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Vermicomposting of two-phase olive mill waste with *Eisenia fetida* to reduce the environmental impact of olive oil production and produce a high-quality soil amendment

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INTRODUCTION

Olive oil production is integral to Mediterranean culture and economy, yet the disposal of olive mill waste (OMW) poses major environmental risks due to its phenolic content, low biodegradability, and phytotoxicity. Vermicomposting using *Eisenia fetida* offers a sustainable method to convert two-phase OMW into a nutrient-rich soil amendment, while reducing its toxicity. This study evaluated the feasibility of vermicomposting OMW mixed with dairy cow manure to produce a high-quality soil amendment without impairing earthworm performance.

MATERIALS & METHODS

A completely randomized design with four treatments and four replicates was used, testing OMW-to-manure ratios of 0:100 (control), 33:67, 50:50, and 67:33 as a feedstock in 20x20x9cm plastic containers. Each container received ten mature *E. fetida* earthworms and was incubated for one month at 21°C and 75% moisture. Parameters monitored included electrical conductivity (EC), and pH, while phytotoxicity was assessed through a germination of lettuce seeds exposed to extracts of the resulting vermicompost.

RESULTS & DISCUSSION

Fig. 1. Vermicomposting container

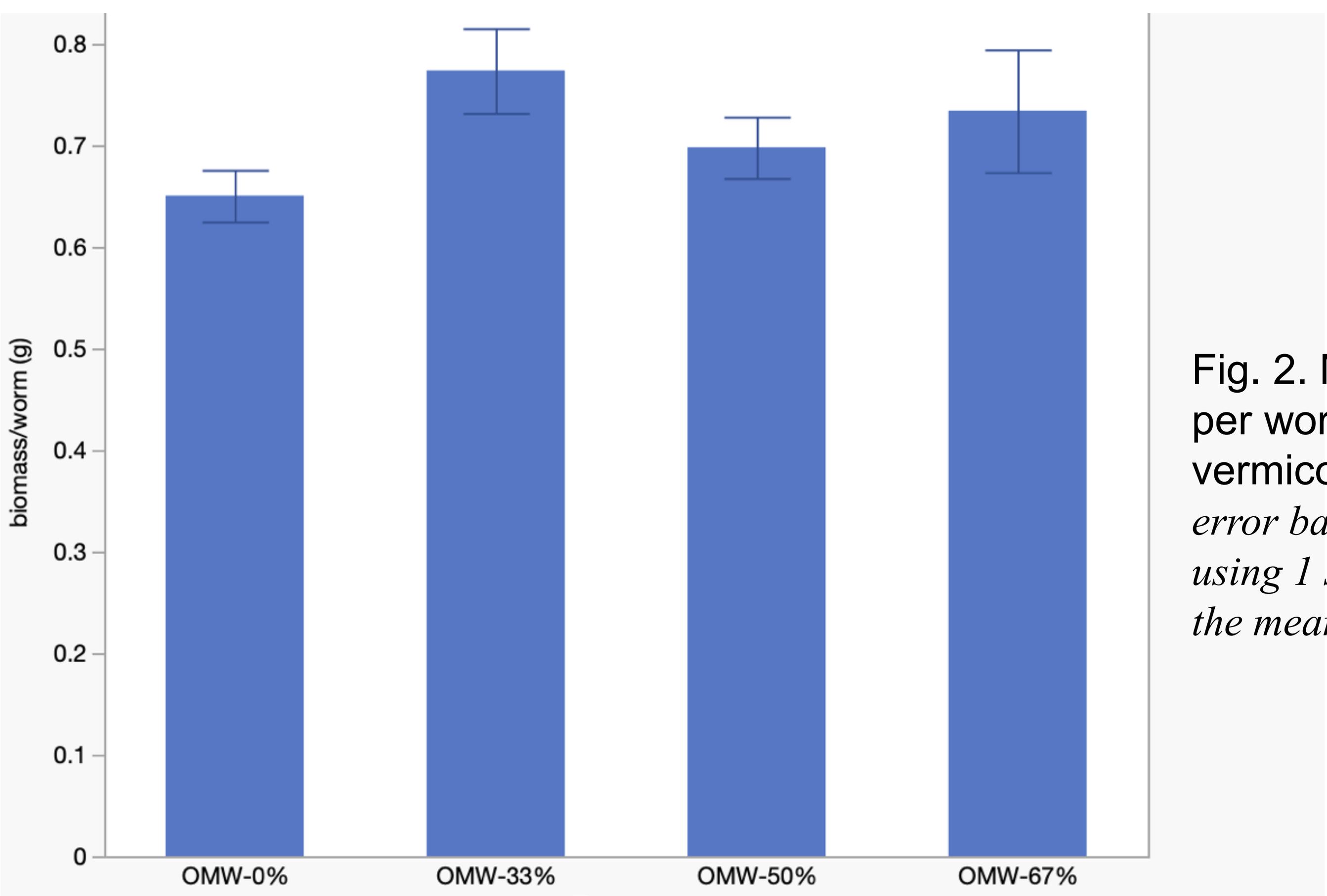

Fig. 2. Mean biomass per worm following vermicomposting. *(Each error bar is constructed using 1 standard error from the mean).*

