POSSIBLE ALTERNATIVE HOST PLANTS FOR SOME MAJOR POD SUCKING BUG PESTS OF PULSE CROPS IN THE SOUTH BURNETT REGION OF QUEENSLAND

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Summary

The alydids *Riptortus serripes* (Fabricius) and *Mirperus scutellaris* Dallas (Hemiptera: Alydidae), and the pentatomids *Piezodorus hybneri* (Gmelin), *Dictyotus caenosus* and *Plautia affiinis* Dallas (Hemiptera: Pentatomidae), feed on the pods of pulse crops in Australia. Farmers currently control these bugs with insecticides. Alternative plant hosts could potentially be used as pest monitoring tools or in an integrated pest management approach as trap crops. Consequently, a survey of the possible alternative host plants of these bugs was carried out in southeast Queensland between 1992 and 1995. Additional information was obtained by searching host plant records compiled by the Queensland Department of Primary Industries, and from records in the literature. In the South Burnett, *R. serripes* was found only on legumes, especially *Sesbania cannabina*, and only in autumn which suggests it is an immigrant species. *M. scutellaris*, *P. hybneri*, and *P. affinis* were taken on many common weeds found by roadsides and in farmers' fields. In most cases these bugs were found only on plants that were fruiting. The data were insufficient to make conclusions about *D. caenosus*. The survey was conducted during a period of prolonged drought so the abundance of possible host plants in non-cultivated areas, which is largely determined by rainfall, was reduced. Also the numbers of bugs taken were low on both cultivated and non-cultivated plants.

Many possible alternative host plants were found but few appeared to be powerful attractants. Low numbers of bugs in the 'wild' host plants correlated with low numbers in cultivated crops. The opportunity to compare large populations in 'wild' host plants with populations in cultivated crops never arose, because of the drought.

The main possible alternative hosts of *Riptortus serripes* were *Senna* trees and *Sesbania cannabina* and these have a very restricted distribution in the South Burnett. *S. cannabina* was frequently observed to host two other pests of cultivated grain legume and pulse crops viz. *Maruca vitrata* (Fabricius) (Lepidoptera: Pyralidae) and *Zygrita diva* (Coleoptera: Cerambycidae). Removal of *Senna* trees and *S. cannabina* should result in big reductions of populations of those three insect species.

Macroptilium atropurpureum (siratro), *M. lathyroides* (phasey bean) and *Medicago sativa* (lucerne) appeared to be attractive to *R. serripes*, *M. scutellaris* and *P. hybneri* and could be evaluated as potential trap crops or as pest population monitoring tools.

INTRODUCTION

In south Queensland, pulse crops which are usually planted in summer become attractive to pod sucking bugs in autumn. Then they may be damaged by the alydids *Riptortus serripes* (Fabricius) and *Mirperus scutellaris* Dallas and the pentatomids *Piezodorus hybneri* (Gmelin), *Dictyotus caenosus* (Westwood) and *Plautia affinis* Dallas (Brier 1992). Currently bugs are controlled with insecticides, but alternative methods are desirable to avoid disruption to an integrated pest management system to be implemented for other major insect pests of pulses such as heliothis, *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae).

Alternative hosts can act as breeding grounds for bugs which may subsequently move into commercial crops (Jones and Sullivan 1982). While it is not practical either to eliminate these alternative hosts or to control bugs on roadside vegetation with chemical insecticides, the alternative hosts which grow on roadsides and in uncultivated soil could be cultivated as trap crops. Trap crops have been used successfully to control bean leaf beetles and pentatomids in soybean crops (Newsom and Herzog 1977). Once attracted to the trap crop, the insects can be controlled with insecticides (McPherson and Newsom 1984). This method avoids disruption to other integrated pest management systems operating in the cropping ecosystem. Alternative hosts also may act as breeding sites for the parasitoids and predators of pests. Cochereau (1982) grew maize as an alternative host around sugar cane in the Ivory Coast, and obtained biological control of *Eldana saccharina* (Lepidoptera: Pyralidae) with the egg parasitoid *Telenomus applanatus* (Hymenoptera: Scelionidae). Hardee and Bell (1994) described control of *Helicoverpa zea* and *Heliothis virescens* with virus sprays applied to alternative host plants.

