7. OTHER PLANTS AS COMPETITIVE NECTAR AND POLLEN SOURCES

7.1. INTRODUCTION

Although individual honeybees are flower-constant (oligolectic), it is seldom found that all foragers from a single colony will utilize the same nectar and / or pollen source (Hurd et al., 1980). It is therefore accepted that a certain percentage of foragers will explore other sources as well, even where colonies are adjacent to large plantings of a reliable and easily accessible food source such as sunflower.

Little is known about the role of surrounding vegetation as competitive nectar and / or pollen sources to sunflower. Weeds and / or other commercial crops within the vicinity of hives could attract honeybees and solitary bees in such numbers that the pollination of the target crop is drastically reduced. Competing nectar and / or pollen sources were mentioned by various researchers as one of the factors influencing the ability of honeybees to pollinate the target crop without, however, giving details (Benedek et al., 1972; Kleinschmidt and Harden, 1983; Krause and Wilson, 1981). Palmer-Jones and Forster (1974) reported hawkbit (Leontodon hispidus L.) and thistle (Cirsium arvense L.) as heavy competitors in New Zealand, though only localised.

To be regarded as a competitor, a plant must co-exist in the same locality and flower at the same time as the plant that it is competing with for pollinating insects. The competitors must also have pollen and / or nectar available as reward to the anthophilous insects. Competitors can attract anthophilous insects from the target crop at specific times of the day depending when nectar and / or pollen is available. In commercial sunflower, where pollen is shed early in the morning and the majority of nectar secreted before noon, plants attracting honeybees and solitary bees during this period, can be regarded as direct competitors. Afternoon competitors can be predicted to be of lesser consequence.

A plant's competitive status can be determined only by taking both the abundance of the plant and the number of pollinators that it attracts into account.

7.2. MATERIAL AND METHODS

Observations on honeybees and solitary bees at competitive plants

Observations on the abundance and diversity of pollinating insects on competitive nectar and pollen sources were conducted at Settlers, Pretoria and Hartbeesfontein during the sunflower bloom for 3 seasons (1985-1987). A general description of the areas is given in Chapter 3 (page 12).

Counts were made on plants surrounding the sunflower field where pollinator activity was observed. The same field record data sheet and methods described in Chapter 3 (p. 12) was used, with only a minor modification in the method of surveying. According to the type of plant involved, either the number of flowers per square meter was calculated and converted to a hundred flowers (as for plants such as the common 'dubbeltjie' and travellers' joy), or a linear route count was used, observing a hundred flowers (as for plants such as sage and sorghum). Data were recorded for each plant species, using table 1 (page 15).

To investigate nectar and pollen loads of honeybees foraging on competitive plants, foragers were caught in a ethyl acetate killing bottle. Honey stomachs were pulled out a tweezer. Nectar volume was determined, using the 1-5 scale developed by Johannsmeier (in press), while sugar concentrations were determined with an Atago 500 hand refractometer. Pollen baskets were investigated for pollen pollen or propolis loads.

A numeric nectar and pollen value was designated according to Anderson et al. (1983), to those competitors where enough data was recorded. This value is influenced by many factors such as quantity and quality of nectar and pollen, weather conditions and the reliability of the source Johannsmeier (in press).

Pollen trapping

An O.A.C.-type pollen trap was fixed onto a honeybee hive during three consecutive sunflower seasons (1985-1987) in Settlers (fig. 27). The pollen pellets trapped from the hive were sorted according to colour, size and texture. Pellets from each group was dissolve in water and grains mounted in glycerine jelly or as semi-permanent water mounts. Pollen grains were identified with a dissecting microscope.

