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MARIGREEN

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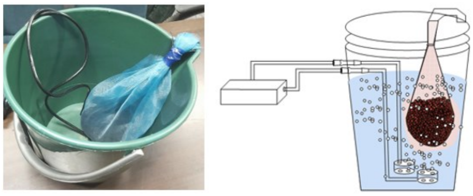
How can we make a good compost tea to grow plants?

Compost tea



Aerated CT

Non-aerated CT

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Compost tea − general aspects

Compost tea (CT) is a filtrate obtained from compost fermented in water. It is either aerated (prepared from a compost-water slurry that was aerated during the fermentation) or non-aerated (prepared from a slurry that was not aerated or received minimal aeration only at the initial mixing stage of the fermentation). Due to its composition, especially macronutrients, micronutrients, humic acids, phytohormons, and beneficial microorganisms (bacteria, fungi, protozoa), CT can significantly improve the growth, yield, and quality of different plants as well as reduce the incidence and severity of plant pests and diseases.

The effectiveness of CT depends on different factors, including:

- type of compost;
- fermentation conditions (with/without or with minimal aeration; compost/water ratio; temperature; process duration; nutrient additives, *e.g.*, molasses, glucose, fish or kelp powder/slurry);
- application method of CT (undiluted/diluted; to roots or/and leaves);
- type of plant.

Compost tea production

Non-aerated CT was obtained from compost produced by windrow composting of fish and rockweed residues with woodchips. The compost-water slurry was stirred once at the beginning of fermentation and then left in the dark at 25 °C. At the end of the experiment, the broth was filtered through cheesecloth and the filtrate (CT) was analyzed.

Marine residue-based compost and related CT

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Experimental design, process factors and responses

The study aimed at determining the impact of various factors on CT production using Central Composite Design (CCD).

Two key factors were considered (Table 1):

- water/compost ratio (*R*);
- fermentation time (*t*).

Twelve experiments were conducted, varying the water/compost ratio from 4.2 to 9.8 g water/g compost and fermentation time from 4.2 to 9.8 days.

The contents of three macronutrients in CT were chosen as responses:

- nitrogen content (*N*);
- phosphorus content (*P*);
- potassium content (*K*).

Table 1. Values of process factors and responses in CCD

Exp.	*R* (g/g)	*t* (day)	*N* (%)	*P* (mg/kg)	*K* (%)
1	5	5	1.516	524.90	0.532
2	5	9	0.783	236.10	0.443
3	9	5	1.480	281.84	0.323
4	9	9	0.946	166.18	0.233
5	7	7	1.356	266.68	0.388
6	7	7	1.425	299.64	0.393
7	4.2	7	1.490	588.14	0.684
8	9.8	7	1.432	163.25	0.296
9	7	4.2	1.466	303.88	0.413
10	7	9.8	0.987	225.36	0.338
11	7	7	1.490	286.75	0.421
12	9	9	1.412	275.35	0.412

The statistical models described by Equations (1) to (3) were used to determine ***predicted (pr) process responses***. Regression coefficients in these models were calculated from experimental data.

- $N_{pr} = 0.9226 - 0.0125R - 0.0051R^2 + 0.2735t - 0.0344t^2 + 0.0124Rt$ (1)
- $P_{pr} = 1794.2 - 280.98R + 10.580R^2 - 61.704t - 3.3050t^2 + 10.821Rt$ (2)
- $K_{pr} = 1.0006 - 0.1677R + 0.0077R^2 + 0.0754t - 0.0066t^2 - 0.0001Rt$ (3)

The ***optimization of process factors***, which aimed at maximizing the process responses, was conducted using the desirability function approach. The optimal levels of process factors identified were:

- R_{opt} = 4.2 g/g;
- t_{opt} = 5.6 days.

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Compost tea testing

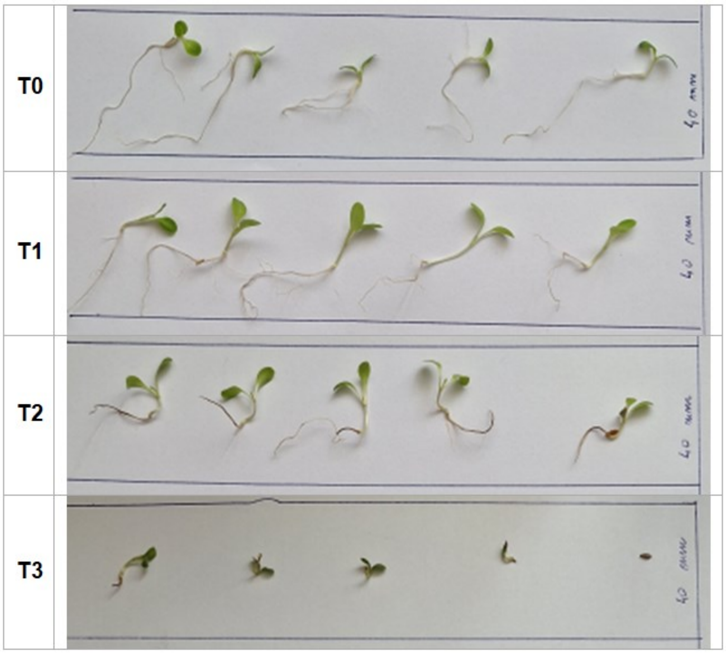
CT obtained at optimal levels of process factors was tested for lettuce 'Lollo Rossa' seed germination and seedling growth.

Four treatments were applied:

- (T0) 100% ultrapure water (control);
- (T1) 25% CT + 75% ultrapure water;
- (T2) 50% CT + 50% ultrapure water;
- (T3) 100% CT.

Each treatment was replicated 4 times, using 50 seeds per replicate.

The progress of germination and seedling growth was observed for 10 days in a controlled climate chamber maintained at 20 °C, with alternating light cycles mimicking natural conditions.



Lettuce seedlings after 10 days from sowing

Data summarized in Table 2 highlight the following aspects:

- treatment T1 had significant positive effects on seedling growth parameters, including seedling length (*SL*), root length (*RL*), and total leaf surface area (*LA*);
- treatment T0 had a significant beneficial impact on mean germination time (*MGT*) and germination speed (*GS*);
- treatment T3 had significant adverse effects on seed germination and seedling growth parameters compared to the other treatments.

Consequently, it is possible to add diluted CT (25% CT + 75% ultrapure water) to lettuce growth medium to facilitate seedling growth and maintain a high germination percentage (GP).

Table 2. Mean values of relevant parameters for lettuce seed germination and seedling growth

Parameter	Treatment			
	T0	T1	T2	T3
Germination percentage, $GP = 100N_{g,T}/N_T$ (%)	98a	97a	97a	73b
Mean germination time, $MGT = (\Sigma t_i N_{g,i})/N_{g,T}$ (d)	1.2d	1.6c	2.2b	5.2a
Germination speed, $GS = \Sigma N_{g,i}/t_i$ (d^{-1})	44.5a	34.7b	25.5c	7.9d
Seedling length, *SL* (cm)	3.92b	4.95a	3.75b	1.98c
Root length, *RL* (cm)	3.18a	3.80a	2.21b	0.75c
Total leaf surface area, *LA* (cm^2)	0.29c	0.48a	0.35b	0.10d

N_T - total number of lettuce seeds; $N_{g,T}$ - total number of germinated seeds; t_i - time from sowing (1, 2...10 day); $N_{g,i}$ - germinated seed number at t_i; different letters indicate a significant difference.

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