A survey was carried out in the South Burnett region of southern Queensland from 1992 to 1995 to determine the possible alternative host plants and extent of occurrence of *R. serripes*, *M. scutellaris*, *P. hybneri*, *D. caenosus*, and *P. affinis*. In addition, host records of the Queensland Department of Primary Industries were searched and miscellaneous collections made outside the South Burnett region to bolster the results of the survey.

A knowledge of the sources of bugs is prerequisite to formulating and evaluating strategies for their control. No attempt is made to speculate on bug

movement patterns, which would be *a priori* knowledge in formulating and evaluating strategies for their control. Bug movement patterns may be as complex as those adopted by *Helicoverpa* spp i.e. short, medium, or long range (Fitt 1989).

There is debate as to what constitutes a host plant. Wallace (1941) considered a plant to be a host when an insect species occurred on it in numbers in several locations and months of the year, were often accompanied by nymphs, and were very abundant in at least one crop. Zalucki (1991) pointed out that a host plant is one on which oviposition occurred, and the emerging immature stage completed its development to the adult stage, which then produced fertile offspring. The definition used by Wallace was used for the survey. It was beyond the scope of this survey to rear the bugs and use the Zalucki (1991) method. The QDPI records may include simple associations of a plant with a bug species.

MATERIALS AND METHODS

The 1992–95 survey was carried out mainly in the South Burnett region (latitude approx. 26°S to 27°S, longitude approx. 151°30 to 152°15) of southern Queensland where sampling was done at least one day per week. Occasional sampling (3–4 times per year) was carried out near Gympie, Warra, Chinchilla, Biloela, Theodore, Esk, and Redbank. Roadside and non-cultivated plants were sampled by searching, net sweeping, and suction sampling using a portable motorised vacuum sampling device (Echo PB–1000 model). The vacuum device was not appropriate for sampling *R. serripes*, as the suction was not strong enough to pull bugs off the plants.

Sampling sites were chosen when different vegetation patterns were encountered, e.g. roadsides where grass dominated, roadsides where legumes dominated, creek banks, weedy areas on farms, 'natural' bushland (e.g. *Eucalyptus* or *Acacia* stands). A possible host was defined in this survey as a plant on which nymphs were found, or on which five or more adults were found (but not necessarily on the same day). Host plants were identified by referring to Hacker (1990), and Stanley and Ross (1983, 1986, 1989). Occasional identifications were made by staff of the Queensland Herbarium. QDPI records list the plant on which an insect was collected, the date and locality of that collection, and are considered to associate the insect with that plant.

Nymphs were often found with adults in samples. Nymphs, and adult insects not able to be identified on site, were returned to the laboratory for incubation. In some cases, such adults laid eggs. Attempts to rear nymphs to the adult stage were usually unsuccessful. Nymphs usually only survived to the second or third instar. However, the two methods resulted in a reference collection of eggs and nymphs for all species except *D. caenosus*. It was beyond the scope of this survey to cultivate possible hosts and rear the bugs on them.

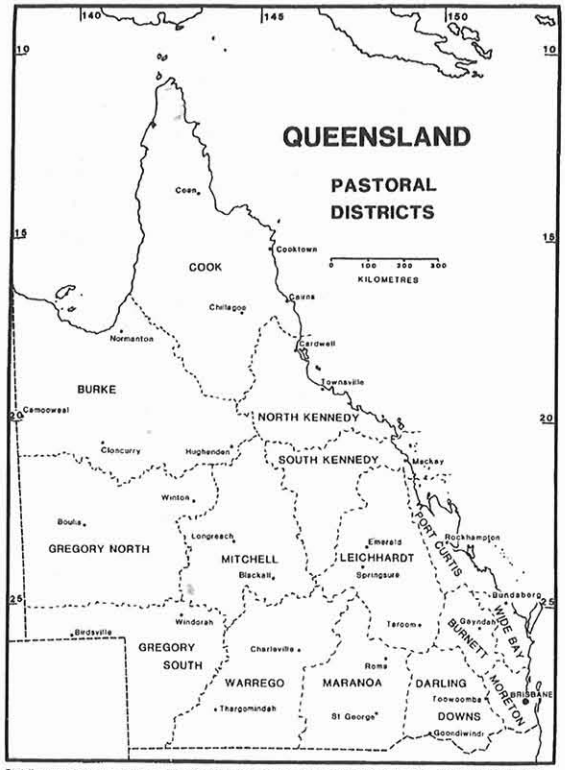
RESULTS

A search of the literature for host plants of the bug species is shown in table 1.

