

insects. The active ingredients of Essentria® IC-3 Insecticide Concentrate are rosemary oil, geraniol, and peppermint oil. The label of Essentria® IC-3 Insecticide Concentrate states that it controls ants, bed bugs, cockroaches, fleas, flies, mosquitos, occasional invaders, spiders, ticks, wasps and 30 other pests. NatureShield® Insect & Pest Repellent uses different active ingredients including garlic oil, cinnamon oil, castor oil, and cedar oil to control mosquitoes, ticks, fleas, ants, carpenter ants, centipedes, cockroaches, gnats, fire ants, silverfish, and other crawling and flying insects. Thyme Guard® bactericide and fungicide, with insecticidal activity, is a 23% thyme oil composition that is a broad spectrum contact liquid bactericide, fungicide, and insecticide for use on all organic crops.

[0006] However, these formulations suffer from numerous disadvantages including inadequate repellency. These natural insect repellents also fail to persist after application and either lose their repellency or require frequent application. Thus, there remains a need for compositions that efficiently kill and continue to kill and repel insects at each life cycle stage and retain efficacy after application. Further, while the aforementioned natural oils contain some level of cidal activity, there is a need in the art to maximize activity for both the killing and control of pests. Additionally, a matrix of activity across such a diverse list of agricultural pests by oil type and by combination to reach synergistic performance is lacking in the field.

SUMMARY

[0006a] In a first aspect of the present disclosure, there is provided an insect, bacteria, and/or fungi control composition comprising:

- (a) about 0.05% to about 20% by weight castor oil;
- (b) about 0.05% to about 20% by weight of a first oil selected from the group consisting of rosemary oil, thyme oil, clove oil, garlic oil, geraniol, peppermint oil, and cinnamon oil;
- (c) about 0.05% to about 20% by weight of a second oil selected from the group consisting of rosemary oil, thyme oil, clove oil, garlic oil, geraniol, peppermint oil, and cinnamon oil, wherein in the first oil is different from the second oil;
- (d) balance water about 20% to about 80% by weight.

[0006b] In another aspect of the present disclosure, there is provided a method of killing insects, bacteria, and/or fungi in a treatment area comprising:

applying the insect, bacteria, and/or fungi control composition as disclosed herein to the treatment area in an amount effective to kill insects, bacteria, and/or fungi in the treatment area.

[0006c] In yet another aspect of the present disclosure, there is provided a method of preventing insect reproduction in a treatment area comprising:

applying the insect, bacteria, and/or fungi control composition as disclosed herein to the treatment area in an amount effective to at least one of (a) disrupt an insect egg cycle and/or inhibit ovo deposit by adult female insects and (b) kill an insect larva in the treated area.

[0006d] In a further another aspect of the present disclosure, there is provided a method of controlling insects, bacteria, and/or fungi on a surface comprising

applying the insect, bacteria, and/or fungi control composition as disclosed herein to a surface in an amount effective to control insects, bacteria, and/or fungi on the surface.

[0006e] In another aspect of the present disclosure, there is provided an insect, bacteria, and/or fungi control composition comprising:

- (a) about 0.05% to about 20% by weight of a carrier oil;
- (b) about 0.05% to about 20% by weight of a first essential oil;
- (c) about 0.05% to about 20% by weight of a second essential oil different from the first essential oil;
- (d) balance water about 20% to about 80% by weight.

[0007] One example is for an insect, bacteria, and/or fungi control composition comprising: about 0.05% to about 20% by weight castor oil; about 0.05% to about 20% by weight of a first oil selected from the group consisting of rosemary oil, thyme oil, clove oil, garlic oil, geraniol, peppermint oil, and cinnamon oil; about 0.05% to about 20% by weight of a second oil selected from the group consisting of rosemary oil, thyme oil, clove oil, garlic oil, geraniol, peppermint oil, and cinnamon oil, wherein the first oil is different from the second oil; balance water about 20% to about 80% by weight. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 7% by weight potassium sorbate, sodium sorbate, or a combination thereof. In some examples, the

insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 35% by weight soaps; in some examples, the soap is an organic soap; and in some examples, the soap is a regular soap. In some examples, the insect, bacteria, and/or fungi control composition further comprises