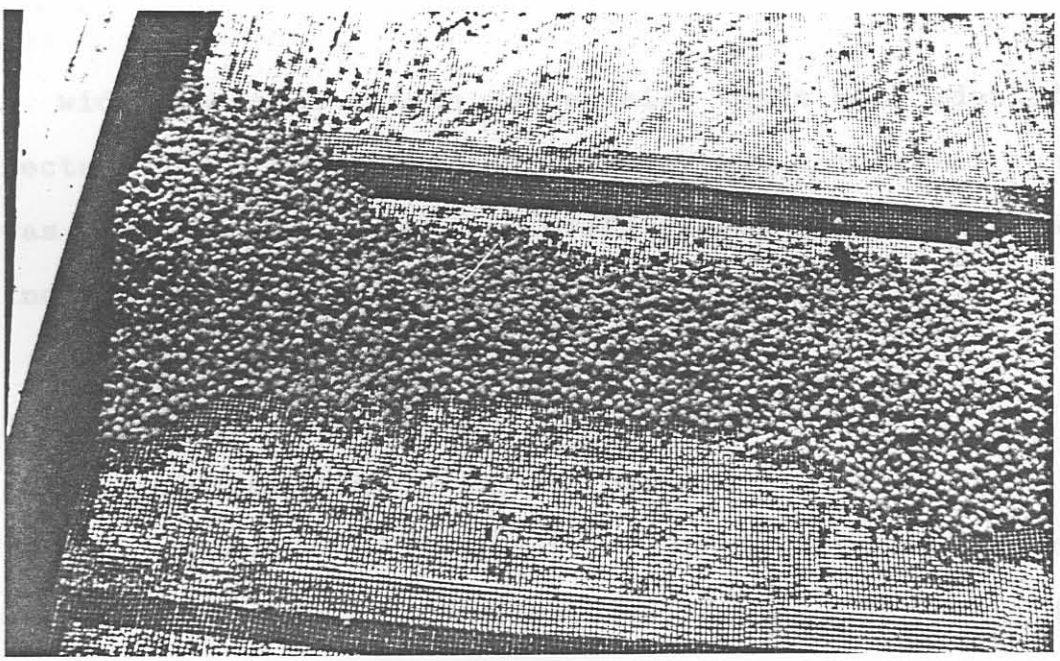

Fig. 27. Pollen pellets trapped by the O.A.C.-type pollen trap.

Mellissopalynology

A sample of 'pure' sunflower honey obtained in cleaned supers at Settlers in 1987, was analysed. The floral origin of the honey was determined by identifying and counting the pollen grains present in the honey with a dissecting microscope. A sample of honey was diluted in water and centrifuged. A permanent, glycerine jelly mounted pollen slide was made from the pollen sediment after staining with basic fuchsin in alcohol.

7.3. RESULTS

A wide range of plants, especially weeds were identified as nectar and / or pollen competitors when commercial sunflower was the target crop (table 17). These plants are discussed individually.

Amaranthus hybridus L. and A. thunbergii Moq. (Amaranthaceae) Common and red pigweed

These pigweeds are commonly found in commercial sunflower fields. Only one honeybee was seen to collect pollen from A. hybridus during the period of observations at Settlers. No other records of honeybee visits to this weed are known. A. thunbergii pollen was identified from two of thirteen pollen trap samples, though in a very low quantities (less than 0,2%).

Bidens bipinnata L. (Asteraceae) Spanish black jack

Scattered individuals of this annual weed was found adjacent to experimental sunflower plots at Pretoria. Honeybees as well as solitary bees were observed to visit this weed for both nectar and pollen. No other observations were recorded.

Bidens pilosa L. (Asteraceae) Common black jack

Of the two species of black jack this is the more common one. It is nevertheless rarely noticed in commercial sunflower fields, being more common in the surrounding pastures or along roadsides. Two surveys on small 5x20m plots adjacent to sunflower plots of the same size were conducted during 1985 at Pretoria.

Medium to major activity of honeybees was observed before noon (34-44 honeybees / 100 capitula). Eighteen honeybees were each examined for nectar and pollen loads. Only four had nectar crops of size 3 and larger. Mean sugar concentration of the nectar was 27%. Fifteen foragers had pollen loads ranging in size from 1-5. Pollen pellets were of an orange-brown to light-brown colour. Bidens spp. is assigned a N2P2 value by Anderson, et al. (1983), which is confirmed by these limited observations.

Solitary bees of the Family Halictidae, which included the Subfamilies Halictinae and Nomiinae, occurred in numbers of 2-6 / 100 capitula. Other insects found included snout

TABLE 17. COMPETITIVE NECTAR AND POLLEN SOURCES AT SETTLERS, PRETORIA AND HARTBEESFONTEIN, 1985-1987.

