

1 **Herbicidal Potential of Combined Essential Oil Nanoemulsions Against**
2 ***Megathyrus maximus* (Jacq.) B.K.Simon & S.W.L.Jacobs and *Lactuca***
3 ***sativa* L.**

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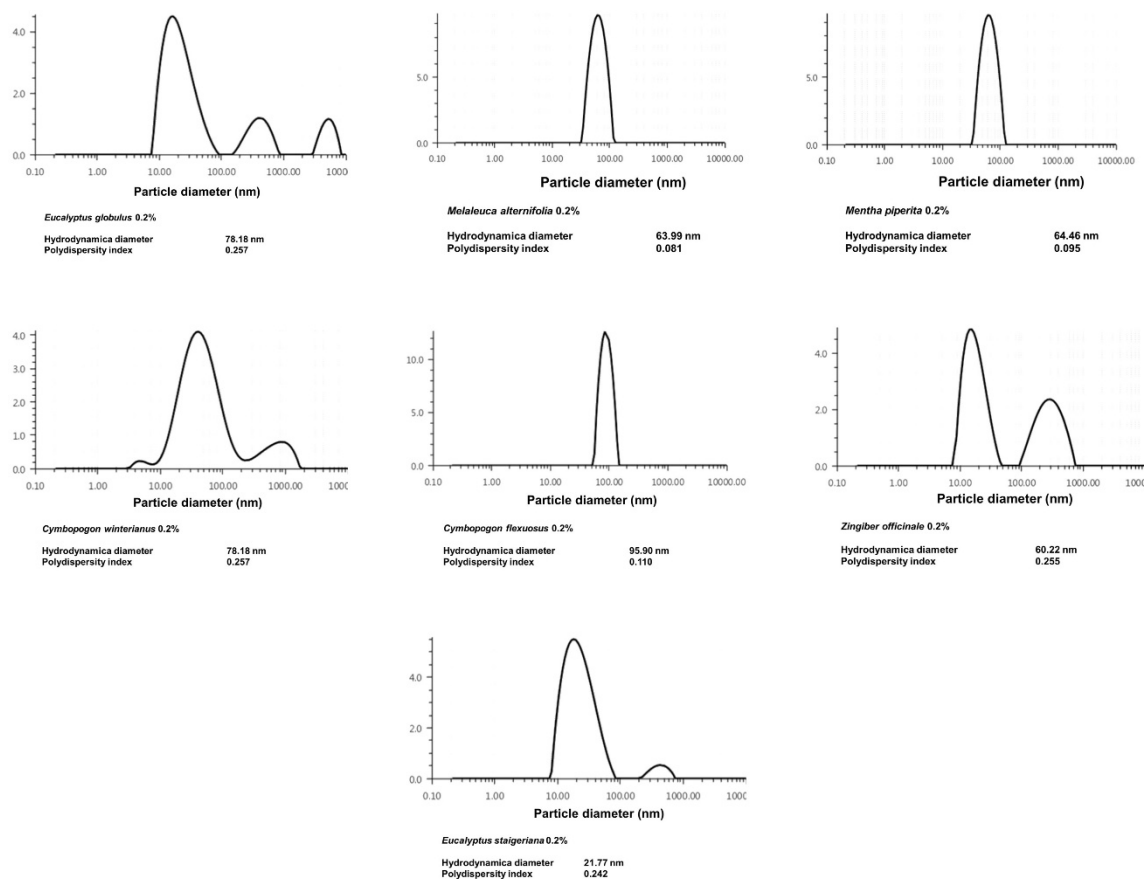
5 **Material supplementary**

6 **Table S1.** Substances identified in the essential oils of the by gas chromatography coupled to mass spectrometer (GC/MS)

