

Boosting beneficials in your vegetable crop

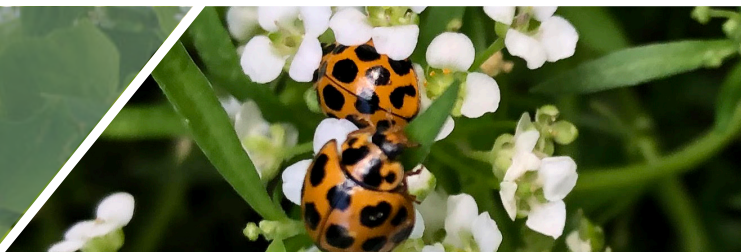
Beneficial insects and other invertebrates ('beneficials') include pollinators, nutrient cyclers, predators and parasitoids of plant pests. The role that predators and parasitoids play in pest suppression on farms is becoming increasingly evident.

To reach their potential, and to maximise their value to growers, predators and parasitoids require suitable habitat. Research led by Charles Sturt University demonstrates that taking the time to create suitable habitat close to crop rows using fast-growing, nectar-producing species, can increase beneficial activity and lead to economic benefits.

Using results from Australian on-farm trials and international findings, this fact sheet covers evidence-based actions to support beneficials and suppress pests in vegetable crops. These actions involve establishing strips of plants in vegetable paddocks to act as habitat and provide food for beneficials, or to attract and 'trap' pest species by limiting their development.



Nectar producing flowering strips that are planted next to a crop can improve beneficial activity in the paddock



Actions to improve in-crop beneficial activity

- 1** To improve beneficial activity in the crop, establish strips of flowering (nectar producing) plants approximately 30 metres apart.
- 2** To achieve maximum returns, plant flowering strips in areas such as sprinkler rows so that no crop area is sacrificed.
- 3** Plant flowering strips that are single-species or mixed-species depending on seed availability and cost.
- 4** Pair flowering strips with planting of trap-crop strips to improve control of pest species.



Parasitoids are small insects that develop either within or attached to the outside of other insects (hosts).

Unlike some parasites, like ticks or fleas, parasitoids eventually kill the host in which they develop. Many parasitoids found in vegetable fields are types of wasp.



Aphidius sp. laying an egg into an aphid nymph

The science behind the actions



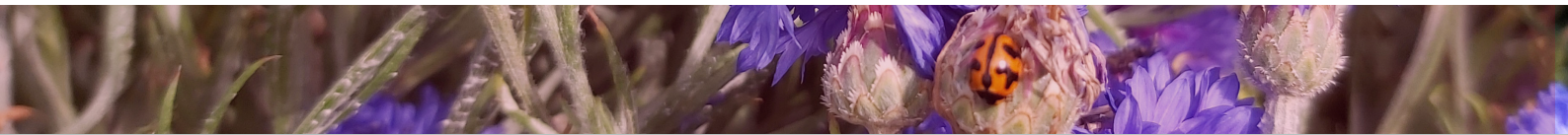
An extensive review of international research highlighted three non-weedy, fast growing, nectar producing plant species that may be planted in vegetable paddocks to support beneficials. These are sweet alyssum, buckwheat and cornflower.

Across 2018-2020, twelve on-farm trials tested the effect of planting flowering strips on beneficial abundance and impact in adjacent brassica vegetables. The abundance and damage caused by key pests, such as diamondback moth and cabbage white butterfly, were also recorded.

Abundance of beneficials and pest species in the crop were compared between:

1. Areas of crop adjacent to a 1 metre wide flowering strip, and
2. Equivalent areas of crop adjacent to a fallow, control strip (to serve as a baseline).

The attractiveness of sweet alyssum, buckwheat and cornflower to key beneficial groups was also investigated.



What was found?

