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Innovative Use of By-Products Recovered from Thyme Residues to Optimize Basil Growth

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Introduction

The cultivation technique for aromatic plants for fresh consumption for Mass Market Retailers requires periodical removal of the lignified and flowered portions to promote the regrowth of new fresh shoots. The residual aromatic biomass may be recovered to obtain derivable new by-products, such as essential oils (EOs) and aromatic waters (AW).

This study aimed to set up an innovative model based on the recovery pruning residues of thyme (*Thymus vulgaris* L.) to produce OE and AW by an eco-friendly technology without solvents and, then, to use the AW in a potted greenhouse cultivation of basil (*Ocimum basilicum* L.), type "Genovese", intended to MMR (Capaccio, SA).

Materials and Methods

The pruning residues of thyme were collected (October 25th) at "Palma Company". The biomass was submitted to hydrodistillation (75 min; 70°C) using an extractor with a capacity of 25 Kg (EOE-10, Tred Technology, Ripalimosani, CB, Italy). The water-essential oil mixture was separated with a separating funnel. The pot trial was conducted at "Orto Più Company" from the transplanting to the beginning of flowering (December 7th-28th) in a cultivation of basil grown in 24 cm diameter pots with 4 seedlings per pot.

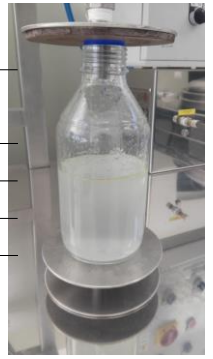
Three treatments (six repetitions, represented by a pot) were performed on a weekly basis: soil application of 50 mL of thyme AW, distributed on the surface (T); AW sprayed on the aerial part of the basil plants until a complete and uniform wetting (T1); T+T1 (T2); control without any treatment (C). The height of the plants was monitored weekly. At the end of the cycle, (21 days after the first treatment) leaves number, SPAD, fresh total and leaves biomass, water content, leaf area, downy mildew damage by *Peronospora belbarhii* (visual inspection) were determined.

Results

The characteristics of thyme biomass residues, of EO and AW after the hydrodistillation processd (Table 1) are comparable to those reported in literature both for EO and analogous AW.

Table 1. Recovery of thyme residues

Biomass		Essential Oil	
Fresh biomass (g m^{-2})	588.9±211.4	Color	Red
Water content (%)	59.4±3.7	Content (%)	0.18±0.02
Aromatic Water		Density (mg μL^{-1})	0.91±0.051
Yield (L Kg^{-1})	0.22±0.02	Refractive index	1.49±0.0001
EO content (g L^{-1})	1.04±0.02	Composition	*p*-cymene (54.0%)
Density (mg μL^{-1})	1.189±0.001		thymol (14.6%)
Refractive index	1.336±0.0001		γ-terpinene (9.8%)



The comparison among the treatments (Table 2) demonstrated a positive effect on the growth of basil respect to the control when AW was sprayed on the the aerial part of seedlings (T1 and T2). Anyway the highest values of number of leaves, fresh biomass and Specific Leaf Weight were registered for T2. Interestingly, in this treatment, a low damage percentage on the leaves was also observed. This is probably due to the antifungal components of the EO in the AW of thyme, which are able to counteract the high humid environment on the leaf surface, favourable to pathogen development.

Table 2. Growth and disease parameters data under the different treatments

Treatment	Height increase (cm d^{-1})	Leaves (n.)	SPAD	Total fresh biomass (g)	Leaves fresh biomass (g)	Leaves water content (%)	Specific Leaf Weight (g cm^{-2})	Downy mildew damaged leaves (% on total)
T	0.27±0.08c	60.3±0.4b	47.2±4.9ab	23.6±0.1b	16.1±0.4b	85.68±1.13ab	0.020±0.001ab	16.60±2.4b
T1	0.53±0.01a	78.4±5.0ab	48.7±6.1a	40.5±3.4a	25.2±3.0a	86.26±0.53ab	0.019±0.002ab	33.16±4.9a
T2	0.50±0.01a	83.7±6.1a	48.3±5.7a	45.3±3.7a	28.7±2.7 a	85.85±1.31ab	0.021±0.001a	1.20±2.9c
C	0.41±0.03b	77±6.5ab	47.4±6.5ab	36.5±3.0a	24.1±1.3a	87.15±0.82a	0.020±0.001ab	10.39±1.7b

Conclusions

The results highlighted the favorable effect of the AW recovered from the residual biomass of thymus pruning to increase the biomass and number of leaves in a cultivation of basil for MMR. At the same time it was registered a reduced presence of the damages induced by downy mildew. In addition, this study showed an innovative circular model, which can be applied to specialized farms in improving sustainability. Further studies are needed to fine-tune the use of these innovative by-products.