The results from the survey (table 2) and the plants and localities with which the bug species have been associated in past records of the Queensland Department of Primary Industries are given in table 3. Localities are given as the Pastoral District as shown (figure 1). No attempt has been made to rate the relative importance of any particular plant as a possible host as the numbers of bugs collected from different species varied considerably both in time and space. For example, on one occasion *P. hybneri* was found in large numbers on *Rhynchosia minima* on one side of a road but none were found on the opposite side, about 25 m away.

Mirperus scutellaris

The survey showed that *M. scutellaris* was found between September and May on plants in flower or with pods. The records for September are of a single specimen from vetch and two specimens from white clover. These plants are frost tolerant.



Distribution references: Burke - Bk., Burnett - Bur., Cook - Co., Darling Downs - D.D., Gregory North - G.N., Gregory South - G.S., Leichhardt - Lei., Maranoa - Ma., Mitchell - Mi., Moreton - Mo., North Kennedy - N.K., Port Curtis - P.C., South Kennedy - S.K., Warrego - Wa., Wide Bay - W.B.

Figure 1. Queensland Pastoral Districts used to define the locality records

Table 1. Host plants and locality records of *Riptortus serripes*, *Mirperus scutellaris*, *Piezodorus hybneri*, *Plautia affinis*, and *Dictyotus caenosus*, and the respective references from a literature search.

Plant 'host'	*Riptortus serripes*	*Mirperus scutellaris*	*Piezodorus hybneri*	*Plautia affinis*	*Dictyotus caenosus*	References
Callitris sp			Australia			Carver *et al.* (1991)
Glycine max			Madhya Pradesh			Singh *et al.* (1989)
Glycine max			Japan			Higuchi (1988)
Leguminoseae			Japan			Kobayashi (1972)
Veronica spp			Japan			Kobayashi (1972)
Cucurbitaceae			South Australia			Gross (1976)
Indigofera			South Australia			Gross (1976)
Indigofera			Ceylon			see Joseph (1953)
Cajanus indicus			Malaya			see Joseph (1953)
Hibiscus esculentus			Malaya			see Joseph (1953)
Sesbania aculeata			Malaya			see Joseph (1953)
pulses			South Australia			Gross (1976)
Crotalaria sp.			South Australia			Gross (1976)
Medicago sativa			South Australia			Gross (1976)
Medicago sativa			Delhi			Joseph (1953)
berseem			Delhi			Joseph (1953)
linseed			Delhi			Joseph (1953)
chillies			Delhi			Joseph (1953)
potato			Delhi			Joseph (1953)
tomato			Delhi			Joseph (1953)
Solanum sp			Delhi			Joseph (1953)
Seed legumes					New Zealand	Wightman *et al.* (1982)
Salvia splendens cv. Bonfire				New South Wales		McDonald (1971)
Mulberry				New South Wales		McDonald (1971)
Tomato				New South Wales		McDonald (1971)
Peach				New South Wales		McDonald (1971)
Apricot				New South Wales		McDonald (1971)
Grape				New South wales		McDonald (1971)
Silver beet				New South Wales		McDonald (1971)
Phaseolus vulgaris				New South Wales		McDonald (1971)
Oryza sativa				New South Wales		see McDonald (1971)
Acacia spp	Australia					Carver *et al.* (1991)
Beans	Australia					Carver *et al.* (1991)
Cyamopsis tetragonoloba	Queensland					Jackson *et al.* (1985)

The majority of QDPI records for this species are from coastal locations and most collections were made between October and April. One notable exception is a record from 'peas' in Stanthorpe on 10 October, 1926 which suggests *M. scutellaris* can overwinter in areas that experience heavy frosts and therefore capable of overwintering in the South Burnett.

