

BugMace Broad-Spectrum Repellency Evidence Packet

Executive conclusion

BugMace is a broad-spectrum botanical insect and arthropod repellent. The current ready-to-use formulation contains nine botanical active ingredients totaling 22.7% by weight. The positive published evidence base supports repellent capability across every pest category evaluated in this packet. For each listed pest, one or more active ingredients present in BugMace has demonstrated repellency, avoidance, barrier activity, spatial repellency, or feeding deterrence against that pest or a recognized representative of the common-name category. [1-15]

Supported broad-spectrum coverage: Mosquitoes; gnats; no-see-ums (sand gnats); flies; biting flies; black flies; stable flies; ticks; deer ticks; lone star ticks; brown dog ticks; fleas; ants; fire ants; Argentine ants; mites; chiggers; bed bugs; and wasps.

Current BugMace repellent formulation

Geraniol 4.0%	Citronella oil 3.0%	Lemongrass oil 3.0%	Thyme oil 3.5%	Clove oil 1.5%
Cedarwood oil 2.5%	Rosemary oil 2.0%	Peppermint oil 1.5%	Geranium oil 1.7%	Vanillin (other ingredient) 5.0%
Total botanical active ingredients: 22.7%				

Formulation support: BugMace also contains 5.0% vanillin. Published mosquito-repellent formulation research found that vanillin can materially extend the protection time of citronella-based formulations; a 5% vanillin formulation was the strongest formulation tested in one human-bait study. [16]

Pest-by-pest positive substantiation

Pest / category	BugMace active(s)	Positive evidence	Refs.
Mosquitoes	Geraniol; clove; peppermint; geranium; lemongrass; citronella	Human-skin testing documented repellency for all six. Clove and geraniol were among the longest-performing 10% botanical lotions; peppermint, geranium, lemongrass and citronella also produced measurable complete-protection periods.	[2]
Gnats	Lemongrass; citronella; geraniol/rosemary/cedarwood blend precedent	Published biting-midge and black-fly research demonstrates repellency of small bothersome biting flies commonly described by consumers as gnats. Commercial geraniol/rosemary/lemongrass/cedarwood products also expressly claim gnat repellency.	[3-5,17]
No-see-ums / sand gnats	Lemongrass	Culicoides biting midges significantly avoided lemongrass oil. A field lotion containing lemongrass also produced very high protection against Culicoides biting midges.	[3,5]

Pest / category	BugMace active(s)	Positive evidence	Refs.
Flies	Peppermint; lemongrass	Housefly studies found peppermint and peppermint-lemongrass combinations strongly repellent; formulated peppermint also reduced fly density in field testing.	[6,18]
Biting flies	Lemongrass; citronella	Direct stable-fly feeding-choice work and citronella-based field work against blood-feeding flies demonstrate deterrent/repellent activity.	[4,7]
Black flies	Citronella	A citronella-based field treatment significantly reduced black-fly abundance in treated avian nests.	[4]
Stable flies	Lemongrass	Stable flies spent significantly less time near a lemongrass-treated blood source; none fed from the treated source while flies fed from the untreated source.	[7]
Ticks	Geraniol; clove; geranium; cedarwood; thyme; citronella; peppermint	Multiple direct studies across deer/blacklegged, lone star and brown dog ticks demonstrate repellency by BugMace actives.	[2,8,9]
Deer ticks / blacklegged ticks	Geraniol; clove; thyme	Direct on-arm Ixodes scapularis testing demonstrated substantial contact repellency and complete-protection periods for these BugMace actives.	[2]
Lone star ticks	Clove; geranium; cedarwood; thyme; citronella; peppermint	Direct Amblyomma americanum testing showed strong contact and/or spatial repellency from multiple BugMace oils; clove, geranium, cedarwood and thyme ranked among the strongest oils at tested concentrations.	[8]
Brown dog ticks	Geraniol	Direct Rhipicephalus sanguineus larval-repellency testing found geraniol to have strong repellent effects.	[9]
Fleas	Peppermint	Human-subject testing against field-collected Pulex irritans found peppermint essential oil repellent to fleas.	[10]
Ants	Citronella; peppermint	Essential-oil barrier tests showed citronella and peppermint deterred ants from crossing treated surfaces to reach food/water.	[11]
Fire ants	Citronella; peppermint	Direct Solenopsis invicta testing found citronella and peppermint to be effective deterrent barriers.	[11]
Argentine ants	Citronella; peppermint	Direct Linepithema humile testing found citronella and peppermint to be effective deterrent barriers.	[11]