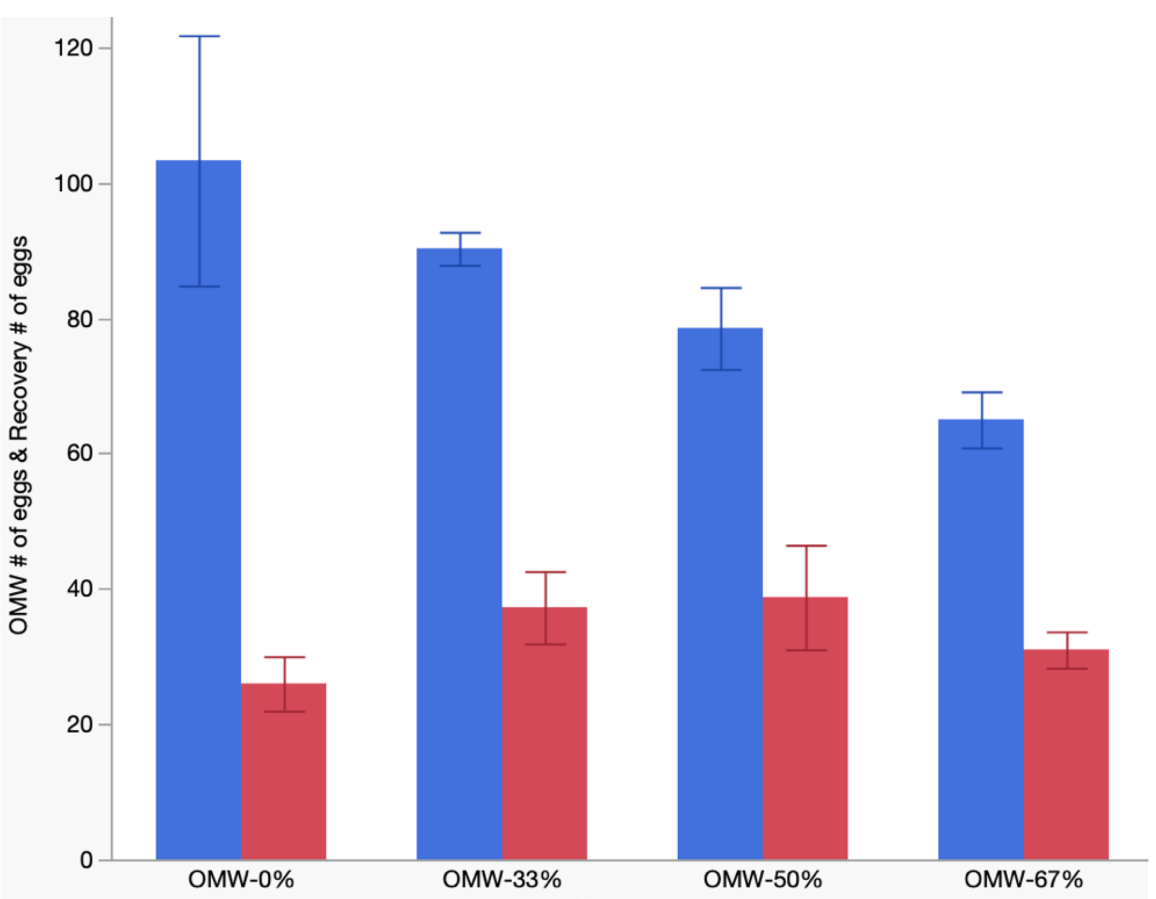

Fig. 3. Number of cocoons during vermicomposting with OMW and recovery phase. Blue bars: OMW phase, red bars: recovery phase. *(Each error bar is constructed using 1 standard error from the mean).*

Vermicompost pH was 7.7 across treatments, while EC increased with increasing OMW concentrations, ranging from 685 µS/cm (control) to 1062 µS/cm (OMW-67%). Earthworm biomass increased in all OMW treatments relative to the control (Fig. 2). However, cocoon production declined with higher OMW content, suggesting temporary reproductive inhibition (Fig. 3). During a subsequent recovery phase where earthworms were transferred to dairy manure, biomass remained similar among treatments, and cocoon production increased above control levels, demonstrating a temporary rather than permanent reduction in reproductive activity (Fig. 3). Lettuce seed germination exceeded 90% in all treatments (91-93%), indicating low residual phytotoxicity (Fig. 4). Total carbon content (%) of the produced vermicomposts increased consistently with higher proportions of OMW in the mixtures, and these differences were statistically significant (Table 1).

Table 1. Effect of OWM treatments on total carbon (TC %).

