Comparing Organic Pesticide Options to Conventional Synthetic Pesticide Options in Vegetables: A Grower's Choice

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A major objective of this guide is to help identify some organic insecticide and fungicide options that growers may have and how they compare to conventional synthetic pesticide options, so growers can make a sounder choice in deciding whether to utilize organic pesticides or convert to organic production. Both pest control systems rely on preventative, cultural and integrated methods of insect and disease management but often in both systems, spraying pesticides become necessary to suppress and manage emerging insect and disease problems. The reasons for choosing one option over the other are quite varied and can include an idea that organic pest control options are safer for the environment, workers and consumers. However, studies have evaluated the environmental impact quotients (EIQ) where organic and synthetic pesticides have assigned values for their environmental impact and depending on what is done the EIQ may be worse in an organic pesticide system. This guide was developed to provide a useful and scientifically accurate evaluation of efficacy studies looking at different organic and synthetic pesticides in vegetable crops. The results are from peer reviewed studies as well as individual testing over the last 25 years.

Organic pesticides can be defined as products derived from naturally occurring substances in plants, microbes, or earth-derived products and have been certified as organic by a certifying agency. Synthetic pesticides can be defined as products that are synthesized by man and may have a petroleum basis or may not but do not have an organic certification by a certifying agency.

Percent control is calculated for the season average of pest densities by a simple formula (check – treatment/check X 100) and is not intended to be the only or "best" method for this calculation. Other formulas exist (Henderson and Tilton, 1955 representing percent reductions) for such a calculation. However, it is intended that "control" be expressed in relation to an untreated check to express the true value of treating. To clarify what these values mean to us in relation to pest density dynamics, one must define these numbers in qualitative terms which is how this guide will represent the efficacy studies. Therefore, 90 to 100 percent control is **excellent control**, 80 to 89.9 percent control is **good control**, 60 to 79.9 percent control as **fair control**, 40 to 59.9 percent control as **suppression** and less than 39.9 percent control as **no control**. Also, negative values of percent control occur and these values imply an increase (resurgence) of the pest density due to treating relative to the untreated check. Negative percent control by a treatment may be explained by such factors as removal of the biological/natural (beneficial) control, resistance, or the reproductive stimulation of the pest by this treatment but rarely is quite evident as to the exact nature of the cause. Although the qualitative terms or values differ for the

particular pest and vegetable crop as to what is “control and suppression”, these terms represent a general rule of thumb and their qualitative definitions have merit in most situations. This qualitative information along with statistical separations allows for a better understanding of any product’s potential under field wide use in a given season.

Insects

Leaf-feeding Worms. The larvae of lepidopteran moths to include cabbage looper, diamondback moth, and beet armyworm attack the leaves of many different types of vegetable crops but mainly attack brassica crops such as cabbage, broccoli and mustard greens.

Materials Approved for Organic Production

1. *Bacillus thuringiensis* var. *kurstaki* products give fair to good control of all 3 lepidopteran worms but are best on diamondback moth larvae. *Bacillus thuringiensis* var. *aizawi* product gives best control on beet armyworm.
2. Spinosad product gives fair to good control of all 3 lepidopteran worms but is best on diamondback moth larvae.
3. Pyrethrum without piperonyl butoxide product gives fair to good control of all 3 lepidopteran worms but is best on cabbage looper.

Materials Approved for Conventional Production Systems

1. Synthetic pyrethroid products give good to excellent control of all 3 lepidopteran worms but are best on cabbage looper.
2. Chlorantraniliprole (Coragen^{R}) products give good to excellent control of all 3 lepidopteran worms but is best on beet armyworm.
3. Spinetoram (Radiant^{R}) product gives good to excellent control of all 3 lepidopteran worms but is best on diamondback moth larvae.

Piercing-sucking Homopterans. The immature and adult stages of aphids, whiteflies, and psyllids can be grouped together because they have piercing-sucking mouthparts and are closely related to each other because they belong in the same insect order. Normally these insects can quickly develop into explosive pest numbers. In addition, due to their mouthparts they could transmit plant viruses and plant bacteria which can severely affect plant growth and final vegetable yields. These 3 insect groupings can cover many vegetable crops but cucurbits, tomatoes, peppers and potatoes seem most affected.

Materials Approved for Organic Production

1. Kaolin clay products give fair to good control of all 3 homopterans but is best on psyllids.
2. Summer oil products give mixed results on all 3 homopterans but at best can only achieve suppression on whitefly populations.

3. Insecticidal soap products give mixed results on all 3 homopterans but at best can only achieve suppression on aphid populations.
4. Garlic based products give no control of all 3 homopterans but in some field trials has increased yield such as bell peppers.

