

*Final report*

**CONFIDENTIAL**

**Field test of Gaucho 350 FS seedressed sunflowers on honeybee colonies**

(Guideline No. 170, EPPO-1992, EPA-1982 No. 141-5 and EPA-1996

No. OPPTS 850.30.40)

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## GENERAL DATA

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Study Director: [REDACTED]

Deputy of study director: [REDACTED]

Experimental starting date: 05 July 1999

Experimental completion date: 20 July 1999

Archives: All raw data and documents as well as the final report have been lodged in the Central Archives of the Ecotoxicological Laboratory under No. 13/T-4/1999

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Name of the test item: Gaucho 350 FS

Code of the test item at test facility: 03/99

Test species: Honey bee (*Apis mellifera carnica*)

Test Guidelines: U.S. EPA, Pesticide Assessment Guidelines, Subdivision L, Hazard Evaluation: Nontarget Insects, Series 141 Nontarget Insect Testing-Pollinators, 141-5 (1982) and EPA Ecological Effects Test Guidelines OPPTS 850.3040 Field testing for pollinators, Public draft (1996), as well as the European and Mediterranean Plant Protection Organization (EPPO) Guideline on test methods for evaluating the side-effects of plant protection products on honey bees No. 170, EPPO Bulletin 22, 203-215 (1992)

Standard Operating Procedures used in the Ecotoxicological Laboratory: No. T4.15

Test code: 3103/99

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Experienced beekeeper: [redacted]

Technical staff:



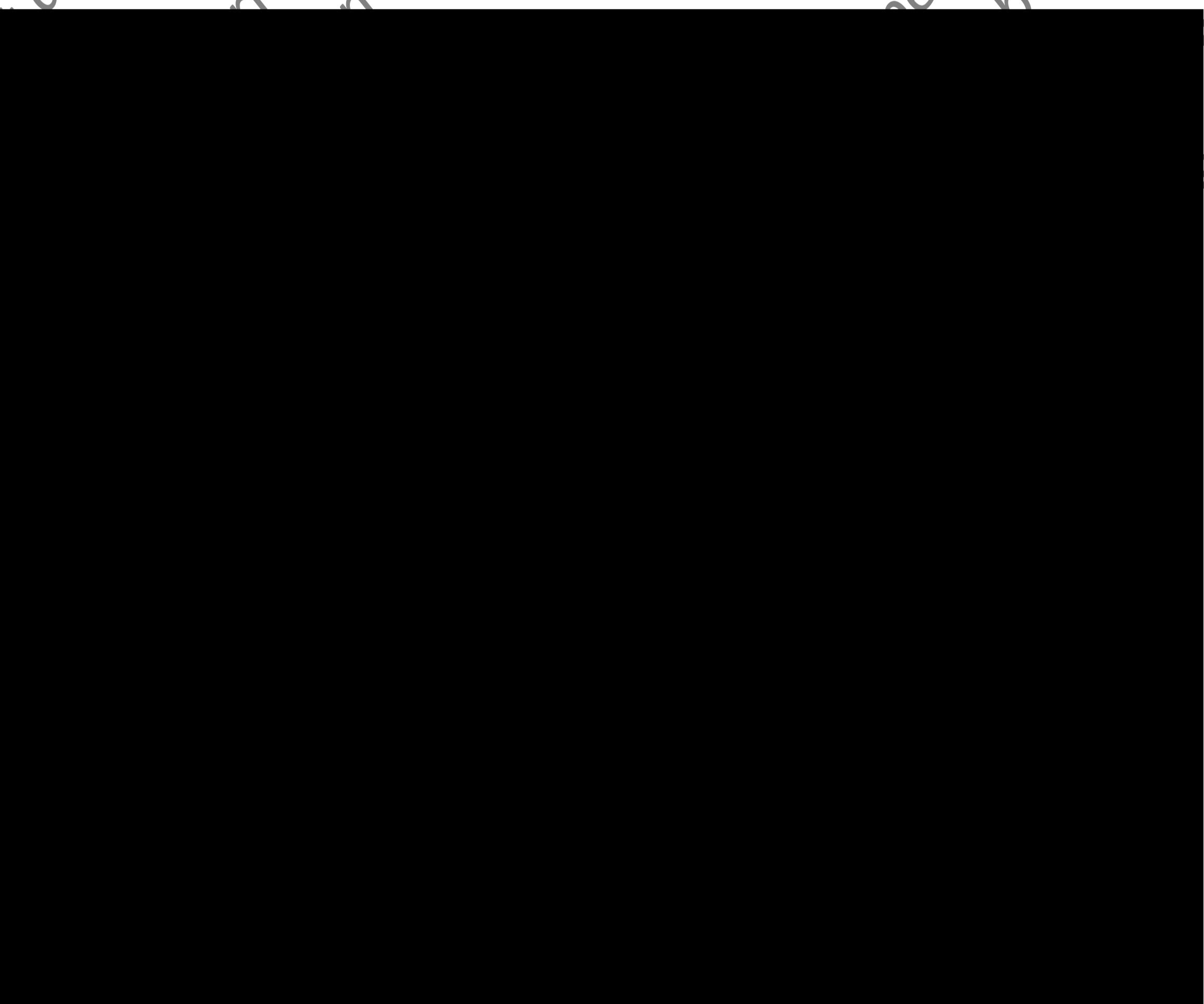
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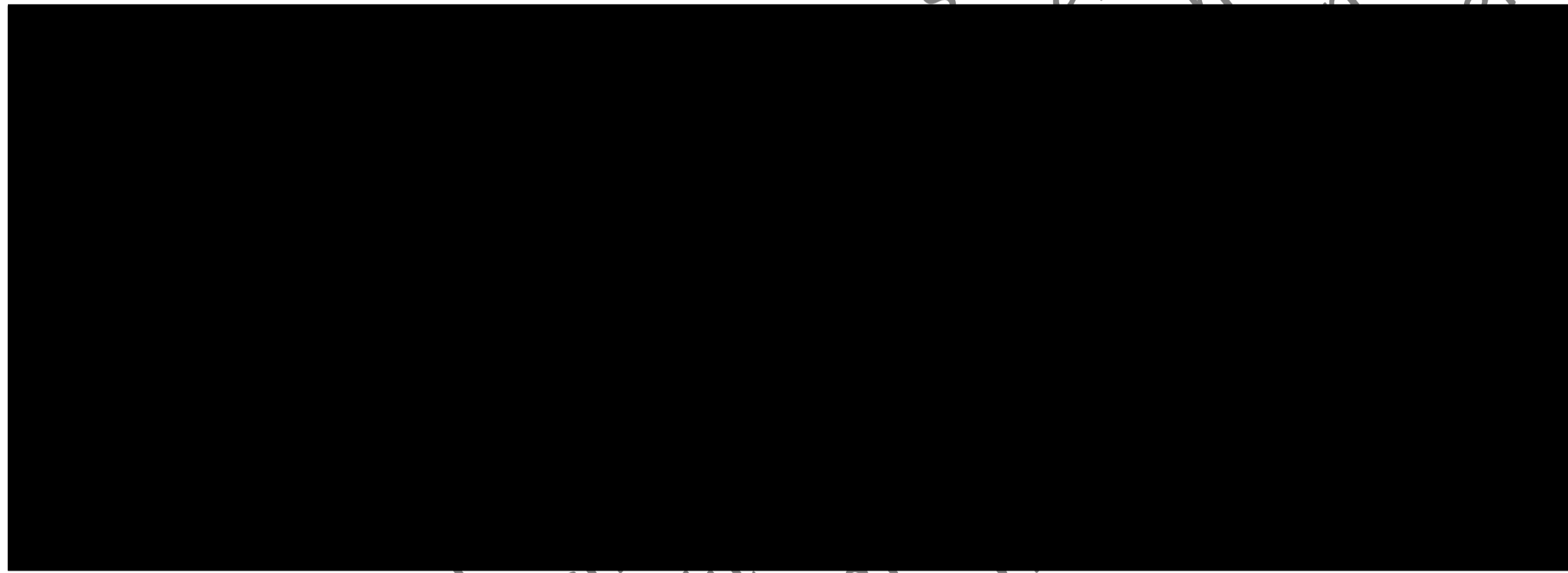
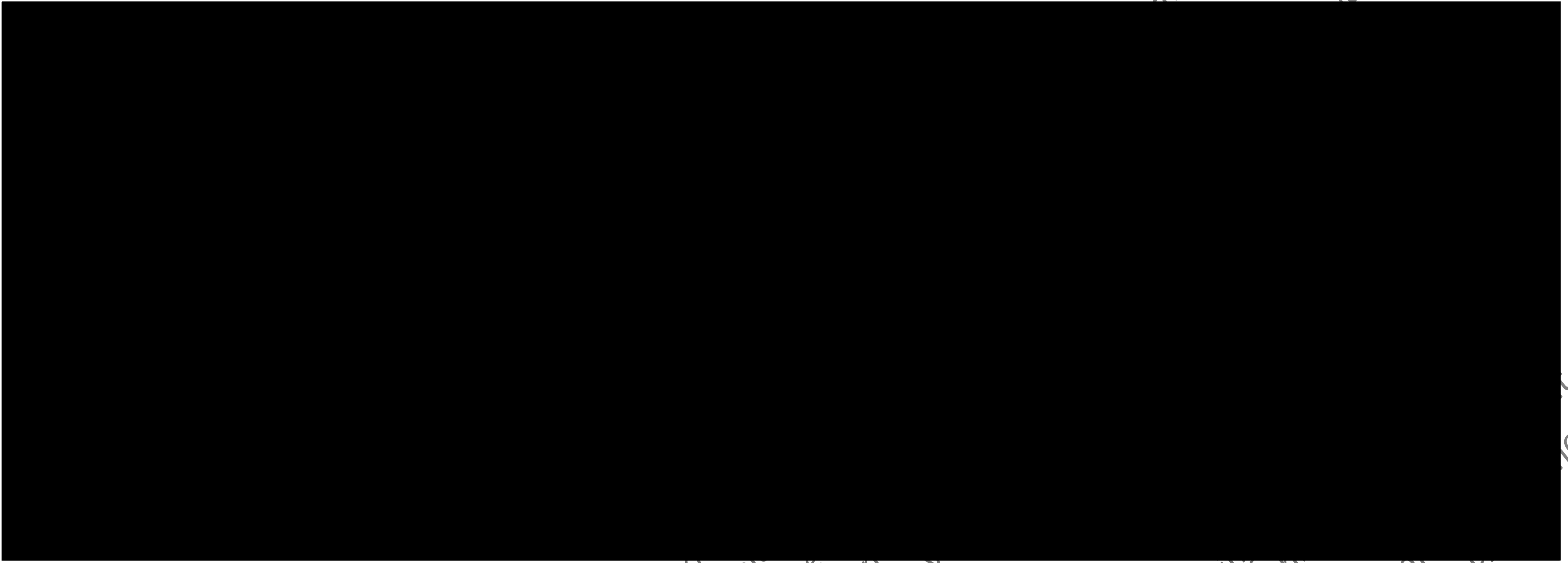
Laboratory assistant



