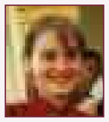
Spider Ballooning...

for crop colonisation and movement



Sarina Pearce

The University of Queensland, Department of Zoology and Entomology, St. Lucia 4072, Australia.
spearce@zen.uq.edu.au

Grains Research & Development Corporation

Introduction

Spiders are among the most abundant predators recorded when sampling in grain crops in Australia and may play an important role in the reduction of pest populations. Spiders have been the subject of very few investigations. My preliminary study examines the significance of ballooning behaviour for the colonisation of a soybean field by spiders.

The spider species present within a summer grain crop must colonise the field from source areas such as standing winter crops, stubble, fallow fields and "refuge" areas. The methods of colonisation include short-distance walking, and potentially long-distance aeronautic behaviour. Aerial dispersal, known as ballooning, is practiced by the juveniles of many spider species, and in some spider families by the adults as well. Ballooning behaviour begins by a spider climbing to the top of a plant and producing a silk thread. The wind drag on a silk thread provides lift. The spider is passively carried by the air current (Turnbull, 1973). Ballooning ability is one characteristic that permits spider populations to exist in ephemeral agroecosystems (Weyman & Jepson, 1994; Weyman et al. 1995). Ballooning behaviour can result in spiders colonising crops prior to other predator species (Weyman and Jepson, 1994; Plagens, 1986).

I addressed the following questions:

1. **Is ballooning behaviour an important method for the colonisation of a soybean field, and at what rate does this occur?**
2. **What trap types are best for studying both ballooning rate and composition of ballooning fauna?**

Study site & Methods

At five sites located 20m from the boundary of a 5 ha soybean field (Cawana variety), at the Gatton campus of the University of Queensland, a sticky trap, a water trap and a pitfall trap were erected next to each other (Fig. 1). The sticky traps were coated with tangle-foot and examined *in situ* every two weeks. The pitfall traps and the water traps were checked weekly and the spiders collected and returned to laboratory for identification to family level. Tangle-foot was coated around the poles of the water traps and sticky traps to ensure that only spiders moving through the air were captured.

Results & Discussion

Water traps

190 spiders were collected from the water traps, of which 66% were immatures and 34% were adults. The majority of the adults were small in size and belonged to the Family Linyphiidae. This represents an average of 5.94 spiders/m^2/day displaying aeronautic behaviour. Assuming this figure is an estimate of spiders ballooning into the field from an external source area, this represents an influx into the soybean field of 297,000 spiders per day. This figure more likely includes spiders ballooning out of the field and spiders moving within the field. The ballooning rate calculated is greater than that of comparable studies (see Table 1). The numbers of ballooning spiders increased throughout the season in a wave-like pattern (Fig. 2). As the season progressed the proportion of adult spiders in the catch increased.

The most abundant families collected from the water traps were Linyphiidae (33%), Araneidae (14%) (Fig. 3). Spiders in the families Linyphiidae and Araneidae are web builders. Most species in the family Araneidae (genus *Araneus* and *Agriope*) construct large orb webs which can capture adult *Helicoverpa* spp. moths, as well as other flying pests. The webs would be unlikely to capture *Helicoverpa* spp. larvae and may have a negative impact on beneficial Hymenoptera. Spiders in the family Linyphiidae have not been readily recorded in cropping systems. Their small size makes them hard to observe in the field, or capture using conventional scouting techniques. The results show they constitute a significant proportion of ballooning spider fauna and cursoral spider fauna. Both adults and immatures were recorded ballooning, suggesting that aeronautic behaviour is used for movement and dispersal.

Sticky traps

To check the accuracy of the *in situ* sticky trap counts clear plastic sheets were placed on a selection of traps and coated with tangle-foot. After two weeks the sheets were examined in the field, then removed from the poles and examined under a microscope. The relationship between the *in situ* count and the true number of spiders on the sticky trap was compared using linear regression. *In situ* counts generally underestimated the actual count. After the *in situ* counts were corrected it was estimated that the sticky traps captured 2.13 spiders/m^2/day.

Pitfall traps

394 spiders were collected from the pitfall traps, of which 71% were adults and 29% immatures. The Lycosidae (38%) and the Linyphiidae (33%) were the most abundant families caught in the pitfall traps (Fig. 4).

Figure 3.
Family level composition of ballooning spiders caught in water traps placed in a soybean field.

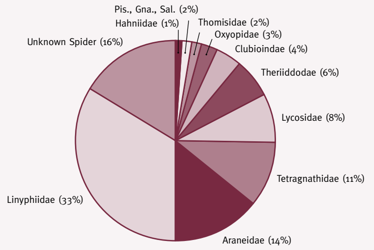


Figure 4.
Family level composition of cursoral spiders caught in pitfall traps placed in a soybean field.

