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EFFECT OF HONEYBEE ACTIVITY ON THE POLLINATION OF SUNFLOWERS

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SUMMARY

A 2 000 x 22 m strip of sunflowers cv. Sunfola 68-1 was grown at a site on the Darling Downs expected to be lacking in honeybees for pollination. Honeybee colonies were placed at one end, and pollinator activity was observed and seed set determined.

Honeybees were the only insects playing a significant role in pollination. Numbers of visits per head per hour declined with distance from the colonies. Visits to flowerheads were usually brief, 61% lasting less than 1 minute.

Only 10·7% of florets in bagged heads set seed, indicating that an external agent was necessary for pollination. At distances up to 2000 m from the colonies all florets in open heads set seed, indicating that the necessary pollinators were present.

I. INTRODUCTION

The need for agents of pollination in sunflower (*Helianthus annuus* L.) has been demonstrated by reduced seed set in heads covered with mesh bags (Putt 1940) and heads enclosed in flywire cages (Langridge and Goodman 1974). Honeybees (*Apis mellifera* L.) are effective pollinators of sunflower (Langridge and Goodman 1974), but honeybee introduction to sunflower fields does not necessarily increase seed set and yield. In Canada, for example, provision of honeybee colonies has had no effect on sunflower yield (Arnason 1966) but has also increased yield (Furgala 1954). Yield reductions occurred only 60 m from colonies in Manitoba, Canada (Furgala 1954). In Illinois, U.S.A., however, reductions in seed set did not occur 180 m from colonies (Guynn and Jaycox 1973).

The present experiment was set up to measure the effects of distance from honeybee colonies on bee activity and seed set in a sunflower crop on the Darling Downs. The site chosen lay at the centre of the naturally treeless Jimbour plain where there was the least chance of interference from feral honeybees, which are indistinguishable from domestic bees.

II. MATERIALS AND METHODS

A 2 000 $\times$ 22 m strip of sunflowers cv. Sunfola 68-1 (derived from Peredovik 6296) was sown in north-south rows on black earth soil on 15 January, 1974. Plant population was approximately 40 000 ha^{-1} and row spacing 100 cm.

Twenty hives of honeybees were placed at the southern end of the strip. All other known honeybee colonies within a 5 km radius of the centre of the strip were removed. During flowering there were no other flowering crops competing for pollinators. At 0, 500, 1 000, 1 500 and 2 000 m from the hives, two heads were covered with water-resistant paper bags to exclude insects and two were tagged for observation and later harvest. Each of the 10 tagged heads was observed for 15 min within a 95 min period, and this set of observations was repeated nine times in two days. For each set of observations, the total number of insect visits at each distance from the hives was recorded. The duration of individual bee visits to flowerheads was also recorded, including the duration of incomplete visits (bees present at the start or finish of observation periods).

To determine the flight distance of honeybees, approximately 500 worker bees in two hives were marked with a spot of red, non-toxic paint on the dorsal surface of the thorax.

The tagged heads were harvested on 9 May, 1974, and randomly chosen sub-samples of 50 achenes from each head were opened and examined for the presence of a seed.

III. RESULTS

Number of honeybee visits

Mean number of honeybee visits per head per hour are presented in figure 1, which shows a decline in visitation rate with increasing distance from the hives up to a distance of 1 500 m.

Duration of honeybee visits

Mean duraton of honeybee visits to flowerheads was 95 s, but the frequency distribution of duration of individual visits to the flowerheads was strongly skew (figure 2). Most visits were brief, 61% lasting less than 1 min and 42% of these lasting 10 s or less.

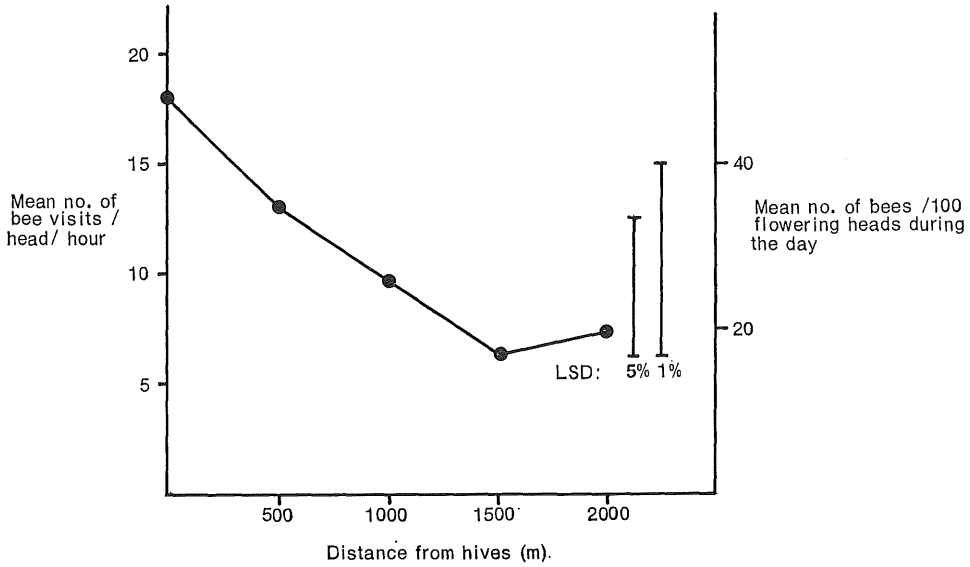

Figure 1. Effect of distance from hives on number of honeybee visits.

