

TABLE 2-29. ALTERNATIVE & BIORATIONAL INSECTICIDES FOR INSECT PEST CONTROL STRATEGIES IN VEGETABLE CROPS.

NOTE: Results of many specific control tactics listed below are highly variable. Many have not been tested thoroughly in commercial vegetable systems.

Target Pest	Cropping System	Systems-based Practices (for pest prevention)	Mechanical & Physical tactics (for pest prevention)	Biorational Insecticides (before pests reach outbreak status)	Natural Enemies (NE) [†]
Aphid	Multiple crops	Timely planting and harvest. Reduce water stress; trap crop of okra, sorghum, etc.; removal of alternative hosts	Use of reflective mulches to protect transplants or use row covers after transplanting; use water jet or frequent irrigation to dislodge aphids & reduce plant stress	Insecticidal soap & oil, neem, Pyrethrin, <i>Chromobacterium</i> (Grandevo), Azera (insecticide premix)	Lady beetles, Lacewings [†] , Midges, Parasitic wasps [†] , Predatory stink bugs, Syrphid fly larvae [†]
Asparagus beetle	Asparagus	Use some portion of field as trap crops; use insecticides on trap crops (repeated sprays)	Manually remove beetles from trap crops	Pyrethrin, Spinosad, <i>Chromobacterium</i> (Grandevo)	Lady beetles, Eulophid wasps
Bean leaf beetle	Snap, lima, pole beans	Sanitation (removal of crop debris), site selection (away from wooded areas), delayed planting date.	Hand-pick beetles off the leaves	Insecticidal soap, Pyrethrin, Neem	Tiphidae (parasitoids)
Beet armyworm	Multiple crops	Timely harvest	Destroy egg masses and caterpillars	<i>Bacillus thuringiensis</i> (Xentari, Dipel), Spinosad, <i>Chromobacterium</i> (Grandevo), viruses (Spod-X)	Lady beetles, Lacewing larvae, Soldier bugs
Blister beetle	Multiple crops	—	Hand-picking, insect netting	Spinosad	—
Cabbage looper	Multiple crops	—	Sanitation (remove crop debris). Remove alternate host plants (wild mustard, shepherd's purse)	<i>Bacillus thuringiensis kurstaki</i> , Insecticidal soap & oil, Spinosad, Neem, <i>Chromobacterium</i> (Grandevo)	Trichogramma, Encyrtid & Pteromalid parasitoids, Lacewings
Colorado potato beetle	Multiple crops	Crop rotation, tolerant varieties	Hand-picking	Insecticidal soap, Neem, Pyrethrin (use for larval control)	Lacewing, Ichneumonid wasp
Corn earworm/ Tomato fruitworm	Multiple crops	—	Hand-picking	<i>Bacillus thuringiensis</i> , Insecticidal soap & oil, spinosad, Neem, <i>Chromobacterium</i> (Grandevo)	Flower bugs, Lacewings, Ichneumonid and Pteromalid parasitoids
Cowpea curculio	Snap, lima, pole beans	Crop rotation, sanitation	Timely or early harvest of crop	Insecticidal soap & oil, Pyrethrin, Neem (adults are difficult to kill)	Soldier beetle, Braconid wasps
Cucumber beetle	Multiple crops	Trap crop of Hubbard squash	Insect netting to block beetles (early season protection)	Pyrethrin, neem, parasitic nematodes (weekly soil drench)	Braconid wasps
Cutworm	Multiple crops	Vigorously growing plant varieties; timely planting	Plant collars, floating row covers.	<i>Bacillus thuringiensis</i> (Xentari, Dipel) directed spray to plant base. Spinosad foliar and stem spray; Seduce(spinosad) bait	Lady beetle, Ground beetles
Diamondback moth & Imported cabbageworm	Collard & Mustard greens	Use pheromone traps to monitor moths	Destroy caterpillar clusters on leaves; pheromone mating disruption	<i>Bacillus thuringiensis kurstaki</i> , insecticidal soap, Neem, Pyrethrin, <i>Chromobacterium</i> (Grandevo), Azera (insecticide premix)	<i>Trichogramma brassicae</i> Parasitic wasp [†] , <i>Macrolophus caliginosus</i> (Predatory beetle [†])
European corn borer	Multiple crops	Use tolerant cultivars when possible	Remove caterpillars on foliage	<i>Bacillus thuringiensis kurstaki</i> , insecticidal soap, Neem, Pyrethrin, <i>Chromobacterium</i> (Grandevo)	<i>Trichogramma</i> wasps encourage native Parasitic flies and Wasps
Flea beetle	Multiple crops	Timely planting of crops, trap crops	Use row covers to protect transplants	Insecticidal oil, Neem, Spinosad, Parasitic nematodes (drench in soil), Azera (insecticide premix)	Braconid wasps
Grasshopper	Multiple crops	Maintain a grassy patch away from main crop and use insecticidal bait	Hand-picking, sweep netting	Pyrethrin (multiple applications), Nolo Bait (<i>Nosema locustae</i>)	Nematode bait (Sema-spore)
Hornworm	Tomato	—	Hand-picking	Spinosad, <i>Bacillus thuringiensis kurstaki</i> , Pyrethrin, Neem, <i>Chromobacterium</i> (Grandevo)	Lacewings, Lady beetles, Trichogramma and Braconid wasps
Japanese beetle	Multiple crops	Timely harvest; trap crops to deter feeding on main crop	Manual removal of beetles by sweep netting or other means.	Pyrethrin, Neem (multiple sprays), Milky spore disease	Tiphid parasitoids
Lace bug	Eggplant	—	—	Parasitic nematodes (drench in soil weekly)	Braconid
Leaffooted bug	Fruiting vegetables (tomato, okra, eggplant)	Timely planting of main crops, trap crop of <i>Peredovik</i> sunflower & silage sorghum <i>NK300</i> provides significant reduction	Hand-pick and destroy adults; bug vacuum may be used for removing nymphs	Pyrethrin	—
Leafhopper	Multiple crops	—	—	Insecticidal soap & oil, Pyrethrin, Neem	Flower bugs, Lacewings
Leafminer	Multiple crops	—	Pick and destroy mined leaves; remove egg clusters	Neem, spinosad, <i>Chromobacterium</i> (Grandevo)	Eulophid wasps (<i>Diglyphus</i> , <i>Dacnusa</i>) [†]
Mealy bugs	Multiple crops	—	Hand-picking	Insecticidal soap and oil	<i>Leptomastix</i> parasite [†] , <i>Cryptolaemus montrouzieri</i> predatory beetle [†]
Onion maggot	Onion	Use well-composted manure; soil tillage exposes maggots	—	—	Braconid parasitoid