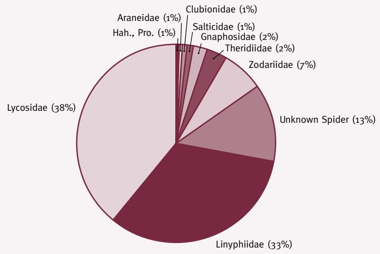


Figure 1.
Trap types used in study.

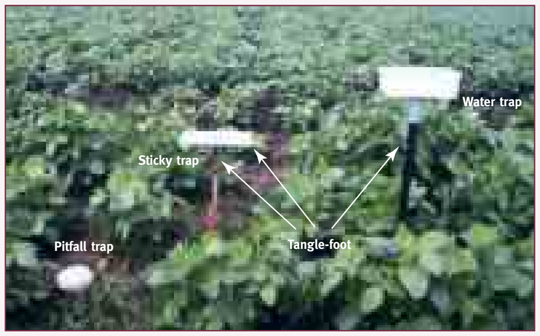
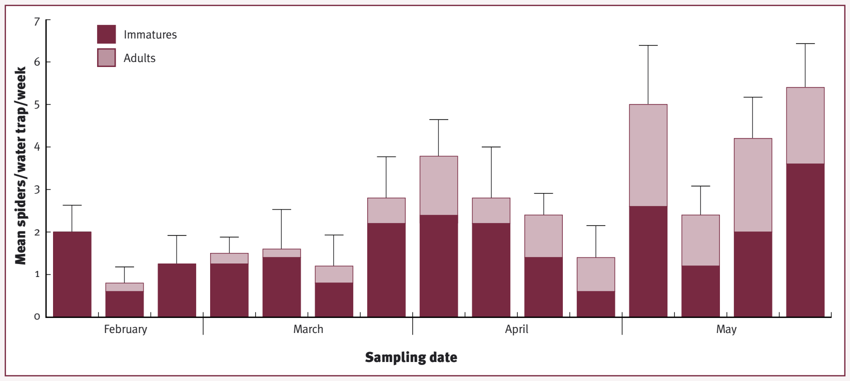


Figure 2.
Seasonal pattern of spider ballooning in a soybean field from February to May 2001 (bars indicate standard error).



Conclusions

- Ballooning appears to be an important method for immature spiders to colonise and move within soybean throughout the season. The family level composition of the ballooning spider fauna is different to that of the cursoral spider fauna. Similar sampling techniques, replicated in a number of fields, in the coming season should confirm this. Exclusion studies, (eliminating the cursoral spiders), are planned determine the significance of ballooning behaviour to prey mortality.
- Water traps are preferable to sticky traps for studying the ballooning spider fauna. As well as various technical difficulties, sticky traps underestimate spider numbers.
- Little is known about the diet range of the spiders captured in this study. Further identification of the individuals collected, and investigations into prey of both web building and hunting spiders will be conducted.

Table 1.
Comparison of spider ballooning data collected from traps in a soybean field in Southeast Queensland with similar overseas studies.

data source	system	total spiders	trap type#	trap size cm²	number of traps	observation period days	mean/m²/day
my data water traps	soybean crop Southeast Queensland	190	water	621.6	5	103 (Jan.-May)	**5.94**
my data sticky traps adjusted*	soybean crop Southeast Queensland	83.5	sticky (microscope count)	621.6	5	125 (Jan.-May)	**2.13**
my data sticky traps raw data	soybean crop Southeast Queensland	52	sticky (*in situ* count)	621.6	5	125 (Jan.-May)	**1.34**
Bishop & Riechert 1990	garden/old field East Tennessee	1865	sticky (*in situ* count)	2325	20	196 (Mar.-Nov.)	**2.04**
Greenstone et al. 1985	soybean crop Missouri	3560**	sticky (microscope count)	2432	72	72 (Jun.-Oct.)	**2.82**
Weyman & Jepson 1994	grass field UK	258	deposition	1242	16	24	**5.41**
Weyman & Jepson 1994	grass field UK	340	barley plant trays + aphids	1242	24	24	**4.75**
Weyman & Jepson 1994	grass field UK	251	barley plant trays - aphids	1242	24	24	**3.51**
Weyman et al. 1995	wheat field UK	3.99/8trap/day	deposition	1242	8	Jan.-Aug.	**4.02**
Weyman et al. 1995	grass field UK	2.6/8trap/day	deposition	1242	8	Nov.-Aug.	**2.62**

For full description of trap type see reference
* raw data adjusted for in situ observation error using y = 1.5871x + 0.9315 (R2 = 0.703)
**estimate calculated from a graph

Refererences

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Acknowledgements

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