Plant species	Settl.	Pta.	Htbfn.
Amaranthaceae			
Amaranthus hybridus (Common pigweed)	X		
Amaranthus thunbergii (Red pigweed)	X		
Asteraceae			
Bidens bipinnata (Spanish black jack)		X	
Bidens pilosa (Common black jack)	X	X	
Flaveria bidentis (Smelter's bush)	X		
Tagetes minuta (Khaki weed)	X	X	X
Xanthium strumaruim (Large cocklebur)	X		
Capparidaceae			
Cleome monophylla (Single-leaved cleome)		X	
Fabaceae			
Sesbania bispinosa (Spiny sesbania)	X		
Lamiaceae			
Salvia reflexa (Sage)	X		
Malvaceae			
Hibiscus cannabinus (Stockrose)	X		
Hibiscus trionum (Bladderweed)	X		
Myrtaceae			
Eucalyptus spp. (Eucalypts)	X	X	X
Poaceae			
grasses	X	X	X
Sorghum vulgare (Grain sorghum)	X		
Zea mays (Maize)		X	
Polygonaceae			
Fagopyrum esculentum (Buckwheat)		X	
Ranunculaceae			
Clematis oweniae (Traveller's joy)	X		
Zygophyllaceae			
Tribulus terrestris (Common 'dubbeltjie')	X		

beetles (Curculionidae), yellow bee pirates Philanthus diadema F. (Sphecidae), other sphecid wasps and bee flies (Bombyliidae).

Of the mean total of 54 insects / 100 capitula, honeybees represented 72%, solitary bees 19% and other insects 9%.

Clematis oweniae Harv. (Ranunculaceae) Traveller's joy

This is an indigenous climber found closely associated with trees such as acacias as supports. It is also commonly found along roadside fences in the Springbok Flats. Five surveys of insects visiting this plant were done at Settlers during the 1985 and 1986 seasons.

Minor to medium honeybee activity was recorded before noon, with no activity in the afternoon. Honeybee numbers ranged between 3 - 20 / 100 flowers. Twenty-four foragers were investigated for nectar or pollen loads. All crop sizes were in the order of 0-2, indicating that this plant is not a source of nectar for honeybees. All foragers had light lemon coloured pollen loads, ranging in size from 2-5. Very minor honeybee activity was observed directly after a rain shower. This plant is assigned a P2 value.

No solitary bees were observed to visit traveller's joy. Other insects included net-winged beetles (Lycidae), flies (Diptera) and African humming moths, Macroglossum trochilus

Hübner (Sphingidae).

The mean total insects on a hundred flowers was 50. Honeybees represented 86% of flower visitors.

Clematis pollen was present in six samples from a total of thirteen pollen trap samples from Settlers (table 18). The frequency ranged between 0,1 - 6,8% with a mean of 1,4%. In pollen analyses of sunflower honey from Settlers, Clematis represented only 0,3% of 636 pollen grains (table 19).

Cleome monophylla L. (Capparidaceae) Single-leaved cleome

Two surveys were done on two small plots (5 x 20m) adjacent to sunflower plots of similar size at University of Pretoria Experimental Farm during 1985.

Minor to medium honeybee activity was observed before noon with no activity after noon. Honeybee frequency ranged from 4-12 honeybees / 100 flowers. Of nine honeybees that were sampled, only one had a medium-sized crop (size 3) with a sugar concentration of 41%. All honeybees carried a khaki to light brown pollen (size range 2-4). A N1?P2 value is given to Cleome.

