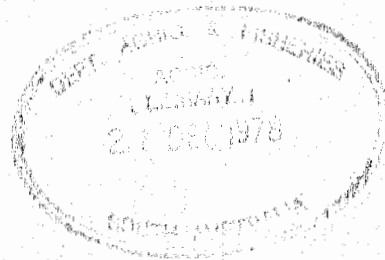


DEPARTMENT OF AGRICULTURE AND FISHERIES, SOUTH AUSTRALIA

Agronomy Branch Report

REVIEW OF THE LITERATURE ON THE
GENUS PATASSON (HYMENOPTERA MYMARIDAE)



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Review of the literature on the
genus *Patasson* (Hymenoptera Mymaridae)

Contents

	<u>Page</u>
Summary	1
1 Introduction	2
2 Nomenclature	2
3 Egg parasites belonging to the genus <i>Patasson</i>	2
3.1 Biology of <i>Patasson</i> sp.	2
3.2 Life histories of <i>Patasson</i> sp.	3
4 Biological control programmes involving <i>Patasson</i> sp.	4
4.1 History and outcome	5
4.1.1 <i>Patasson luna</i> on <i>Hypera postica</i>	5
4.1.2 <i>Patasson nitens</i> on <i>Gonipterus scutellatus</i>	5
4.2 Details of rearing and releasing parasites	5
4.2.1 Culture techniques	5
4.2.2 Stages of <i>Patasson</i> released	6
4.2.3 Numbers of parasites released	6
4.2.4 Establishment and spread of parasite	7
5 References	7
Appendix I List of known <i>Patasson</i> sp. and their hosts	11
Appendix II Information on <i>Patasson lameerei</i>	12

SUMMARY

There are two species of wasps of genus *Patasson* that have been used in biological control programmes against weevils, one programme being successful while the other was partly successful. The biology and seasonal life history of these two species are described along with relevant details of these control programmes such as culture techniques, stages released, numbers released, establishment and spread. Both programmes provide very useful information which will be used when *Patasson lameerei* is released in South Australia for the control of sitona weevil.

REVIEW OF THE LITERATURE ON THE GENUS PATASSON

1. INTRODUCTION:

Sitona weevil was first recorded in South Australia in 1966 and since that time it has spread throughout the agricultural areas of the state to become a major pest. The adults defoliate annual medics and lucerne and the larvae feed on the root nodules which are important in nitrogen fixation. There are no suitable measures available for sitona weevil control in pastures at present. Control methods involving the use of organo-phosphorus insecticides against adults are expensive and provide little residual effect and hence reinfestation is a problem. These chemical treatments are only recommended in high value situations such as lucerne or medic seed crops.

A programme for the biological control of sitona weevil commenced in 1972 when C.S.I.R.O. began collecting and selecting suitable parasites of sitona weevil from the Mediterranean Region. The first parasite, *Patasson lameerei*, was collected in southern France in 1973 (Aeschlimann, 1975). This parasite was passed through quarantine in Canberra by C.S.I.R.O. and is now available for multiplication and release in South Australia.

Very little is known of the biology/ecology of *P. lameerei*, a tiny egg parasite, and it is for this reason that the literature on the genus *Patasson* has been reviewed. The information on other *Patasson* sp. collected herein will provide useful guidelines when planning and executing the programme in South Australia.

2. NOMENCLATURE:

There are two synonyms for the genus *Patasson*

1. *Anaphoidea* = *Patasson* (Ogloblin, 1938)
2. *Mymar luna* = *Patasson luna* (Niemczyk & Flessel, 1970)

3. EGG PARASITES BELONG TO THE GENUS PATASSON:

A list of parasites, their hosts and references are given in Appendix 1. Most *Patasson* sp. are parasites of weevils with many of them being specific to one species of weevil.

The biology and life history of two *Patasson* species were described in detail.

3.1 Biology of *Patasson* sp.

The biology of *Patasson nitens* was described by Williams *et al* (1951). It is an egg parasite of the eucalyptus snout beetle, *Gonipterus scutellatus*. In common with most mymarids, *P. nitens* is solitary, only one parasite developing within a host egg. The larvae

consumes the contents of the egg and pupates within the chorion of the host egg. The adult parasite emerges from the egg 12 to 15 days after oviposition by chewing a neat round hole in the chorion.

In the laboratory, mating takes place soon after emergence and oviposition commences the same day. The female is capable of laying about 27 eggs during her life of 6 days. The eggs are usually laid within 3 to 4 days of mating with about 50% of the total number laid in the first 24 hours. The females prefer to oviposit in weevil eggs less than 4 days old. Parthenogenic reproduction also occurs and results in males only.