16 December 1999  
Date

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STATEMENT OF COMPLIANCE WITH GOOD LABORATORY PRACTICE

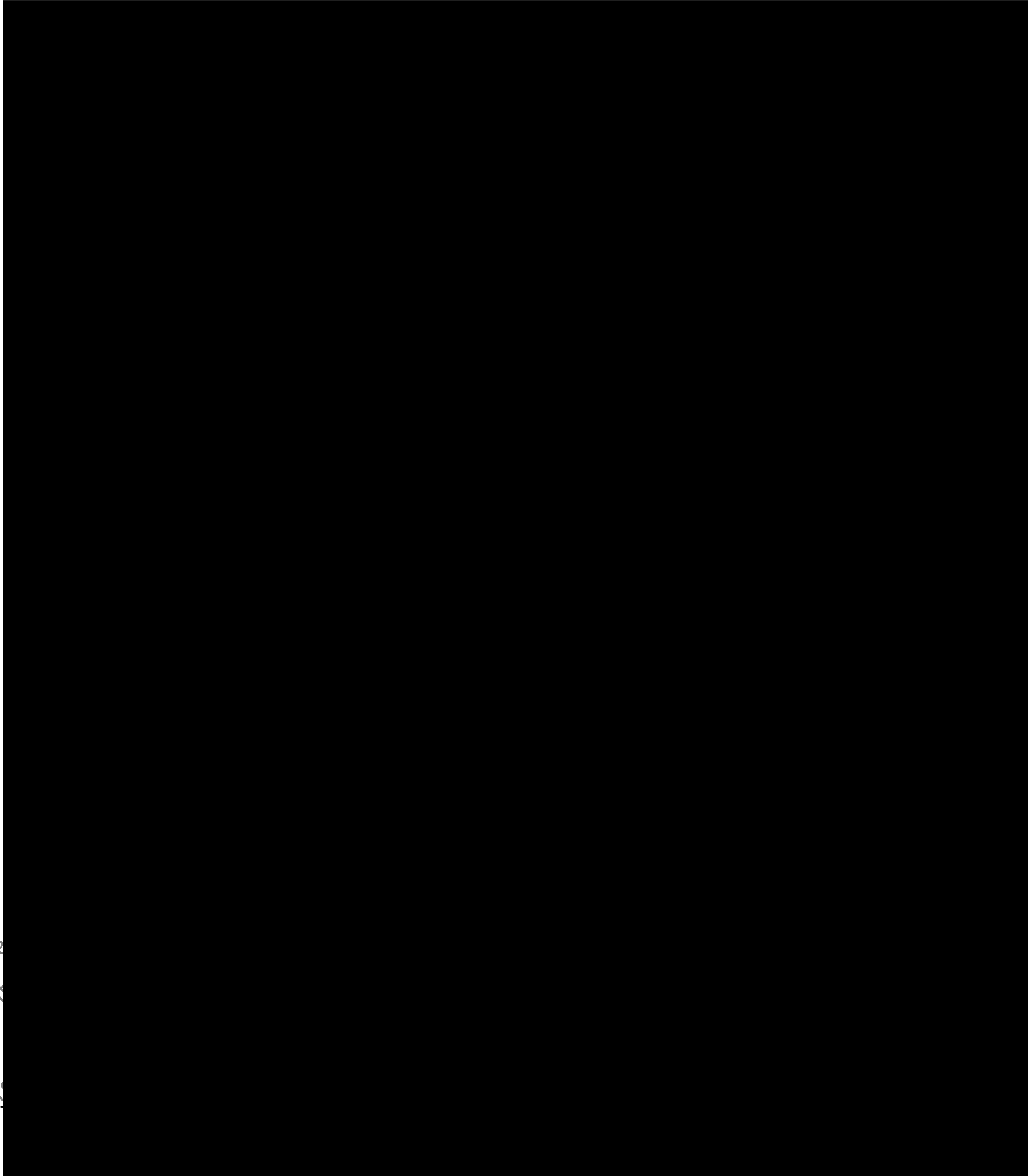


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## 1. SUMMARY

*Sponsor:* BAYER Hungária Ltd. 4-6 Pálya Steet, 1012 Budapest, Hungary

*Test facility:* Ecotoxicological Laboratory, 7136 Fácánkert, Hungary

*Test item:* Gaucho 350 FS

*Test crop:* sunflower (*Heliantus annuus*)

*Seed dressing dose:* 0.3 l/150,000 seeds

*Test species:* Honey bee (*Apis mellifera carnica*)

*Colony number:* 30, 15 on the treated field and 15 on the control field

*Placing:* The colonies were allocated in multiple-store hives of 4 suppers and were placed at the edge of the fields.

