TECHNICAL WHITE PAPER: EPISHIELD™

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EpiShield: What it is and how it works

EpiShield from BioWorks is a 25(b) miticide & insecticide with a unique formulation that uses a synergistic blend of clove and peppermint essential oils. EpiShield's name is derived from how it shields the epidermis of plants from damaging arthropods. EpiShield's MOA includes suffocation, disruption of the nervous system and desiccation, however, additional MOA may include repellency, antifeedant, anti-oviposition, increased pest movement, disruption of receptors regulating cell function, and/or physiological changes that result in pest mortality.

FIFRA 25(b) exempt oil-based products contain active and inert ingredients that are considered minimum risk and are registered under Section 25(b) of FIFRA (Federal Insecticide, Fungicide, Rodenticide Act). Products with 25(b) exemption do not require an EPA pesticide registration and the associated regulations regarding toxicity and environmental testing. However, these products do need to be registered in most states which can include efficacy, crop tolerance or microbial testing. The mode of action (MOA) of 25(b) products is related to the type(s) of formulated essential oil(s).

ACTIVE INGREDIENTS:

PEPPERMINT OIL 15%

CLOVE OIL 10%

SODIUM LAURYL SULFATE 3%

INERT INGREDIENTS:

SOAP, POLYGLYCERYL OLEATE, VEGETABLE OILS, OLEIC ACID, CITRIC ACID 72%

TOTAL: 100.00%

TARGET PESTS

+ Mites
+ Aphids
+ Whitefly
+ Mealybug
+ Thrips

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HISTORY OF DEVELOPMENT AND USE OF INSECTICIDE OILS

Traditional horticultural mineral oils (HMO) have been on the market for over one hundred years. Early oil formulations were heavy and contained volatiles that were often phytotoxic. Over time, the quality of oil products has improved significantly. There have been increases in the range of plants that can be treated, as well as the range of arthropods and diseases that can be controlled simultaneously.

BENEFITS OF EPISHIELD

The advantages of EpiShield are listed below when compared against traditional HMOs:

+ Exempt from restricted entry interval (REI) and preharvest interval (PHI) requirements
+ 10-28x lower use rates
+ Highly efficacious against major arthropod pests
+ Efficacy on par with chemical pesticides
+ Exempt from food tolerance requirement (no MRLs)
+ Exempt from pesticide use reporting
+ Fewer personal protective equipment requirements due to only containing minimum risk ingredients
+ Can be used on indoor and outdoor crops
+ Excellent resistance management tool
+ Less oil applied reduces the risk of phytotoxicity
+ Greater flexibility in application timing due to improved tolerance to temperature and humidity
+ Limited side-effects on natural enemies (no harmful residues)
+ Little to no residue left on the plant

With all these benefits, growers are better able to control arthropod pests while keeping their workers safe. That said, how do you choose between the traditional and highly reliable HMOs and 25(b) products like EpiShield? It doesn't have to be either or. Both HMOs and 25(b) products have unique advantages that give growers the flexibility to decide what is best for their operation. For example, HMOs are an effective hammer to apply a large amount of oil to suffocate harmful pests. 25(b) products allow for flexibility in application such as spot spraying without observing REI restrictions. Having both products on hand allows the grower to protect their crop in a wide range of situations.

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FOLIAR APPLICATION GUIDELINES

Apply 9-12 fl oz per 100 gallons of water (0.07-0.1% v/v solution). Begin applications when arthropods first appear. Repeat applications as needed, 5–7-day interval recommended. Use enough spray solution to completely penetrate the leaf canopy and cover both top and bottom of all leaves until wet without runoff. Use caution when applying to open bloom. Avoid intense light, heat, and humidity exposure after spray. Ensure plants are dry within two hours after application.

Follow these steps for conventional hydraulic sprayers:

1. Ensure that spray tank is clean.
2. Fill tank halfway and begin agitation; the agitator should be in constant operation.
3. Add desired amount of EpiShield and fill tank. The addition of a wetting agent is not essential but will improve leaf contact and spreading. Do not use surfactants that claim to be “penetrants” or “stomatal flooders or infiltrators”. Check crop safety prior to application to entire crop.
4. Use spray mixture immediately. Do not allow spray mixture to stand overnight.
5. Apply to leaf wet (glisten), but not to runoff!

DIP APPLICATION GUIDELINES

Mix 0.09 fl oz (2.7 mL) per gallon of water (0.07 % solution). This product may be used to control pests when applied as a dip of unrooted cuttings or foliage (above-ground portions) of rooted cuttings.

