13. APPENDIX A. CHECK LIST OF ANTHOPHILOUS INSECTS FOUND ON SUNFLOWER (<u>HELIANTHUS ANNUUS</u>)

Species	Settlers	Pretoria	Hartbeesfontein
ORTHOPTERA			
Tettigoniidae	(1 sp.)	-	-
Acridoidea	1 sp.	1 sp.	-
PHASMATODEA			
Phasmatidae	(1 sp.)	-	-
MANTODEA	-	1 sp.	-
HEMIPTERA			
Reduviidae	-	-	1 sp.
Coreidae	1 sp.	1 sp.	-
Pyrrhocoridae	1 sp.	-	1 sp.
Lygaidae	2 spp.	2 spp.	2 spp.
Cercopidae	1 sp.	-	-
Cicadellidae	2 spp.	1 sp.	2 spp.
Aphididae	-	1 sp.	-
NEUROPTERA			
Chrysopidae	1 sp.	-	-
COLEOPTERA			
Scarabaeidae:			
Cetoniinae	1 sp.	1 sp.	1 sp.
Lycidae	-	1 sp.	-
Melyridae:			
<u>Astylus</u> <u>atromaculatus</u>	1 sp.	1 sp.	1 sp.

	Settlers	Pretoria	Hartbeesfontein
COLEOPTERA (Continue)			
Coccinellidae	-	1 sp.	-
Tenebrionidae:			
Lagriinae	1 sp.	-	-
Meloidae	1 sp.	-	1 sp.
Anthicidae	1 sp.	-	-
Chrysomelidae:			
Alticinae	1 sp.	-	-
Bruchidae	2 spp.	-	-
DIPTERA			
Asilidae	-	-	-
Bombyliidae:			
Lomatia sp.	1 sp.	1 sp.	1 sp.
Syrphidae:			
Metasyrphus sp.	1 sp.	1 sp.	1 sp.
Eristalinus sp.	1 sp.	1 sp.	1 sp.
unidentified	2 spp.	2 spp.	1 sp.
Tephritidae	1 sp.	1 sp.	1 sp.
Anthomyidae:			
Anthomyia sp.	1 sp.	-	-
Muscidae	1 sp.	1 sp.	1 sp.
Calliphoridae:			
Rhinia sp.	1 sp.	1 sp.	-
unidentified	1 sp.	1 sp.	1 sp.
Tachinidae	-	1 sp.	1 sp.

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	Settlers	Pretoria	Hartbeesfontein
LEPIDOPTERA			
Pyralidae:			
Zinckenia fascialis	1 sp.*	-	-
Nymphalidae	2 spp.	1 sp.	1 sp.
Pieridae	2 spp.	1 sp.	-
Sphingidae:			
Macroglossum trochilus	-	1 sp.	1 sp.
unidentified	(2 spp.)	-	-
Arctiidae:			
Utetheisa pulchella	(1 sp.)	-	-
Noctuidae:			
Heliothus amigera	1 sp.*!	1 sp.~	1 sp.~
Agrotis segetum	(1 sp.)	-	-
Agrotis spinifera	(1 sp.)	-	-
Mythimna loreyi	(1 sp.)	-	-
Trichoplusia orichalcea	1 sp.~	-	-
HYMENOPTERA			
Chalcidoidea	-	1 sp.	-
Scoliidae	1 sp.	1 sp.	1 sp.
Pompilidae	-	1 sp.	-
Vespidae:			
Belanogaster sp.	-	1 sp.	-
Polistis sp.	-	1 sp.	1 sp.

	Settlers	Pretoria	Hartbeesfontein
Sphecidae			
Larrinae:			
Philanthus diadema	-	1 sp.	1 sp.
Sphecinae	1 sp.	2 spp.	1 sp.
Halictidae			
Halictinae:			
Halictus sp.	1 sp.	1 sp.	1 sp.
Lasioglossum spp.	2 spp.	2 spp.	2 spp.
Zonalictus sp.	-	1 sp.	-
Sphecodes sp.	1 sp.	-	-
Nominae	1 sp.	-	-
Megachilidae			
Megachile stellarum?	-	1 sp.	-
Creihtoniella sp.	-	1 sp.	-
Anthophoridae			
Anthophorinae:			
Anthophora mimadvena	1 sp.	1 sp.	1 sp.
Tetralonia braunsiana	1 sp.	-	-
Thyreus sp.	1 sp.	1 sp.	1 sp.
Xylocopinae:			
Allodapula sp.	-	1 sp.	1 sp.
Apidae			
Apis mellifera	1 sp.	1 sp.	1 sp.

	Settlers	Pretoria	Hartbeesfontein
Formicidae			
Myrmicinae:			
<u>Pheidole</u> <u>megacephala</u>	1 sp.	-	-
Formicinae:			
<u>Camponotus</u> spp.	2 spp.	-	-

( ) night visitors only   * day and night visitors

! adults and larvae   ~ larvae only

14. APPENDIX B:

Honeybees as pollinators of commercial sunflower

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The use of honeybees *(Apis mellifera),* as crop pollinators is well known. Researchers all agree that the honeybee must be considered the major pollinator of cultivated sunflower. Two reasons are given: firstly, honeybees are "domesticated" to some degree as they are kept in manageable hives which can be brought in for pollination at wish. Secondly, the areas planted with sunflower are usually well cultivated regions where agricultural activities have led to a reduction in the local solitary bee as well as honeybee populations.