*Test fields:* The treated field of 45 hectares and the control field of 35 hectares belonged to "Gold ear" Agricultural Producers' Co-operative. On both field variety Alexandra sunflower seeds were sown in clay-loamy soil. The sowing conditions, the plant growth and the pesticide treatments were the same in both fields.

*Objective of the study:* The field test should prove, that the active ingredient of Gaucho 350 FS does harm/influence or not the foraging bees during the flowering period.

*Test dates:*

Issue of the study plan: 31 March 1999

Experimental phase of the study: 05 July - 20 July 1999

Issue of the final report: 16 December 1999

### **Results**

#### *Foraging activity and behavior of the bees*

Except the last two days the foraging activity was intensive during the whole period of the experiment. In the experimental period in average 76 foragers were counted on 400 sunflower-heads on the treated field and 43 on the control field.

On the treated field the average bee ingress was 23.9 bees per minutes, and 26.6 bees per minutes in the control field. On days 1 and 2 and on the last four days of the experiment just few bees were observed returning to the hives with pollenloads. The pollen gathering was characteristic between 09 - 15 July.



On both fields in average 1.9 bees per minutes were observed entering the hives with orange-red pollenloads.

No abnormal behavior of the bees was observed during foraging and around the hives.

#### *Weight gain of the hives*

The weight gain of the hives on the treated field was 12.5 % and 23.1 % on the control fields.

#### *Strength of the colonies*

Initially, the strength of the colonies has been slightly higher in the control. Number of the inhabited combs increased by 2.8 % on the treated field and by 6.5 % on the control field.

#### *Brood status and behavior of the queens*

The number of the combs with brood and the total area of all brood stages increased at the bee colonies placed on the treated field. In contrast the brood of the bee colonies placed on the control field decreased. The number of the combs with brood in the control bee colonies also decreased.

Some empty cells were found at the end of the experiment in case of the 100 marked brood cells/colony which was designated for observation at the starting of the experiment. This was attributed to the marking frame which disturbed the bees. The unharmed brood development was normal.

In the experimental period 3 natural requeening was observed in case of the colonies on the treated field and 1 in case of the colonies on control field.

The behavior and eggs laying of the queens were normal in case of the other bee colonies.

#### *Mortality*

Except 2 cases in the control bee colonies the bee mortality did not exceed the accepted natural mortality level which is less than 100 dead bees/colony/day. The mortality of the drones was not significant during the whole period of the experiment.

In front of the hives on the treated field 44-365 dead bees per day and 15-972 dead bees per day on the control field were found. The mortality of the drones was not significant during the whole period of the experiment.

### *Weather conditions and soil moisture*

During the experiment sunny days and no winds characterised the weather conditions. Most of the rainfalls were registered during the night, which was 90 mm on the treated and 109 mm on the control field.

The soil moisture of the treated field was 17.12 - 32.53 % and 16.26 - 34.08 % on the control field.

### *Evaluation made by the beekeeper*

At the initiation of the experiment lot of rainfalls and high relative humidity were registered. This why the sunflower produced thin nectar. That was one of the reasons for slight weight gain of the hives. As the weather changed for the better, greater nectar input was registered at the second part of the experiment.

In case of the bee colonies with no requeening, activity of the queens was totally normal. The eggs laying dynamism of the queens was according to the season on both fields.

### *Conclusion*

The honey production of the bees was generally poor in this year in Hungary. Under the conditions of the experiment the weight gain of bee hives on the field sown with Gaucho 350 FS treated seeds at a dose of 0.3 l/150,000 seeds was less than the weight gain of bee hives on the control field. This could be corroborated by a higher energy demand of the the bee colonies placed on the treated field which produced substantially more brood. The seeddressing product had no adverse effect on the forager bees, the queens and the brood.

## 2. INTRODUCTION

Imidacloprid is used as a seeddressing pesticide in sunflower. The active ingredient is a systemic insecticide, which is translocated to the upper parts of the plant. The field test should prove, that the active ingredient during the flowering period does harm/influence or not the foraging bees.

Recommendations of the U.S. EPA, Pesticide Assessment Guidelines, Subdivision L, Hazard Evaluation: Nontarget Insects, Series 141 Nontarget Insect Testing-Pollinators, 141-5 (1982) and EPA Ecological Effects Test Guidelines OPPTS 850.3040 Field testing for pollinators, Public draft (1996), as well as the European and Mediterranean Plant Protection Organization (EPPO) Guideline on test methods for evaluating the side-effects of plant protection products on honey bees No. 170, EPPO Bulletin 22, 203, 215 (1992) were taken as basis for this study. Standard Operating Procedures used in the Ecotoxicological Laboratory: No. T415, version No.: 6.

## 3. MATERIALS AND METHODS

### 3.1 Test item

- name: Gaucho 350 FS
- active ingredient: imidacloprid 350 g/l
- expiry date: 06 April 2000
- analytical method No. at the Sponsor: 2001-0026606-95E
- solubility in water: 0.51 (a.i.)
- n-octanol/water: 0.57 (a.i.) at 20 C°
- solubility in other solvent:
  - n-hexane: < 0,1
  - 2-propanol: 1-2
  - toluol: 0.5-1
- physical appearance: red liquid
- storage: dry place, between (-) 10 - (+) 40 C°
- treated seed suited for storage: 15 December 1999
- field dose: 0,3 l/150000 seed
- arrival date: 06 April 1999
- transportation: transported by Sponsor
- arrived quantity: gross weight 12550 g (net 10 l)
- used quantity: 11304 g

### 3.2 Test animals and animal keeping practice

Species: honeybee (*Apis mellifera*)

Race: carnica bee

Origin: from apiary with good bee keeping practice of [REDACTED]

Colony number: 30 (15 on the treated field and 15 on the control field).

The queen-right bee colonies were in good condition with approximately the same population. They were placed in multiple-store hives of 40 combs of 42 x 18 cm size. The queens were 1 - 2 year old. The broodnest was adequate to the size of the colonies and contained all immature stages.

At the start of the flowering (10-20 % open flowers) the colonies were placed at the edge of the fields for the whole flowering period and were removed at the end of the flowering period. Dead-bee traps were fitted to 6 treated and 6 control hives.

Justification for choosing the species: honey bee is one of the standard species of ecotoxicological studies moreover it was the Sponsor's request.

At the initiation of the experiment the bee colonies were in good health condition, no treatment was performed 2 month before the experiment started.

### 3.3 Test fields and surroundings

The treated field of 45 hectares and the control field of 35 hectares belonging to "Gold ear" Agricultural Producers' Co-operative were isolated by 5000 m distance from each other. On both field Alexandra sunflower seeds were sown. Nearby the control field other 3 small fields of 11 ha, 7 ha and 4 ha respectively were also planted with Alexandra seeds. The type of the soil was: clay-loamy soil (see details in Appendix 1.)

Around the treated field within 2000 m there were winter wheat, maize, pasture and forest. According to our observations the field was visited by strange forager bees from direction south-southeast.

Around the control field within 2000 m there were winter wheat, maize, pasture, grove and forest and 3 other small sunflower fields (planted with Alexandra) of 11 ha, 7 ha and 4 ha.