TABLE 18. POLLEN TRAP ANALYSIS OF POLLEN TRAPPED FROM A HIVE ADJACENT TO COMMERCIAL SUNFLOWER FIELDS AT SETTLERS, 1985-87

Date	Number pellets examined	Sunflower %	Grasses %	Other %
1985: (Yura farm)				
1985-03-15	891	96,3	3,7	0
1985-03-20	1708	72,7	27,2	0,1
1985-03-22	812	78,3	20,8	0,9
1985-03-27	1407	65,7	34,1	0,2
1986: (Yura farm)				
1986-03-20	1786	91,6	7,9	0,5
1986-03-24	1529	95,5	4,0	0,5
1986-04-02	1607	99,3	0,5	0,2
1986-04-11	613	96,6	3,4	0
1987: (Semmelink farm)				
1987-02-23	1414	79,0	20,5	0,5
1987-03-02	1513	83,0	16,4	0,6
1987-03-09	817	67,0	16,8	16,2
1987-03-16	1736	90,5	1,6	6,9
1987-03-31	1449	81,6	0,4	18,0

The frequency and diversity of solitary bees were relatively high, compared to their numbers on sunflower (table 19). The following species were recorded:

Halictidae:	Zonalictus sp.	2-10 / 100 flowers
	Lasioglossum (2 spp.)	2-4 / 100 flowers
	Nomiinae (2 spp.)	4-8 / 100 flowers
Anthophoridae:	Anthophora sp.	2 / 100 flowers

Other insects include sphecid wasps (Sphecidae) and hover flies (Syrphidae).

The mean total of insects on single-leaved cleome was 34 / 100 flowers. Honeybees represented only 24% of the total insect population, with solitary bees 64% and other insects 12% (table 20).

Eucalyptus species (Myrtaceae) Eucalypts

Eucalypts are major nectar and pollen competitors where they flower at the same time as sunflower. Eucalypts with a flowering period overlapping that of commercial sunflower on the Highveld include E. camaldulensis (N3P3), E. viminalis (N2P2) and to a lesser extent E. sideroxylon (N4) and E. melliodora (N4). Eucalypts are commonly seen on Highveld farms as wind shelters or shade trees. During the investigations, only E. sideroxylon was flowering in 1986 during the sunflower bloom in Settlers. Eucalypts in general are considered exceptionally good beeplants (Anderson et al. 1983), and honeybees are known to forsake other forage.

TABLE 19. POLLEN ANALYSIS OF A 'PURE' SETTLERS SUNFLOWER HONEY, APRIL 1987.

n=636

61,6% Helianthus.

16,3% Eucalyptus. Small grains: sizes 1 and 1(-). Larger grains punctate.

4,7% Xanthium.

3,9% Poaceae. Size 3.

2,5% Liliaceae. Similar to Aloe.

2,3% Papilionaceae? Size 2, subprolate, 3-colporate. Thick exine heavily reticulated away from colpi. Faint cross-pori.

1,4% Unknown. Size 2(+), oval in equatorial view and round in polar view, 3-colporate. Colpi long. Pori +/- square. Exine finely punctuate. Contents sometimes granular. Tiliaceae?

1,4% Unknown. Size 2, irregularly-shaped, thin clear exine. Long sunken colpi. Pseudocolpi? 3-colporate.

1,3% Unknown. Size 1, subprolate, 3-colporate. Thin exine. Long colpi.

0,9% Unknown. Size 1, T. repens habitus, 3-colporate. Exine medium and punctuate.

0,8% Unknown. Size 2(+), irregularly round, 3-porate? Exine thick and smooth.

0,6% Sorghum. Size 4.

0,6% Zea. Size 5.

0,5% Tribulus.

0,3% Unknown. Size 2, angulaperturate, 3-colporate. Exine medium, finely punctate, finely striate in OS. Colpi 3/4 to poles, with centre 'ridge'.

0,3% Clematis. Granular colpi.

0,3% Acacia. With furrows, 16 cells.

0,2% Campanulaceae? Size 3(-), round, 3-porate. Thick smooth exine. Pori globular.

0,2% Acanthaceae. Ruellia type. Size 3-4, round, 5-porate? Fine puncti within reticules.

Honey extracted from three 'clean' supers. A golden honey (61mm Pfund) of medium density (18,6% moisture). Soft, fine, beige-coloured granulation. Bland sweet taste.

TABLE 20. PERCENTAGE FREQUENCY OF SOME ANTHOPHILOUS INSECTS TO COMPETITIVE NECTAR AND POLLEN SOURCES IN RELATION TO SUNFLOWER AT SETTLERS, PRETORIA AND HARTBEESFONTEIN, 1985-1987.

