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Survey of beneficial arthropods in potato crops in south-east Queensland

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Summary

An autumn and spring crop of potatoes were grown using standard cultural practices except that no insecticides were applied. Crops were divided into plots of equal size and a number of randomly chosen plots inspected weekly and all arthropods (pest and beneficial) recorded. Each plot was sampled only once in the duration of each crop. Sampling methods included pitfall and yellow pan traps left in place for one week and suction machine samples and plant inspections made once weekly. A malaise trap was used to monitor flying insect populations in the area of the crop for its duration. All arthropod species recovered from both crops are listed according to their status (pest, parasite or predator) and host associations given for parasites and predators of pest species.

INTRODUCTION

The potato moth *Phthorimaea operculella* is the major pest of potatoes in south-east Queensland. Franzmann (1980) reported on its hymenopterous parasites but there is no published information on other beneficial arthropods associated with pests of potatoes for this region. A knowledge of the naturally occurring parasites and predators of insect pests is essential in formulating integrated pest management programmes. The aim of this study was to survey for all beneficial arthropods present in potato crops in south-east Queensland.

METHODS

A 0.25 hectare site at the Queensland Department of Primary Industries Research Station at Gatton was used for the project. Autumn and spring crops of Sebago potatoes were grown using standard cultural practices except that no insecticides were applied. Insect pests and beneficial arthropods were sampled as described below.

The survey of the autumn crop began on 30 March 1981 approximately 1 month after planting. The site was divided into plots each 3 metres long and 4 rows wide and each plot was sampled only once during the experiment. Over a period of 10 weeks, 180 plots were randomly sampled on a weekly basis as follows:

1. 'D-vac' suction machine (4 replications). This is a machine powered by a small petrol engine driving a fan creating a strong suction through an attached flexible hose with a diameter of 200 mm. The unit is carried on the back of the operator and used in a similar manner to a sweep net; insects are caught in a net near the mouth of the hose. Plants in the 2 central rows of each plot were vacuumed as thoroughly as possible.

2. Leaf sampling (2 replications). Young compound leaves near the top of plants, partially expanded leaves from the middle of plants and mature leaves from the base of plants were placed separately in plastic bags for later microscopic examination. The aim of this technique was to sample closely adhering organisms such as scale insects that may not be removed in a 'D-vac' sample.

3. Aerial plant sample (2 replications). Four plants per plot were severed just above ground level and placed in a plastic bag for later examination for tissue-mining insects.

4. Root and tuber inspections (2 replications). Four plants per plot were dug up and the roots, tubers and surrounding soil examined for arthropods.

5. Pitfall traps (4 replications). Plastic buckets, 165 mm diameter, were set in the soil between plants with the rim level with the soil surface. A quantity of a formalin mixture

was added and an aluminium tray placed over the opening as a water shield, being supported above the bucket by wire legs pushed into the soil. The traps were left in a plot for one week and sampled ground-dwelling arthropods in the crop.

6. Yellow pan traps (4 replications). These consisted of shallow aluminium trays 270×210×40 mm deep painted bright yellow and partly filled with a water-ethylene glycol mixture to reduce evaporation, set in the ground between plants with the rim level with the soil surface. Plastic sheets were suspended about 250 mm above the pans as a water shield. Like pitfalls, these pans were left in place for one week and sampled insects moving within the crop canopy. In addition, a malaise trap was erected on an adjacent headland and emptied weekly. It sampled flying insect activity in the area generally.

Sampling of the spring crop began on 9 September 1981 approximately 1 month after planting and continued for 11 weeks using the same potato variety, plot size and techniques except that leaf and aerial plant sampling were replaced by random scouting throughout the crop. Because of this reduction, only 154 plots were sampled. The malaise trap was shifted to the centre of the study site where it occupied an area equivalent to 6 plots and thus collected only those insects flying in or over the crop.

RESULTS

All insect pests and beneficial arthropods collected during the entire survey are listed in Tables 1-3 (with the addition of host information in Table 3) and parasite-predator-host interactions are summarized in Figure 1. Host information in Table 3 and Figure 1 is compiled from field observations and rearing studies supplemented by published records (Carver and Stary 1974; Crosskey 1973; Franzmann 1980; Galloway and Franzmann 1983; Hodek 1973; Kerrich 1973; Townes *et al.* 1961) and unpublished Entomology Branch records. Hosts for the parasite species listed in Table 3 were only included if they were encountered during the survey and therefore listed in Tables 1-3. The remaining parasite species were included to illustrate the wealth of beneficial arthropods present in the ecosystem studied but their hosts (where known) were omitted.

