FINAL REPORT

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

ABE00001

Improved pollination practices with honey bees

PROJECT DETAILS

PROJECT CODE:	ABE00001
PROJECT TITLE:	IMPROVED POLLINATION PRACTICES WITH HONEY BEES
START DATE:	30.06.2009
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Summary

Incidental and unpaid pollination services from feral and managed honeybee hives are worth over $4 billion a year to Australian agriculture. However recent experiences in the United States of America, New Zealand and Europe indicate these 'free' but valuable services may soon cease.

Like the USA and NZ, Australia has many crops that require or benefit from insect pollination. Honeybees account for 90-100% of the yield in crops such as almond, apple, avocado, blueberry, cherry, cucumber, macadamia, rockmelon, sunflower, watermelon and zucchini. Crops such as canola and cotton can gain yield increases of over 15% with honeybee pollination and recent trials conducted in South Australia suggest increases in yields of over 50% are possible in crops such as faba beans and 30% in other pulse crops. The role of honeybees play in pollination processes in pulse and oilseed crops in Australia is largely unrecognised.

Experts claim it is not a matter of 'if' but 'when' the bee mite, *Varroa destructor,* invades Australia. This will destroy feral hives and eliminate many amateur and poorly-managed hives. The $65m honey crop will be affected; but that damage is small compared to the loss of crops dependent on pollination. *Varroa* mite was identified in the US in 1996 and New Zealand in 2000.

In the USA, the number of managed hives fell by half in the last 20 years because of pesticides and changes in farming practices. The decline was hastened by the spread of *Varroa*; and in the last two years, losses are at unprecedented levels due to a new problem called Colony Collapse Disorder (CCD). The largest apiarist in the US, Richard Adee lost 40,000 of his

70,000 hives in 2008 due to "unknown" causes. The cause of CCD is unknown. Bees are simply vanishing. No single pathogen has been identified. Similar mysterious disappearances are also occuring in Europe.

This project will research managed pollination in a range of broadacre pulse crops in order to increase crop yield and quality. This will be achieved through controlled field trials to prove the concept of managing hives to maximise crop pollination through co-ordinated placement throughout the crop to improve pollination effectiveness. The outcome of the project will be quantitative analysis of pollination contribution from honey bees in pulse crops grown commonly in the southern regions of Australia. The project will also investigate the effects of other common insect species found in pulse crops to determine their contribution to pollination. It will build knowledge and understanding of the impact of *Varroa* mite and CCD will have on pulse and oilseed crops and assist in developing robust industry driven managment measures to deal with mite and disease incursions if and when they arrive.

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Conclusions

Discussion

The yield of the 2009 fields (average 4t/ha) are very high and perhaps limit the amount of potential yield increase possible. This in combination with the extreme heat recorded in November may have influenced the severe pod loss prior to harvest.

The data collected 2009 indicates that the benefit gained by converting additional flowers into fruit was carried through to harvest. The pod abortion event effected both the near bee site and the far from bees site equally.

The hive density used in this study was 2.5 hives/ha. This stocking level provided an average of 22 bees per 10 m2. This high level of bee activity can only be provided by the introduction of managed colonies. During previous studies conducted by the authors the hive stocking rates have been manipulated. Stocking rates of 3 hives/ha have had detrimental impacts on hive health as the available food resources are not adequate in beans to support this density. Lower hive densities (1.5-2 hives/ha) provided the bees with surplus food resources that are stored in the hive. When the hive is full of food reserves the hive decreased in activity, decreasing the field bee density.

The yield response of 0.38316 tonnes per hectare in 2008 returned the grower a yield increase of 30%. Whilst this was lower in 2009 (10%) the economical benefit to the grower is clear. These numbers should be thought of as the minimum estimate of effect size. This is because we do not have data on the yield of these beans when pollinators are missing altogether. We only have a comparison between near and far from added hives. At the far sites there may still be bee pollination from unmanaged bees, native bees and from the bees we added to the field. It is possible the effect of adding hives extends beyond the range of our analysis.

The other legume crops used in this study showed a mixed response to managed pollination. Lupins showed a significant response in pod numbers per plant but this response didn't translate into increased final yield differences. Langridge et al (1985) conversely showed that managed pollination resulted in a 32% yield increase.

Chickpeas had no response in pods numbers or yield. This response in chickpeas is similar to results in previous studies and observations by the authors.

Lentils showed a large increase in pod numbers but little yield response, although the number of fields examined was low. More work needs to be conducted in lentils to obtain more data sets and confidence.