Moreover an other sunflower field of 160 ha was located at 1400 m distance belonging to the Bogyiszló "Pearl of Danube" Agricultural Producers' Co-operative. On this field variety "Florix" seed was used.

The bee colonies were placed to the forest edge of the control field so the distance was more than 2000 m from the field sown with Florix. Test fields are shown in Appendices 2-4.

The flowering of the sunflower was approximately the same in both of the fields. Detailed data are shown in Appendix 5.

### 3.4 Test procedure

Activities before the experimental phase of the study:

Seeddressing: 07 April 1999

Sowing: 13 - 14 April 1999

Weed control: 20 April 1999, 07 June 1999

Assessing the plant density: 04 May 1999

Experimental phase of the study: 05 - 20 July 1999

#### 3.4.1 Seeddressing

The seeddressing was carried out in 8 batches on 07 April 1999 using "Amazone" seed dressing machine. No vehicle was used. The detailed data are shown in Appendix 6.

#### 3.4.2 Sowing

Sowing was carried out by "Gold ear" Agricultural Producers' Cooperative, Tolna. The treated field was sown on 13 April 1999, the control on 14 April 1999. Type of the sowing machine was IHC-Cyclo-400 in both case. Row distance was 76.5 cm, sown plants 53953/ha.

#### 3.4.3 Weed control

As plant protection treatments only weed control was carried out. The date of treatment, the used pesticides and the doses were the same in both fields. Detailed data are shown in Appendix 1.

#### 3.4.4 Plant density

Number of the emerged plants were determined on 04 May 1999 when the plants had 4 leaves. In both field the plants were counted on 20 different 10 meter long rows. The average emerged plants was  $39.9 \pm 3.88/10$  m on the treated field and  $38.5 \pm 2.96/10$  m on the control field.

#### 3.4.5 Experimental phase of the study

The experimental starting date was 05 July 1999 (day 0). The activity started with the weighing of the hives and the placing of the colonies (at night time) on the test fields. The observations were carried out during the whole flowering period, from 07 July to 20 July 1999.

### 3.5 Observations

#### *Foraging activity and behavior of the bees*

On the flowering fields all bees collecting nectar or pollen on 100 sunflower-heads were counted. This evaluation was performed once a day at 4 spots on each field. The bees with pollenloads (orange-red sunflower pollen) entering the hives were counted for 1 minutes/colony, once a day, at 6 treated and 6 control colonies.

#### *Nectar input*

All the hives were weighed at the starting of the experiment just before the transfer to the fields. The same procedure was performed at the end of the flowering period.

#### *Strength of the colonies*

Number of the inhabited combs and behavior of the bees were recorded at 6 treated and 6 control colonies at the starting and at the end of the experiment. Inhabited comb means a comb covered with bees at least in 70 %.

#### *Brood status and behavior of the queens*

Experienced beekeeper inspected the combs at the starting and at the end of the experiment. In case of 6 treated and 6 control colonies area and composition of the brood were assessed, moreover approximately 100 of newly laid eggs were marked at each colony then the development of the larvae was observed.

### *Mortality*

Bee mortality was observed daily in bee traps placed on 6 treated and 6 control hives. Furthermore in front of the all hives dead bees were also counted on a 5 m strip of field.

### *Weather conditions and soil moisture*

Meteorological data such as air temperature and humidity, cloudcover, wind velocity were recorded during the observations.

Starting at two weeks before flowering and continued till to the of the experiment the rainfalls and soil moisture were registered. The rainfall was recorded daily, the soil moisture was determined weekly by gravimetric method.

## **4. RESULTS**

### **4.1 Foraging activity and behavior of the bees**

Except the last two days the foraging activity was intensive during the whole period of the experiment. In this period during the daily observations on average 76 foragers were counted on 400 sunflower-heads on the treated field and 43 on the control field. The totalized data are shown in Table 1 and Appendix 7. The number of the bumblebees was on average of 0.6 on the treated and 0.9 on the control field.

On the treated field the average bee ingress was 23.9 bees per colony per minutes, and 26.6 bees per colony per minutes on the control field.

On days 1 and 2 and on the last four days of the experiment only few bees returning to the hives with pollenloads were observed. The pollen gathering was characteristic between 09 - 15 July.

On both fields in average 1.9 bees per minutes were observed entering the hives with orange-red pollenloads.

The average number of bee ingress is shown in the Table 2, detailed data are shown in Appendix 8.

No abnormal behavior of the bees was observed during foraging and around the hives.

Table 1. The number of the forager bees (bee/400 sunflower heads)

| Date July 1999 | Treated field | Control field |
|----------------|---------------|---------------|
| 07             | 41            | 38            |
| 08             | 85            | 79            |
| 09             | 83            | 54            |
| 10             | 75            | 68            |
| 11             | 137           | 77            |
| 12             | 126           | 41            |
| 13             | 104           | 61            |
| 14             | 79            | 32            |
| 15             | 85            | 40            |
| 16             | 74            | 39            |
| 17             | 59            | 15            |
| 18             | 28            | 4             |
| 19             | 17            | 6             |
| Total          | 993           | 554           |
| Daily average  | 76            | 43            |

Remark: the treated field was visited by strange forager bees.

Table 2. The average number of the bee ingress (bee/colony/minutes)

| Date<br>July 1999 | Treated field |                  | Control field |                  |
|-------------------|---------------|------------------|---------------|------------------|
|                   | Total         | With pollenloads | Total         | With pollenloads |
| 07                | 12.5          | 0.0              | 23.2          | 0.5              |
| 08                | 12.0          | 0.8              | 20.5          | 2.2              |
| 09                | 16.3          | 6.5              | 22.3          | 6.3              |
| 10                | 18.7          | 3.5              | 21.0          | 3.8              |
| 11                | 21.8          | 3.8              | 26.7          | 2.5              |
| 12                | 25.5          | 3.8              | 24.3          | 2.3              |
| 13                | 24.3          | 1.3              | 25.8          | 1.0              |
| 14                | 27.7          | 1.0              | 32.7          | 2.3              |
| 15                | 28.0          | 1.8              | 30.5          | 2.2              |
| 16                | 31.3          | 1.0              | 30.3          | 0.7              |
| 17                | 33.0          | 0.2              | 28.8          | 0.3              |
| 18                | 34.5          | 0.0              | 28.2          | 0.2              |
| 19                | 35.3          | 0.3              | 30.8          | 0.0              |
| Total             | 311.0         | 24.2             | 345.2         | 24.3             |
| Daily average     | 23.9          | 1.9              | 26.6          | 1.9              |



#### 4.2 Nectar input

The weight gain of the hives on the treated field was 12.5 % and 23.1 % on the control fields. The average and totalized data are shown in Table 3 and Appendix 9.

Table 3. Average weight of the hives at the starting and at the end of the experiment (kg)

|         | Treated field            |  |            | Control field            |  |            |
|---------|--------------------------|--|------------|--------------------------|--|------------|
|         | At the placing (05 July) | At the end of the experiment (20 July) | Difference | At the placing (05 July) | At the end of the experiment (20 July) | Difference |
| Average | 42.0                     | 47.2                                   | 5.3        | 40.6                     | 49.9                                   | 9.4        |
| SD      | 2.5                      | 4.2                                    | -          | 3.2                      | 6.7                                    | -          |
| Total   | 629.4                    | 708.2                                  | 78.8       | 608.4                    | 748.7                                  | 140.3      |

#### 4.3 Strength of the colonies

Number of the inhabited combs increased by 2.8 % on the treated field and by 6.5 % on the control field. The average and totalized data are shown in Table 4 and Appendix 10.

