

Farmscaping Techniques for Managing Insect Pests

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Farmscaping – definition and description.

Farmscaping is a holistic (whole-farm) ecological approach to pest management—particularly for insects. An entomologist, Dr. Robert Bugg coined the term ‘farmscaping’ - defining it as the “*deliberate use of specific plants and landscaping techniques to attract and conserve ‘beneficials’.*” It refers to the arrangement of plants used for economic purposes (cash crops) and insectary plants used for food and habitat for beneficial insects. Sometimes, the term “farmscaping” is broadened beyond just augmentation of insectary plants to include using trap crops—i.e. plants that are more attractive to the pest, established adjacent to the cash crop.

Farmscape plantings can be arranged in one or a combination of designs and farm sites: (1) as living mulches or trap crops near cash crops; (2) in fence rows or borders, as islands patches within rows or occupying entire rows spaced at regular intervals within the field; or (3) as herbs/flower cash crops intercropped with vegetable/fruit crops. Ideal farmscape plantings provide a habitat for beneficial insects, suppress weeds, and grow in close proximity to the cash crop without competing for space (light, water and nutrients).

Farmscape plantings constitute an ideal form of conservation biological management or control – i.e. farmscape plantings attract beneficial insects from surrounding areas and provide conditions where they can thrive and become established in sufficient numbers to hold insect pests in check. Farmscape plantings can also serve as an overwintering habitat, which is another important component of conservation biological management that can ensure carryover of beneficial insects from year to year. If beneficials do not live in your area you will need to take a step back and try importing the beneficial to your farm. Hopefully the combination of this classic biological control technique with conservation biological control methods will allow for the long-term establishment of beneficial insects. If you are starting from scratch, realize this process will take 3 to 5 years to get set up and running properly. If you have more pristine conditions, you may just have to increase certain plants, or change a few management practices to increase natural enemy numbers very quickly.

Why should I farmscape?

- 1) *Work smarter, not harder.* Working with and using natural processes, like farmscaping, will help control pests sustainably, earlier in the season. This will increase your farms productivity with less direct intervention thus minimizing labor inputs. Farmscaping helps to establish balance in a system, and it is this balance that provides for the stability of your agroecosystem.
- 2) *More \$\$ in your pocket.* Farmscaping lowers the production costs of crops by encouraging and using natural enemies to suppress pests below the economic threshold. When conditions are right, natural enemies can hold these pest levels down sustainably. Also, natural diseases of pests are encouraged.
- 3) *It's cheap and you don't need much!* You only need to farmscape about 5% or less of the field area. This means, for every acre, you need about 2200 square feet of farmscaping. Farmscaping seed is cheap. You can seed an entire solid acre from a commercial mix for about \$10 acre. An ounce of prevention is truly worth 16 times its weight in cure here. Beneficial insects don't require health insurance, a form of identification, and they will gladly work on holidays during the growing season.
- 4) *You can put farmscape plants where you want.* As long as the plants (and some are trees) are in the area, you can get good benefits. We put farmscaping mixes in pull out rows; grass roadways are changed to farmscape plants; drainage ditches and steep banks make great harborage for beneficials.
- 5) *Less time spent on pest and weed control* – more time spent on other things, especially in the spring. In our broccoli system, we spray when the plants are cupping (just before heading) once and maybe twice, using Bt that costs \$10 acre.
- 6) *Erosion control/soil building.* Farmscaping in contours between fields, steep ditches, or places that are more easily eroded gives stability to the soil. Farmscaping can be used as a buffer strip, and has benefits to crops growing in fields nearby. Several of the farmscaping mixes are also good soil builders.
- 7) *Good habitat and overwintering sites for beneficials.* That's what the rest of this bulletin is about.

How does Farmscaping work?

Most crops have pests that are specific to that crop (example: Imported cabbageworm (ICW) on broccoli) or pests that attack a specific plant family (Brassica – mustards - ICW attacks many cruciferous crop). Classical biological control of insects, a field within entomology that is over 100 years old, has given us the entomological tools to identify specific insect natural enemies, which attack these crop pests. An example of a specific natural enemy of the imported cabbageworm is: *Cotesia glomerata*, a small parasitic wasp which attacks 1st through 3rd instar ICW caterpillars. By understanding the life history requisites for this natural enemy, including food plants, extrafloral nectary sites, overwintering plants and sites, we are able to use natural enemies to bring about a stable low population of the pest. Field practitioners variously call this Integrated Parasite, Pathogen, and Predator Management (IPPM), Biologically-based IPM, (BIPM), or Integrated Biological Control (IBC), which focuses on conservation of natural enemies through increased understanding of their food, mating, and egg deposition, larval, pupal and adult developmental habits.