Plant species	Number of insects / 100 flowers	Frequency of insects %		
		honeybees	solitary bees	all other insects
Helianthus annuus *1	45	72	0,6	27,4
Helianthus annuus *2	147	90	1	9
Helianthus annuus *3	64	47	1	52
Bidens pilosa	54	72	19	9
Clematis oweniae	50	86	0	14
Fagopyrum esculentum	14	57	7	36
Flaveria bidentis	12	25	33	42
Salvia reflexa	7	57	14	29

*1 as recorded at Settlers (Table 2-1)

*2 as recorded at Pretoria (Table 2-2)

*3 as recorded at Hartbeesfontein (Table 2-3)

No Eucalyptus pollen was present in any of thirteen pollen trap samples from Settlers. In the pollen analysis of a sunflower honey, Eucalyptus however comprised 16.3% of 636 pollen grains (table 18).

Fagopyrum esculentum Moench. (Polygonaceae) Buckwheat

Two surveys were conducted on this crop during 1986, on 5 x 20m plots next to similar sunflower plots at the University of Pretoria Experimental Farm.

Minor to medium honeybee activity was observed in the morning. Foragers ranged from 4-13 / 100 flowers. Both nectar and pollen were collected. Nectar and pollen loads were not evaluated. Buckwheat is rated by Anderson et al. (1983) as a major foraging source for honeybees (N4P2).

During the period surveyed, only one solitary halictid bee was observed to visit buckwheat flowers. Other insects included spotted maize beetle and yellow bee pirates. The mean total insects on buckwheat was 14 insects / 100 flowers. Honeybees accounted for 57%, solitary bees for 7% and other insects for 36% of the total flower visitors (table 20.)

Flaveria bidentis L. (Asteraceae) Smelter's bush

This is an uncommon weed on disturbed soil around ploughed fields, but is more commonly seen along roadsides. Two surveys were undertaken during 1985 at Settlers. Minor honeybee activity was detected in the morning (2-3 honeybees / 100 capitula). Of three honeybees examined, all had orange pollen in their baskets, pellets ranging in size from 2-4. Foragers had no noticeable nectar crops. Smelter's bush is rated on this limited observations as a N0?P1? pollen plant. No activity was observed after rain.

The frequency of solitary bees on smelter's bush was low, 1-3 / 100 capitula, though the diversity was relatively high. Three genera of the Family Halictidae were recorded from this weed, namely Lasioglossum sp., Sphecodes sp. and Halictus sp. Other insects included net-winged beetles (Lycidae); masarid wasps (Masaridae); paper wasps Belanogaster sp. (Vespidae); yellow bee pirate Philanthus diadema F. (Sphecidae); house flies (Muscidae); bee flies Lomatia sp. (Bombyliidae); African humming moths Macroglossum trochilus Hübner (Sphingidae).

The mean total of insects per hundred capitula was twelve. Honeybees comprised 25%, solitary bees 33% and other insects 42% of the total number of anthophilous insects (table 20).

Grasses (Poaceae)

Other than natural pastures, these also included weeds such as Urochloa panicoides Beauv. (herringbone grass); Cynodon dactylon (L.) Pers. (common couch) and Paspalum notatum Flügge (lawn paspalum). Minor to medium solitary bee activity was observed on all three species at the University of Pretoria Experimental Farm, while honeybees were only seen on the last mentioned. Foraging activity was restricted to early morning when, pollen was collected. No observations were made in the natural pastures.

Grass pollen was present in all of the thirteen pollen trap samples from Settlers. It ranged in frequency from 0,4 - 34,1% with a mean of 12,1%. Pollen pellets from the various grass species differ in colour, being from brown to green. A P3 pollen value is given to grasses based on pollen trapping in Settlers (table 18). Anderson et al. (1983) rated grasses as P1-3.

Although grasses are a pollen source only, they nevertheless comprised a relatively high 3,9% of 636 pollen grains from a Settlers sunflower honey gathered during the period 1987-02-10 to 1987-03-30.