[†]Denotes natural enemies that can be purchased from commercial insectaries.

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Target Pest	Cropping System	Systems-based Practices (for pest prevention)	Mechanical & Physical tactics (for pest prevention)	Biorational Insecticides (before pests reach outbreak status)	Natural Enemies (NE) [†]
Parsleyworm (black swallowtail)	Parsley, dill, carrot	—	Hand-pick and destroy caterpillars	Bacillus thuringiensis kurstaki	Trichogramma wasps
Pepper weevil	Pepper	Crop rotation	Hand-pick insects	Insecticidal soap, Neem, Pyrethrin, Parasitic nematodes (drench in soil weekly)	Lady beetles, Predatory mites, Lacewings
Pickleworm	Cantaloupe, muskmelon	—	—	—	Lady beetles, Predatory mites, Lacewings
Seedcorn maggot	Snap, lima, pole beans	Reduce organic matter	—	—	Parasitoid, Parasitic nematodes
Spider mite	Multiple crops	Plant and harvest timely; provide irrigation; problem could be severe in drought years; tolerant varieties	—	Paraffinic oil, Neem oil, Sulfur dust or spray (check label before use); do not use pyrethrin	<i>Amblyseius californicus</i> [†] & <i>Phytoseiulus persimilis</i> [†] (Predatory mites), <i>Feltiella acarisuga</i> gall midge
Squash vine borer	Pumpkin, squash	Timely planting, tolerant varieties, sanitation (remove crop debris)	Practice de-worming, insect netting at plant base (early season)	Pyrethrin, Spinosad (early season spray after detecting moths or eggs at plant base)	—
Squash bug	Pumpkin, squash	Trap cropping with Hubbard squash; plant tolerant varieties, sanitation (remove crop debris)	Insect netting early in season	Pyrethrin weekly spray at low population levels	—
Stink bug & Harlequin bug	Multiple crops	Trap crop of sorghum, okra	Hand-picking	Insecticidal oil, Pyrethrin	Eucoliid & Scellionid parasitoids
Thrips	Multiple crops	Trap crops	—	Spinosad, Insecticidal soap, Paraffinic oil	<i>Orius insidiosus</i> [†] & <i>O. majusculus</i> (flower bugs), Lacewings, <i>Hypoaspis miles</i> & <i>Amblyseius swirskii</i> (predatory mites) [†]
Whitefly	Multiple crops	Crop rotation	—	Insecticidal soap, Neem oil, <i>Chromobacterium</i> (Grandevo)	Lacewings, <i>Encarsia formosa</i> [†] & <i>Eretmocerus eremicus</i> (parasitoids), <i>Amblyseius swirskii</i> (Predatory mite) [†]
Wireworms	Multiple crops	Crop rotation is a major IPM strategy	—	None	—
Yellow-striped armyworm	Multiple crops	Sanitation (remove crop debris after harvest)	Hand-picking eggs and larvae	<i>Bacillus thuringiensis</i> (Xentari, Dipel), Neem (azadirachtin), Spinosad, <i>Chromobacterium</i> (Grandevo), Azera (insecticide premix)	Spined soldier bugs

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