Table 4. Number of the inhabited combs

|         | Treated field               |  |            | Control field               |  |            |
|---------|-----------------------------|--|------------|-----------------------------|--|------------|
|         | Following placing (07 July) | At the end of the experiment (20 July) | Difference | Following placing (07 July) | At the end of the experiment (20 July) | Difference |
| Average | 18,9                        | 19,5                                   | 0,5        | 20,7                        | 22,0                                   | 1,3        |
| SD      | 4,72                        | 4,96                                   | -          | 6,21                        | 6,47                                   | -          |
| Total   | 284                         | 292                                    | 8          | 310                         | 330                                    | 20         |

#### 4.4 Brood status and behavior of the queens

The number of the combs with brood and the total area of all brood stages increased at the bee colonies placed on the treated field. The area of the capped brood increased in case of the bee colonies placed on the control field but the brood area containing eggs and larvae decreased.

The number of the combs with brood and the changing of the brood composition are shown in Table 5 and Appendix 11.

In case of 100 brood cells/colony marked on July 07 and checking on 20 July some empty cells were found in the marked brood area. This was attributed to the marking frame which disturbed the bees. The unharmed brood development was normal. On 20 July normal developed pupae were found.

In the experimental period 3 natural requeening were observed (colonies number: 41, 10, 174) in case of the colonies on the treated field and 1 in case of the colonies on control field (colony number: 33). The behavior of the queens were normal in case of the other bee colonies.

Table 5. The number of the combs with brood and the changing of the brood composition

| Field   | Average changing between 07- 20 July 1999 |                                     |                                       |                             |
|---------|---|-------------------------------------|---------------------------------------|-----------------------------|
|         | Number of combs with brood                | Number of patches with capped brood | Number of patches with uncapped brood | Number of patches with eggs |
| Treated | 2.0                                       | 17.3                                | 6.3                                   | 5.3                         |
| Control | -1.7                                      | 1.0                                 | -7.0                                  | 9.3                         |

Remark: area of one patch is 1/8 part of the total comb area (cca 0.8 dm<sup>2</sup>)

## 4.5 Mortality

### 4.5.1 Mortality in dead bee traps

In case of colony No 77 (control field) 141 dead bees were found on 11 July and 238 dead bees on 13 July. On the other days of the experiment the bee mortality was bellow 100/day which is considered natural mortality level/colony/day. In case of other colonies (treated and control field) less than 100 dead bees per colony were found a day. No significant mortality of the drones was registered during the whole experiment. The average and totalized data are shown in Table 6 and Appendix 12.

### 4.5.2 Mortality in front of the hives

In front of the hives on the treated field 44-365 dead bees per day a day and 15-972 dead bees per day on the control field were found. The mortality of the drones was not significant during the whole period of the experiment. The average and totalized data are shown in Table 7.

Table 6. Average bee mortality in traps (bee/colony/day)

| Date<br>July 1999 | Treated field |       | Control field |       |
|-------------------|---------------|-------|---------------|-------|
|                   | worker        | drone | worker        | drone |
| 07                | 16.3          | 0.5   | 7.8           | 0.5   |
| 08                | 12.7          | 2.2   | 3.8           | 0.2   |
| 09                | 3.3           | 0.5   | 4.5           | 0.2   |
| 10                | 10.0          | 0.0   | 10.2          | 0.0   |
| 11                | 2.3           | 0.0   | 28.0          | 0.3   |
| 12                | 3.2           | 0.2   | 3.0           | 0.0   |
| 13                | 4.7           | 0.5   | 54.2          | 0.7   |
| 14                | 9.5           | 0.0   | 2.2           | 0.0   |
| 15                | 5.8           | 0.2   | 1.2           | 0.0   |
| 16                | 6.3           | 0.0   | 7.3           | 0.0   |
| 17                | 4.8           | 0.2   | 7.2           | 0.2   |
| 18                | 1.3           | 0.5   | 5.0           | 0.0   |
| 19                | 0.8           | 0.0   | 2.7           | 0.0   |
| Total             | 81.2          | 4.7   | 137.0         | 2.0   |

Table 7. Mortality in front of the hives

| Date<br>July 1999 | Treated field |       | Control field |       |
|-------------------|---------------|-------|---------------|-------|
|                   | worker        | drone | worker        | drone |
| 07                | 128           | 0     | 142           | 0     |
| 08                | 161           | 0     | 173           | 0     |
| 09                | 223           | 7     | 573           | 41    |
| 10                | 364           | 3     | 953           | 11    |
| 11                | 358           | 8     | 671           | 9     |
| 12                | 218           | 5     | 584           | 4     |
| 13                | 256           | 6     | 972           | 14    |
| 14                | 161           | 14    | 246           | 34    |
| 15                | 138           | 0     | 141           | 0     |
| 16                | 48            | 0     | 15            | 0     |
| 17                | 48            | 0     | 66            | 1     |
| 18                | 62            | 5     | 36            | 4     |
| 19                | 44            | 1     | 29            | 1     |
| Total             | 2209          | 49    | 4601          | 119   |

Remark: between 07-15 July polyethylene sheet was placed in front of the hives. During the rainfalls in accumulated water high number of bees were drowned. This was replaced with plastic mesh on 16 July.

#### 4.6 Weather conditions and soil moisture

During the experiment sunny days and no winds characterised the weather conditions. Most of the rainfalls were registered during the night. The maximal and minimal values of the meteorological parameters are shown in Table 8, the daily data and the weekly registered soil moisture are found in Appendix 13.

Table 8. The maximal and minimal values of the meteorological parameters

| Field   | Temperature (°C) | Relative humidity (%) | Wind velocity (m/s) | Cloud cover (%) | Rainfall (mm) | Soil moisture content (%) |
|---------|------------------|-----------------------|---------------------|-----------------|---------------|---------------------------|
| Treated | 22.6 - 28.3      | 52 - 87               | 0.00 - 1.97         | 0 - 100         | 90            | 17.12 - 32.53             |
| Control | 23.1 - 29.8      | 35 - 83               | 0.00 - 2.55         | 0 - 100         | 109           | 16.26 - 34.08             |

#### 5. EVALUATION MADE BY THE BEEKEEPER

At the initiation of the experiment lot of rainfalls and high relative humidity were registered. This why the sunflower produced thin nectar. That was the reason for slight weight gain of the hives. As the weather changed for the better greater nectar input was registered at the second part of the experiment.

In case of the bee colonies with no requeening, activity of the queens was totally normal. The eggs laying dynamism of the queens was according to the season on both fields.

## 6. DISCUSSION

Two fields with same soil conditions were selected. One of them (treated field) was sown with Gaucho 350 FS treated seed (dose: 0.3 l/150,000 seed), the other one was sown with untreated seed (control field). The bee foraging meet proper weather conditions (sunny and calmy during the day, rain was generally at night) but high quantity of rainfall was registered (90 mm on treated field and 109 mm on the control field). This why the sunflower produced thin nectar and the flower fed rapidly. This was the reason for unusual low nectar production. In the experimental period the nectar production in treated field was in average 5.3 kg and 9.3 kg in the control field. This year low nectar production was registered in whole the Hungary. The apiary that took part in the study had produced 14,0 - 39,4 kg honey on sunflower in this area in the period of the last six year.

At the starting of experiment the strength of the colonies was 18.9 inhabited combs in the treated field which increased in average by 0.5 inhabited combs at the end of the experiment. In the control field strength of the colonies was 20.7 inhabited combs which increased in average by 1.3 inhabited combs at the end of the experiment.

In the colonies of treated field 3 and control field 1 natural requeening was observed. In case of the colonies with no requeening the eggs laying was normal during the whole period of the experiment. In case of the control field the combs area containing eggs and brood decreased.

