

Licorice (*Glycyrrhiza glabra* L.)



2

Licorice waste composting and the horticultural value of the resulted compost

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1

Materials and methods

- ✓ 1:1 mixture of licorice waste and coarse fraction of separated cattle manure.
- ✓ Rutgers-type, semi-static aerated and insulated composting bin.
- ✓ Forced aeration (aeration rate: 400 m³ h⁻¹).
- ✓ Set-point temperature: 60°C.
- ✓ Moisture content (MC): 50 - 60%
- ✓ Two turnings with a front-end loader to improve homogeneity.
- ✓ Physical analysis: water release curve
- ✓ Chemical analysis
- ✓ Phytotoxicity test

4

Introduction

Licorice (*Glycyrrhiza glabra* L.) is a leguminous herbaceous perennial. An extract, made of its roots is used as a flavoring agent for the food and tobacco industries. Few thousands tones of licorice root residues are annually accumulated in Israel.

The aim of the present work was to develop a reliable and practical protocol for licorice root wastes composting, and evaluate the resulted compost as a growing medium.

3



Composting was conducted in a Rutgers-type, actively-aerated facility in Newe Ya'ar, with two turnings.





Growing experiment

Licorice compost was compared to standard peat moss as a control. Both media were mixed with perlite #3, (1:1, V:V). The role of perlite is to ensure optimal drainage. Tomato (CV. 5656, Hazera, Israel) were grown as a test plant for 38 days. At the end of the experiment, the above-ground parts were harvested and their fresh and dry weights were determined.

7

Inoculated plant survival

Melon plants (CV. Ofir, Zeraim Gedera, Israel) served as test plants. Their roots were immersed in a suspension of 1.5×10^5 FOM spores ml^{-1} and the seedling were planted in the tested media. Visual symptoms of the disease were monitored over a 22-days period. The difference between the areas under the disease progress curves (AUDPC) of the media was analyzed (One-way ANOVA).

10

Spore survival

This test was conducted under the assumption that pathogen added to a suppressive medium may decline faster than that added to a control medium.

Fusarium oxysporum f. sp. melonis

(FOM) microconidia were added at a rate of 6×10^5 microconidia gram^{-1} to the tested media. The survival of the FOM microconidia was studied during 35 days.

9

The chemical analysis of the licorice suggests that it is a suitable feedstock for composting as a fibrous ingredient in a mix, provided that proper inoculum and nutrient source will be supplied. If treated alone, its stabilization process may take a long time, as suggested by its relatively low BOD ($9.2 \text{ gr O}_2 \text{ Kg DM}^{-1}$), considering its high OM content. Cattle manure may serve as a proper source of both microorganisms and nutrients. Therefore we used a mixture of 50% licorice waste and 50% of the coarse fraction ($>1.8 \text{ mm}$) of separated cattle manure.

12

Results: Table 1. Chemical analysis of licorice waste

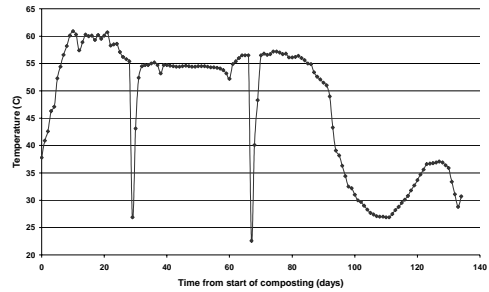
Parameter	Unit	Total content
Moisture content	%	73.4
OM	%	92.1
C	%	54.2
N	%	1.17
P	%	0.023
K	%	0.02
Ca	%	2.60
Mg	%	0.20
C/N	Ratio	46.3

11

Table 2. Chemical analysis of the composting mix and of the mature compost.

Parameter	Unit	Raw mix	Mature C.
MC	%	74.6	61.0
OM	%	90.2	77.4
C	%	53.1	45.5
N	%	1.25	2.15
P	%	0.13	0.28
K	%	0.27	0.63
Ca	%	2.10	4.80
Mg	%	0.25	0.53
C/N	Ratio	42.4	21.2

Fig. 1: Temperature evolution during the composting process



13

The C/N ratio dropped by half, from 42.4 to 21.2. The total N content rose almost at a similar rate, suggesting almost no N loss.

