Use of Soybean *Glycine max* (L.) as a trap crop to manage green vegetable bug *Nezara viridula* (L.) in cotton

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With increasing adoption of IPM practices in cotton, green vegetable bugs (GVB) have emerged as important sucking pests causing considerable damage to growing bolls (Khan and Bauer 2001, 2002). GVB damage includes black spots at feeding sites on the boll, warty growth inside the boll wall and brown coloured lint.

GVB is a polyphagous insect and feeds on a wide variety of field crops including cotton, corn, sunflower, a range of legumes and pulses including adzuki, mung, navy and soybeans, lucerne, pigeon pea, fruit crops, vegetables and variety of weed hosts including wild turnip, noogoora burr, marshmallow and castor oil. Some of these hosts are more attractive to GVB than others.

In Australia GVB pass 1 or 2 generations in cotton depending on crop stage at first migration. They overwinter as adults, diapausing under the bark of trees, crevices, leftover corn stalks, winter vegetables, etc. In August - September, with the rising temperature, they start to build up and large recruitment occurs in October – November on wild hosts. During December – January these wild hosts dry down and GVB then move to cotton in small numbers if no other attractive hosts such as soybean or mungbean are available, and continue to multiply.

Currently, insecticides are sprayed to control GVB in cotton. The insecticides registered for GVB are quite disruptive to a wide range of beneficial arthropods and their use in January will undermine the existing IPM systems. Therefore, it is crucial to develop management options for GVB that are compatible with the existing IPM systems. One such possible option may be to take advantage of the polyphagous nature of GVB and to find out the host plants that are more attractive to GVB than cotton which can be used as trap crop. Trap cropping using mustard has been recommended to manage GVB in sweet corn in New Zealand (Rea *et al.* 2002). In Australia, a trap-cropping strategy interplanting cotton with lucerne has been recommended for another sucking pest of cotton green mirid *Creontiades dilutus* (Ståll) (Mensah and Khan 1997). In both cases the effectiveness of the trap crop depended on the degree to which GVB or mirid were attracted to mustard or lucerne relative to sweet corn or cotton.

In this paper we present the results of trap crop experiments; firstly, examining the attractiveness of soybean, lablab and pigeon pea for GVB interplanting with cotton; secondly, considering the fact that soybean is the preferred host of whitefly, examining the attractiveness of mungbean relative to soybean to replace soybean as a trap crop for GVB where whitefly is an issue; and finally examining the effectiveness of soybean as a trap crop on a field scale.

Methods

Trial to evaluate attractiveness of soybean, lablab and pigeon pea

Two replicated field trials, one at Kingaroy and other at Byee, 60 km north of Kingaroy, were conducted in irrigated cotton during 2001-02 season. In both locations 3-replicated trap crops were grown in strips within the 3 blocks of cotton and each trap crop strip then divided into three equal blocks to accommodate 3 trap crops to be tested (Figure 1). Trap crops were allocated in the block randomly. In Kingaroy for every 10 rows of cotton, 4 rows of trap crop strips, each 120 m long and in Byee for every 54 rows of cotton, 6 rows of trap crop strips, each 300 m long, were grown. Since podding stage of legume crops is the most attractive stage to GVB (Hugh Brier, personal communication) and GVB move from wild hosts after late December, trap crops were planted in such a way that crops reached podding stage by mid January. While cotton (cv. Siokra V16i in Kingaroy and NuPearl in Byee) and pigeon pea (cv. Quantum) were planted at the same time, soybean (cv. Melrose) and lablab (cv. Koala) were planted two weeks after cotton. In Byee cotton was planted in mid November and in Kingaroy in early December. The field in Byee was sprayed with folimat and endosulfan in January for mirids.