DISCUSSION

The collecting methods used in this survey were designed to sample arthropods from all levels within the crop. Thus inspections of roots and tubers revealed arthropods in the vicinity of the tubers, e.g. root aphids; pitfall traps collected specimens crawling on the soil surface, e.g. earwigs, ground-hunting spiders, crickets, predatory beetles; yellow pan traps trapped low-flying wasps, flies and moths as well as some ground-dwelling species; the 'D-vac' suction machine collected arthropods sheltering or flying within the foliage e.g. moths, predatory and phytophagous bugs and beetles; and the malaise trap sampled specimens flying above the crop e.g. most flies and wasps.

The sampling techniques were successful and proved to be sensitive enough to reveal subtle differences in arthropod distributions within the crop. For example the aphid parasite, *Aphidius colemani*, was more commonly collected in the malaise trap (225 specimens), yellow pan traps (23 specimens) and the 'D-vac' samples (22 specimens). Only 2 specimens were collected in pitfall traps. This distribution within the crop is consistent with that of its host *Myzus persicae* which is usually found on the upper parts of the plant.

Araneida

During this survey most spiders were collected at ground level in either pitfall or yellow pan traps. The ground-hunting spiders included species of Lycosidae, Sparassidae, Selenopidae and Pisauridae, with the Lycosidae being dominant. Spiders foraging on plants were collected in both the 'D-vac' machine and the malaise trap and included species of Clubionidae, Salticidae and Thomisidae. The web-spinning species of Araneidae, Linyphiidae and Theridiidae represented approximately 30% of the spiders collected. Linyphiidae were particularly numerous in the pitfall and yellow pan traps, reflecting their habit of building webs close to the ground.

Most spiders are insect predators but little is known of their host range or their impact upon pest populations. Twice as many spiders were collected in the spring crop as in the autumn crop. In the spring crop large populations of *Phthorimaea operculella* and *Nysius vinitor* were present. Adult *P. operculella* are known to be active at dusk (Rossiter 1975) and the yellow pan catches indicated large numbers of moths close to the ground, probably searching for exposed tubers. It would be expected therefore, that night-feeding spiders which hunt close to the ground would be the most likely predators of the potato moth viz. those in the families Clubionidae, Linyphiidae, Lycosidae and Theridiidae. *N. vinitor* is most active on the plant during the day and so species of Araneidae, Oxyopidae and Salticidae would be its most likely spider predators.

Table 1. Insects recorded feeding in autumn and spring potato crops, Gatton, S.E. Queensland

Order	Family	Species
Orthoptera	Gryllidae	*Teleogryllus commodus* (Walker) *T. oceanicus* (Le Guillou)
Hemiptera	Aleyrodidae	*Bemisia tabaci* (Gennadius) *Trialeurodes vaporariorum* (Westwood)
	Aphididae	*Aphis gossypii* Glover *Macrosiphum euphorbiae* (Thomas) *Myzus persicae* (Sulzer) *Rhopalosiphum rufiabdominalis* (Sasaki)
	Cicadellidae	*Austroagallia torrida* Evans *Austroasca alfalfae* (Evans) *A. viridigrisea* (Paoli) *Cicadulina bimaculata* (Evans)
	Cixiidae	*Oliarus* sp.
	Lygaeidae	*Nysius clevelandensis* Evans *N. vinitor* Bergroth *Oxycarenus luctuosus* (Montrouzier and Signoret)
	Pentatomidae	*Nezara viridula* (L.) *Plautia affinis* Dallas
Thysanoptera	Thripidae	*Frankliniella schultzei* (Trybom) *Thrips tabaci* Lindeman
Coleoptera	Coccinellidae	*Epilachna vigintioctopunctata pardalis* (Boisduval)
	Chrysomelidae	*Haltica* sp. *Lema trivittata* Say
	Tenebrionidae	*Gonocephalum carpentariae* (Blackburn) *G. macleayi* (Blackburn)
Lepidoptera	Gelechiidae	*Phthorimaea operculella* (Zeller)
	Noctuidae	*Chrysodeixis* sp. *Spodptera litura* (F.)