Poor seedset is one of the major factors affecting the sunflower crop in South Africa. Seedset and yield is determined by the separate but vital processes of flowering initiation, pollination, fertilization and seed development. Factors which influence these processes include cultivar characteristics, climate, pollinating insects and plant nutrition.

Since 1983 South Africa has been dependant on imports of sunflower seed because of the drought and an increase in demand. This therefore requires an increase in production per unit area as well as an increase in the total area planted.

After a survey of insects visiting the commercial sunflower heads in the Springbok Flats (Transvaal) it was found that honeybees represented more than 70% of all anthophilous insects. Honeybees were active from 07h00 till dusk. Peak activity was reached between 09h00 and 11h00, though the average number of honeybees per hundred florets was always above 30 honeybees per 100 open heads. 24 - 30 honeybees per 100 heads is accepted by researchers overseas as the minimum number on sunflower. Both nectar and pollen was collected throughout the day. However most of the pollen and nectar was removed before noon. Crop size and pollen pellets decreased in size after noon.

Researchers and extension officers are always confronted with the question of hive stocking rate on sunflowers. To calculate the number of colonies needed for commercial sunflower pollination, various aspects must be kept in mind. The following reasoning could be followed, where a theoretical calculation is made to determine the number of hives needed to pollinate sunflower:

* Sunflowers planted at a density of 35 000 plants per hectare have an average of 1 800 seeds per head.
* Individual heads flower over a period of seven days.
* If it is assumed that all heads flower evenly over a period of seven days, then the number of florets that need pollination on each day will be 1 800 ÷ 7 per head.
* Researchers have determined that each floret must receive an average of 8 honeybee visits to ensure effective pollinatiion.
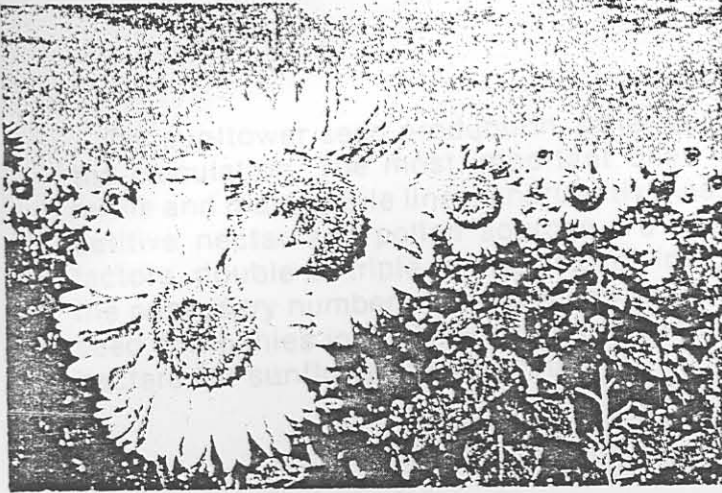
Sunflower must be regarded as one of the main target crops for members of the new association, POSA North.

★ It then follows that the average number of honeybee visits per head per day is (1 800 ÷ 7) x 8.

★ The average time of a single honeybee visit per floret was determined as 2.8 seconds.

★ The total time required per head per day is then (1 800 ÷ 7 x 2.8) x 8, or 1.6 hours of honeybee activity per head.

★ The total time of forager activity in a blooming sunflower field is on average 8 hours per day.

★ If 1.6 hours of honeybee activity per head per day is required to ensure effective pollination and foragers are active for an average of 8 hours per day, the percentage time that a single forager must spend on one head to pollinate that head effectively is 1.6 ÷ 8 x 100, or 20% of the available time.

★ If it is assumed that honeybees are distributed evenly in a field, then 20% of open flower heads, receptive for pollen, must be occupied with honeybees, in other words 20 honeybees per 100 heads are required.

★ As the calculation is based upon mean values, in practice it won't be unrealistic to boost the figure by 50%. A practical number would then be 30 honeybees per 100 receptive heads.

★ 30 honeybees per 100 heads represents 10 500 foragers per hectare at any given time at a plant density of 35 000 plants per hectare.

★ The average production-colony of African honeybees kept in hives, consists of an average of 50 000 honeybees.

★ On average 45% of the bees in a production colony are foragers. This implies that there are 22 500 field workers per hive. Theoretically, 50% of foragers are busy inside the hive unpacking their loads. There would thus be 11 250 field workers at a given time busy to explore florets for food.

★ The 10 500 field workers required for adequate pollination is nearly equal to the 11 250 available foragers per hive. According to these calculations an estimated one production colony per hectare is required for adequate pollination of commercial sunflower.

Beekeepers that utilize commercial sunflower as a honey source, usually place one hive per hectare during normal production years while the number of hives may be less during drought seasons.

For sunflower seed production, other sets of factors strongly influence the calculation. The most important ones would be the separated male-fertile and male-sterile lines, unattractiveness of male-sterile lines and competitive nectar and pollen sources. To eliminate the influence of these factors, double or triple the number of foragers are needed to ensure that the necessary number of honeybees visit the male-sterile lines. Most of the seed companies in South Africa recommend a hive density of 2-3 hives per hectare for sunflower seed production.