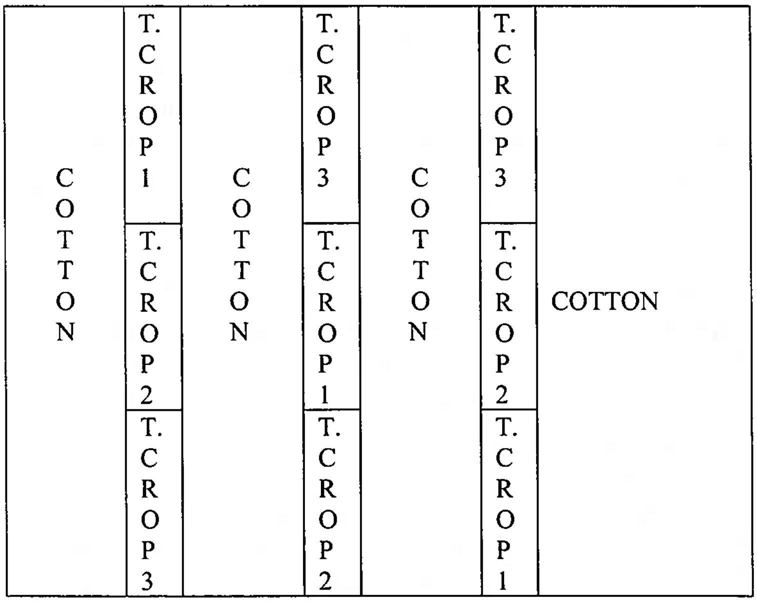

Figure 1. Diagrammatic representation of the trial layout.

GVB and other arthropod communities were sampled with a beat sheet once every week starting from 3 January 2002 in Kingaroy and 11 December 2001 in Byee. Three 1 m row lengths from each replication of cotton or trap crops were sampled each week.

Trial to evaluate attractiveness of mungbean relative to soybean

This trial was conducted in irrigated cotton at Byee during 20002-03 season. The trial layout was same as the trials described above. However, each trap crop strip was 4 rows wide and 200 m long and cotton strip was 48 rows wide and 200 m long. Cotton (cv. NuPearl) and trap crops, soybean (cv. Melrose) and mungbean (cv. Regur Black Gram) were planted at same time in mid October 2002. The field was sprayed two times (4 and 18 January 2003) with endosulfan and steward for mirids. Both cotton and trap crops were sampled with a beat sheet, 3 X 1 m row lengths per replication, once every week starting from 26 November 2003 to 4 March 2003. Mungbean matured earlier than soybean but sampling continued on regrowth until termination of the trial.

Field scale trials

Two trials, 5 km apart, were conducted in irrigated cotton at Byee during 2003 – 04 season. The fields selected for the trials had a history of GVB infestation.

In Trial 1, soybean strips (cv. Melrose) 24 rows wide X 240 m long, were grown along the length of a 7.7 ha cotton (cv. NuPearl) field. Another cotton (cv. NuPearl) field, with no adjacent soybean, and about 1 km away from the first field was used for comparison. Trial 2 design was similar to Trial 1. However, in this trial, soybean, 4 rows wide and 400 m long, were grown adjacent to a 40 ha Bollgard II cotton field. On the opposite side of the field, and about 500 m away from the soybean, 200 rows of cotton were used for comparison.

In both trials, cotton and soybean were planted in the first week of November 2003. Insects were sampled once every week from 3 December 2003 to 25 March 2004. Up to late December, sampling was done in 3 X 20 m row lengths in soybean and 5 X 20 m row lengths in cotton, with a suction machine. Thereafter sampling was done in 3 X 1 m row lengths in soybean and 5 X 1 m row lengths in cotton, with a beat sheet. In both trials, soybeans were sprayed with endosulfan if GVB numbers exceeded 8 – 10 per metre. Damage in cotton (number of bolls damaged) in 10 X 1 m row lengths per field, was assessed at harvest. If at least one locule suffered a medium level of damage (Figure 2), the boll was deemed to be damaged.

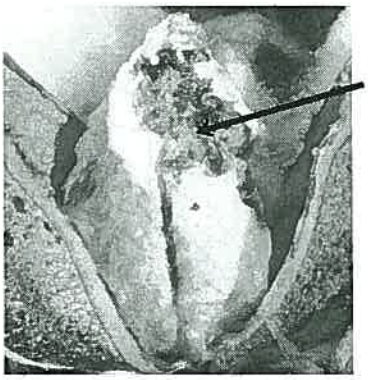

Figure 2. GVB damage to cotton boll at harvest. Arrow indicates damaged part.

