable amount of nitrogen rich material can be good providers of this element for growing seedlings.

Vermicompost (compost made by worms) can be an affordable source of high quality commercial compost available in bulk. Many commercially available composts have a high level of carbon rich woody material or bark that may sequester nitrogen from the potting media if used (with bark composts, ensure that the inside of bark fragments has turned black and is not still pink indicating further nitrogen robbing breakdown will be taking place). Vermicast is more usually higher in nitrogen lower in carbon to nitrogen ratio. Vermicast for this research was sourced from Central Wormworx in Cromwell.

The Experiment
An experiment was set up which looked at the growth rates of chilli pepper (cultivar 'Fogo F1') seedlings in cell transplant trays with varying levels of organic potting media and vermicastm these being…

Original Potting Media Only
Potting Media plus Vermicompost (50:50 ratio by volume)
Vermicompost Only

Three replicate cell transplant trays were set up for each treatment. The trays were Flight Plastic with 60 cells of 45 mL volume each. Two seeds were placed in each cell and covered with a small amount of relevant potting media according to treatment (seedlings were later thinned as required to aim for one seedling per cell. Trays were randomly positioned on a partially shaded heat bed and following seedling emergence transferred to nursery tables without heat bed and in full light.

Seedling emergence in this slow germinating species was statistically significantly lower in the potting media only treatment (see Table) possibly relating to the finer nature of the vermicompost material that may have had better contact with seeds to promote germination. Within a month though it was obvious that the vermicompost only treatment seedlings were not growing as fast as the other two treatments. This appears to have been related to poor physical structure of the vermicompost for the purpose of using by itself as potting media. It was noted that there was poor macropore presence in the vermicompost and .the product had a tendency to compact in the seedling tray environment.

In the second month of growing, nutrients began to be limiting for production to the extent that by twelve weeks, the vermicompost only treatment had seedlings roughly twice the size of those in the other treatments (see Table). Chlorophyll content estimated at 9 weeks post sowing were also highest in the vermicompost treatment.

Vermicompost alone was a cost effective medium for the growing of chilli pepper seedlings.

Table: Growth parameters of chilli pepper seedlings in the different potting media treatments

	Potting Media Only	Potting Media + Compost	Compost Only
Seedling Emergence[x]	89.2%[a]	95.0%[b]	93.3%[b]
Chlorophyll Level[y]	22.1[a]	28.4[a]	38.3[b]
Shoot Dry Weight[z]	31.4[a]	43.2[b]	78.2[c]

[a,b and c] Results sharing same letter in a each row were not statistically significantly different at 95% confidence level. For statistical analysis, a one-way anova was conducted using each transplant tray as a distinct replicate.

[x] Seedling Emergence is percentage of seeds that successfully germinated and the shoots emerged (out of 120 seeds sown per 60 cell transplant tray).

[y] Chlorophyll level as estimated after 9 weeks using a Minolta SPADmeter 502 device (used on youngest fully emerged leaf for ten randomly selected plants in each replicate tray).

[z] Mean shoot dry weight per plant as assessed after 12 weeks by harvesting five random plants per tray and oven drying at 70^{o}C for 48 h then weighing.

Enhancing the Solution

The vermicompost sourced was good quality for amendment of garden soil but as a potting media it was lacking in macropore space resulting in insufficient drainage and aeration especially in initial vegetable seedling establishment. The high nutrient content in the vermicompost only treatment is likely to have been responsible for the eventual high performance of this treatment compared to potting media alone and the 50:50 treatment. If the physical quality of the compost used is high then superior results are likely to be achieved that will suit vegetable seedlings that are in the medium for a short duration as well as long duration. Alternatively the compost for be partially dried off first, dolomite added and or pumice or other amendment added to improve drainage. Good physical structure will also reduce the likelihood of a range of root pathogens including damping off.

Viable weed seeds, especially white clover that can survive animal digestive systems, would have mostly been from the cow paunch ingredient in the vermicompost. Ideally vegetable raising mixes are weed seed free to reduce labour requirements in seedling production. This can be achieved with compost that avoids potential weed seed sources or by spreading moist compost out on trays and allowing a flush of weed seedlings to grow and then be controlled by bagging compost back up into the dark.

Note that although the use of vermicompost would have provided high levels of many essential plant nutrients, magnesium deficiency showed up by week 10 in the vermicompost only treatment probably due to high growth rates using up available magnesium as present in the compost and naturally high potassium levels present (as in most composts) competively excluding the other base cation magnesium. This could probably be corrected by foliar magnesium sprays or initial incorporation of dolomite or other organically acceptable magnesium sources into the potting medium.

Photo 1: Individual seedlings of the best and worst potting media treatment tested for chilli pepper production. Note stronger shoot growth and root growth in the vermicompost only treatment seedling and leaf yellowing and stem purpling (potentially phosphorus deficiency) in the original potting media only treatment seedling.

Photo 2: Sample trays of chilli pepper seedlings for each treatment at 12 weeks.

Photo 3: Interveinal chlorosis symptoms on chilli pepper seedlings in the vermicompost only treatment. The yellowing or chlorosis between the veins of especially older leaves is indicative of magnesium deficiency.