about 0.05% to about 35% by weight glyceryl monostearate. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 15% by weight cedarwood oil. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 35% hydrogenated castor oil. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 1.0% to about 16% by weight cinnamaldehyde. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 1.0% to about 16% by weight eugenol. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 1.0% to about 16% by weight allicin. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 1.0% to about 16% by weight thyme oil. In In some examples, the insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 29% silica. In some examples, the first oil is rosemary oil and the second oil is peppermint oil. In some examples, the first oil is rosemary oil and the second oil is cinnamon oil. In some examples, the first oil is thyme oil and the second oil is peppermint oil. In some examples, the first oil is thyme oil and the second oil is cinnamon oil. In some examples, the first oil is clove oil and the second oil is garlic oil. In some examples, the first oil is clove oil and the second oil is geraniol. In some examples, the first oil is geraniol and the second oil is cinnamon oil. In some examples, the first oil is peppermint oil and the second oil is cinnamon oil. In some examples, the first oil is cinnamon oil and the second oil is garlic oil. In some examples, the first oil is geraniol and the second oil is peppermint oil. In some examples, the first oil is geraniol and the second oil is rosemary oil. In some examples, the first oil is geraniol and the second oil is thyme oil. In some examples, the first oil is geraniol and the second oil is garlic oil. In some examples, the first oil is clove oil and the second oil is peppermint oil. In some examples, the first oil is clove oil and the second oil is rosemary oil. In some examples, the first oil is clove oil and the second oil is thyme oil. In some examples, the first oil is rosemary oil and the second oil is peppermint oil. In some examples, the first oil is rosemary oil and the second oil is thyme oil. In some examples, the first oil is thyme oil and the second oil is garlic oil. In some examples, the first oil is rosemary oil and the second oil is peppermint oil.

[0008] Another example is for an insect, bacteria, and/or fungi control composition comprising: about 0.05% to about 15% by weight geraniol; about 0.05% to about 20% by weight castor oil;

about 0.05% to about 20% by weight rosemary oil, mint oil, or a combination thereof; balance water about 20% to about 80% by weight. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 7% by weight potassium sorbate, sodium sorbate, or a combination thereof. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 35% by weight soaps; in some examples, the soap is an organic soap; and in some examples, the soap is a regular soap. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 35% by weight glyceryl monostearate. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 15% by weight cedarwood oil. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 35% hydrogenated castor oil. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 1.0% to about 16% by weight cinnamaldehyde. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 1.0% to about 16% by weight eugenol. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 1.0% to about 16% by weight allicin. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 1.0% to about 16% by weight thyme oil. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 29% silica. In some examples, the insect, bacteria, and/or fungi control composition further comprises peppermint oil, linalool, or a combination thereof.

[0009] An additional example is for an insect, bacteria, and/or fungi control composition comprising: about 0.05% to about 20% by weight castor oil; about 0.05% to about 20% by weight of a first oil selected from the group consisting of rosemary oil, thyme oil, clove oil, garlic oil, geraniol, peppermint oil, and cinnamon oil; about 0.05% to about 20% by weight of a second oil selected from the group consisting of rosemary oil, thyme oil, clove oil, garlic oil, geraniol, peppermint oil, and cinnamon oil, wherein the first oil is different from the second oil; balance water about 20% to about 80% by weight. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 7% by weight potassium sorbate, sodium sorbate, or a combination thereof. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 35% by weight soaps; in some examples, the soap is an organic soap; and in some examples, the

soap is a regular soap. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 35% by weight glyceryl monostearate. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 15% by weight cedarwood oil. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 35% hydrogenated castor oil. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 1.0% to about 16% by weight cinnamaldehyde. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 1.0% to about 16% by weight eugenol. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 1.0% to about 16% by weight allicin. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 1.0% to about 16% by weight thyme oil. In some examples, the insect, bacteria, and/or fungi control composition further comprises about 0.05% to about 29% silica. In some examples, the first oil is rosemary oil and the second oil is peppermint oil. In some examples, the first oil is rosemary oil and the second oil is cinnamon oil. In some examples, the first oil is thyme oil and the second oil is peppermint oil. In some examples, the first oil is thyme oil and the second oil is cinnamon oil. In some examples, the first oil is clove oil and the second oil is garlic oil. In some examples, the first oil is clove oil and the second oil is geraniol. In some examples, the first oil is geraniol and the second oil is cinnamon oil. In some examples, the first oil is peppermint oil and the second oil is cinnamon oil. In some examples, the first oil is cinnamon oil and the second oil is garlic oil. In some examples, the first oil is geraniol and the second oil is peppermint oil. In some examples, the first oil is geraniol and the second oil is rosemary oil. In some examples, the first oil is geraniol and the second oil is thyme oil. In some examples, the first oil is geraniol and the second oil is garlic oil. In some examples, the first oil is clove oil and the second oil is peppermint oil. In some examples, the first oil is clove oil and the second oil is rosemary oil. In some examples, the first oil is clove oil and the second oil is thyme oil. In some examples, the first oil is rosemary oil and the second oil is peppermint oil. In some examples, the first oil is rosemary oil and the second oil is thyme oil. In some examples, the first oil is thyme oil and the second oil is garlic oil. In some examples, the first oil is rosemary oil and the second oil is peppermint oil.