Results

Attractiveness of soybean, lablab and pigeon pea

There were differences among plant species in attractiveness for GVB (Figure 3). In both locations significantly more bugs were found in soybean followed by lablab, but the differences between them was not significant. In Kingaroy, however, soybean attracted significantly more bugs than lablab. Pigeon pea attracted the least number of GVB and was not significantly different from cotton.

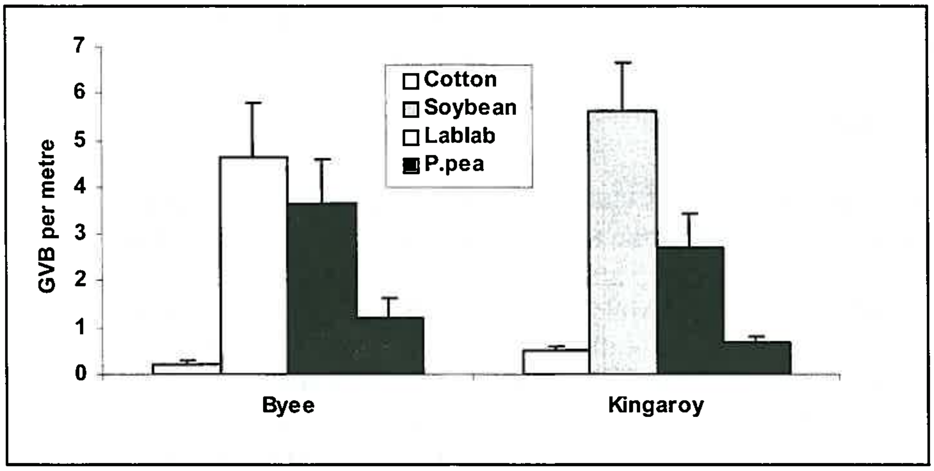

Figure 3. Number of green vegetable bugs (average of 14 observations) in different hosts at Byee and Kingaroy. Error bars indicate standard errors.

Attractiveness of mungbean relative to soybean

The results are summarised in Figure 4. Both soybean and mungbean were found equally effective in attracting GVB. The bugs moved to both soybean and mungbean in 2nd week of December, but in higher numbers in mungbean where they stayed until mungbeans started to dry off. Trap crop phenology might play an important role in attraction. Mungbean started podding during 2nd week of December while soybean started podding in 1st week of January.

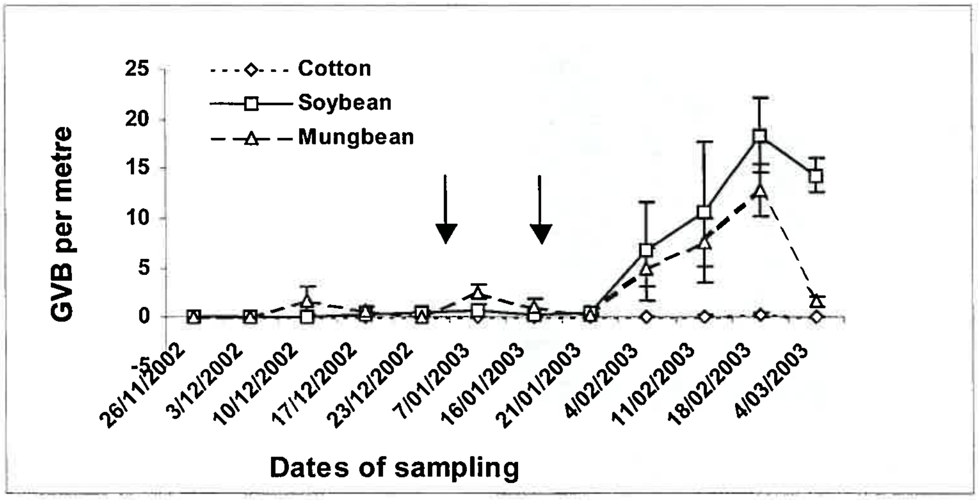

Figure 4. Number of green vegetable bugs in mungbean and soybean. Arrows indicate spray time. Error bars indicate standard errors.