Riptortus serripes

All *R. serripes* bugs collected during the survey were from leguminous plants bearing seed pods, and usually between January and April. A single gravid female collected from a shrub, *Senna artemisioides*, at Oakey on 12th August 1993 when the minimum overnight temperature was -4°C had eggs in all stages of development in her ovaries.

Most records that listed the legumes as associated plants indicated that the bugs were on pods. QDPI records indicate that *R. serripes* has been collected from plants other than legumes.

Table 2. Possible alternative hosts plants of *Mirperus scutellaris, Riptortus serripes, Piezodorus hybneri, Plautia affinis* and *Dictyotus caenosus* found in the survey in the South Burnett region in 1992–95

Plant	*Mirperus scutellaris*	*Riptortus serripes*	*Piezodorus hybneri*	*Plautia affinis*	*Dictyotus caenosus*
Acacia sp.	xii.				
Crotalaria lanceolata	iv.	iii.	iii.		
Crotolaria mitchellii	iv.				
Ligustrum lucidum				ix. x. xi. xii.	
Lotononis bainesii			x. xi. xii.		
Macroptilium atropurpureum	i.	ii. vii.	i.		
Macroptilium lathyroides	i. xii.	iii.	iii.		
Medicago polymorpha			x.		
Medicago sativa	i. iii. ix to xii.	iii.	iii.		
Psoralea tenax	xii.				
Rhynchosia mimima			iii.		
Senna artemisioides		viii.			
Senna barklayana	xii.				
Senna floribunda	ii.	iii.	i.	i.	
Senna pendula	i.	i. iv.	i.		
Sesbania cannabina	i.	i. iv.			
Solanum mauritianum			ix. x.		
Solanum sp.				ix. x.	
Sorghum bicolor				iii.	
Swainsona galigifolia			x.		
Trifolium repens			i. x. xi. xii.		x. xi. xii.
Vicia villosa	ix. x.		ix. x.	ix.x.	

Piezodorus hybneri

The survey showed that *P. hybneri* was commonly found between October and April. A single male specimen was collected on the 16 August, 1993 at Kingaroy. This specimen was observed flying and was collected in a butterfly net. *P. hybneri* was also collected at Kingaroy from burr medic in October, which suggests that it can overwinter in the South Burnett.

QDPI records show that *P. hybneri* has been collected in each month, except August, from numerous legumes and from cotton (*Gossypium hirsutum*), 'citrus', tomato (*Lycopersicon esculentum*), tobacco (*Nicotiana tabacum*), 'grass' and maize (*Zea mays*).

Plautia affinis

The survey showed that *P. affinis* was found only on hosts that carried fruit or pods.

The majority of QDPI records are from coastal areas from Brisbane to Palm Island. There are 22 species from 15 plant families listed as hosts, and bugs were recorded in every month except June. The combined data suggest that *P. affinis* overwinters in the South Burnett in low numbers.

Dictyotus caenosus

The data on *D. caenosus* are very limited. The survey showed that *D. caenosus* was recorded only from white clover between October and December.

The QDPI records list soybeans and emu foot weed (*Psoralea tenax*) as the only hosts and they were recorded between September and March. The September record was from Stanthorpe (no host given). The combined data suggest that the adults could overwinter successfully in the South Burnett.

DISCUSSION

The combined data from the survey and QDPI records show these bugs have a wide host range, including many common roadside plants. As the survey involved intensive searching, it is considered that most of the local possible alternative hosts have been determined.