Integrated Parasite, Pathogen and Predator Management

Researchers in the 1950s and 1960s, especially Everett Dietrich at Rincon-Vitova Insectaries in California, realized that by focusing on having significant numbers of natural enemies present when they are needed, control of pests could be sustainably achieved. IPPM and farmscaping treat beneficial insects like mini-livestock. Given the right food and habitat, you can encourage the right natural enemy at the right time to be present to attack your pests. Let's use the wasp mentioned above. *Cotesia glomerata* lays its eggs in the small larvae of the imported cabbageworm, where 20 to 50 wasp larvae develop, mature, emerge, and destroy the imported cabbage worm larvae at the same time. The wasp larvae spin yellow cocoons next to or near the dying caterpillar from which they emerged. In the fall, many of the last caterpillars parasitized by this wasp will be found on leaves and stems of brassica plants. Thus, to start this cycle from a farmscaping IPPM perspective, you must set back or let part of your brassica crop overwinter, *because this is where many of the wasp cocoons are found*. This practice of setting back plants with cocoons, or a portion of your plants, gives you significantly more adult wasps in the spring than if the plants were all tilled under or composted which destroys the cocoons. If the adult *Cotesia glomerata* has easy access to nectar from flowering plants in the spring, its longevity, fecundity and offspring sex ratio are positively affected. Ultimately if wasp longevity and egg productivity are increased, this beneficial will destroy more imported cabbageworm larvae and give suppression of the ICW sooner in the season. Since pest control is a numbers game, increasing the productivity of the beneficials usually gives them the upper hand. One needs to plan ahead so that the resources needed by beneficials will be readily available throughout the growing season. These include:

- flowers or extra-floral nectaries that provide ample nectar flow
- flowers that provide ample pollen production
- plants that attract non-crop pests that sustain the beneficial insect until they are needed to patrol your cash crop
- pollen/nectar sources having a flower structure that is accessible to beneficial insects

Spatial arrangement

Mobility of the beneficial insects is the determining factor in deciding spatial arrangement of the farmscaping plots on a farm. A very mobile beneficial can travel to outside of a field and still provide ample control. However, less mobile beneficials will need small farmscaping patches interspersed throughout the field in order to get ample control.

Weed suppression

The ability of farmscape plantings to suppress weeds will determine the amount of time needed for proper establishment. Buckwheat is as close as you can get to an ideal farmscaping plant, because it:

- provides abundant nectar to a wide range of beneficials
- has extra-floral nectaries and a relatively long bloom period
- suppresses weed growth very well

- is easy and inexpensive to grow
- is easy to kill

Large seeded versus small seeded farmscaping plants

Plant species like buckwheat, coriander or sunflower are larger seeded and vigorous germinators. These plants can jump ahead of the weeds and minimize weeding. However, many farmscape species are small seeded and slow germinators. Limiting areas that need weeding will greatly decrease labor costs without sacrificing the effectiveness of your farmscape. Experience has shown that a single, well-timed hand weeding (generally 2-4 weeks after crop emergence) is sufficient to manage weeds and minimize weeding costs. In order to do well, a farmscape species must:

- germinate reliably and rapidly
- be able to handle competition during establishment
- be able to keep down weeds once established
- have seed that is readily available and relatively inexpensive
- provide ample amounts of nectar or pollen

Annual species that reseed or perennial species will be a plus if you intend on establishing permanent farmscape plots. Research needs to be carried out to determine the critical percentage of land in farmscape to achieve control of insect pests.

Broad cast seeding versus using a seeder

We have found that using an inexpensive Earthway Seeder is superior to broadcast seeding. Germination is much higher when farmscape species are drilled in rows. This allows you to cultivate with a hoe and minimize hand weeding while achieving significantly higher germination rates. Using the Earthway Seeder allows grouping seeds that can enable:

- planting combinations that work well together
- obtaining desired spatial arrangement
- making adjustments for germination characteristics (light vs. dark germinators)

Using a row seeder allows adjusting planting density by adding a seed diluent to lower the seeding rate. After some experimentation, both corn grits (cg) and soybean meal (sbm) were shown to flow uniformly through plate #22 (beet-chard) of the Earthway Seeder at a rate of approximately 1 gram per foot of row. Mixing farmscape seeds with cg or sbm at a desirable rates and seeding with the Earthway Seeder gave excellent uniform spacing and germination of small-seeded farmscape species. Additionally, some plants can be included in your farmscaping by planting/transplanting. Carrots and parsnips are excellent farmscaping plants that can be included in the farmscape by plugging the intact root into the ground right where you need it. It is hard to get around certain limitations at times – slow germination, poor germination from seed, or expensive seed are all examples. In this case, buying a few plants or growing them in your greenhouse might be an option for you. Remember that your goal is diversity and that sometimes certain farmscaping niches are harder to fill (i.e. early spring or late fall) than others.