[0010] Another example is for a method of killing insects, bacteria, and/or fungi in a treatment area comprising: applying the aforementioned insect, bacteria, and/or fungi control composition to the treatment area in an amount effective to kill insects, bacteria, and/or fungi in the treatment area. In some examples, the method is applied in an amount effective to kill at least 80% of insects, bacteria, and/or fungi in the treatment area one hour after applying the insect, bacteria, and/or fungi control composition to the treatment area. In some examples, the method further comprises diluting about 0.5 ounces, about 1 ounce, about 1.5 ounces, about 2 ounces, about 2.5 ounces, about 3 ounces, about 3.5 ounces, about 4 ounces, about 4.5 ounces, about 5 ounces, about 5.5 ounces, about 6 ounces, about 6.5 ounces, about 7 ounces, about 7.5 ounces, about 8 ounces, about 8.5 ounces, about 9 ounces, about 9.5 ounces, about 10 ounces, about 10.5 ounces, about 11 ounces, about 11.5 ounces, about 12 ounces, about 12.5 ounces, about 13 ounces, about 13.5 ounces, about 14 ounces, about 14.5 ounces, about 15 ounces, about 15.5 ounces, about 16 ounces, about 16.5 ounces, about 17 ounces, about 17.5 ounces, about 18 ounces, about 18.5 ounces, about 19 ounces, about 19.5 ounces, or about 20 ounces of an insect, bacteria, and/or fungi control composition concentrate with water to make a gallon of the insect, bacteria, and/or fungi control composition. In some examples, applying the insect, bacteria, and/or fungi control composition comprises spraying. In some examples, the insect is a scale, aphid, slug, snail, grasshopper, cricket, moth, worm, beetle, spider, ant, mite, looper, fly, thrip, spotted lantern fly, borer, psyllid, mealy bug, stink bug, tarnished plant bug, chinch, armyworm, mosquito, cockroach, centipede, gnat, silverfish, or tick. In some examples, the bacteria is *E. coli*, a *Erwinia*, a *Pseudomonas*, a *Xanthamonas*, or *Candidatus Liberibacter*.

[0011] An additional example for a method of preventing insect reproduction in a treatment area comprising: applying the aforementioned insect, bacteria, and/or fungi control composition to the treatment area in an amount effective to at least one of (a) disrupt an insect egg cycle and/or inhibit ovo deposit by adult female insects and (b) kill an insect larva in the treated area. In some examples, the treatment area comprises a residential landscape, a commercial landscape, or an area that comprises a water feature, a lake, or a stream. In some examples, the insect, bacteria, and/or fungi control composition is applied directly to the insect, bacteria, and/or fungi. In some examples, the method further comprises diluting about 0.5 ounces, about 1 ounce, about 1.5 ounces, about 2 ounces, about 2.5 ounces, about 3 ounces, about 3.5 ounces, about 4 ounces, about 4.5 ounces, about 5 ounces, about 5.5 ounces, about 6 ounces, about 6.5 ounces,

about 7 ounces, about 7.5 ounces, about 8 ounces, about 8.5 ounces, about 9 ounces, about 9.5 ounces, about 10 ounces, about 10.5 ounces, about 11 ounces, about 11.5 ounces, about 12 ounces, about 12.5 ounces, about 13 ounces, about 13.5 ounces, about 14 ounces, about 14.5 ounces, about 15 ounces, about 15.5 ounces, about 16 ounces, about 16.5 ounces, about 17 ounces, about 17.5 ounces, about 18 ounces, about 18.5 ounces, about 19 ounces, about 19.5 ounces, or about 20 ounces of an insect, bacteria, and/or fungi control composition concentrate with water to make a gallon of the insect, bacteria, and/or fungi control composition. In some examples, applying the insect, bacteria, and/or fungi control composition comprises spraying. In some examples, the insect is a scale, aphid, slug, snail, grasshopper, cricket, moth, worm, beetle, spider, ant, mite, looper, fly, thrip, spotted lantern fly, borer, psyllid, mealy bug, stink bug, tarnished plant bug, chinch, armyworm, mosquito, cockroach, centipede, gnat, silverfish, or tick. In some examples, the bacteria is *E. coli*, a *Erwinia*, a *Pseudomonas*, a *Xanthamonas*, or *Candidatus Liberibacter*.