Hibiscus cannabinus L. and H. trionum L. (Malvaceae)

These two annual weed species occur at Settlers in disturbed soil surrounding commercial sunflower fields. During several

observations no honeybee or solitary bee activity was noted on their flowers.

Hibiscus pollen was nevertheless present in two of the thirteen samples from Settlers. It comprised a minor part of the total pollen pellets, occurring in quantities of 0,1 and 0,4% respectively, with a mean of 0,25%.

Salvia reflexa (Lamiaceae) Sage

This is an indigenous perennial that occurs commonly as part of the natural vegetation in grass veld. Four surveys were done at Settlers during 1985 and 1986.

Minor honeybee activity was observed throughout the day. Honeybees ranged from 3-6 / 100 flowers. Of the eight honeybees examined, all had crop sizes of 2 and smaller. All honeybees had yellowish pollen loads with sizes of between 2-4. No activity was observed directly after rain. Sage is designated a N0?P1 value based on these observations.

Solitary bees of the Families Halictidae and Anthophoridae were recorded as visiting the flowers. Other insects recorded included hover flies (Syrphidae), butterflies and African humming moths (Sphingidae). The mean total number of floral visitors was 7 / 100 flowers. Honeybees comprised 57%, solitary bees 14% and other insects 29% of the insect visitors (table 20).

Sesbania bispinosa (Jacq.) W.F. Wight (Fabaceae) Spiny sesbania

No honeybees had been observed on this weed of disturbed soil and roadsides during the three seasons of 1985 to 1987. Solitary bees of the Family Anthophoridae, genera Anthophora and Tetralonia, were more commonly observed on this weed than on commercial sunflowers. Bees of these genera are large and capable of opening the sesbania calyx to reach the protected nectar.

Sorghum vulgare L. (Poaceae) Grain sorghum

Two surveys were carried out at Settlers during March 1986 on sorghum regrowth, adjacent to sunflower fields.

Minor to medium activity of 2-14 honeybees / 100 sorghum ears was observed very early in the morning, before 08h00. At this time no honeybee activity was recorded on the adjacent sunflower. Honeybees collected a straw-yellow coloured pollen from the ears. At 10h00 only one honeybee was observed on all of the sorghum. Sorghum is a known source of aphid honeydew honey, when aphids are present in large numbers on the sorghum. No honeydew foraging was observed, as the aphid populations were probable to low. No visible honeydew could be seen. Sorghum is given a P2 value based on these observations.

Two halictid bees / 100 ears were collecting pollen.

A 'pure' sunflower honey sample from Settlers contained 0,45% sorghum pollen (n = 636) (table 19).

Tagetes minuta L. (Asteraceae) Khaki weed

Very minor activity of honeybees was observed on khaki weed capitula in Settlers, Pretoria and Hartbeesfontein during the seasons of 1985 to 1987. The main flowering period of this annual weed is usually after the sunflower bloom. Major activity of yellow bee pirates was observed at Pretoria, where capitula were visited for nectar.

Tribulus terrestris L. (Zygophyllaceae) Common 'dubbeltjie'

Medium honeybee activity was observed at Pretoria and Settlers early in the morning during the three seasons of 1985 to 1987. Both nectar and pollen were collected. Flowers closed by 11h00 in sunny weather, bringing honeybee activity on these flowers to a halt.

Solitary bees of the Family Halictidae were found on flowers of this weed, gathering nectar and pollen. These bees were not recorded on sunflower.

Tribulus comprised 0,5% of 636 pollen grains from a Settlers sunflower honey (table 18).

Xanthium strumarium L. (Asteraceae) Large cocklebur

Large cocklebur pollen was present in three of thirteen pollen trap samples, all from the same locality, viz. Semmelink farm in Settlers, during 1987. It ranged from 0,8 to 12,2%, with a mean of 5,7%. In a pollen analysis of a sunflower honey from the same locality, this pollen comprised 4,7% of 636 pollen grains. No records of honeybee activity on the plants were encountered. According to Johannsmeier (personal communication, 1988) this pollen is collected early in the morning in Pretoria.