On the sunflower heads the flower visit was by 79% more in the treated field compared to the control which seems to be controversial in view of the nectar production. That could be the result of the bee visit from a strange apiary. The number of the bees returning to the hives was similar in both fields (23.9 bee/minutes in the treated and 26.6 bee/minutes in control field).

## 7. CONCLUSION

The honey production of the bees was generally poor in this year in Hungary. Under the conditions of the experiment the weight gain of bee hives on the field sown with Gaucho 350 FS treated seeds at a dose of 0.3 l/150,000 seeds was less than the weight gain of bee hives on the control field. This could be corroborated by a higher energy demand of the the bee colonies placed on the treated field which produced substantially more brood. The seeddressing product had no adverse effect on the forager bees, the queens and the brood.

Appendix 1

Characteristic of the test fields

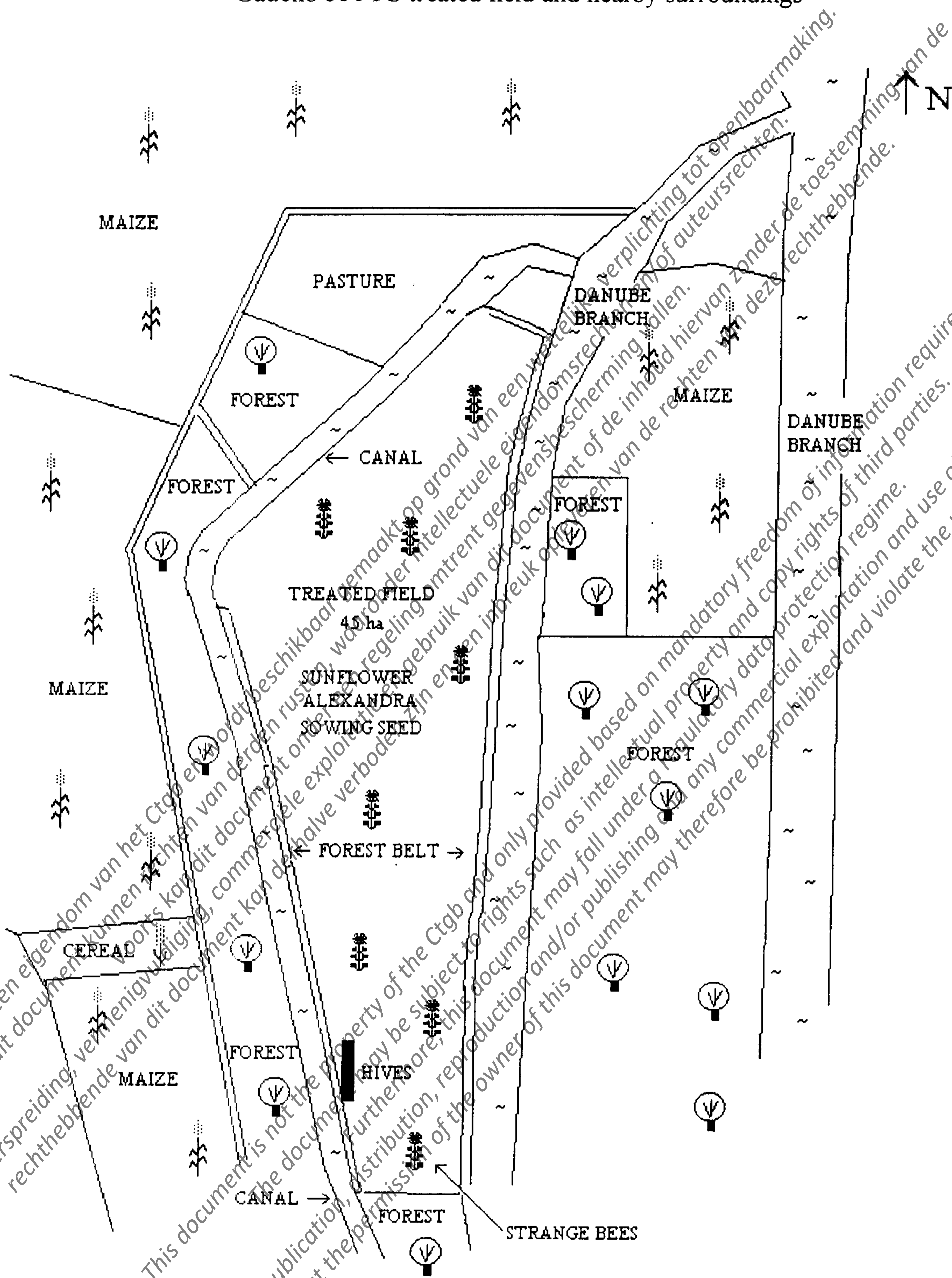
|  | Treated field  | Untreated field                                      |
|--|--|--|
| code of field:                                 | R5   | Dokomlás   |
| size of field:                                 | 45 ha  | 35 ha  |
| type of soil:                                  | clay-loamy soil                                      | clay-loamy soil                                      |
| subtype of soil:                               | calcareous-humus alluvial soil                       | calcareous-humus alluvial soil                       |
| cohesion of soil:                              | $K_A = 43 - 50$                                      | $K_A = 43 - 50$                                      |
| parent material of the soil:                   | alluvial mud, alluvial sand                          | alluvial sand  |
| previous crop:                                 | maize  | maize  |
| soil preparation:                              | deep tillage, cultivator 2x,<br>seed bed combination | deep tillage, cultivator 2x,<br>seed bed combination |
| Dates of the sowing                            | 13 April 1999  | 13 April 1999  |
| Distance between the rows:                     | 76.5 cm  | 76.5 cm  |
| Seeds sown:                                    | 539553   | 539553   |
| Sowing machine:                                | IHC-Cyclo-400  | IHC-Cyclo-400  |
| Average plant density on<br>10 m (04 May 1999) | $39.9 \pm 0.88$                                      | $38.5 \pm 2.96$                                      |

Plant protection on the test fields

|                             | Treatment     |          | Used chemicals                             |
|-----------------------------|---------------|----------|--|
|                             | date          | method   |  |
| Treated field<br>(R5)       | 20 April 1999 | spraying | Racer 2,0 l/ha + Dual Gold 960 EC 1,5 l/ha |
|                             | 07 June 1999  | spraying | Alert S 1,0 l/ha + Pantera 40 EC 1,2 l/ha  |
| Control field<br>(Dokomlás) | 20 April 1999 | spraying | Racer 2,0 l/ha + Dual Gold 960 EC 1,5 l/ha |
|                             | 07 June 1999  | spraying | Alert S 1,0 l/ha + Pantera 40 EC 1,2 l/ha  |