Effectiveness of soybean as a trap crop

In Trial 2 soybean establishment was poor and in both trials soybeans were sprayed with endosulfan in 1st week of March. In Trial 1 the spray failed due to rain.

In both trials soybean was found to be quite effective in trapping GVB and attracted 90% of the GVB caught during the trial period (Table 1). Cotton away from soybean attracted 2 times more GVB than cotton adjacent to soybean.

Table 1. GVB numbers in cotton adjacent to soybean or away from soybean

Trial	Soybean	Cotton adjacent to soybean	Cotton away from soybean
1	2.86 ± 1.27	0.21 ± 0.08	0.34 ± 0.16
2	6.55 ± 2.12	0.06 ± 0.03	0.14 ± 0.05

When data was analysed across time, it was found that in Trial 1 GVB reached threshold level (1 per metre) twice at the end of the season in both cotton crops (Figure 5). This was perhaps due to the fact that soybean and cotton fields surrounding the trial plots were sprayed, resulting in GVB movement into the trial field. GVB numbers in cotton away from soybean (Cotton2) were higher than in cotton adjacent to soybean (Cotton1) on both occasions. In Trial 2 GVB never reached threshold level in cotton, indicating the effectiveness of the trap crops.

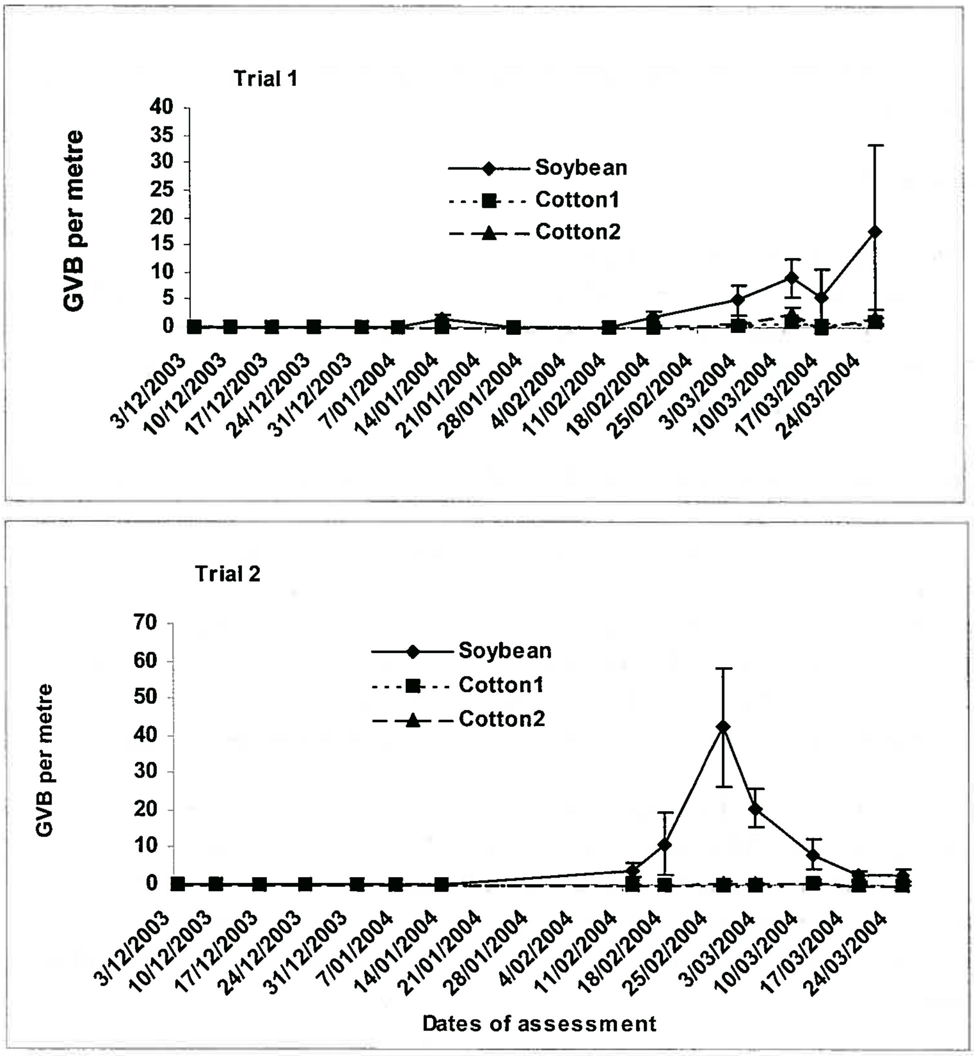

Figure 5. GVB numbers on different sampling occasions in soybean and cotton adjacent to (Cotton1) or away from soybean (Cotton2). Error bars indicate standard errors.

In Trial 1 cotton away from soybean suffered significantly more damage than cotton adjacent to soybean. However, in Trial 2 while the difference was not significant, cotton away from soybean incurred more boll damage (Figure 6).

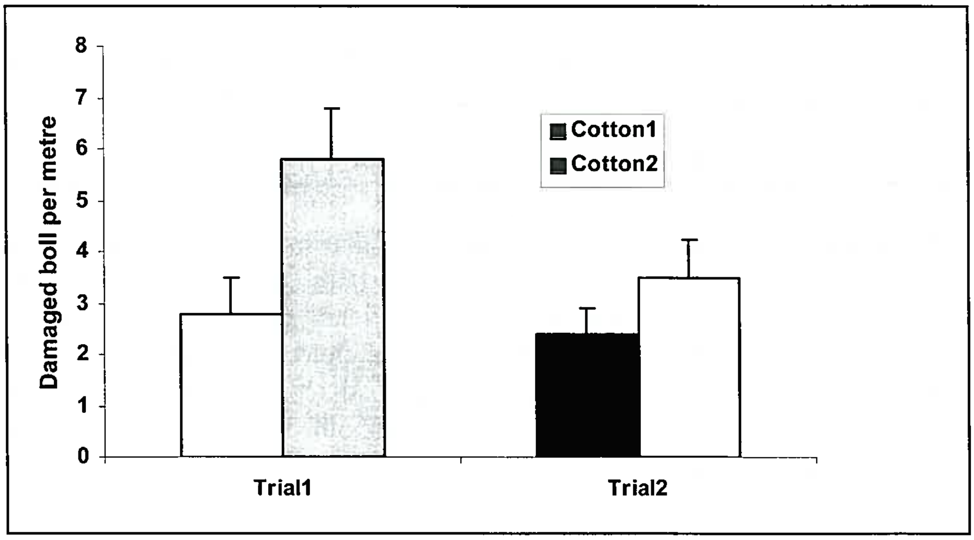