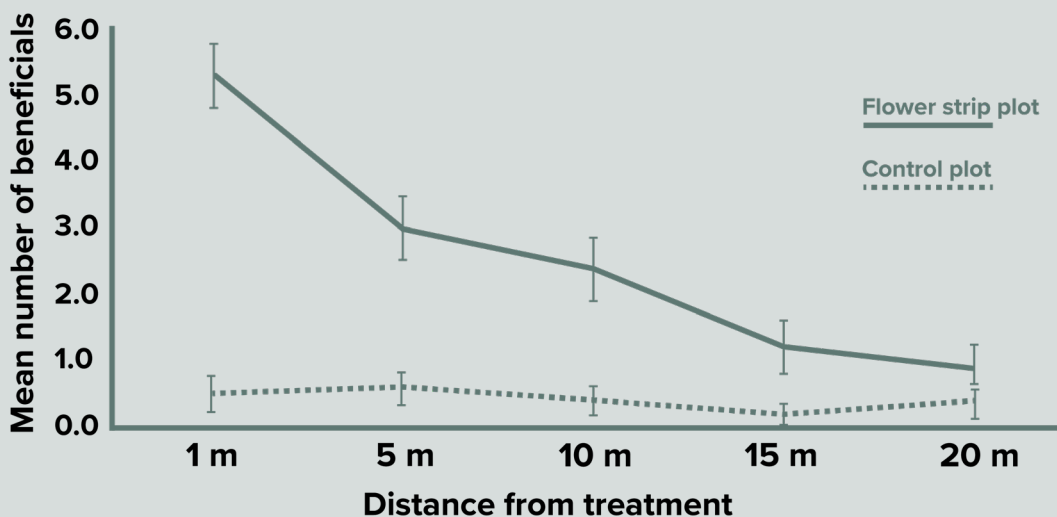
Flowering strips increase beneficial abundance

Planting flowering strips within or on the borders of brassica crops increased numbers of natural enemies at least 15 m into the crop*.

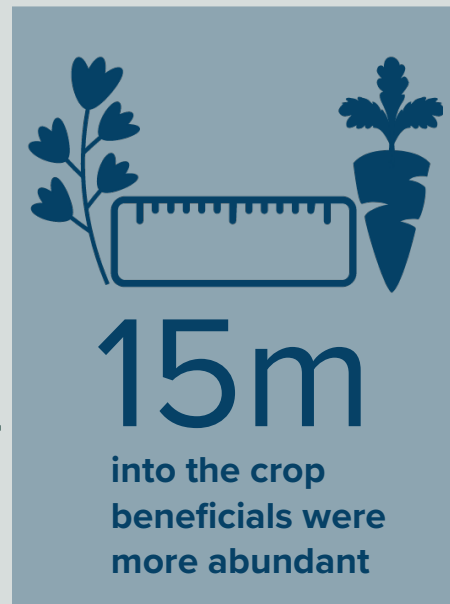
The abundance of beneficials was highest near the flowering strips; the numbers gradually decreased with the increasing distance from the flowering strips into the crop (see graph).

Benefits were evident for a wide range of important beneficials, especially ladybird beetles, spiders, parasitoid wasps, brown lacewings, damsel bugs, and carabid beetles.

**This observation was also made in sweetcorn trials, although low numbers were present and this part of the project was constrained by drought and low water allocations.*



Flowering strips increase beneficial (predator and parasitoid) abundance at least 15 m into the crop. The above graph shows the average number of beneficials on crop plants at differing distances from either a flower strip (solid line) or a bare earth control strip (dashed line). The standard error is indicated for each mean.



Flowering strips reduce pest pressure

While densities of pests remained very low in trial sites, trends suggest that numbers of caterpillar pests (diamondback moth and cabbage white butterfly) were suppressed as an effect of planting flowering strips. For example, the diamondback moth parasitism rate more than doubled in crops near flowering strips when compared with crops near the fallow, control strip. Jassids were favoured but these are minor pests of brassica.



Larvae of the cabbage white butterfly and diamondback moth are key pests of brassica.



Trap crops hold high potential

Review of international studies suggest that yellow rocket (*Barbarea vulgaris*) is highly preferred for egg laying by diamondback moth. It is a potential 'trap crop' because caterpillars cannot complete their development when feeding on it. Strips of this plant may potentially lure moths away from laying eggs in the main crop.

Planting consideration: This project found that yellow rocket is difficult to establish from seed during drought years. It did, however, give encouraging results as a diamondback moth attractant on sites with irrigation, or when strips were established with transplanted yellow rocket plants rather than seed.