[0012] A further example is for a method of controlling insects, bacteria, and/or fungi on a surface comprising applying the aforementioned insect, bacteria, and/or fungi control composition to a surface in an amount effective to control insects, bacteria, and/or fungi on the surface. In some examples, the insect, bacteria, and/or fungi control composition is applied in an amount effective to control at least 85% of insects, bacteria, and/or fungi on the surface one hour after applying the insect, bacteria, and/or fungi control composition to the surface. In some examples, the surface is selected from the group consisting of a soil surface, a plant surface, and an exterior building surface. In some examples, the method further comprises diluting about 0.5 ounces, about 1 ounce, about 1.5 ounces, about 2 ounces, about 2.5 ounces, about 3 ounces, about 3.5 ounces, about 4 ounces, about 4.5 ounces, about 5 ounces, about 5.5 ounces, about 6 ounces, about 6.5 ounces, about 7 ounces, about 7.5 ounces, about 8 ounces, about 8.5 ounces, about 9 ounces, about 9.5 ounces, about 10 ounces, about 10.5 ounces, about 11 ounces, about 11.5 ounces, about 12 ounces, about 12.5 ounces, about 13 ounces, about 13.5 ounces, about 14 ounces, about 14.5 ounces, about 15 ounces, about 15.5 ounces, about 16 ounces, about 16.5 ounces, about 17 ounces, about 17.5 ounces, about 18 ounces, about 18.5 ounces, about 19 ounces, about 19.5 ounces, or about 20 ounces of an insect, bacteria, and/or fungi control composition concentrate with water to make a gallon of the insect, bacteria, and/or fungi control composition. In some examples, applying the insect, bacteria, and/or fungi control

composition comprises spraying. In some examples, the insect is a scale, aphid, slug, snail, grasshopper, cricket, moth, worm, beetle, spider, ant, mite, looper, fly, thrip, spotted lantern fly, borer, psyllid, mealy bug, stink bug, tarnished plant bug, chinch, armyworm, mosquito, cockroach, centipede, gnat, silverfish, or tick. In some examples, the bacteria is *E. coli*, a *Erwinia*, a *Pseudomonas*, a *Xanthamonas*, or *Candidatus Liberibacter*.

[0013] Another example is for an insect, bacteria, and/or fungi control composition comprising a synergistically effective amount of rosemary oil, lemongrass oil, and geraniol.

[0014]

[0015] An additional example is for an insect, bacteria, and/or fungi control composition comprising: about 0.05% to about 20% by weight of a carrier oil; about 0.05% to about 20% by weight of a first essential oil; about 0.05% to about 20% by weight of a second essential oil different from the first essential oil; balance water about 20% to about 80% by weight. In some examples, the carrier oil is an active carrier oil; and in some examples, the active carrier oil is castor oil. In some examples, the first essential oil is peppermint oil, and the second essential oil is selected from the group consisting of thyme oil, cinnamon oil, geraniol, and garlic oil. In some examples, the first essential oil is clove oil, and the second essential oil is selected from the group consisting of garlic oil and geraniol. In some examples, the first essential oil is geraniol, and the second essential oil is selected from the group consisting of rosemary oil, thyme oil, and garlic oil. In some examples, the first essential oil is thyme oil, and the second essential oil is garlic oil.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] **Fig. 1** shows inhibition of *E. coli* testing individual ingredients. Columns: Control (*E. coli* only); Essential Oils – Ark (Castor Oil, Rosemary Oil, and Geraniol); Rosemary; Geraniol; Castor Oil; C + R (Castor Oil and Rosemary); C + G (Castor Oil and Geraniol); R + G (Rosemary and Geraniol); Soap; Potassium Sorbate; Glyceryl Monostearate. Y-axis: colony forming units.

[0017] **Fig. 2** shows a comparison of antibacterial activity of essential oils.