Retention time	Compound name	Relative area (%)						
		<i>E. globulus</i>	<i>M. alternifolia</i>	<i>M. piperita</i>	<i>C. winterianus</i>	<i>C. flexuosus</i>	<i>Z. officinale</i>	<i>E. staigeriana</i>
6.766	Tricyclene	-	-	-	-	-	1.654	-
6.927	α -Thujene	-	0.795	-	-	-	-	-
7.144	α -Pinene	4.606	3.144	0.996	-	-	5.98	4.30
7.631	Camphene	-	-	-	-	1.359	23.883	2.73
8.500	Sabinene	-	0.616	-	-	-	-	-
8.603	β -Pinene	-	0.618	1.258	-	-	0.808	-
9.004	6-methyl-5-Hepten-2-one	-	-	-	-	1.137	1.572	-
9.152	Myrcene	-	-	-	-	-	1.837	-
10.44	<i>o</i> -Cymene	2.979	29.02	-	-	-	0.627	5.24
10.583	Limonene	-	1.735	2.544	-	1.181	-	19.48
10.611	Sylvestrene	-	-	-	3.81	-	-	-
10.646	<i>p</i> -Mentha-1(7),8-diene	-	-	-	-	-	15.545	-
10.726	1,8Cineole	90.357	2.52	6.49	-	-	8.921	5.31
11.854	γ -Terpinene	0.972	-	-	-	-	-	-

13.610	Linalool	-	-	-	0.81	1.459	-	1.52
15.020	<i>cis</i> -Limonene oxide	-	-	-	-	-	-	1.10
15.220	<i>trans</i> -Limonene oxide	-	-	-	-	-	-	0.56
15.590	Isopulegol	-	-	-	1.48	-	-	-
16.139	iso-Menthone	-	-	25.323	-	-	-	-
16.225	Citronellal	-	-	-	28.61	-	-	-
16.436	Borneol	-	-	-	-	0.589	4.803	-
16.508	neo-Menthol	-	-	8.759	-	-	-	-
16.960	Terpinen-4-ol	-	-	-	-	-	-	1.39
17.198	iso-Menthol	-	-	42.079	-	-	-	-
17.249	Isocitral	-	-	-	-	0.572	-	-
17.289	Terpinen-4-ol	-	36.742	-	-	-	-	-
17.386	<i>p</i> -Cymen-8-ol	-	-	-	-	-	-	1.76
17.581	α -Terpineol	-	4.622	-	-	-	2.657	1.35
19.521	Citronellol	-	-	-	14.47	-	-	-
19.744	Pulegone	-	-	1.091	-	-	-	-
20.150	Neral	-	-	-	-	30.767	-	6.84
20.379	Piperitone	-	-	0.433	-	-	-	-
20.774	Geraniol	-	-	-	18.3	5.176	0.855	3.80
21.060	Ascaridol glycol	-	0.819	-	-	-	-	-
21.592	Geranial	-	-	-	0.52	38.317	-	9.40
22.147	2-Undecanone	-	-	-	-	-	0.956	-
22.251	Menthyl acetate	-	-	7.616	-	-	-	-
23.475	Citronellic acid	-	-	-	0.43	-	-	-
23.561	Methyl geranate	-	-	-	-	-	-	7.24
23.984	δ -Elemene	-	-	-	-	-	0.805	-
24.802	Citronellyl acetate	-	-	-	3.6	-	-	-

24.922	Eugenol	-	-	-	1.07	-	-	-
25.123	Cyclosativene	-	-	-	-	-	1.374	-
25.260	Neryl acetate	-	-	-	-	-	-	2.99
25.609	α -Copaene	-	-	-	-	-	3.681	-
26.021	Geranyl acetate	-	-	-	3.68	4.424	1.277	5.74
26.336	β -Elemene	-	-	-	2.75	-	4.904	-
26.908	Sesquithujene	-	-	-	-	-	1.487	-
27.418	Caryophyllene	-	-	1.159	-	2.159	-	-
28.115	Bergamotene	-	-	-	-	-	0.614	-
28.235	Aromadendrene	-	2.79	-	-	-	-	-
29.002	(E)- β - Farnesene	-	-	-	-	-	2.714	-
29.105	9- <i>epi</i> -(E)-Caryophyllene	-	0.673	-	-	-	-	-
29.963	Germacrene D	-	-	-	1.69	-	3.046	-
30.284	<i>ar</i> -Curcumene	-	-	-	-	-	59.645	-
30.490	β -Selinene	-	-	-	-	-	4.748	-
30.730	α -Zingiberene	-	-	-	-	-	35.358	-
30.759	α -Muurolene	-	-	-	1.03	-	-	-
30.925	α -Bulsebene	-	-	-	0.92	-	-	-
31.234	β -Bisabolene	-	-	-	-	-	29.392	-
31.291	γ -Cadinene	-	-	-	1.25	3.054	-	-
31.703	δ -Cadinene	-	-	-	3.7	-	-	-
31.880	β -Sesquiphellandrene	-	-	-	-	-	31.322	-
32.699	Elemol	-	-	-	-	-	1.787	-
32.733	Edcaryol	-	-	-	4.3	-	-	-
33.751	Spathulenol	-	0.926	-	-	-	-	-
33.941	Caryophyllene oxide	-	-	1.683	-	-	-	-
33.986	Globulol	-	0.944	-	-	-	-	-