Zea mays L. (Poaceae) Maize

Maize pollen was present in a sunflower honey sample obtained from Settlers in 1987 in a very small quantity (0,6% of 636 pollen grains). In Settlers the main maize pollen shed was prior to the sunflower bloom during the seasons 1985-1987. In Pretoria major pollen gathering activity was observed during 1986 and 1987 on experimental maize plots of ca. 10 hectare in total, adjacent to experimental sunflower plots of ca. 2 hectare. According to Anderson et al. (1983) maize has a P4 pollen value.

7.4. DISCUSSION

Pollen trapping during the three seasons of 1985, 1986 and 1987 produced fifteen pollen sources in the Settlers area. The origin of five of these is still unknown. Pellets

consisting of propolis (bee glue) and fungal spores were also found. Sunflower pollen was the predominant pollen in all of the thirteen pollen trap samples. It ranged in frequency from 67% - 99,3%. This indicates satisfactory visitation to commercial sunflower pollen gatherers, where adequate honeybees are present due to migrated hives.

Pollen trapping showed grasses to be a major pollen source at certain times during the sunflower bloom period. This was particularly noticeable about two weeks after good rains. Pollen sources other than sunflower and grasses contribute little to the total pollen trapped and can be regarded as insignificant. With the exception of three samples, the 'other' pollens contributed less than 1% of the total sampled (table 16). In the pollen sample of 1987-03-09, the 16,2% 'other' pollen pellets consisted of 12,2% Xanthium and 4,0% represented by six species of minor importance. The 1987-03-16 sample was made up of seven minor pollen sources and propolis, totalling 6,9% of all pellets. Clematis (6,8%) and Xanthium (4,6%) were the major pollen sources, excluding Helianthus in the third sample of 1987-03-31. A further eight 'other' sources contributed to the (6,6%) (table 18).

Johannsmeier (personal communication, 1988) found maize to be the second most important pollen source after sunflower at Settlers (1984) and Moloto (1985 and 1986). This could only have been as a result of sunflower and maize plantings

in close proximity, with pollens available during the same period. No maize pollen was found in pollen traps at Settlers during the period studied (table 18) and Moloto during 1987 (Johannsmeier, personal communication, 1988). Kleinschmidt (1986) working in Australia, found maize to be a major pollen competitor to sunflower.

Mellissopalynology of a 'pure' sunflower honey from Settlers, 1987 (table 19) revealed that nineteen plant species were represented in the honey. Ten of these could not be identified. Sunflower contributed 61,6%, an Eucalyptus sp. 16,3%, Xanthium 4,7%, grasses 3,9% and all other species less than 3%.

In an April 1983 sunflower honey from Settlers, sunflower represented 96% of the pollen, grasses 2% and four different weeds a combined total of 2% (Johannsmeier, 1984). The relatively high content of grass pollen (Settlers, April 1987: 3,9% and Settlers, April 1983: 2,0%) in the honey is of interest as grasses are not sources of nectar . Maize and sorghum, which are pollen sources only, each contributed 0,6% to the pollen in the 1987 honey sample. Pollen, from these exclusively pollen producing plants, are believed to be incorporated into honey by either pollen foragers that switch to nectar foraging or by contamination inside the hive. Pollen foragers switch readily to nectar gathering when pollen is no longer available. Foragers, inside the

hive, have regular contact with one another resulting in direct exchange of pollen on the setae, but also through grooming.

Observations on the abundance of weeds, natural vegetation and other crops surrounding commercial sunflower fields in the Transvaal, together with the frequency of honeybee and solitary bee activity on these plants, indicated that only a very few plant species can be regarded as competitors of any consequence. The status of all competitive nectar and pollen sources is determined by their abundance, time of flowering, climatic conditions and attractiveness to honeybees and solitary bees.

The more important competitors identified in this study were grasses, maize, eucalypts, traveller's joy and large cocklebur. Though weeds are of lesser importance as forage for honeybees, they could be important nectar and pollen sources to especially the short-tongued Halictid bees, judging by their frequency of occurrence (table 19). Even long-tongued anthophorid bees might prefer a source such as spiny sesbania, to sunflower. In Settlers, no weed control would be recommended or necessary during sunflower bloom other than mowing of the vegetation in the immediate vicinity of sunflower.