THE EFFECT OF MULCH ON THE INCIDENCE OF INSECT PESTS, NATURAL ENEMIES AND PLANT DAMAGE IN ORGANICALLY GROWN CAULIFLOWERS

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A diverse assemblage of natural enemies of pest arthropods is desirable in cultivated fields and methods to encourage them are important in many integrated pest management programmes. Although specialist natural enemies have received more attention (Caltagirone 1981), generalists are also significant in both natural (Clarke and Grant 1968) and agricultural ecosystems (Sunderland *et al* 1985; Wratten 1987).

Recently, Riechert and Bishop (1990) showed that generalist predators can be encouraged by mulching and this results in reduced pest numbers and plant damage. In a similar experiment, we tested for such an effect under New Zealand conditions.

The experiment was performed on the organic farm at the Horticultural Research Centre, Levin. The test crop was cauliflower as many pest species attack this plant in New Zealand (Butcher 1984). Four 7 m x 7.5 m plots (one treatment plus one control, replicated twice), linearly arranged, were established in late October 1990. The block was bordered by 2 m weed-free strips on all sides. The neighbouring vegetation was grass (on two sides), lettuce, and carrots. Cauliflower cv. 'Dok Elgon' seedlings, germinated in the glasshouse, were planted out at a spacing of 45 cm x 45 cm, on 1 November 1990. To reduce weed growth, the plots were cultivated fortnightly, except during the Christmas period. Because of heavy cutworm damage, some plants had to be re-planted. Replacement plants were the same age as the ones originally planted.

We used wheat straw to mulch between rows and around the plants at a depth of 10 cm, 1 week after planting. To discourage arthropod inter-plot movement, galvanized metal sheet barriers were placed between plots, extending 30 cm below ground + 40 cm above ground.

At harvest on 1 February 1991, ten plants were picked randomly from each plot (avoiding the outer rows). Pests and natural enemies were identified to functional groups and counted. The size of aphid colonies was estimated and categorized as small (<10 aphids/colony, all developmental stages included), medium (10-50 aphids/colony) or large (>50 aphids/colony). Leaf damage (% of leaf surface eaten) was visually assessed; fresh curd weights were measured. Five mulch samples (50 x 50 cm) in each plot were taken and searched in the laboratory for arthropods.

The most common pests found on the plants at harvest were caterpillars and aphids, mainly the white butterfly *Pieris rapae* and the cabbage aphid *Brevicoryne brassicae*. The most frequently found predators were spiders, the brown lacewing *Micromus tasmaniae* (both larvae and adults), and syrphid larvae. Coccinellids, earwigs, predatory Heteroptera and staphylinids were also found in small numbers (total of <5 individuals). The most common parasitoid was the white butterfly parasite *Apanteles glomeratus*, emerging from pupae. An estimated 45% of the pupal cases were empty, the others had fully developed adult wasps ready to hatch.

The mulch samples yielded virtually no arthropods, apart from a few cursorial spiders and centipedes (not identified to species).

The results of plant inspection and their statistical tests are presented in Table 1. It was hypothesized that mulch would retain a larger number of natural enemies than bare ground in the control plots by providing higher humidity and shelter. This,

if predators are effective, should result in less plant damage, and fewer herbivores on the plants.

There was significantly less leaf damage in the mulched plots but fresh curd mass did not differ between treatment and control (Table 1). The total number of aphid colonies as well as the number of small and medium-sized ones were significantly fewer in the mulched plots. The mean number of large aphid colonies was also smaller but this was only marginally significant (P=0.11). In the control, 53% of the colonies were small and 13% of them large. In the treated blocks, 66% of the colonies were small and only 5.7% large. This is another indication of the lower success of aphids in the treated area.

The number of predators and parasitoids was not significantly different; spiders were more common on plants in the control than the mulched plots.

In conclusion, we found that mulching decreased plant damage and the incidence of aphids as predicted. However, the densities of natural enemies did not conform to expectations. Lower aphid incidence and plant damage could have resulted from higher predator activity or a lower host finding success by aphids in mulched plots. The frequency of observations does not allow us to decide between these two possibilities. As olfactory stimuli are important in host-finding of cruciferous pests, and the plant chemistry was not influenced by the treatment, we believe that the natural enemy activity hypothesis is the more acceptable one to explain the patterns observed.

TABLE 1: The effect of mulch on the incidence of natural enemies, herbivores, and plant damage (mean per plant ± S.D.)

	Treated	Control	Student's	Significance
All predators	3.1 ± 2.0	4.5 ± 4.6	1.25	N.S.
Spiders	0.4 ± 0.8	2.2 ± 2.6	2.93	0.006
Parasitoids	1.8 ± 2.4	1.2 ± 1.6	0.94	N.S.
Herbivores*	2.4 ± 2.5	2.6 ± 3.7	0.2	N.S.
Aphid colonies, total	10.5 ± 10.5	2.3 ± 20.8	2.46	0.02
' , small**	7.0 ± 7.3	12.5 ± 10.2	1.98	0.06
' , medium	3.0 ± 4.7	7.8 ± 8.2	2.24	0.03
' , large	0.6 ± 0.9	3.1 ± 6.9	1.64	0.11
Leaf damage (%)	21.2 ± 5.1	26.3 ± 7.1	2.61	0.01
Curd mass (g)	973 ± 409	1127 ± 569	0.96	N.S.

*aphids excluded; **small colony: ≤10 aphids; medium: 10-50 aphids; large: >50 aphids.

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REFERENCES

Butcher, M.R., 1984. Vegetable crop pests. *In:* New Zealand Pests and Beneficial Insects. Scott, R.R. (Ed) Lincoln College, Christchurch, pp. 89-118.

Caltagirone, L.E., 1981. Landmark examples in classical biological control. *Ann. Rev. Entomol. 26:* 213-232.

Clarke, R.D. and Grant, P.R., 1968. An experimental study of the role of spiders as predators in a forest litter community. Part 1. *Ecology 49:* 1152- 1154.

Riechert, S.E. and Bishop, L., 1990. Prey control by an assemblage of generalist predators: spiders in garden test systems. *Ecology 71:* 1441-1450.

Sunderland, K.D., Chambers, R.J., Stacey, D.L. and Crook, N.E., 1985. Invertebrate polyphagous predators and cereal aphids. *Bull. Int. Org. Biol. Cont. West. Palearct. Regional Sect. VIII/3:* 105-114.

Wratten, S.D., 1987. The effectiveness of native natural enemies. *In:* Integrated Pest Management. Jepson. P. and Coaker, T.H. (Eds) Academic Press, New York, pp. 89-112.