Having a relatively low EC, the compost can be used as a growing medium without the need for a pre-wash.

16

Table 3. concentrations of ions (in a 1:10, water extract) of the composting mix and of the mature compost.

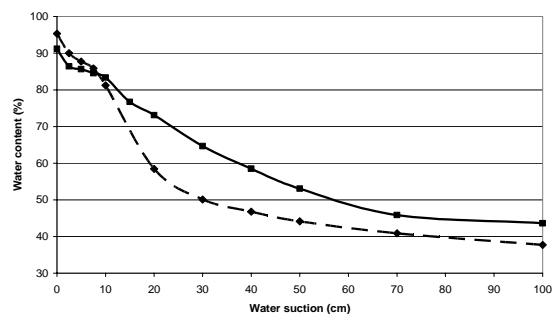
Parameter	Unit	Raw mix	Mature C.
pH		7.8	8.2
EC	dS m ⁻¹	1.42	2.35
N-NO ₃	mmol _c l ⁻¹	0.00	0.77
N-NH ₄	mmol _c l ⁻¹	0.16	0.24
P-PO ₄	mmol _c l ⁻¹	0.27	0.29
K ⁺	mmol _c l ⁻¹	4.9	9.0
SOM	mg l ⁻¹	1143	1281
SON	mg l ⁻¹	57.1	66.0

15

The water release curve is typical of high-quality composts, intended for use as peat substitute. Its main characteristics are: total porosity: 91%; air filled porosity: 8%; easily available water: 30%, water buffering capacity: 9% and bulk density: 0.20 g cm⁻³.

18

Fig. 2: Water release curve of licorice compost (solid line) and of peat (dashed line).



17

Table 4: Growth parameters of tomato grown in peat and in licorice compost.

	Peat	Licorice compost	Significance (P<)
FW (gr)	31.4	61.5	0.001
DW (gr)	3.41	6.66	0.001
Maximum height (cm)	41.8	51.4	0.0003
No. of flowers	6.9	10.3	0.004

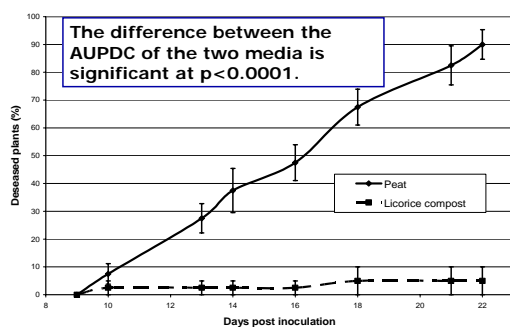
20

Phytotoxicity test

Germination rate of both the control and the extracted compost were 100%. Average root length of the seedling, grown on compost extract was 11.6 mm while that of the control was 7.7 mm ($P < 0.0005$). It clearly suggests that the licorice compost was not phytotoxic. The root growth in the compost extract was enhanced, probably due to nutrient availability

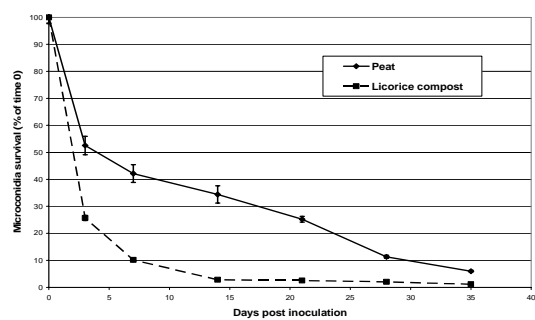
19

Fig. 4. Disease development in FOM-inoculated melon plants grown in peat or licorice compost.



22

Figure 3. Survival of FOM microconidia over time in peat and licorice compost media.



21

**Thank you
Questions?**



Conclusions

- Licorice waste can be successfully composted during a reasonable period, provided enough inoculum and sufficient nutrients are supplied, e.g. by cattle manure.
- The resulted compost has adequate chemical and physical properties for its use as a component of growing media, and its performance as such was clearly demonstrated.
- The compost showed clear suppression against *Fusarium oxysporum* f. sp. *melonis*.

23