CLAIMS

1. An insect, bacteria, and/or fungi control composition comprising:
 - (a) about 0.05% to about 20% by weight castor oil;
 - (b) about 0.05% to about 20% by weight of a first oil selected from the group consisting of rosemary oil, thyme oil, clove oil, garlic oil, geraniol, peppermint oil, and cinnamon oil;
 - (c) about 0.05% to about 20% by weight of a second oil selected from the group consisting of rosemary oil, thyme oil, clove oil, garlic oil, geraniol, peppermint oil, and cinnamon oil, wherein the first oil is different from the second oil;
 - (d) balance water about 20% to about 80% by weight.
2. The insect, bacteria, and/or fungi control composition of claim 1, further comprising about 0.05% to about 7% by weight potassium sorbate, sodium sorbate, or a combination thereof.
3. The insect, bacteria, and/or fungi control composition of claim 1 or 2, further comprising about 0.05% to about 35% by weight soaps.
4. The insect, bacteria, and/or fungi control composition of claim 3, wherein the soap is an organic soap.
5. The insect, bacteria, and/or fungi control composition of claim 3, wherein the soap is a regular soap.
6. The insect, bacteria, and/or fungi control composition of any one of claims 1-5, further comprising about 0.05% to about 35% by weight glyceryl monostearate.
7. The insect, bacteria, and/or fungi control composition of any one of claims 1-6, further comprising about 0.05% to about 15% by weight cedarwood oil.

8. The insect, bacteria, and/or fungi control composition of any one of claims 1-7, further comprising about 0.05% to about 35% hydrogenated castor oil.
9. The insect, bacteria, and/or fungi control composition of any one of claims 1-8, further comprising about 1.0% to about 16% by weight cinnamaldehyde.
10. The insect, bacteria, and/or fungi control composition of any one of claims 1-9, further comprising about 1.0% to about 16% by weight eugenol.
11. The insect, bacteria, and/or fungi control composition of any one of claims 1-10, further comprising about 1.0% to about 16% by weight allicin.
12. The insect, bacteria, and/or fungi control composition of any one of claims 1-11, further comprising about 1.0% to about 16% by weight thyme oil.
13. The insect, bacteria, and/or fungi control composition of any one of claims 1-12, further comprising about 0.05% to about 29% silica.
14. A method of killing insects, bacteria, and/or fungi in a treatment area comprising:
applying the insect, bacteria, and/or fungi control composition of any one of claims 1-13 to the treatment area in an amount effective to kill insects, bacteria, and/or fungi in the treatment area.
15. A method of preventing insect reproduction in a treatment area comprising:
applying the insect, bacteria, and/or fungi control composition of any one of claims 1-13 to the treatment area in an amount effective to at least one of (a) disrupt an insect egg cycle and/or inhibit ovo deposit by adult female insects and (b) kill an insect larva in the treated area.

16. A method of controlling insects, bacteria, and/or fungi on a surface comprising applying the insect, bacteria, and/or fungi control composition of any one of claims 1-13 to a surface in an amount effective to control insects, bacteria, and/or fungi on the surface.
17. The method of any one of claims 14-16, further comprising diluting about 0.5 ounces, about 1 ounce, about 1.5 ounces, about 2 ounces, about 2.5 ounces, about 3 ounces, about 3.5 ounces, about 4 ounces, about 4.5 ounces, about 5 ounces, about 5.5 ounces, about 6 ounces, about 6.5 ounces, about 7 ounces, about 7.5 ounces, about 8 ounces, about 8.5 ounces, about 9 ounces, about 9.5 ounces, about 10 ounces, about 10.5 ounces, about 11 ounces, about 11.5 ounces, about 12 ounces, about 12.5 ounces, about 13 ounces, about 13.5 ounces, about 14 ounces, about 14.5 ounces, about 15 ounces, about 15.5 ounces, about 16 ounces, about 16.5 ounces, about 17 ounces, about 17.5 ounces, about 18 ounces, about 18.5 ounces, about 19 ounces, about 19.5 ounces, or about 20 ounces of an insect, bacteria, and/or fungi control composition concentrate with water to make a gallon of the insect, bacteria, and/or fungi control composition.
18. An insect, bacteria, and/or fungi control composition comprising:
- (a) about 0.05% to about 20% by weight of a carrier oil;
 - (b) about 0.05% to about 20% by weight of a first essential oil;
 - (c) about 0.05% to about 20% by weight of a second essential oil different from the first essential oil;
 - (d) balance water about 20% to about 80% by weight.
19. The insect, bacteria, and/or fungi control composition of claim 18, wherein the carrier oil is an active carrier oil, preferably the active carrier oil is castor oil.

20. The insect, bacteria, and/or fungi control composition of claim 18 or 19, wherein
- (i) the first essential oil is peppermint oil, and the second essential oil is selected from the group consisting of thyme oil, cinnamon oil, geraniol, and garlic oil;
 - (ii) the first essential oil is clove oil, and the second essential oil is selected from the group consisting of garlic oil and geraniol;
 - (iii) the first essential oil is geraniol, and the second essential oil is selected from the group consisting of rosemary oil, thyme oil, and garlic oil; or
 - (iv) the first essential oil is thyme oil, and the second essential oil is garlic oil.