Competition for nectar between Argentine ants (*Iridomyrmex humilis*) and honeybees (*Apis mellifera*) on black ironbark (*Eucalyptus sideroxylon*)

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Black ironbark trees secrete nectar during the night. Argentine ants collected 42% of the nectar before honeybees started foraging in the morning.

Swartysterbasbome skei nektar snags af. Argentynse miere het 42% van die nektar versamel voordat heuningbye in die oggend begin wei het.

In a survey on the status of the nectar fly (*Drosophila flavohirta*) as a nectar competitor (Buys 1983), it was suggested that Argentine ants were major nectar competitors with honeybees. If this were so, they could be a limiting factor in honey production and detrimental to beekeeping. In the interests of beekeeping, this matter needs to be clarified. In early April, 1984, an exploratory study was made of ants and bees foraging on a young black ironbark tree in Stellenbosch.

To measure the amount of nectar secreted by black ironbark flowers, two branches were covered with muslin sleeves to exclude bees, and the bases of these branches were banded with a sticky ant barrier to exclude ants. As the proprietary brand of ant barrier used did not repel ants, it was treated with a soapy Bouin's fluid solution to overcome this problem. The open flowers on the branches were periodically inspected for the presence of nectar. Nectar was collected in capillary tubes 75 mm long with an inner diameter of 1,15 mm. The sugar concentration of the nectar was determined with a hand-held refractometer.

Foraging activity at various times of the day was measured on two open branches by (i) counting the number of bees visiting the branches and the number of flowers they visited, and (ii) counting the number of ants leaving the branches. For the limited scope of this study, the actual number of flowers visited by ants was not recorded. Data for bees and ants were each based on three 3-min counts spaced 5 min apart.

The nectar capacity of the ants was estimated by weighing replete and empty individuals, and converting the load to volume, after having determined the specific gravity of the nectar.

To measure nectar collection by bees and ants separately, ants and bees were each excluded from two branches by banding and sleeving respectively. The branches were periodically inspected until the nectar in the flowers had been depleted by foragers.

The amount of nectar collected by ants during the night was estimated from the difference at sunrise in the amount of nectar in the non-foraged and open-foraged flowers. The two branches with open-foraged flowers had to be protected from foraging bees 30 min before sunrise.

The secretion of nectar was assessed following on the observation times listed in Table 1.

Only at sunrise could appreciable amounts of nectar be collected with the method used. The average yield per flower was then 25,02 mm^3 nectar (data from 165 flowers) with an average sugar concentration of 11,8% (10 nectar samples). There was a substantial variation in the amount of nectar secreted by different flowers which is probably related to their stage of maturity. Nectar secretion at other times was scant, for instance, the average yield per flower for the period of sunrise until noon was only 0,77 mm^3 (165 flowers). Nectar was therefore mainly secreted between midnight and sunrise. From sunrise until late afternoon the sugar concentration in the nectar rose gradually from 11,8 to 24,2%.

The bees collected nectar from 30 min before sunrise until 20 min after sunset, whereas the ants foraged continuously. Data on the foraging activity of bees and ants are summarized in Table 1. The ratio of foraging bees to ants was about 1 to 6,5. Ant activity decreased considerably during late afternoon, probably indicating a shortage of nectar. Similarly, the number of foraging bees decreased, but each bee visited more flowers. The sustained foraging activity of the bees throughout the day, on what must have become a very restricted amount of nectar, can be explained by the fact that black ironbark was the only known source of nectar in the area.

Although nectar secretion at 00h00 could not in practice be demonstrated with the technique employed, the intensity of ant-foraging activity indicated that secretion had started by this time. At 00h00 15,66 ants per minute returned from 100 flowers. The nectar load of an ant was estimated to be 0,26 mg or 0,23 mm^3 (weight of 93 replete ants and 251 empty ones) so that they could collect 3,60 mm^3 nectar per minute, or 60% of the 2 502 mm^3 nectar secreted from midnight until sunrise. Similarly, at the 06h30 foraging rate, ants could collect 2,44 mm^3 nectar per minute, or 41% of the nectar.

At sunrise the amount of nectar left by foraging ants was found to be 1 333 mm^3 per 100 flowers. The ants had therefore collected 47% of the available nectar with an average effective collecting rate of 2,78 mm^3 nectar per minute. The collecting rate is in reasonable agreement with the rate previously estimated from foraging activity. This implies that *I. humilis* is a highly effective forager.