Pest / category	BugMace active(s)	Positive evidence	Refs.
Mites	Thyme	Thyme was the strongest repellent oil in poultry red mite testing, with nearly 80% of the treated area avoided.	[12]
Chiggers	Clove; geranium	Direct Leptotrombidium imphalum testing found 5% clove oil produced 100% repellency; geranium oil also produced greater-than-50% repellency in the same research program.	[13]
Bed bugs	Geraniol	Cimex lectularius significantly avoided fresh and 24-hour-aged geraniol residues, directly demonstrating bed-bug repellent/avoidance activity.	[14]
Wasps	Clove; geranium; lemongrass; rosemary; citronella; thyme; peppermint	Field research found multiple BugMace oils significantly repellent to yellowjackets and paper wasps. A four-oil blend of clove + geranium + lemongrass + rosemary - all present in BugMace - completely blocked attraction to baited traps.	[15]

Substantiation synthesis

The evidence supports BugMace as a broad-spectrum repellent across the complete listed-pest set. The formulation is not dependent on a single essential oil: it combines nine repellent actives with overlapping activity across mosquitoes, small biting flies, house/stable flies, multiple tick species, fleas, ants, mites, chiggers, bed bugs and social wasps. The breadth of the literature, plus direct multi-oil blend results, provides a coherent scientific basis for BugMace's broad-spectrum repellent positioning. [2-15]

Key substantiation sources

1. BugMace Safety Data Sheet, Revision 1.2, May 5, 2026 - current 22.7% formulation and ingredient percentages. [\[Source\]](#)
2. Repellent efficacy of 20 essential oils on Aedes aegypti mosquitoes and Ixodes scapularis ticks in contact-repellency assays. Scientific Reports (2023). [\[Source\]](#)
3. Attraction and Repellent Behaviors of Culicoides Biting Midges toward Cow Dung, Carbon Dioxide, and Essential Oils (2021). [\[Source\]](#)
4. Testing the use of a citronella-based repellent as an effective method to reduce the prevalence and abundance of biting flies in avian nests. Parasitology Research (2009). [\[Source\]](#)
5. Field efficacy of a repellent formulation containing p-menthane-3,8-diol and lemongrass against Culicoides pachymerus (2012). [\[Source\]](#)
6. Repellency potential of essential oils against housefly, Musca domestica L. (2017). [\[Source\]](#)
7. The repellency of lemongrass oil against stable flies, tested using video tracking. Parasite (2013). [\[Source\]](#)
8. Repellent activity of essential oils to the Lone Star tick, Amblyomma americanum. Parasites & Vectors (2024). [\[Source\]](#)
9. Evaluating the repellent effects of major essential oil components on brown dog tick Rhipicephalus sanguineus s.l. Veterinary Parasitology (2025). [\[Source\]](#)
10. Repellency Effect of Essential Oils of some Native Plants and Synthetic Repellents against Human Flea, Pulex irritans (2017). [\[Source\]](#)
11. Wiltz BA, Suiter DR, Gardner WA. Deterency and Toxicity of Essential Oils to Argentine and Red Imported Fire Ants. Journal of Entomological Science 42(2):239-249 (2007). [\[Source\]](#)
12. The repellent and persistent toxic effects of essential oils against the poultry red mite, Dermanyssus gallinae. Veterinary Parasitology (2015). [\[Source\]](#)
13. Laboratory evaluation of aromatic essential oils as candidate repellents against Leptotrombidium chiggers (2008). [\[Source\]](#)
14. Behavioral Responses of the Common Bed Bug to Essential Oil Constituents (2021). [\[Source\]](#)
15. Essential oils and their compositions as spatial repellents for pestiferous social wasps. Pest Management Science (2013). [\[Source\]](#)
16. Effects of Glucam P-20, Vanillin, and Fixolide on Mosquito Repellency of Citronella Oil Lotions. Journal of Medical Entomology (2012). [\[Source\]](#)
17. Momar Geraniol Granules - commercial corroboration for geraniol/rosemary/lemongrass/cedarwood coverage including gnats and no-see-ums. [\[Source\]](#)
18. Repellent, larvicidal and pupicidal properties of essential oils and their formulations against the housefly, Musca domestica. Medical and Veterinary Entomology (2011). [\[Source\]](#)