Appendix 2

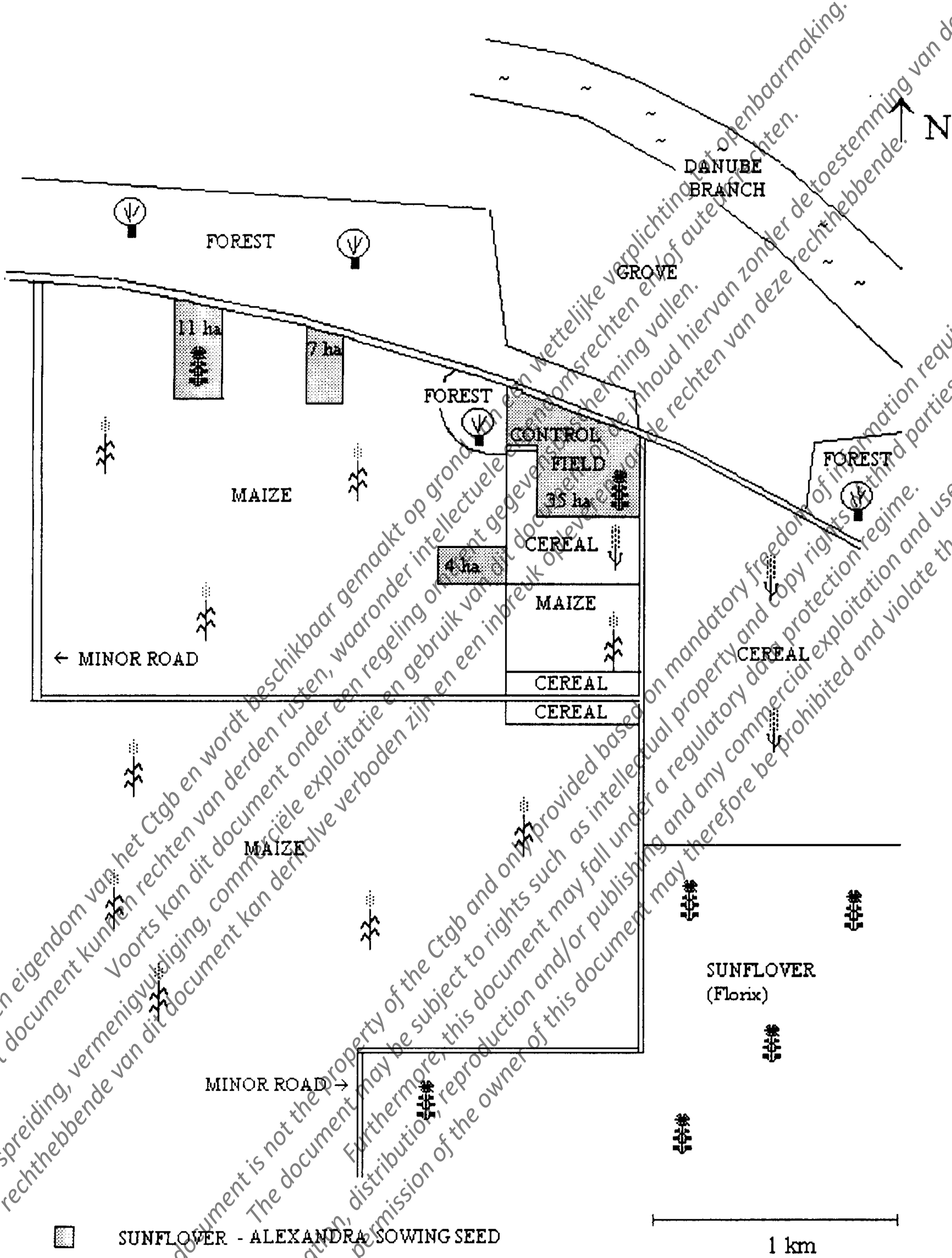
Gaicho 350 FS treated field and nearby surroundings