Treatment	TC (%)	Std. Error
OWM-67	44.150 a	0.802
OWM-50	40.918 ab	0.802
OWM-33	38.533 bc	0.802
OWM-0	36.580 c	0.802

Different letters indicate statistically significant differences (Tukey HSD, $p < 0.05$).

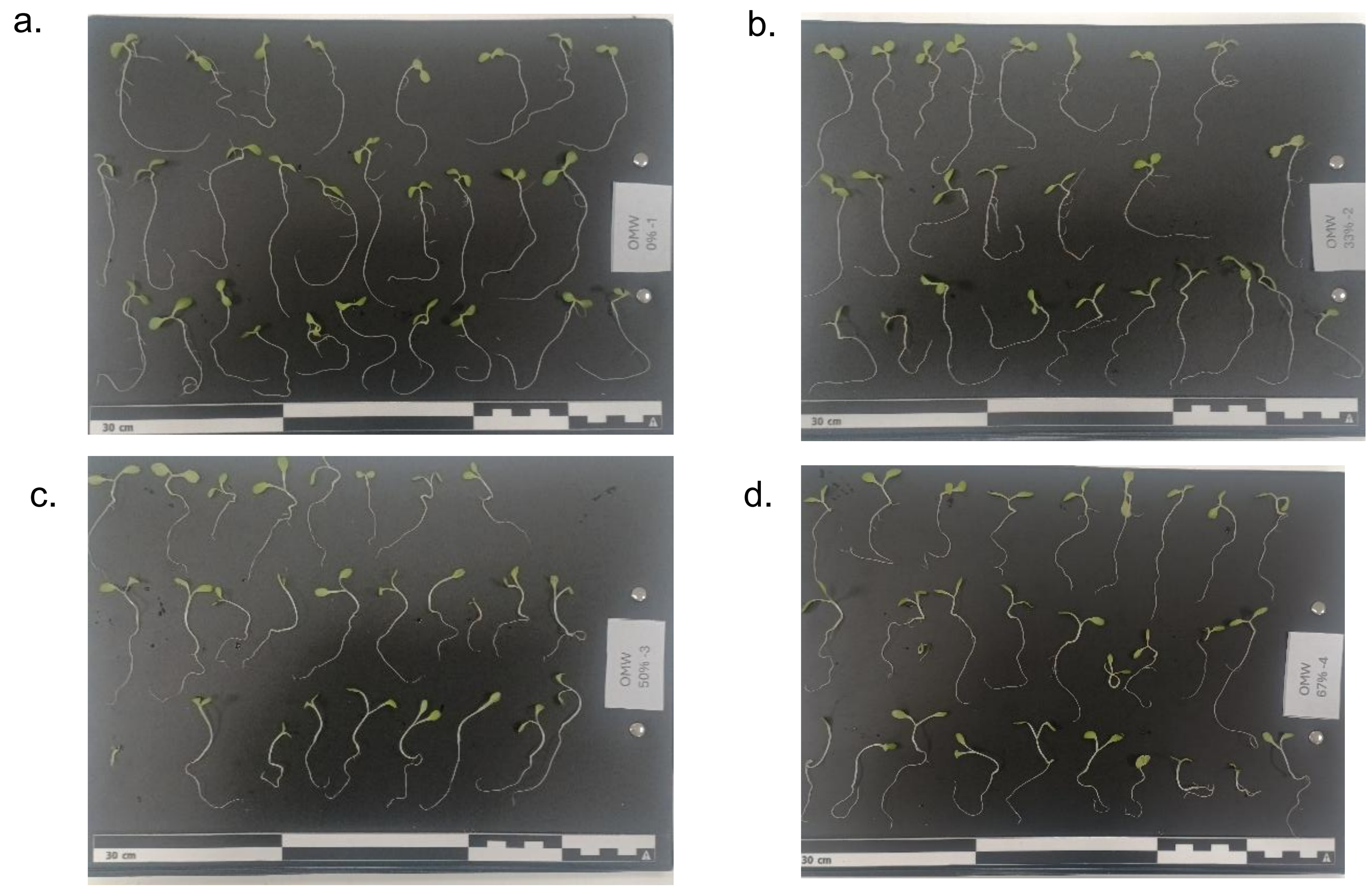

Fig. 4. Lettuce seedling growth on vermicompost extracts: a. OMW-0%, b OMW 33%, c. OMW 50%, d. OMW 67%)

CONCLUSION

These findings indicate that OMW can be effectively converted to a quality soil amendment through vermicomposting when mixed with cow manure, while maintaining viable and reproductively active earthworm populations. The resulting vermicomposts also exhibited significantly higher total carbon content with increasing OMW proportions, further enhancing their value as soil amendments. Overall, this process offers a practical and environmentally sound approach to managing a major agro-industrial byproduct in Mediterranean regions, supporting circular economy practices and sustainable agricultural development.