The large populations of spiders in the crop were accompanied by a range of wasp parasites of spiders including a number in the family Pompilidae, an ichneumonid *(Zaglyptus glabrinotum)* which develops in the egg sacs of ground-nesting spiders and some tiny scelionids which parasitise individual spider eggs.

Hemiptera

Of the phytophagous Hemiptera recorded in the crop, only *Austroasca alfalfae, A. viridigrisea, Cicadulina bimaculata* and *Nysius vinitor* were recorded in large numbers. The most common predatory bugs were *Nabis kinbergii* and *Orius tantillus.*

Although whitefly adults were numerous early in the autumn crop they appeared to cause little damage. The record of *Bemisia tabaci* is the first from Queensland. This species is known overseas to transmit a number of virus diseases of potatoes but it has not yet been implicated as a vector in Queensland (J. Thomas pers. comm.).

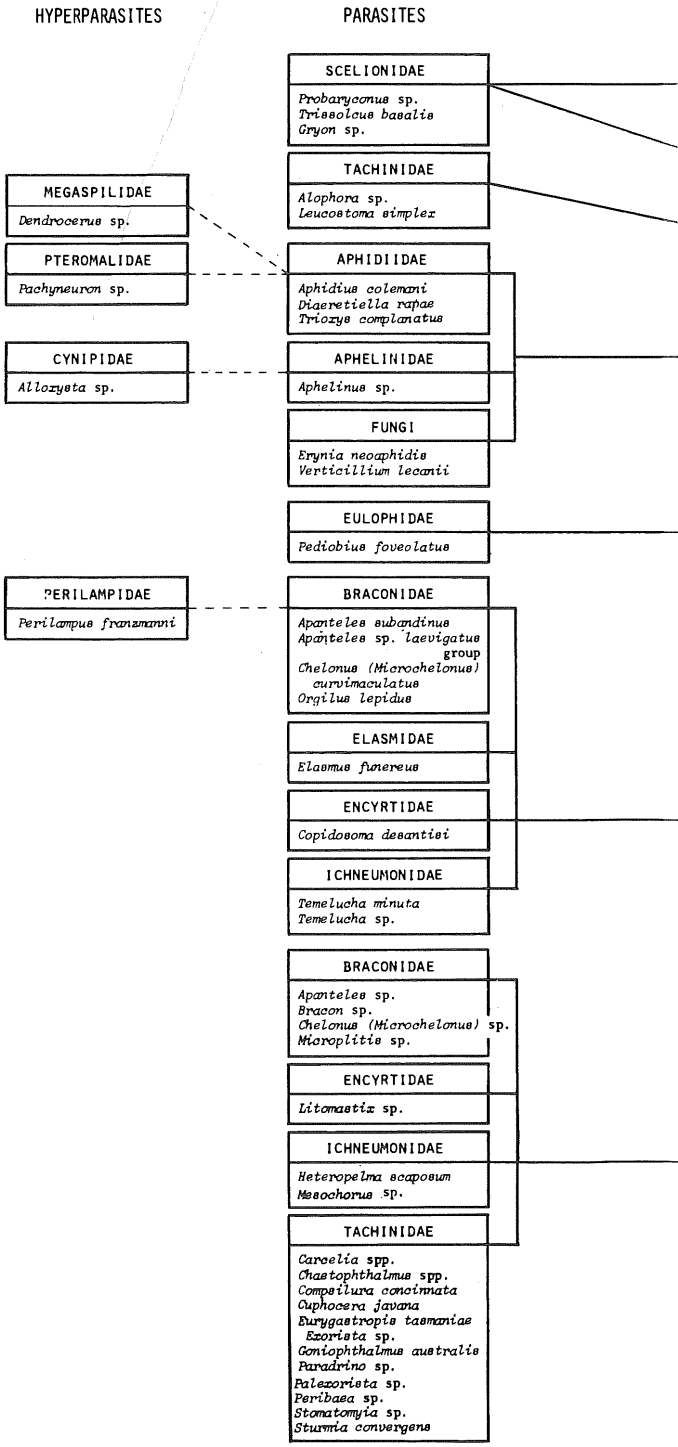
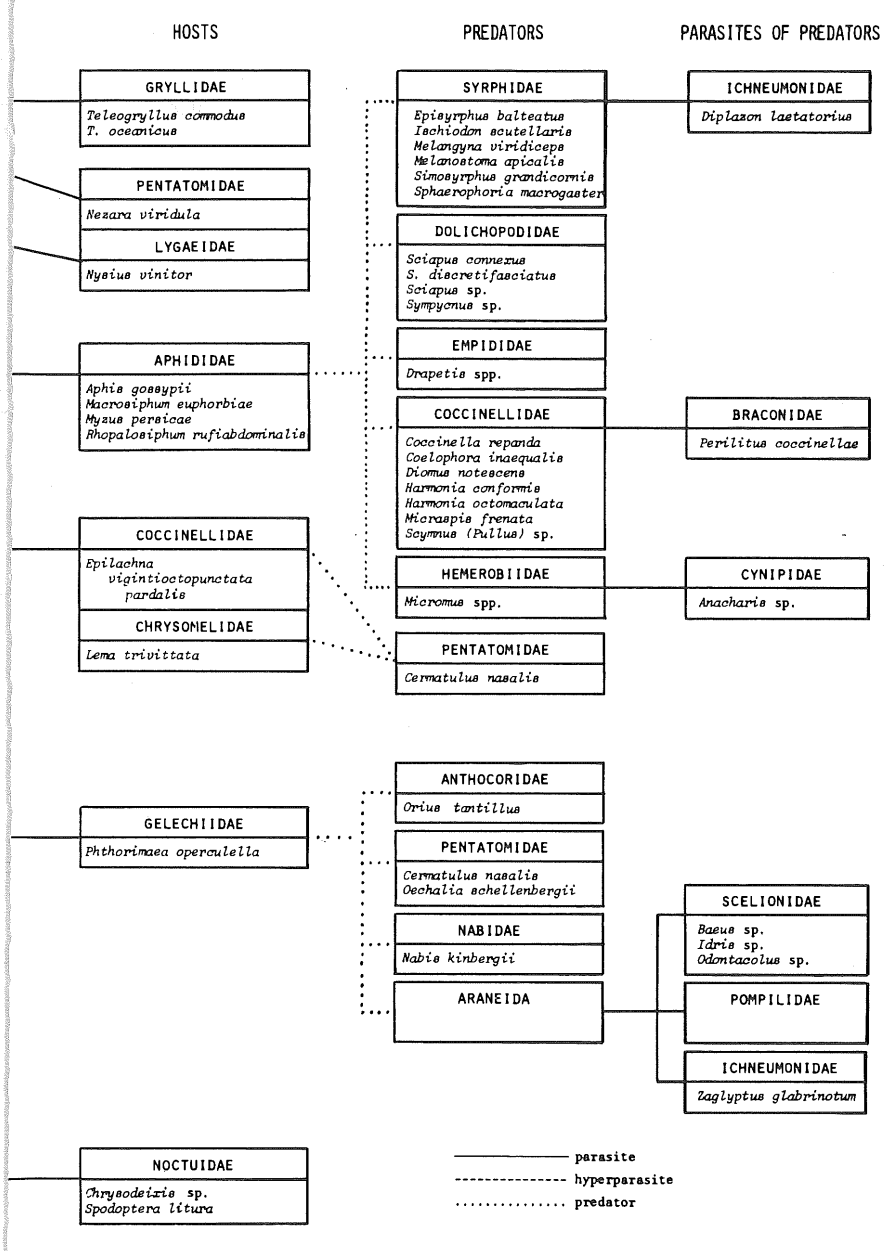