The sex ratio in the field was determined by Williams *et al* (1951) to be 2 males to 3 females indicating that most reproduction was sexual. Sex ratios of 1 male to 2 females (Frappa, 1960) and 1 male to 3 females (Moutia, 1947) were also recorded in the field.

The biology of a *Patasson* sp., an egg parasite of the Egyptian alfalfa weevil, *Hypera brunneipennis*, was described by Fisher *et al* (1961). This parasite is also a solitary endoparasite. It takes 11 and 17 days to pass from egg to adult at 27°C and 21°C respectively. In the laboratory, adults live for 7-12 days and display a strong attraction for water when it is made available from cotton-wool plugs. The emergence of the *Patasson* adults always lags several days behind the eclosion of the first instar weevil larvae.

3.2 Life histories of *Patasson* sp.

In Africa, the seasonal history of *P. nitens* is controlled by the availability of host eggs (Tooke, 1942). In the winter rainfall areas of South Africa, its host, *G. scutellatus*, has 2 complete generations and a partial third generation each year. The eggs of the 1st and 2nd generations are present in the periods July to November and December to February, respectively, and those of the third from April to July. Thus, *P. nitens* has a supply of host eggs available all year round and its numbers are relatively stable.

In summer rainfall areas, the third generation of the host is shorter and host eggs are rare from April until the end of winter. Despite this period without host eggs, *P. nitens* survives and the percentage parasitism still remains high throughout the year. However, in the high veldt, at altitudes of 4000-6000', there is no third generation and host eggs are completely absent from May until October. The absence of host eggs causes a great reduction in the number of parasites and no parasitism is found until December or January when it is about 0-5%. The parasite multiplies quickly and 90% parasitism occurs by the end of summer. It is not known how the parasite survives the period from May until October.

The survival of egg parasites during unfavourable times of the year has been studied in North America. The role of overwintering eggs of the alfalfa weevil, *Hypera postica*, in the survival of *Patasson luna* has been examined in north eastern U.S.A. (Stream and Feaster, 1966). In New Jersey, Pennsylvania, Maryland and Delaware, sampling of the overwintering weevil egg populations in November, 1962 and January 1964 showed parasites were present. Monthly sampling of a site in

New Jersey from November 1962 to March 1963 showed that parasite numbers varied throughout this period but no significant mortality was obvious. From this sampling, Streams and Feaster concluded that the immature stages of *P. luna* can survive severe winter temperatures and that the eggs of the alfalfa weevil are suitable hosts for this overwintering. However, they also noted that the absence of *P. luna* during winter appeared to be poorly correlated with the abundance of overwintering weevil eggs. In some areas, overwintering eggs were numerous and the presence or absence of the parasite appeared to be governed by some other factors. They suggested the presence or absence of weevil eggs in the field in the previous summer or the presence or absence of an alternate host as other factors. Since little or no oviposition by the weevil occurred during summer and no diapause in the parasite was known, it was suggested that an alternate host was the most likely explanation.

P. luna was also studied in Ohio (Niemczyk and Flessel, 1970). Sampling from October to June at four sites over a three year period showed that parasites were mainly present during the months, April to June. Host eggs were numerous in most sites during winter but very few parasites were observed.

Sampling of eggs of *H. postica* in Ontario from April to October showed that they were present for the whole of the above period (Ellis, 1973). *P. luna* was recovered from April until October showing it could oversummer without an alternate host. This situation was different to that of north eastern United States where no host eggs were present during summer and it was thought an alternate host was necessary for oversummering. In Ontario, it was also shown that *P. luna* was able to survive the winter period in overwintering eggs which were laid by the weevil in autumn but did not hatch until the following spring.

Notes on the biology of a *Patasson* sp. which parasitises *H. brunneipennis* gave several ideas on how the parasite may oversummer (Fisher *et al* 1961).

The ideas were that

1. a parasite may find an alternate host.
2. an adult parasite may live through summer as diapausing adult.
3. developing immature stages of *Patasson* may enter diapause in the host egg and pass through the summer in the dry alfalfa stubble.

P. lameerei was found parasitising *Sitona humeralis* in France, Greece, Italy and Spain (Aeschlimann, 1975). The wasp was recovered from eggs from October until April but no details were given on how it oversummered.

4. BIOLOGICAL CONTROL PROGRAMMES INVOLVING PATASSON SP

There are two main biological control programmes that have been documented in the literature, *P. luna* was used against *H. postica*

in U.S.A. and *P. nitens* against *G. scutellatus* in N.Z. and Africa. A programme involving the use of a *Patasson* sp. against *H. brunneipennis* in California was terminated in its early stages when the percentage parasitism was found to be very low (Van Den Bosch, 1964).