International experience highlights applications across other vegetables

International studies provide encouraging results for several approaches that were not tested in the field. These approaches include:

- Intercropping brassica with onion, tomato, barley and yellow clover has potential for reducing pests.
- Sorghum as a potential banker plant to encourage early-season build-up of beneficials.
- Intercropping basil to promote beneficials for control of capsicum pests.
- Sunn hemp and cowpea can be grown with sweetcorn to attract parasitic wasps.
- Intercropping French bean with sweetcorn or coriander to attract beneficials.
- Intercropping carrot with onion to attract beneficials.

Beneficials that were more abundant in the presence of flowering strips



Brown lacewings

The brown lacewing will feed on aphids, thrips, mites, caterpillars and moth eggs. Both the adult and larval stages are predatory.



Parasitoid wasps

Certain wasp species can aid in pest control by parasitising specific life stages of pest species. The species *Diadegma semiclausum* specialises in laying its eggs in diamondback moth larvae.



Ladybird beetles

A number of ladybird beetle species are generalist predators and will attack a range of insect pests including aphids, leafhoppers, thrips, mites, moth eggs and small larvae. Both the adult and larval stages are predatory.



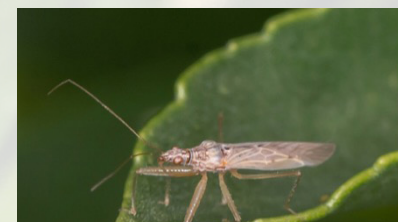
Spiders

Spider species found in vegetable crops are generalist predators that will attack a variety of prey.



Carabid beetles

There are many types of carabid beetle species. They are ground dwelling, tending to remain in the same area and are generalist predators. Both the larval and adult stages of carabid beetles will feed on other invertebrates.



Damsel bugs

Damsel bugs are generalist predators and will attack a variety of prey, including aphids, moth eggs and small moth larvae.

Becoming familiar with planting strip options

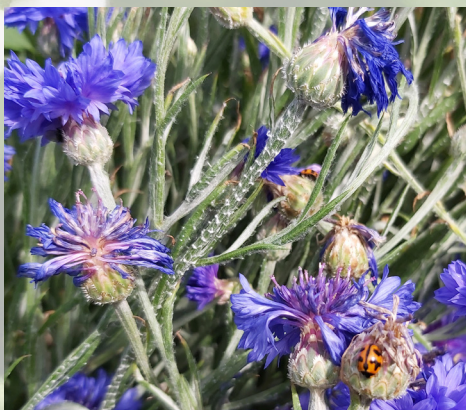
It is important to consider the growing patterns of crops and 'companion plants' so that they overlap in time. The following information will aid in planning for planting of flowering strips and other companion plants.



Sweet alyssum
Lobularia maritima

Height: 20-30 cm
Germination: 10-15 days
Flowering: 4-5 weeks after germination, blooms year-round
Sowing depth: Surface sow
Sowing rate: 1-1.5 kg/ha
Cost (1 m x 80 m): \$10.00

Comments: Low maintenance. Not known to attract brassica pests. Attractive to beneficials, particularly carabid beetles, rove beetles, *Orius* spp., and red and blue beetles. Has the longest flowering period. Will self-sow to persist over successive crop phases.



Cornflower
Centaurea cyanus

Height: 50-75 cm
Germination: 10-15 days
Flowering: 5-6 weeks after germination, blooms spring, summer, and autumn
Sowing depth: Surface sow
Sowing rate: 2-3 kg/ha
Cost (1 m x 80 m strip): \$4.00

Comments: Very low maintenance. Not known to attract brassica pests. Best choice for enhancing parasitoid wasps and attracting some generalist predator species. Can provide shelter for beneficials even pre-flowering.



Common buckwheat
Fagopyrum esculentum

Height: 75-125 cm
Germination: 10-15 days
Flowering: 4-5 weeks after germination, blooms spring, summer and autumn
Sowing depth: 2-3 cm
Sowing rate: 20-25 kg/ha
Cost (1 m x 80 m strip): \$2.00

Comments: Cost effective seed. Fast to flower and provides early season nectar. Least optimal for parasitoid wasp enhancement. Flowers only for a short period in spring. Frost tender.



Companion planting is the planting of different plant types in close proximity, usually for the purpose of pest control, pollination, or habitat for beneficial species.

A **trap crop** attracts pest species away from the main crop.

A **banker crop** supports non-pest insects that serve as prey to support a local community of beneficials that can rapidly respond to any pest outbreak.