Figure 1. Host—parasite-predator interactions.


HOSTS
PREDATORS
PARASITES OF PREDATORS
GRYLLIDAE
Teleogryllus commodus
T. oceanicus
PENTATOMIDAE
Nezara viridula
LYGAEIDAE
Nysius vinitor
APHIDIDAE
Aphis gossypii
Macrosiphum euphorbiae
Myzus persicae
Rhopalosiphum rufiabdominalis
COCCINELLIDAE
Epilachna vigintioctopunctata pardalis
CHRYSOMELIDAE
Lema trivittata
GELECHIIDAE
Phthorimaea operculella
NOCTUIDAE
Chrysodeixis sp.
Spodoptera litura
SYRPHIDAE
Episyrphus balteatus
Ischiodon scutellaris
Melangyna viridiceps
Melanostoma apicalis
Simosyrphus grandicornis
Sphaerophoria macrogaster
DOLICHOPODIDAE
Sciapus connexus
S. discretifasciatus
Sciapus sp.
Sympycnus sp.
EMPIDIDAE
Drapetis spp.
COCCINELLIDAE
Coccinella repanda
Coelophora inaequalis
Diomus notescens
Harmonia conformis
Harmonia octomaculata
Micraspis frenata
Scymnus (Pullus) sp.
HEMEROBIIDAE
Micromus spp.
PENTATOMIDAE
Cermatulus nasalis
ANTHOCORIDAE
Orius tantillus
PENTATOMIDAE
Cermatulus nasalis
Oechalia schellenbergii
NABIDAE
Nabis kinbergii
ARANEIDA
ICHNEUMONIDAE
Diplazon laetatorius
BRACONIDAE
Perilitus coccinellae
CYNIPIDAE
Anacharis sp.
SCELIONIDAE
Baeus sp.
Idris sp.
Odontacolus sp.
POMPILIDAE
ICHNEUMONIDAE
Zaglyptus glabrinotum
parasite
hyperparasite
predator

Myzus persicae was present in both autumn and spring crops and populations fluctuated. *Rhopalosiphum rufiabdominalis* was present in large numbers in the autumn crop, both as subterranean and aerial populations. A sudden decrease in the populations late in the crop appeared to be associated with wet weather and an outbreak of the fungi *Verticillium lecanii (A.W. Zimmermann) Viegas* and *Erynia neoaphidis* Remaudiere & Hennebert. *Aphis gossypii* was present in low to moderate numbers early in the autumn crop while large populations of *Macrosiphum euphorbiae* were observed early in the spring crop. Of the three species of aphid parasite recorded, *Aphidius colemani* was the most common. Aphid populations were also affected by predatory flies such as species of Syrphidae, Dolichopodidae and Empididae, predatory bugs, coccinellid bettles and hemerobiid lacewings.

Thysanoptera

Of the two species of thrips recorded feeding in the crop, *Frankliniella schultzei* was present in small numbers in both crops while large numbers of *Thrips tabaci* were collected in the spring crop. Some species of *Desmothrips* Hood are believed to be predatory (Mound 1972). Low to moderate numbers of *D. tenuicornis* were present in both crops and as its population fluctuations appeared to correlate with those of *T. tabaci*, it may be a predator of this pest.

Neuroptera

Adults and larvae of hemerobiid lacewings (*Micromus* spp.) were recorded in low to moderate numbers feeding on *Myzus persicae* and aerial populations of *Rhopalosiphum rufiabdominalis* in the autumn crop and on *Macrosiphum euphorbiae* and *M. persicae* in the spring crop. Late in the spring season they appeared to be also feeding on other prey, possibly larvae of *Phthorimaea operculella* and/or *Thrips tabaci*. Larvae of chrysopid lacewings (*Chrysopa* spp.) were collected in small numbers in the spring crop but their prey was not determined.

Coleoptera

Only three species of leaf-feeding beetles *(Epilachna vigintioctopunctata pardalis, Haltica* sp. and *Lema trivittata)* were recorded feeding in the crop; all were present in low numbers.

Of the predatory coccinellids recorded during the survey adults of *Harmonia octomaculata* and *Coelophora inaequalis* and adults and larvae of *Scymnus (Pullus)* sp. and *Coccinella repanda* were present in low numbers in the autumn crop. *Scymnus (Pullus)* sp. was recorded feeding on aerial populations of *Rhopalosiphum rufiabdominalis* and *C. repanda* was preying on *Aphis gossypii*. In the spring crop low to moderate numbers of adult *Diomus notescens, Micraspis frenata* and *C. repanda* were recorded. *D. notescens* and *C. repanda* were present in moderate numbers in the crop when aphid populations were very low and may have been feeding on alternative hosts such as *Thrips tabaci* and the eggs and larvae of *Phthorimaea operculella*.

Table 2. Predatory arthropods collected in autumn and spring potato crops, Gatton, S.E. Queensland

Order	Family	Species
Araneida	Agelenidae	Gen. indet.
	Araneidae	*Arachnura* sp.
		Araneus theisi (Walckenaer)
		Araneus sp.
		? *Gea* sp.
		Leucauge sp.
		Nephila sp.
		Poltys sp.
		Tetragnatha sp.
		Gen. indet.
	Clubionidae	*Chiracanthium mordax* L. Koch
		Chiracanthium sp.
		Clubiona sp.
		Miturga sp.
		Supunna picta (L. Koch)
		Gen. indet.