Materials Approved for Conventional Production Systems

1. Neonicontinoid products in mode of action class 4A give good to excellent control of all 3 homopterans but are best on whitefly.
2. Chlorantraniliprole (Coragen^{R}) products give good to excellent control of all 3 homopterans but are best on whitefly.
3. Spirotetramat (Movento^{R}) gives good to excellent control of all 3 homopterans but is best on aphids.

Thrips. The immature and adult stages of thrips have rasping-sucking mouthparts. Thrips attack many vegetable crops but 2 different species (western flower thrips and onion thrips) are key pests on onions.

Materials Approved for Organic Production

1. Kaolin clay products give suppression to fair control of thrips on onions.
2. Sulfur based products give suppression to fair control of thrips on onions.
3. Insecticidal soap mixed with azadirachtin gives suppression of thrips on onions.
4. Insecticidal soap products give no control of thrips on onions.
5. Garlic based products give no control of thrips on onions but in some field trials has increased yield such as bell peppers but not onions.

Materials Approved for Conventional Production Systems

1. Methomyl (Lannate^{R}) gives fair to good control of thrips on onions.
2. Spinetoram (Radiant^{R}) gives fair to good control on thrips on onions.
3. Extract of *Chenopodium* (Requiem^{R}) gives suppression to fair control on thrips on onions.

Weevils. The immature and adult stages of weevils have chewing mouthparts. Weevils are very specific to crops and include carrot weevil, pepper weevil and cowpea curculio. The immature stage is often protected because they develop on the inside of the plants so generally it is the adult stage of the weevil that is targeted.

Materials Approved for Organic Production

1. *Steinerema* sp. (beneficial nematodes) gives suppression to carrot weevil.
2. Garlic based products give no control of pepper weevil and cowpea curculio but in some field trials has increased yield such as bell peppers but not cowpeas.

Materials Approved for Conventional Production Systems

1. Oxamyl (Vydate^{R}) gives suppression to fair control of weevils.
2. Synthetic pyrethroid products give suppression of weevils.

Mites. Mites are not insects but often confused with which pesticides should be used for them. Mites generally are not affected by insecticides therefore the terminology of miticides is used for them. They attack many vegetable crops and can explode if the environmental conditions are right for them and sometimes because of certain insecticides that increase their populations.

Materials Approved for Organic Production

1. Sulfur based products give suppression to fair control of mites.
2. Compost tea based products give no control of mites in citrus.

Materials Approved for Conventional Production Systems

1. Abamectin (Agri-Mek^{R}) gives good to excellent control of mites.
2. Spiromesifen (Oberon^{R}) gives good to excellent control of mites
3. Bifenthrin (Capture^{R}) gives fair to good control of mites

Diseases

Foliage diseases. There are many fungal and bacterial diseases on vegetables that cause death to the foliage otherwise known as foliage blight. Most of the diseases on vegetable are fungal so fungicides are used to control them. However, if bacteria are causing problems on the foliage then bactericides are used for them. This section will only cover foliage disease caused by *Alternaria* sp. in onions and carrots.

Materials Approved for Organic Production

1. Extract of *Reynoutria* sp. (Regalia^{R}) product give suppression to fair control of *Alternaria* in onions.
2. *Bacillus subtilis* type products give no control of *Alternaria* in carrots.

Materials Approved for Conventional Production Systems

1. Iprodione (Rovral^{R}) gives suppression to fair control of *Alternaria* on onions and carrots.
2. Tebuconazole (Tebuzol^{R}) gives suppression to fair control of *Alternaria* on onions.

Soil-borne diseases. There are many fungal and bacterial diseases on vegetable that cause death to the root systems. Most of the diseases on vegetable causing soil-borne problems are fungal so fungicides are used to control them. This section will only cover soil borne disease called pink root caused by Phoma sp. in onion.

Materials Approved for Organic Production

1. *Streptomyces lydicus* (Actinovate^{R}) product give suppression to fair control of pink root in onions.
2. *Bacillus subtilis* type products give no control of pink root in onions.

Materials Approved for Conventional Production Systems

1. Hybrid resistant varieties are used in conventional systems. Older onion varieties that may be used for organic production systems are generally not resistant to pink root.

Germination and Stand Vigor.

Germination and stand vigor are rarely discussed when evaluating pesticides. However, many benefits may be found with certain products that are overlooked in the discussion of pest management but very important to plant health. This is important in establishing the best plant stands and early growth for the best yields in either system.

Materials Approved for Organic Production

1. Beneficial bacteria (F-68^{R}) product gives statistically significant plant stand in celery when compared to untreated area.
2. Mycorrhizae fungi type products at highest labeled rates give statistically significant plant stand in celery when compared to untreated area.
3. *Bacillus subtilis* type products give statistically significant plant stand in onions when compared to untreated area.

Materials Approved for Conventional Production Systems

1. Generally dependent on starter acid-based fertilizers to help plant stand and vigor.