Calendar guide for companion planting

Temperate

Plant	Intervention	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Sweet alyssum	Flowering plant	Grey	Grey	Grey	Grey	Red	Red	Red	Blue	Blue	Blue	Grey	Grey
Buckwheat	Flowering plant	Grey	Grey	Grey	Red	Red	Red	Red	Red	Red	Red	Blue	Grey
Cornflower	Flowering plant	Grey	Grey	Red	Red	Red	Red	Red	Red	Red	Blue	Blue	Grey
Sunn Hemp	Flowering plant	Grey	Grey	Grey	Red	Red	Red	Red	Red	Red	Blue	Blue	Grey
Sunflower	Flowering plant	Grey	Grey	Grey	Grey	Red	Red	Red	Red	Red	Red	Blue	Blue
Dill	Flowering plant	Grey	Grey	Red	Red	Red	Red	Red	Blue	Blue	Blue	Grey	Grey
Yellow clover	Flowering plant	Red	Red	Blue	Blue	Blue	Blue	Blue	Grey	Grey	Grey	Red	Red
Yellow rocket	Trap crop	Grey	Grey	Grey	Grey	Grey	Red	Red	Red	Red	Blue	Blue	Grey
Collard	Trap crop	Blue	Blue	Blue	Blue	Grey	Grey	Red	Red	Blue	Blue	Grey	Grey
Sorghum	Banker crop	Grey	Grey	Red	Red	Red	Red	Red	Red	Red	Blue	Blue	Grey

Sub-tropical

Plant	Intervention	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Sweet alyssum	Flowering plant	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Blue	Blue	Blue	Grey	Grey
Buckwheat	Flowering plant	Grey	Grey	Grey	Red	Red	Red	Red	Red	Red	Red	Blue	Grey
Cornflower	Flowering plant	Red	Red	Red	Blue	Blue	Blue	Blue	Grey	Grey	Grey	Grey	Grey
Sunn Hemp	Flowering plant	Grey	Grey	Grey	Red	Red	Red	Red	Blue	Blue	Blue	Grey	Grey
Sunflower	Flowering plant	Grey	Grey	Grey	Grey	Red	Red	Red	Red	Red	Blue	Blue	Grey
Dill	Flowering plant	Blue	Blue	Grey	Red	Red	Red	Red	Red	Red	Red	Blue	Blue
Yellow clover	Flowering plant	Red	Red	Red	Red	Red	Red	Blue	Blue	Blue	Grey	Red	Red
Yellow rocket	Trap crop	Grey	Grey	Grey	Grey	Grey	Red	Red	Red	Red	Blue	Blue	Grey
Collard	Trap crop	Red	Red	Blue	Blue	Blue	Blue	Blue	Grey	Grey	Grey	Red	Red
Sorghum	Banker crop	Grey	Grey	Red	Red	Red	Red	Red	Red	Red	Blue	Blue	Grey

Arid

Plant	Intervention	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Sweet alyssum	Flowering plant	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Red	Blue	Blue	Grey	Grey
Buckwheat	Flowering plant	Grey	Grey	Grey	Red	Red	Red	Red	Red	Red	Red	Blue	Grey
Cornflower	Flowering plant	Grey	Grey	Grey	Blue	Blue	Blue	Blue	Grey	Grey	Grey	Grey	Grey
Sunn Hemp	Flowering plant	Grey	Grey	Grey	Red	Red	Red	Red	Blue	Blue	Blue	Grey	Grey
Sunflower	Flowering plant	Grey	Grey	Grey	Grey	Red	Red	Red	Red	Red	Blue	Blue	Grey
Dill	Flowering plant	Grey	Grey	Grey	Red	Red	Red	Red	Red	Red	Red	Blue	Blue
Yellow clover	Flowering plant	Red	Red	Blue	Blue	Blue	Blue	Blue	Grey	Grey	Red	Red	Red
Yellow rocket	Trap crop	Grey	Grey	Grey	Grey	Grey	Red	Red	Red	Red	Blue	Blue	Grey
Collard	Trap crop	Grey	Grey	Grey	Grey	Grey	Grey	Blue	Blue	Blue	Blue	Grey	Grey
Sorghum	Banker crop	Grey	Red	Red	Red	Red	Red	Red	Red	Red	Blue	Blue	Grey



Not suitable for growing



Growing season



Seed sowing



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