Order	Family	Species
Araneida—*continued*	? Ctenidae	Gen. indet.
	Dysderidae	Gen. indet.
	Gnaphosidae	Gen. indet.
	Linyphiidae	Erigoninae gen. indet. sp. A Erigoninae gen. indet. sp. B
	Lycosidae	*Artoria* sp. *Lycosa goyderi* Hickman *L. hasseltii* L. Koch *L. marginatus* (Hogg) *L. propitia* Simon Gen. indet.
	Oxyopidae	*Oxyopes mundulus* L. Koch *Oxyopes* sp.
	Pisauridae	Gen. indet.
	Pholcidae	Gen. indet.
	Salticidae	Gen. indet.
	Selenopidae	Gen. indet.
	Theridiidae	*Achaearanea* sp. *Latrodectus mactans hasselti* Thorell *Steatoda* sp. *Theridion* sp. Gen. indet.
	Thomisidae	*Diaea* sp. ? *Hedana* sp. Gen. indet.
Dermaptera	Labiduridae	*Labidura riparia truncata* Kirby
Hemiptera	Anthocoridae	*Orius tantillus* (Motschulsky)
	Lygaeidae	*Geocoris* sp.
	Miridae	*Creontiades dilutus* (Stal.) *Cyrtopeltis* sp. *Deraeocoris signatus* (Distant)
	Nabidae	*Nabis kinbergii* Reuter
	Pentatomidae	*Cermatulus nasalis* (Westwood) *Oechalia schellenbergii* (Guerin-Meneville)
Thysanoptera	Aeolothripidae	*Desmothrips tenuicornis* (Bagnall)
Neuroptera	Chrysopidae	*Chrysopa* spp.
	Hemerobidae	*Micromus* spp.
Coleoptera	Carabidae	*Pheropsophus verticalis* (Dejean) Gen. indet.
	Coccinellidae	*Coccinella repanda* Thunberg *Coelophora inaequalis* (F.) *Diomus notescens* (Blackburn) *Harmonia conformis* (Boisduval) *Harmonia octomaculata* (F.) *Micraspis frenata* (Erichson) *Scymnus(Pullus)* sp.
Diptera	Dolichopodidae	*Sciapus connexus* (Walker) *S. discretifasciatus* (Macquart) *Sciapus* sp. *Sympycnus* sp.
	Empididae	*Drapetis* sp. A *Drapetis* sp. B
	Syrphidae	*Episyrphus balteatus* (De Geer) *Ischiodon scutellaris* (F.) *Melangyna viridiceps* (Macquart) *Melanostoma apicalis* Bigot *Simosyrphus grandicornis* (Macquart) *Sphaerophoria macrogaster* (Thomson)

Diptera

Eight species of Syrphidae were recorded during the study but only *Simosyrphus grandicornis* and *Sphaerophoria macrogaster* were consistently present in both the autumn and spring crops. Dolichopodids also feed on aphids but in contrast to Syrphidae it is the adult which is the predatory stage. Three species, *Sciapus connexus, S. discretifasciatus* and *Sympycnus* sp. were very abundant in both crops. A third unidentified species of *Sciapus* was less common. Empidid adults are also predatory and one species, *Drapetis* sp. A, was particularly abundant in both crops; species of this genus have been recorded as predators of whiteflies (Mound and Hasley 1978).

Lepidoptera

Of the three species of moths recorded feeding in either crop only *Phthorimaea operculella* caused significant damage. Although its damage was uneconomic in the autumn crop, populations were very high early in the subsequent spring crop and severe damage was caused. Later, when parasites particularly *Copidosoma desantisi* and *Orgilus lepidus* appeared, moth numbers were reduced. Adults of *Hymenia recurvalis* (F.) were frequently collected in both crops but no damage by larvae was recorded.

Hymenoptera

A number of hymenopterous parasites have already been discussed in relation to their hosts. During the survey over 130 species of parasitic Hymenoptera in 21 families were recorded, representing over half the total of all beneficial arthropods. The number of species would have been considerably larger if identifications could have been provided for all specimens collected, but unfortunately identification keys are not available for many Australian groups. However, the number and diversity of identified species indicate that the parasitic Hymenoptera are an important part of the beneficial arthropod fauna present in potatoes.