Figure 6. Boll damage in cotton adjacent to (Cotton1) or away from soybean (Cotton2). Error bars indicate standard errors.

Conclusions

This study clearly indicated that soybean is a preferred host of GVB over cotton and could be used as trap crop. Where whitefly is an issue, soybean could be replaced with mungbean. Although lablab showed some degree of attractiveness to GVB, its characteristic viny growth made it a poor candidate for trap crop interplant with cotton since cotton was entangled by nearby lablab growth.

In soybean-mungbean comparison, the earlier podding of mungbean compared to soybean attracted the first migratory GVB, reinforcing the importance of trap crop stage at first migration from wild hosts. To attract early migratory GVB, soybean should be in the podding stage in mid December, thus requiring soybean planting earlier than cotton. This may not be possible for practical reasons. If soybean and mungbean are interplanted in strips with cotton at the same time, mungbean will pod earlier and attract early migratory GVB. When mungbean dry off, soybean will be in an attractive stage and continue to attract GVB. Further research, however, is needed to refine this technique.

In field scale trials, numbers of GVB were much less and boll damage was lower in cotton interplanted with soybean strips than cotton alone. Soybean attracted more than 90% of GVB, further indicating effectiveness of soybean as a trap crop for GVB management. However, soybean should be sprayed if GVB reach high numbers (8 – 10 per metre) to diminish the chance of any movement of GVB from soybean to cotton due to over crowding.

Acknowledgements

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