

1 **Enhancing Essential Oil Yield and Agronomical Traits in *Melissa Officinalis* L. through**
2 **Synthetic Polyploidization**

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14 *Melissa officinalis* L. is a well-known herb for its ethnopharmacological properties owing to its
15 essential oils. However, essential oil yield remains relatively low when compared to other
16 members of the Lamiaceae family, necessitating breeding for improvement. This study
17 investigated oryzalin as an antimetabolic agent to induce polyploidy in *M. officinalis* for crop
18 improvement mainly aiming for higher essential oil yield. Nodal segments were
19 micropropagated and exposed to 20, 40, and 60 μ M oryzalin for 24 and 48 hours. The survival
20 rate declined exponentially with higher concentrations and durations. The highest polyploid
21 induction rate (8%) occurred with 40 μ M for 24 hours. Tetraploid plants displayed vigorous
22 growth, with longer shoots, larger leaves, and more leaves per shoot. Their average essential oil
23 yield increased by 75% due to larger peltate trichomes. Tetraploid and diploid plants shared
24 geranial, neral, and citronellal as major components although 11.06% and 9.49% increase in
25 geranial and neral, respectively was observed in tetraploid plants. In conclusion, oryzalin
26 effectively induced polyploidy in *M. officinalis*, leading to tetraploid plants with superior
27 agronomical traits and significantly higher essential oil yield. These findings hold promising
28 avenue for meeting commercial demand and advancing the cultivation of this valuable herb.
29 Further research on optimizing polyploid induction methods could contribute to the growth
30 of *Melissa officinalis* L. as a more productive and economically viable crop.