Table 3. Parasitic arthropods (including hyperparasites* and parasites of predator†) collected in autumn and spring potato crops, Gatton, S.E. Queensland

Order	Family	Species	Hosts in Tables 1-3
Diptera	Tachinidae	*Actia* sp.	
		Alophora sp.	*Nysius vinitor*
		Anagonia sp.	
		Blepharella sp.	
		Blepharipa sp.	
		Carcelia cosmophilae (Curran)	*Chrysodeixis* sp.
			Spodoptera litura
		C. illota (Curran)	*Chrysodeixis* sp.
			Spodoptera litura
		Ceromya sp.	
		Chaetophthalmus dorsalis (Malloch)	*Spodoptera litura*
		C. bicolor (Macquart)	*Spodoptera litura*
		Chaetoria spinicosta (Thomson)	
		Compsilura concinnata (Meigen)	*Spodoptera litura*
		Cuphocera javana (Wiedemann)	*Spodoptera litura*
		Cylindromyia atratula Malloch	
		Eurygastropsis tasmaniae (Walker)	*Chrysodeixis* sp.
		Exorista sp.	*Spodoptera litura*
		Goniophthalmus australis (Baranov)	*Spodoptera litura*
		Hyleorus sp.	
		Leucostoma simplex (Fallen)	*Nysius vinitor*
		Linnaemya sp.	
		Palexorista sp.	*Spodoptera litura*
		Paradrino sp.	*Chrysodeixis* sp.
		Peribaea sp.	*Spodoptera litura*
		Sipholeskia sp.	

Order	Family	Species	Hosts in Tables 1-3
Diptera—*continued*	Tachimidae—*continued*	*Siphona* sp.	
		Sisyropa sp.	
		Stomatomyia sp.	*Spodoptera litura*
		Sturmia convergens (Wiedemann)	*Chrysodeixis* sp.
		Tritaxys sp.	
		Voria ruralis (Fallen)	
		Zygobothria ciliata (Wulp)	
Hymenoptera	Aphelinidae	*Aphelinus* sp.	
	Aphidiidae	*Aphidius colemani* Viereck	*Aphis gossypii, Myzus persicae*
		Diaeretiella rapae (M'Intosh)	*Myzus persicae*
		Trioxys complanatus Quilis	
	Bethylidae	*Goniozus* sp.	
	Braconidae	*Agathis rufithorax* Turner	
		Apanteles subandinus Blanchard	*Phthorimaea operculella*
		Apanteles sp. *laevigatus* group	*Phthorimaea operculella*
		Apanteles sp.	*Chrysodeixis* sp.
		Bracon sp.	*Chrysodeixis* sp.
		Chelonus (Microchelonus) curvimaculatus Cameron	*Phthorimaea operculella*
		Chelonus (Microchelonus) sp.	*Spodoptera litura*
		Microgaster (=*Microplitis*)sp.	*Chrysodeixis* sp.
		Orgilus lepidus Muesebeck	*Phthorimaea operculella*
		†Perilitus coccinellae (Schrank)	*Coccinella repanda*
			Coelophora inaequalis
			Harmonia conformis
			H. octomaculata
	Chalcididae	*Phanerotoma* sp.	
		Antrocephalus sp.	
		Brachymeria sp.	
		Dirhinus sp.	
		Epitranus sp.	
		Irochohalticella sp.	
		Proconura sp.	
	Cynipidae	**Alloxysta* sp.	*Aphelinus* sp.
		†*Anacharis* sp.	*Micromus* sp.
		Gen. indet. Eucoilinae	
	Dryinidae	Gen. indet.	
	Elasmidae	*Elasmus funereus* Riek	*Phthorimaea operculella*
		Elasmus sp.	
	Encyrtidae	*Copidosoma desantisi* Annecke and Mynhardt	*Phthorimaea operculella*
		Litomastix sp.	*Chrysodeixis* sp.
	Eulophidae	*Alophomorpha* sp.	
		Aprostocetus sp.	
		Australsecodes sp.	
		Entedonomorpha sp.	
		Euplectrus sp.	
		Hemitarsenus semialbiclava (Girault)	
		Neotrichoporoides sp.	
		†Pediobius foveolatus (Crawford)	*Epilachna vigintioctopunctat pardalis*
		Stenomesius sp.	
		Tetrastichus coccinellae Kurdjumov	
		Tetrastichus sp.	
	Eupelmidae	*Eupelmus* sp.	
	Eurytomidae	*Eurytoma* sp.	
		Plutarchia sp.	
	Ichneumonidae	*Anacis* sp.	
		Biconus sp.	
		Brachycyrtus sp.	
		Campoletis sp.	
		Campoplex sp.	
		Charops sp.	
		Diadegma sp.	
		Diaparsis sp.	
		Dicamptus fuscicornis Erichson	