Table 3. Queensland Department of Primary Industries records of plants from which *Mirperus scutellaris, Riptortus serripes, Piezodorus hybneri, Plautia affinis* and *Dictyotus caenosus* have been collected and the months and respective locations of the collections. Locations are the pastoral districts of Queensland as shown in figure 1

	Mirperus scutellaris	*Riptortus serripes*	*Piezodorus hybneri*	*Plautia affinis*	*Dictyotus caenosus*
LEGUMINOSAE					
Arachis hypogaea	i.Bur.				
Caesalpinia scoparia		i.Mo.			
Cajanus cajan		ii.Bur; iv.Bur.			
Cassia laevigata		xii.Mo.			
Desmodium sp.	vi.N.K.				
Glycine max	i.Bur.; iii.Mo.	iii.Bur.; iii.Mo.	i.Co.; ii.D.D.; ii.Co.; iii.D.D.; iv.D.D.; vii.D.D.		i.Bur.; ii.N.K.
Macroptilium atropurpureum			v.W.B.		
Macroptilium lathyroides		xii.Lei.			
Medicago sativa	ix.Mo; xii.P.K.	iv.Lei.; x.to.xii.Lei.	v.Lei.; ix.D.D.; xii.Lei.	x.Lei.	
Phaseolus lathyriodes	iii.N.K.	iii.N.K.; iv.Bur.			
Phaseolus lunatus		iv.Mo.			
Phaseolus riccardianus		x.N.K.	x.N.K.		
Phaseolus vulgaris			ii.Mo.		
Psoralea tenax					iii.Mo.
Dipogon lignosus	x.				
Vicia faba				x.Mo.	
Vigna radiata	xii. P.C.				
Vigna sesquipedalis		iii.D.D.			
Vigna unguiculata	i.Bur; i.N.K.	i.Mo.; ii.Mo.; vi.Co.; x.Mo.; ?.W.B.	i.N.K.; ix.Co.	ix.Co.; x.Mo.	
OTHER PLANT FAMILIES					
Beta vulgaris ssp.cicla				x.Mo.	
Carica papaya				x.P.C.	
Citrus medica		iii.W.B.			
Gossypium hirsutum			v.Co.; vi.Co.; vii.N.K.; ?.P.C.	v.Co.	
Helianthus annuus				viii.Lei.	
Hibiscus cannabinus				i.N.K.	
Lycopersicon esculentum			xi.Mor.	viii.Co.;ix.Mo.; x.P.C.; xi.Mor.	
Nicotiana tabacum			xi.Co.		
Papaver nudicaule				x.Mor.	
Passiflora quadrangularis				v.Co.	
Pastinaca sativa				xii.Mor.	
Persea armenicana				vii.Co.	
Ricinis communis				ii.N.K.	
Sechium edule		v.Mo.			
Solanum tuberosum		iv.Mo.		ix.Co.; x.Mo.	
Sorghum bicolor				iii.N.K.; iii.Mo.	
Zea mays			v.N.K.		
UNKNOWN:					
Bryonopsis sp.				iv.N.K.	

Table 3. Queensland Department of Primary Industries records of plants from which *Mirperus scutellaris, Riptortus serripes, Piezodorus hybneri, Plautia affinis* and *Dictyotus caenosus* have been collected and the months and respective locations of the collections. Locations are the pastoral districts of Queensland as shown in figure 1 (continued)

	Mirperus scutellaris	*Riptortus serripes*	*Piezodorus hybneri*	*Plautia affinis*	*Dictyotus caenosus*
'beans'	ix.W.B.; x.W.B.	i.W.B.; ii.W.B.; ii.Mo.; iii.D.D.; iii.Mo.; iv.Mo.; x.W.B.; xi.Mo.; xi.P.C.	xi.Mo.; xii.Mo.		
'peas'	iii.Lei.; x.W.B.; x.D.D.	iv.Mo.; x.W.B.			
'citrus'		v.N.K.	vii.N.K.		
Crotalaria sp.		iii.Mo.			
Dolicos		x.N.K.			
'grass'			xi.N.K.		
'legumes'		x.N.K.			
Macadamia sp.				v.W.B.	
mulberry				ii.Mo.	
passionfruit				x.W.B.	
stock				iv.Mo.	
NO HOST RECORDED	i.Bur.; ii.Co.; iii.D.D.; iv.Bur.; vii.Lei.; x.D.D.; xi.Mo.; xi.D.D.: xii.Lei.; xii.Mo.	iii.P.C.; iv.N.K.; v.Mo.		i.Mo.; ii.Mo.; iii.Co.; iv.Mo.; iv.N.K.;v.Co.; ix.Lei.; ix.Mo.; x.Mo.	i.D.D.; i.Mo.; ii.Mo.; iii.Mo.; ix.D.D.; xi.D.D.; xii.Mo.