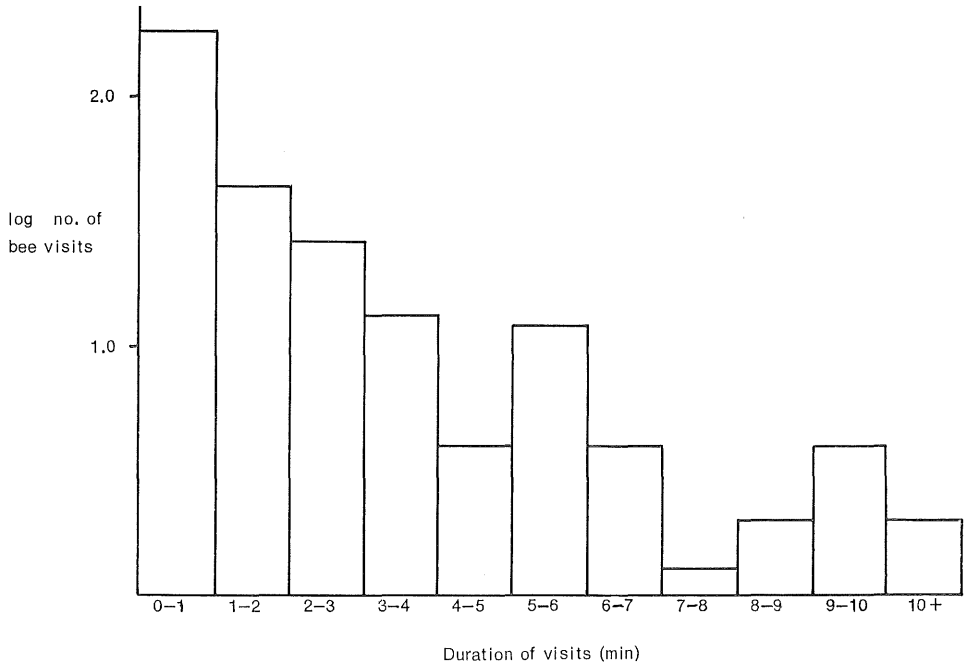

Figure 2. Frequency distribution of duration of individual honeybee visits to flowerheads.

Honeybee behaviour

Most bees were collecting nectar but some were collecting pollen. Both types worked constantly during visits, continually moving over the open florets.

Marked worker bees were seen throughout the crop and three were seen 2 000 m from their hives several hours after paint application.

Other insect visitors

Several insect species other than honeybees were seen on the flowerheads. Most were stationary or showed only limited movement (lepidopterous larvae, bugs and beetles). A few were collecting nectar and thereby disseminating pollen, but of these there were only four moths (*Heliothis armigera* (Hübner)), three hoverflies (Syrphidae) and two native bees (*Trigona* spp.).

Seed set in bagged and open heads

Seed set under bags did not alter with distance from the hives and averaged 10·7%. Seed set in open heads also did not alter with distance from the hives and averaged 100%.

IV. DISCUSSION

A low level of seed set in the bagged heads demonstrated a need for pollen vectors. Field observations revealed large populations of honeybees with a behavioural pattern ideally suited to the role of pollen vector. Although the majority of bees worked within 500 m of the hive, as reported by Grout (1966), there were sufficient bees 2 000 m from the hives to pollinate all florets.

Observations indicated, however, that there were significant numbers of feral honeybees on the crop and that these bees flew at least 4 km to reach the crop. Marked hive bees flew 2 km despite the hindrance of the paint to flight. These long flight distances could have resulted from the lack of alternative flora, the small area of crop and ambient conditions conducive to honeybee flight (Eckert and Shaw 1960).

It is not established whether such feral honeybee colonies can provide a long term stable bee population for sunflower pollination on the Darling Downs. Bee mortality due to pesticide application would have to be offset by generally adequate sources of nectar and pollen throughout the year.

Insect species other than honeybees could have marginally supplemented the pollinating activity of the honeybees. Those showing only limited movement cannot be counted as pollinators (Faegri and van der Pijl 1966). The presence during the day of such predominantly nocturnal insects as moths suggests that they could have made a contribution to pollination at night.

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