4.1 History and Outcome

4.1.1 *Patasson luna* on *Hypera postica*

P. luna was imported from Europe and released in Utah during 1911-1913 and 1925-28 and in California in 1933 and 1934 (Poinar and Gyrisco, 1963). However, apparently it did not establish as no recoveries of the parasite were made in these two western states (Hamlin *et al* 1949). In 1958 *P. luna* was recovered for the first time in eastern U.S.A. in the state of New York (Poinar and Gyrisco, 1963). *P. luna* was also found in Massachusetts (Shaw and Zeiner, 1964), New Jersey, Pennsylvania, Delaware and Maryland (Streams and Feuster, 1966), Illinois (DeWitt and Bursk, 1968), Ohio (Niemczyk and Flessel, 1970), Quebec (Mailloux and Pilon, 1970) and Ontario (Ellis, 1973). It is well established in the east but it is not known how it got there. The percentage parasitism varies from area to area with a mean usually less than 10% and a range of 0-40%. Generally, *P. luna* is regarded as playing a minor role in the biological control of *H. postica*.

4.1.2 *Patasson nitens* on *Gonipterus scutellatus*

Early in the twentieth century *G. scutellatus*, an indigenous insect of Australia, spread to New Zealand and South Africa, being found in the latter in 1916. It eventually became a major pest of eucalypts and difficulties involved with the use of chemicals led to a search for parasites in Australia. This search resulted in the discovery of *P. nitens* which was introduced to South Africa in 1926 where it gave excellent control (Tooke, 1942). In 1927, it was introduced into New Zealand (Miller, 1927) where it established and gave some control (Clark, 1938). The weevil continued to spread on the African continent in the 1930's, sometimes being followed by the parasite. Both the host and the parasite were recorded in Nyasaland in 1937 (Smee, 1937), Mozambique in 1938 (Anon, 1938) and southern Rhodesia in 1940 (Anon, 1940). In all three cases the parasite was achieving good control and no releases were necessary. In 1944, only the weevil was found in Kenya and Eastern Uganda (Kevan, 1946). *P. nitens* was subsequently introduced and it became firmly established.

G. scutellatus was collected in Mauritius for the first time in 1940 but no importance was attached to it until 1943 (Moutia and Vinson, 1945). In 1946, parasites were imported and released and within two years *G. scutellatus* was effectively controlled (Williams *et al* 1951). In the late 1940's, the weevil was reported in Madagascar (Williams 1949). Parasites imported from Mauritius established and gave satisfactory control of their host (Appert *et al* 1969).

4.2 Details of rearing and releasing parasites

4.2.1 Culture techniques

The culture technique used in Kenya was described by Kevan

(1946) as follows:

"Daily collections of egg-capsules were made from a nearby source, both from the field and from specially grown susceptible seedlings. The capsules on their pieces of leaf, up to 50 together, were then placed in tubes into which a number of the adult *Anaphoidea* were introduced, depending on the numbers available at the time. A small drop of honey and water was smeared on the side of the tube as food. The parasites were introduced to fresh capsules daily for 15 days. A second tube was then placed over the mouth of the first and secured to it by a piece of rubberized tape.

When the resulting generation of parasites had emerged, the two tubes were orientated so that the empty one was towards the light, and immediately almost all the wasps which had emerged, entered it and thus were captured without handling".

In Mauritius, the culture technique was described by Williams *et al* (1951) as follows:

"The breeding of *Anaphoidea* was carried out in glass cylinders 5 ins. by 1 in. closed at both ends with a perforated cork covered with muslin. Pieces of Eucalyptus leaves with *Gonipterus* egg capsules were placed in the cylinders with a few *Anaphoidea* and left for one or two days depending upon the number of capsules used. With larger containers, oviposition was reduced. Food was supplied by smearing honey on one side of a slip of paper riddled with pin holes, the slip then stuck to the wall of the cylinder. This method enables the parasites to feed through the pin holes without becoming stuck in the honey. No moisture was supplied, as that given off by the pieces of Eucalyptus leaves was sufficient."

4.2.2 Stages of Patasson released

The stage of the parasite which was released into the field varied from country to country. In South Africa, parasitised eggs were placed in the field and the wasp was left to complete its development and emerge (Mossop, 1929). In Kenya, adults were dispatched in tubes and released directly into the field (Kevan, 1946). Both methods were satisfactory.

The latter approach would be the favoured method for release of *P. lameerei* in South Australia because of ant predation. Since sitona weevil lays its eggs on the soil surface, releases of a passive stage of a parasite into this micro habitat would be open to attack by ants. On the other hand, releases of the active adults minimizes the effect of ant predation and at the same time allows more accurate details of releases to be kept.