The 47% of available nectar collected by ants was based on night foraging until sunrise. However, bees started foraging half an hour before sunrise, so that the period in which ants foraged without competition from bees was shorter. Adjusting for this, Argentine ants would have collected about 42% of the nectar before bees started foraging.

Unfortunately, the branches on which ants only were permitted to forage did not indicate the time required by ants to deplete the total amount of nectar. Although ant foraging on these branches seemed normal during the night, the enclosing muslin sleeves had an obvious repellent effect on foraging ants in daylight. Nectar in the flowers remained abundant throughout the day. At maximum observed foraging rates and efficiency on open branches, ants alone would theoretically require almost 5 h to deplete the day-time residue of nectar in the flowers.

On the open branches just after 06h30, bees visited 3,93% of the flowers per minute (see Table 1). At this rate the bees could cover all the flowers in 25 min, collecting nectar at the rate of 52,37 mm^3 per minute.

However, examination of the residual nectar in flowers showed that bees took far longer to collect the nectar than is suggested by this estimate. Bees collected virtually all the nectar on ant-excluded branches $3\frac{1}{2}$ h after they had begun foraging. This gave an average nectar collecting rate of

Table 1 Experimental conditions, and data on the foraging of Argentine ants and honeybees on black ironbark. (Data converted for 100 flowers per min)

Conditions		Number of foragers		Number of flower visits	Number of flower visits per bee	Number of flowers observed
Time[a]	00h00					
Temp[b]	17°C	Bees:	–	–	–	–
RH[c]	100%	Ants:	15,66	–	–	110
Nectar[d]	–					
Time[e]	06h30					
Temp	16°C	Bees:	2,00	3,93	1,97	167
RH	100%	Ants:	10,59	–	–	127
Nectar	11,8%					
Time	10h30					
Temp	28°C	Bees:	2,93	5,92	2,02	167
RH	55%	Ants:	19,26	–	–	90
Nectar	16,4%					
Time	12h00					
Temp	30°C	Bees:	2,66	6,25	2,35	167
RH	50%	Ants:	20,62	–	–	90
Nectar	22,4%					
Time	15h30					
Temp	26°C	Bees:	1,91	5,59	2,93	169
RH	50%	Ants:	8,18	–	–	110
Nectar	24,2%					
Time[f]	18h40					
Temp	22°C	Bees:	0,91	4,47	4,89	164
RH	82%	Ants:	9,19	–	–	110
Nectar	–					

[a]Observations made within the 30 minutes following; [b]Temperature; [c]Relative humidity; [d]Sugar concentration of nectar; [e]Sunrise at 07h01; [f]Sunset at 18h37

11,91 mm^3 per minute. Unlike ant activity, the data on bee-foraging activity gave no indication of the amount of nectar that was being collected. The duration of bee visits to the flowers could possibly be more closely related to the amount of nectar collected.

The disparity between estimates of the nectar-collecting rate of bees, based on flower visits on the one hand and the time to deplete the nectar on the other, suggests that the nectar-collecting efficiency of bees is non-uniform. According to H.R. Hepburn (Dept. Entomology, Rhodes University, Grahamstown; pers. comm.) the average nectar load of an African bee is 47 mm^3. As the Cape bee is similar in size, this figure could be applied to the Cape bee as well. Compared with the 0,23 mm^3 capacity of the Argentine ant, the bee would be more efficient in collecting the larger volumes of nectar that were available in the early morning. The efficiency of nectar collection would then decrease as the source was gradually depleted until it eventually became little more than searching behaviour. Ants, by virtue of their numbers, would cover the flowers more uniformly. They would still retain their nectar-collecting efficiency even when the amount of nectar had greatly been depleted by the bees later in the morning. Ant competition would then be enhanced as the concentration of sugars in the nectar increased gradually during the day. Although the available data agree with the suggested manner of daytime nectar exploitation by bees and ants, they do not quantify competition adequately.

The results from this study confirm that the Argentine ant can be a serious competitor with the honeybee for nectar. The ant has a competitive advantage by being able to forage at night, when nectar secretion in many nectariferous plants takes place. Ants can then remove a substantial amount of the nectar before bees start foraging in the morning. The data suggest that during daytime bees are efficient in collecting the bulk of the residual nectar. It is suggested that when the nectar reaches a low level, ants regain their competitive position by their more even coverage of the source and the gradual increase in sugar concentration of the nectar.

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Reference

BUYS, B. 1983. *Drosophila flavohirta* a minor nectar competitor with honeybees in the Western Cape. *S. Afr. Bee J.* 55(6): 129.