Order	Family	Species	Hosts in Tables 1-3
Hymenoptera —*continued*	Ichneumonidae— *continued*	†Diplazon laetatorius (F.)	*Ischiodon scutellaris* *Simosyrphus grandicornis* *Sphaerophoria macrogaster*
		Echthromorpha sp.	
		Enicospilus pseudantennatus Gauld	
		Eriborus sp.	
		Eriostethus sp.	
		Eutanyacra sp.	
		Exochus sp.	
		Gaviana sp.	
		Glabridorsum sp.	
		Goryphus sp.	
		Gotra sp. A	
		Gotra sp. B	
		Heteropelma scaposum (Morley)	*Spodoptera litura*
		Ichneumon promissorius (Erichson)	
		Leptobatopsis indica (Cameron)	
		Lissopimpla excelsa (Costa)	
		L. scutata Krieger	
		Lissosculpta sp.	
		Megastylus sp.	
		Mesochorus sp.	*Chrysodeixis* sp.
		Metopius unifenestratus Morley	
		Netelia sp.	
		Olesicampe sp.	
		Paraphylax sp.	
		Pristomerus sp.	
		Sathropterus pumilis Holmgren	
		Scolobatina sp.	
		Stictopisthus sp.	
		Temelucha minuta (Morley)	*Phthorimaea operculella*
		Temelucha sp.	*Phthorimaea operculella*
		Thyraeella collaris Gravenhorst	
		Xanthocampoplex sp.	
		Xanthopimpla flavolineata Cameron	
		†*Zaglyptus glabrinotum* (Girault)	ARANEIDA
		New genus near *Charops*	
	Megaspilidae	**Dendrocerus* sp.	*Aphidius colemani* *Trioxys complanatus*
	Mymaridae	*Mymar* sp.	
	Perilampidae	**Perilampus franzmanni* Galloway	*Orgilus lepidus*
		Perilampus sp.	
	Pompilidae	†Gen. indet.	ARANEIDA
	Pteromalidae	*Acroclisoides* spp.	
		Calitula spp.	
		Coelocyba sp.	
		Cryptoprymna sp.	
		Dinarmus sp.	
		Gastrancistrus sp.	
		Isoplatoides sp.	
		**Pachyneuron* sp.	*Aphidius colemani*
		Pteromalus sp.	
		Syntomopus sp.	
		Systasis sp.	
		Trichomalopsis sp.	
	Scelionidae	*Anteromorpha australica* Dodd	
		†*Baeus* sp.	ARANEIDA
		Baryconus sp.	
		Calliscelio sp.	
		Calotelea sp.	
		Crama sp.	
		Cremastobaeus sp.	
		Doddiella globiceps (Dodd)	
		Duta sp.	
		Gryon sp.	*Nezara viridula*
		†*Idris* sp.	ARANEIDA

Order	Family	Species	Hosts in Tables 1-3
Cynipidae—*continued*	Scelionidae—*continued*	*Macroteleia* sp.	
		Mallateleia sp.	
		Mirotelenomus sp.	
		†*Odontacolus* sp.	ARANEIDA
		Opisthacantha sp.	
		Paridris sp.	
		Platytelenomus sp.	
		Probaryconus sp.	*Teleogryllus commodus*, *T. oceanicus*
		Scelio bipartitus Kieffer	
		S. flavicornis Dodd	
		S. ignobilis Dodd	
		S. striatifacies Dodd	
		Telenomus sp.	
		Trissolcus basalis (Wollaston)	*Nezara viridula*
		†*Trissolcus* sp.	*Oechalia schellenbergii*
		Triteleia sp.	
	Torymidae	*Dimeromicrus* sp.	
		Megastigmus sp.	
		Podagrion sp.	
	Trichogrammatidae	*Trichogramma* sp.	

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