4.2.3 Numbers of parasites released

In Mauritius, 12,500 adults of *P. nitens* were released in 36 districts in colonies of 150-800 (av. 347) between May and September, 1946 (Williams *et al* 1951). In South Africa, 620,000 were reared in

the laboratory and liberated into the four provinces in the 4 years, 1928-31 (Tooke, 1942).

It is very difficult to use the numbers of *P. nitens* released as a guide to determine the numbers of *P. lameerei* that should be released because of the variation in oviposition habits of *G. scutellatus* (eggs laid in batches) and *S. humeralis* (eggs laid singly). The numbers of *P. nitens* released at each site in Mauritius (av. 347) seems low and it is anticipated that the minimum number of *P. lameerei* to be released at any one site would be 4-5000.

4.2.4 Establishment and spread of parasite

Establishment and spread of *P. nitens* were rapid in most countries. In Mauritius, 3-4 months after the first release, the parasite had spread 9 miles (Moutia, 1947). In some African countries, it took as little as 2 years to spread and establish itself over vast areas such as the Republic of South Africa and Kenya.

It is most likely that *P. nitens* was spread mainly by wind. These tiny parasites emerge in the tree tops and would be picked up by the wind very easily and carried long distances. However, *P. lameerei* will occupy a niche on the ground and consequently may not be subjected to wide dispersal by wind. Hence, it is likely that its spread will be much slower than that of *P. nitens* in Africa.

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APPENDIX IList of known *Patasson* sp. and their hosts

Species	Host	Reference
<i>Anaphoidea luna</i>	<i>Hypera punctata</i> (weevil)	Chamberlain (1924)
<i>A. conotracheli</i>	<i>Coeloides inaequalis</i> (weevil)	Brooks (1918)
"	<i>Conotrachelus nenuphar</i> (weevil)	"
"	<i>Rhagoletis pomenella</i> (maggot)	Porter & Alden (1921)
"	<i>Aprosthemata zabriskei</i> (saw fly)	Marcovitch (1916)
<i>A. pullicrura</i>	<i>Chaetocnema denticulata</i> (leaf beetle)	Poos (1955)
<i>A. latipennis</i>	<i>Antianthe expansa</i> (bug)	Chaverri (1954)
<i>A. calandrae</i>	<i>Calandra</i> sp. (weevil)	Mailloux & Pilon (1970)
<i>Patasson brachygaster</i>	<i>Sitona regensteinensis</i> (weevil)	Danthanarayana (1969)
<i>P. chrysomelae</i>	<i>Chrysomela americana</i> (leaf beetles) <i>C. graminis</i> , <i>C. fastuosa</i> , <i>C. herbacea</i> , <i>C. lutea</i> <i>C. banksii</i> , <i>C. haemoptera</i> <i>C. rossia</i>	Bibolini (1970)
<i>P. declinata</i>	<i>Ceutorhynchus assimilis</i> (weevil)	Bakkendorf (1970)
<i>P. diana</i>	<i>Sitona regensteinensis</i> (weevil)	Richards & Waloff (1965)
<i>P. lameerei</i>	<i>S. humeralis</i> (weevil)	Aeschlimann (1975)
<i>P. luna</i>	<i>Hypera postica</i> (weevil)	Mailloux & Pilon (1970)
<i>P. nitens</i>	<i>Gonipterus scutellatus</i> (weevil)	Appert <i>et al</i> (1969)
<i>P. stubaiensis</i>	<i>Rhynchaenus salicis</i> (weevil)	Cavalcaselle (1963)
<i>Patasson</i> sp.	<i>Hypera brunneipennis</i> (weevil)	Fisher <i>et al</i> (1961)
<i>Patasson</i> sp.	<i>Phrydiuchus topiarius</i> (weevil)	Andres & Rizza (1965).

APPENDIX IIInformation on *Patasson lameerei*

The details below were reported in a recent paper.

Life History:

In the Mediterranean region, the adults of *P. lameerei* become active in September. From this time through to May, it is possible to find both parasitised sitona eggs and the adult mymarid. During April, some parasites enter diapause and by the end of May, the whole population is in diapause. The wasp diapause as a larva within the host egg during the summer months until development recommences in autumn and the adults emerge in September.

Biology:

At 21°C and 90% relative humidity, the wasp completes the generation in 15 days. In the field in Europe, it passes through several generations during the egg laying season of the host.

The level of parasitism can be high, sometimes falling in the range 40-50%.

Reference: Aeschlimann, J.P. (1977). Notes on *Patasson lameerei* (Hym: mymaridae), an egg parasitoid of *Sitona* spp. (Col: Curculionidae) in the Mediterranean Region. *Entomophaga* 22(1): 111-114.