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2 **Figure S1.** Hydrodynamic diameter and the polydispersity index (PDI) characterization of
 3 essential oil nanoemulsions

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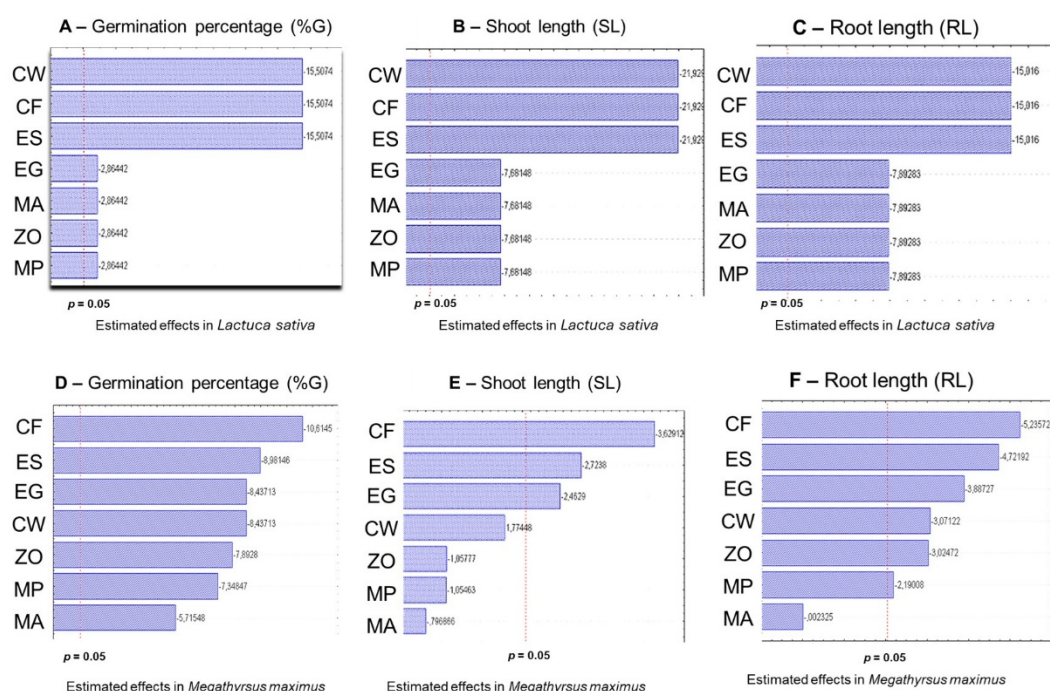


Figure S2. Pareto plots for the response variables of the seven nanoemulsions tested on *Lactuca sativa* (A, B, and C) and *Megathyrus maximus* (D, E, and F), respectively in the Plackett-Burman (Stage 1) screening assay at 0.03% (w/v) total essential oil. EG: *Eucalyptus globulus*; MA: *Melaleuca alternifolia*; MP: *Mentha piperita*; CW: *Cymbopogon winterianus*; CF: *Cymbopogon flexuosus*; ZO: *Zingiber officinale*; ES: *Eucalyptus staigeriana*.

1 **Table S2.** Full three-factor, three-level (3³) factorial design used to evaluate the effect of the
2 concentration (%) of each essential oil (EO) and their combinations in the bioherbicidal
3 formulation.