Buying commercial mixes versus making your own

Some people have had good success with commercial farmscaping mixes. Our experience at Virginia Tech is that you get a mix that has many good species but in the end a few take over. The species that usually do well are the early season plants that are quick germinators. Ironically these are usually among the least expensive components of the mix. However in North Carolina we've had experience with farmscaping mixes (mainly Beneficial Blend from Rincon Vitova) since 1999, and have several large perennial beds separating fields that are now 4 years old. The mix begins to tend toward sweet/white clovers, and umbels like carrots and dill; however there are still mustards, buckwheat, and larger clovers like crimson clover present in our mixes.

Screening plants for use in farmscaping

Our research is geared towards determining which farmscaping species work best on the east coast since many of the farmscaping blends were developed for California.

What comprised the Virginia Tech farmscaping plots in 2004

Early Broccoli

Farmscaping beds (36 - 44 inches wide at the top) were planted with seven rows per bed on June 3 (broccoli transplanted on June 16th)

1. coriander with a little calendula
2. Phacelia, cornflower, borage, cleome, golden marguerite, black oil seed sunflower, Mexican sunflower (transplanted)
3. yarrow, German chamomile, sweet alyssum
4. dill, bishop's weed (*Ammi majus*), fennel, anise, queen anne's lace, angelica, and parsnips
5. yarrow, German chamomile, sweet alyssum
6. Phacelia, cornflower, borage, cleome, golden marguerite, black oil seed sunflower, anise hyssop or Korean mint (transplanted)
7. buckwheat

Late Broccoli

Farmscaping beds (36 - 44 inches wide at the top) were planted with seven rows per bed on June 20th except for the buckwheat which was sown on July 20th (broccoli was transplanted on August 20th):

1. coriander with a little calendula
2. goldenrod, cleome
3. yarrow, German chamomile, sweet alyssum
4. dill, bishop's weed (*Ammi majus*), fennel, anise, queen anne's lace, angelica
5. yarrow, German chamomile, sweet alyssum
6. tansy, cosmos
7. buckwheat

Summer Squash

Farmscaping beds (36 - 44 inches wide at the top) were planted with six rows per bed on May 22th:

1. buckwheat
2. mung bean
3. black oil seed sunflower with a little kenaf
4. black oil seed sunflower with a little kenaf
5. mung bean
6. buckwheat

This farmscaping was an unqualified success (see photo on page 6). All the plants were large seeded and quick germinators so weed competition was not a problem. After planting, these beds needed no maintenance whatsoever and the seed was inexpensive. Insect pests in the summer squash, including Cucumber beetles, were not a problem. The squash crop was not sprayed at all and our yield was ~30,000 lb./acre.



Notes on individual plants

- Buckwheat has been the cornerstone of our farmscaping plantings so far. It provides abundant nectar for a wide range of beneficials and is very reliable. Blooms appear about 25 days after seeding and extra-floral nectaries appear before blooming.
- Coriander is another important farmscaping species that produces abundant nectar and pollen. It is a good germinator and can be partially harvested as a cash crop and still provide its farmscaping benefits.
- Black oil seed sunflower is a reliable farmscaping species whose seed is quite inexpensive (around 30 cents/lb.) and is a prolific pollen producer.
- Mung bean was a pleasant surprise last year. In addition to being good germinators and inexpensive seed (\$1/lb.) they have extra-floral nectaries and are unaffected by the major bean pests (Japanese beetles and Mexican bean beetles).
- Calendula was able to thrive when seeded in a row with coriander and was a reliable performer
- Cleome did quite well and despite being moderately expensive was well worth it. If you plant a few cleome plants off to the side of a bed with room to grow you can collect an ample amount of seed for next year's farmscape plots.
- Phacelia, cornflower, borage, cleome, golden marguerite, black oil seed sunflower, yarrow, German chamomile, sweet alyssum, dill, Bishop's weed (*Ammi majus*), tansy, cosmos all performed well. Make sure that you do not over seed the borage.
- The jury is still out on the following (from seed): fennel, anise, Queen Anne's lace, angelica, parsnips, and goldenrod. Planting the intact carrot and parsnip tubers is more desirable than direct seeding. This allows you to get blooms the first year and minimizes maintenance. Kenaf germinated and grew well but was a strong attractant for Japanese beetles. In fact, kenaf may be a good trap crop for Japanese beetles.
- Mexican sunflower, anise hyssop, and Korean mint were grown in the greenhouse and transplanted because of seed cost. Mexican sunflowers did well and are prolific seed producers so seed saving is quite easy. The anise hyssop and Korean mint are well established.