Clean and disinfect the dipping tank and equipment before a new dip solution is prepared. Prepare only as much dip solution as can be used in one day. If plant pathogens are a concern, prepare a new dip solution regularly throughout the day. Ensure full coverage by dipping for approximately 10-30 seconds while moving the plants around in the solution. Agitate dip solution throughout use. Certain plants may show phytotoxicity symptoms post-dipping. Prior to treating entire crop, test a small portion of the crop for sensitivity. Do not dip stressed/wilted cuttings or transplants. Do not tank mix with another product formulated with an oil carrier.

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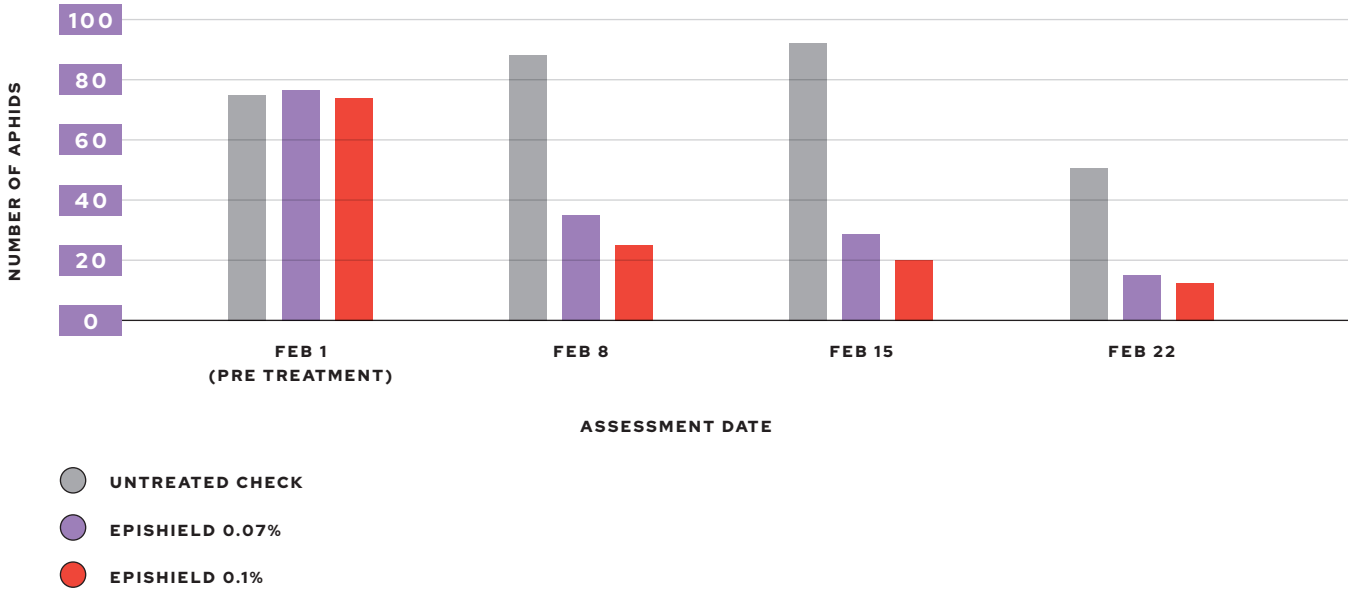
EPISHIELD: PROVEN PERFORMANCE

Extensive trialing of EpiShield has demonstrated its effectiveness and plant safety in a diverse range of crop settings as shown in the following examples from internal R&D trials as well as third-party independent trials. Additional trial data can be found on the BioWorks website at **bioworksinc.com/ask-us**.

EPISHIELD VS CANNABIS APHID ON HEMP (2023)



Average number of cannabis aphids. Treatments were applied on day 0, 7, and 14 days after initial treatment.

Key takeaways

+ EpiShield controlled cannabis aphid populations in hemp.
+ EpiShield at 0.07% killed 74.7% of cannabis aphids after three treatments.
+ EpiShield at 0.1% killed 81.9% of cannabis aphids after three treatments.
+ No phytotoxicity was observed in any treatments during the study.