Tests	Nanoemulsion of essential oil		
	EG (% de OE)	CF (% de OE)	ES (% de OE)
1	0	0	0
2	0	0	0.02
3	0	0	0.04
4	0	0.02	0
5	0	0.02	0.02
6	0	0.02	0.04
7	0	0.04	0
8	0	0.04	0.02
9	0	0.04	0.04
10	0.02	0	0
11	0.02	0	0.02
12	0.02	0	0.04
13	0.02	0.02	0
14	0.02	0.02	0.02
15	0.02	0.02	0.04
16	0.02	0.04	0
17	0.02	0.04	0.02
18	0.02	0.04	0.04
19	0.04	0	0
20	0.04	0	0.02
21	0.04	0	0.04
22	0.04	0.02	0
23	0.04	0.02	0.02
24	0.04	0.02	0.04
25	0.04	0.04	0
26	0.04	0.04	0.02
27	0.04	0.04	0.04

4 EG: *Eucalyptus globulus*; CF: *Cymbopogon flexuosus*; ES: *Eucalyptus staigeriana*.

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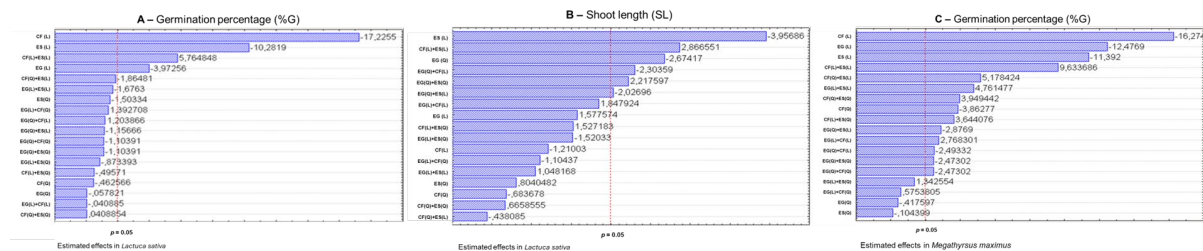


Figure S3. Pareto plot for the response variables of the three nanoemulsions and their combinations tested on *Lactuca sativa* (A and B) and *Megathyrus maximus* (C), respectively. EG: *Eucalyptus globulus*; CF: *Cymbopogon flexuosus*; ES: *Eucalyptus staigeriana*.; L: linear term; Q: quadratic term.

Table S3. Estimated results for germination percentage (%G) of *Lactuca sativa* and *Megathyrus maximus* as a function of nanoemulsion concentration, based on the mathematical model obtained from the 3³ factorial design.

<i>Lactuca sativa</i>		
Treatments	p	Coeficiente
Mean/Interc.	0.000000	38.6667
EG (L)	0.000129	-6.6111
CF (L)	0.000000	-28.6667
ES (L)	0.000000	-17.1111
CF(L)+ES(L)	0.000000	11.75002
Mathematical model for L. sativa: Germinação (%) = 38,7 - 6,6 x [EG] - 28,7 x [CF] - 17,1 x [ES] + 11,7 x CF - ES		
<i>Megathyrus maximus</i>		
Treatments	p	Coeficiente
Mean/Interc.	0.000000	17.1852
EG (L)	0.000000	-7.6667
CF (L)	0.000000	-10.0000
CF (Q)	0.000192	-2.0556
ES (L)	0.000000	-7.0000
EG(L)+CF(L)	0.006633	2.0833
EG(Q)+CF(L)	0.014173	-1.6250
EG(Q)+CF(Q)	0.014957	-1.3958
EG(L)+ES(L)	0.000006	3.5833
EG(Q)+ES(L)	0.004840	-1.8750
EG(Q)+ES(Q)	0.014957	-1.3958
CF(L)+ES(L)	0.000000	7.2500
CF(L)+ES(Q)	0.000414	2.3750
CF(Q)+ES(L)	0.000001	3.3750
CF(Q)+ES(Q)	0.000140	2.2292
Mathematical model for M. maximus: Germinação (%G) = 17.1-7.6*[EG]-10*[CF]-2*[CF]-7*[ES]+2*[EG]-[CF]-1.6*[EG]-[CF]-1.3*[EG]-[CF]+3.5*[EG]-[ES]-1.8*[EG]-[ES]-1.3[EG]-[ES]+7.2*[CF]-[ES]+2.3*[EG]-[ES]+3.3*[EG]-[ES]+2.2[EG]-[ES]		

EG: *Eucalyptus globulus*; CF: *Cymbopogon flexuosus*; ES: *Eucalyptus staigeriana*.; L: linear term; Q: quadratic term.