A search of the literature revealed that the alydids, *R. serripes*, and *M. scutellaris*, and the pentatomids, *P. hybneri*, *D. caenosus* and *P.affinis* were associated with pulses in northern Australia (Shepard *et al.* 1983) and with soybeans in southern Queensland (Evans 1985). Their relative damage potential to soybeans was listed by Brier (1992) as *R. serripes* and *M. scutellaris* > *P. hybneri* > *D. caenosus* > *P.affinis.*

Schaefer (1980) reviewed the world literature on the alydidae and noted that they are invariably associated with, and presumably feed on, legumes. The results here show that *M. scutellaris* is only recorded from legumes. However, *R serripes* has been record at Cardwell (N.K.) on 10.v.1948, from citrus, at Nambour (W.B.) on 29.iii.1971 from *Citrus medica* (Rutaceae), at Nerang (Mo.) on 19.iv.1910 from *Solanum tuberosum* (Solanaceae) and at Brisbane (MO.) on 12.v.1943 from *Sechium edule* (choko).

The records for *P. hybneri* and *P. affinis* indicate that about 50% and 10%, respectively, of the collections were from legumes which indicates that they are found on a much wider range of plant species than are the alydids.

Bug numbers were low throughout the survey period. Unsprayed pulse crops comprising mixtures of navy beans, mung beans and soybeans grown at the J Bjelke-Petersen Research Station, Kingaroy, were searched in the second and third years of the survey and no bugs were found. Low numbers of bugs in possible alternative hosts hence correlated with the low numbers of bugs in cultivated crops. The opportunity to correlate high numbers of bugs in alternative hosts with the numbers in cultivated crops never arose. Further work in seasons which favoured the growth of alternative hosts would determine if high bug numbers in any of those hosts correlated with high numbers in cultivated crops. If such correlations were found, the alternative host/s may be able to be used as a pest monitoring tool.

All species are capable of surviving the winter conditions in the South Burnett, but lack of available plant hosts appears to limit their populations. Farmers spray their pulse crops with insecticides, as required, which indicates these bugs may not be adequately controlled by parasitoids or predators on alternative hosts at other times and places.

From the results of this survey it appears impractical to plant these hosts as trap crops because of their prevalence in the general environment given normal seasonal conditions and because none of the possible alternative host plants appeared to be highly attractive to the bugs. There were many instances where hosts were growing in dense stands, apparently healthy, and bearing 'fruit' but were not hosting any bugs. Trap crops must be more attractive to the pests than the main crop (Hokkanen 1991) and attractiveness data are still required. Todd *et al.* (1994) pointed

out that the use of small areas of earlier maturing soybeans (either by altering planting time or using different cultivars) as trap crops near the main crop, had been shown to have 'tremendous potential for use in IPM programs' but it was largely ignored by farmers. If cultivated *Macroptilium atropurpureum* (siratro), *Macroptilium lathyroides* (phasey bean), and *Medicago sativa* (lucerne), were more attractive to bugs than commercially grown pulses, and their wild counterparts, they would have the best potential as trap crops, for *R. serripes*, *M. scutellaris* and *P. hybneri,* as they flower and pod over a much longer period than do the pulse crops. Data on the relative attractiveness of, and the reasons for bugs moving off, the various possible hosts, are needed before recommendations on trap crops could be given to farmers.

The economics of growing a trap crop compared to the potential losses caused by the bugs would also need to be analysed.

The distribution of *Senna* trees and *Sesbania cannabina* is very restricted in the South Burnett, and removal of these sources of bugs could be a control option for *R. serripes*. *S. cannabina* is only one of many hosts of *M. scutellaris*, so its removal would have little impact on that species. During the survey, *Zygrita diva* (Coleoptera: Cerambycidae) and *Maruca vitrata* (Lepidoptera: Pyralidae) were often found on *S. cannabina*. These two species are also pests of pulse crops and removal of *S. cannabina* could reduce their numbers.

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