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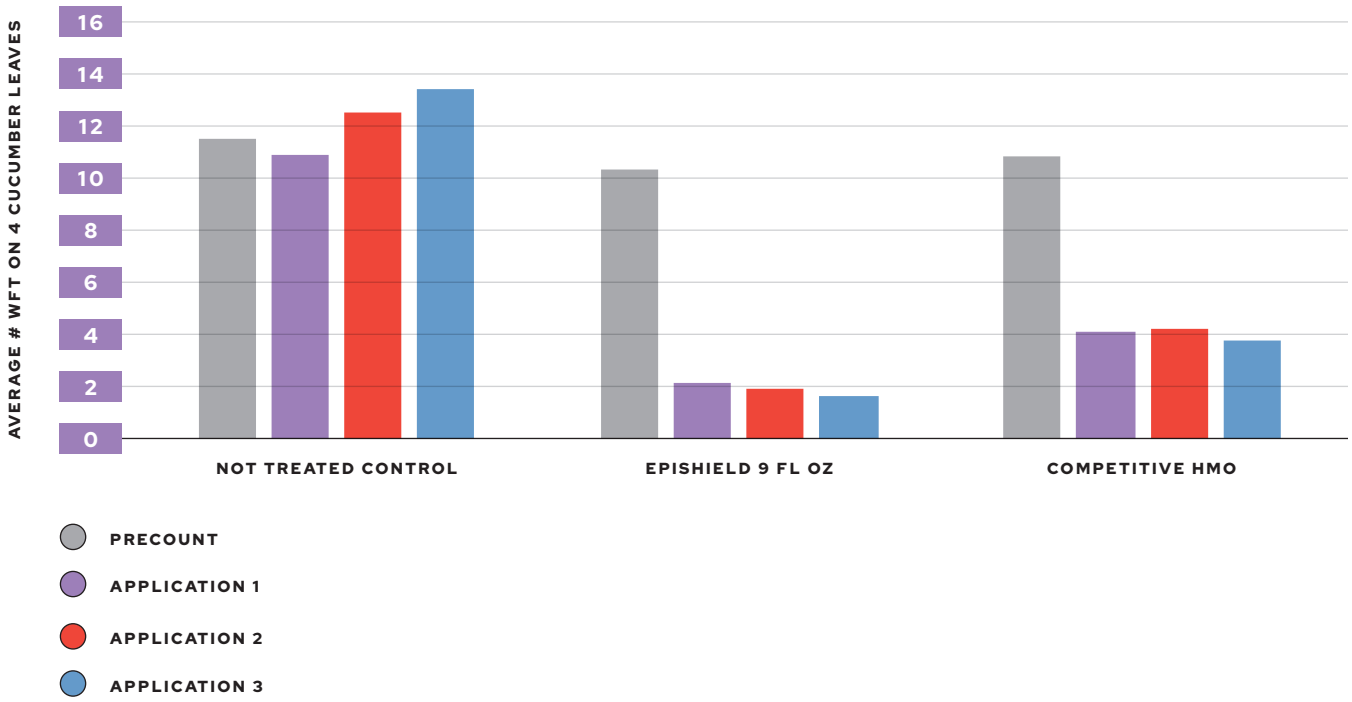
EPISHIELD VS THRIPS ON CUCUMBERS (2023)



Average number of western flower thrips per four leaves. Three applications were made three days apart, data recorded one day after treatment.

Key takeaways

+ EpiShield (15% peppermint oil, 10% clove oil & 3% sodium lauryl sulfate) significantly reduced western flower thrips after three applications.
+ EpiShield at 9 fl oz caused an 84% reduction of western flower thrips after three applications.
+ A competitive oil product caused a 65.5% reduction of western flower thrips after three applications.
+ EpiShield did not cause plant phytotoxicity during the study.

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EPISHIELD VS TWOSPOTTED SPIDER MITES ON GREENHOUSE-GROWN LIMA BEANS (2023)

Average percent mortality of twospotted spider mites. A single application was made, data recorded two days after treatment.

Key takeaways

+ A standard horticultural mineral oil (HMO) and EpiShield (15% peppermint oil, 10% clove oil & 3% sodium lauryl sulfate) significantly reduced twospotted spider mites after a single application.
+ A competitive essential oil product containing castor oil, rosemary oil, clove oil & peppermint oil was included as a standard and caused a 56% reduction of twospotted spider mites.
+ No phytotoxicity was observed in any treatment during the study.
+ EpiShield provided >90% mortality of twospotted spider mites with 10-28x lower rates compared to the HMO treatments.

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EPISHIELD: CROP TOLERANCE

EpiShield has been tested on numerous plant varieties. However, since EpiShield has not been tested on all plant varieties or in combination with all available tank mixes, BioWorks strongly advises testing EpiShield on a small number of plants to check for adverse plant effects before applying to a larger number of plants. Crop tolerance data can be found on the BioWorks website at **bioworksinc.com/ask-us/**.

BioWorks crop tolerance testing followed the IR4 protocol of crop tolerance testing where 1x, 2x, and 4x rates were tested. 1x is 9 fl oz/100 gallons (low label rate), 2x is 18 fl oz/100 gallons (slightly above the high label rate), and 4x is 36 fl oz/100 gallons (well above the high label rate). 2-4x rates are used in research to discover what would happen if applied at off label rates. **The 2-4x off label rates are not intended for use by growers. Do not apply above stated label recommendations of 9-12 fl oz/100 gallons. Do not apply as a drench to the potting media.**

COMMON NAME	BOTANICAL NAME	VARIETY	RATES TESTED (# FL OZ/ 100 GAL)	FOLIAR PHYTOXICITY? YES/NO	FLOWER PHYTOXICITY? YES/NO
Basil			9, 18, 36	Y @ 36 fl oz	N/A
Begonia	Begonia	Bada boom rose	9, 18, 36	N	N
Bibb/Butter lettuce heads	Lactuca sativa		9, 18	N	N/A
Chrysanthemum Pompom (cut flowers)	Chrysanthemum	Green button pom poms	9, 18	N	N
Coleus		Black wizard	9, 18, 36	N	N
Dahlia	Dahlia pinnata	Dahlietta® Patty	9, 18, 36	N	Y
Geranium	Pelargonium	BOLDLY® Hot Pink	9, 18, 36	N	Y
Green leaf lettuce heads	Lactuca sativa		9, 18	N	N/A
Impatiens	Impatiens	SunPatiens® Electric Orange	9, 18, 36	N	Y
Lima bean	Phaseolus lunatus	Fordhook 242	9, 18, 36	Y @ 36 fl oz	N/A
Maidenhair fern	Adiantum raddianum	Rosy	9, 18, 36	N	N/A
Marigold		Bonanza harmony	9, 18, 36	N	N
Pansy	Viola x wittrockiana	Delta Violet	4.5, 9	N	N
Pepper	Capsicum annuum	Sweet pepper (yellow)	9, 18	N	N
Pepper	Capsicum annuum	Hot Portugal	9, 18, 36	Y @ 36 fl oz	N/A
Pepper	Capsicum chinense	Habanero Red	9, 18, 36	Y @ 36 fl oz	N/A
Peruvian lily (cut flowers)	Alstroemeria	White	9, 18	N	N
Petunia	Petunia × hybrida	ColorRush™ Pink Petunia	9, 18, 36	N	Y
Roses (cut flowers)	Rosa rubiginosa		9, 18	N	N
Strawberry		Flamingo	9, 18, 36	Y @ 36 fl oz	N/A

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COMMON NAME	BOTANICAL NAME	VARIETY	RATES TESTED (# FL OZ/ 100 GAL)	FOLIAR PHYTOXICITY? YES/NO	FLOWER PHYTOXICITY? YES/NO
Tomato	Solanum lycopersicum	Big Beef	9, 18, 36	N	N
Tomato	Solanum lycopersicum	Early Girl	9, 18, 36	N	N
Tomato	Solanum lycopersicum	Rutgers	9, 18	N	N

For the most up-to-date crop tolerance information, please visit our website at **bioworksinc.com**.

Further reading

- EPA Minimum risk pesticides exempted from FIFRA registration: **epa.gov/minimum-risk-pesticides**
- Conditions for minimum risk pesticides: **epa.gov/minimum-risk-pesticides/conditions-minimum-risk-pesticides**
- CDPR references: **cdpr.ca.gov/docs/registration/sec25/sect25intro.htm**
- Active ingredients eligible for minimum risk pesticide use: **ecommons.cornell.edu/bitstream/handle/1813/52630/overview-profiles-NYSIPM.pdf?sequence=2&isAllowed=y**
- Oils, Myth & Magic by Julie Graesch: **nxtbook.com/greatamericanmediaservices/GPN/june-2023/index.php#/p/8**

GOING ABOVE AND BEYOND

At BioWorks, we not only help eradicate harmful diseases and pests that threaten your crops, but we design and support integrated plant health management programs. And because we know how quickly some diseases can work, we respond to any questions you might have in just 48 hours. So you can get back to the business of successful growing.

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