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Appendix 3

Control field and far away surroundings

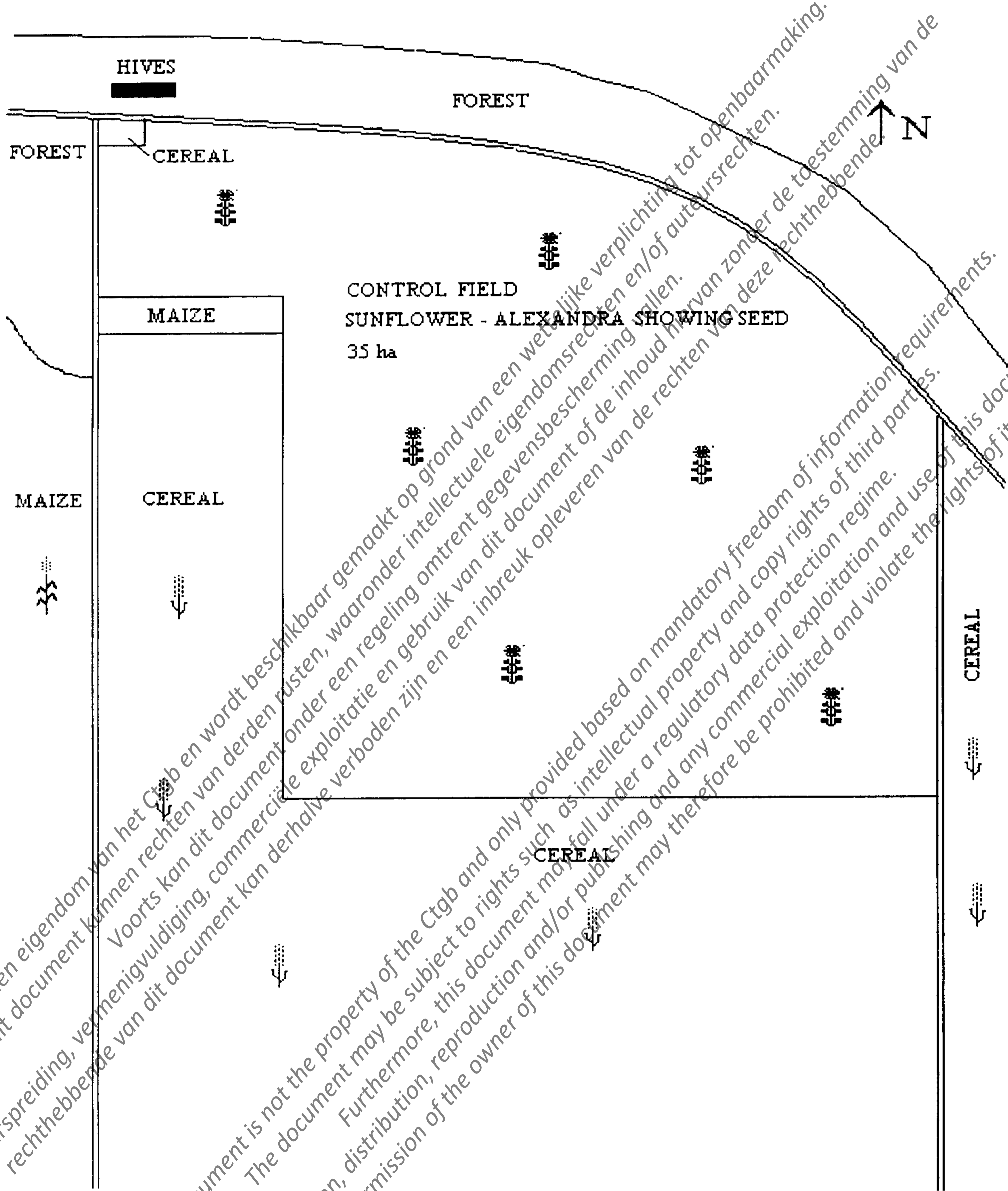


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Appendix 4

Control field and nearby surroundings



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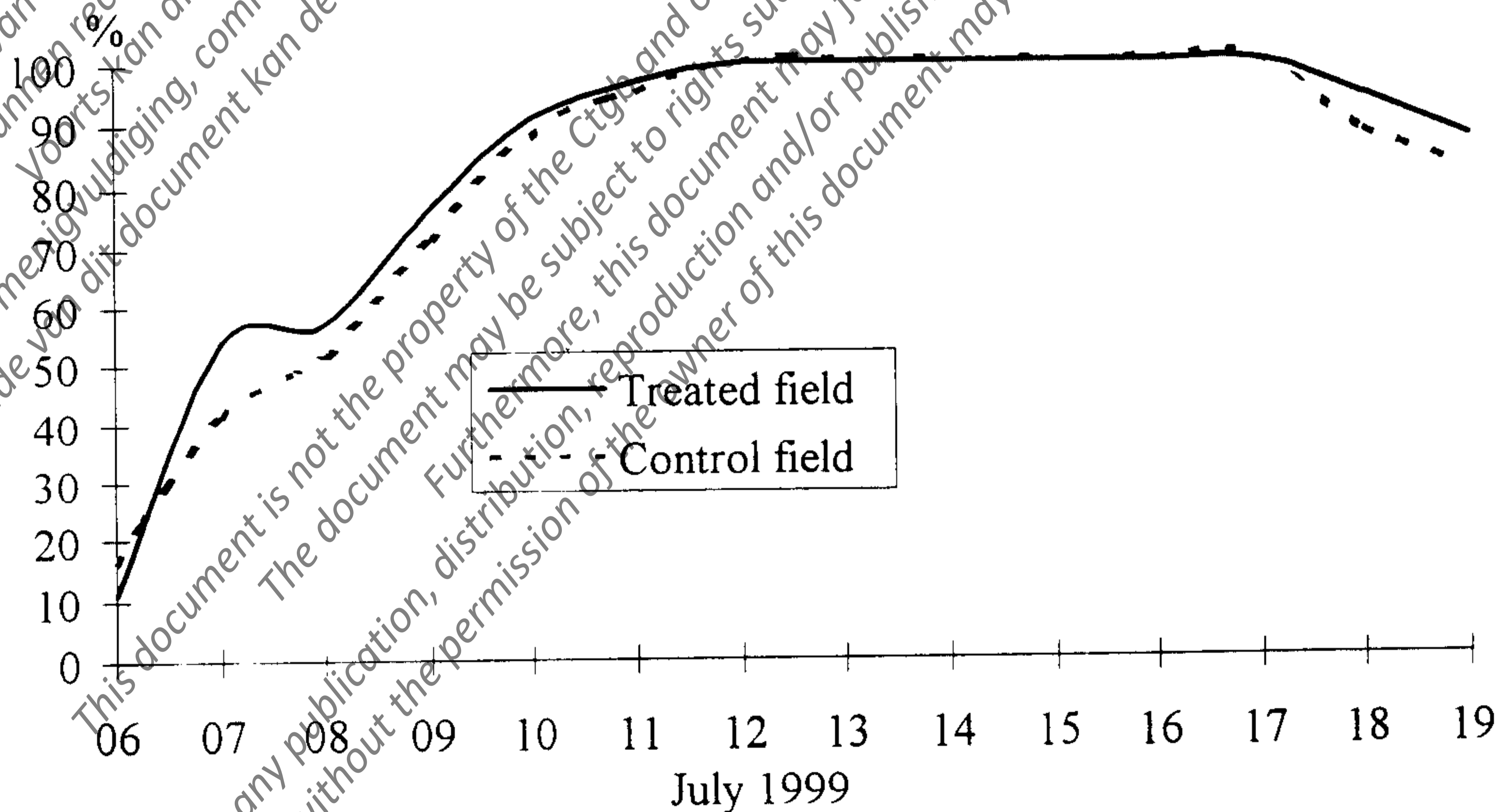
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Appendix 5

Flowering of the sunflower (%)

| Date<br>July 1999 | Treated field | Control field | Remark                              |
|-------------------|---------------|---------------|-------------------------------------|
| 06                | 11            | 16            |                                     |
| 07                | 54            | 41            | -                                   |
| 08                | 57            | 51            | -                                   |
| 09                | 77            | 71            | -                                   |
| 10                | 91            | 88            | -                                   |
| 11                | 97            | 95            | -                                   |
| 12                | 100           | 100           | -                                   |
| 13                | 100           | 100           | -                                   |
| 14                | 100           | 100           | -                                   |
| 15                | 100           | 100           | The petals started to fade and fall |
| 16                | 100           | 100           | The flowers started to shrink       |
| 17                | 100           | 100           |                                     |
| 18                | 94            | 88            |                                     |
| 19                | 87            | 82            |                                     |

Flowering of the sunflower



Appendix 6

Data referring to seeddressing and the sowing seeds

Seeddressing:

- name of the test item: Gaucho 350 FS
- date: 07 April 1999
- dose: 0.3 l/150000 seed (0,7 mg a.i./seed)
- type of the machine: Amazone
- duration of the seeddressing: 10 minutes/batch

Sowing seed:

- name: Alexandra, Hybrid F/1,
- batch No: 8-99/450
- fungicide seeddressing material: Apron 35 SD + Fundazol
- expiry date: 15 December 1999

Following seeddressing samples were taken and sent to the Sponsor for analytical examination.

Remark: The experiment was initially designated to two fields sown with the test item treated seed in Tolna and Alsópél boundary, furthermore two more fields were designated as control fields. The seeddressing and the sowing were performed in both fields. Finally the fields in the Tolna boundary were designated for the experiment. The fields at Alsópél were as reserve fields, where 2550000 treated seeds were sown.

Appendix 7

Number of the foraging honeybees and bumblebees on the sunflower heads  
(bee/100 sunflower heads )

Treated field

| Date<br>July 1999 | Distance of the patches from the hives |               |              |               |              |               |              |               |
|-------------------|--|---------------|--------------|---------------|--------------|---------------|--------------|---------------|
|                   | 100 m                                  |               | 200 m        |               | 300 m        |               | 400 m        |               |
|                   | Honey<br>bee                           | Bumble<br>bee | Honey<br>bee | Bumble<br>bee | Honey<br>bee | Bumble<br>bee | Honey<br>bee | Bumble<br>bee |
| 07                | 0                                      | -             | 13           | -             | 16           | -             | 12           | -             |
| 08                | 8                                      | -             | 35           | -             | 24           | -             | 18           | -             |
| 09                | 19                                     | 0             | 15           | 0             | 24           | 0             | 25           | 1             |
| 10                | 15                                     | 1             | 18           | 1             | 23           | 0             | 19           | 0             |
| 11                | 27                                     | 0             | 31           | 0             | 44           | 0             | 35           | 0             |
| 12                | 43                                     | 3             | 25           | 0             | 26           | 0             | 32           | 1             |
| 13                | 32                                     | 0             | 26           | 1             | 28           | 0             | 18           | 0             |
| 14                | 18                                     | 0             | 16           | 0             | 21           | 0             | 24           | 0             |
| 15                | 26                                     | 0             | 18           | 0             | 25           | 1             | 16           | 0             |
| 16                | 24                                     | 0             | 22           | 0             | 13           | 0             | 15           | 1             |
| 17                | 22                                     | 0             | 17           | 0             | 17           | 0             | 3            | 0             |
| 18                | 10                                     | 0             | 9            | 0             | 8            | 0             | 1            | 0             |
| 19                | 7                                      | 0             | 4            | 0             | 5            | 0             | 1            | 0             |
| Total             | 251                                    | 4             | 249          | 2             | 274          | 1             | 219          | 3             |

Control field

| Date<br>July 1999 | Distance of the patches from the hives |               |              |               |              |               |              |               |
|-------------------|--|---------------|--------------|---------------|--------------|---------------|--------------|---------------|
|                   | 100 m                                  |               | 200 m        |               | 300 m        |               | 400 m        |               |
|                   | Honey<br>bee                           | Bumble<br>bee | Honey<br>bee | Bumble<br>bee | Honey<br>bee | Bumble<br>bee | Honey<br>bee | Bumble<br>bee |
| 07                | 14                                     | -             | 3            | -             | 12           | -             | 9            | -             |
| 08                | 22                                     | -             | 17           | -             | 18           | -             | 22           | -             |
| 09                | 15                                     | 0             | 12           | 0             | 15           | 0             | 12           | 0             |
| 10                | 20                                     | 0             | 15           | 1             | 16           | 0             | 17           | 2             |
| 11                | 22                                     | 0             | 23           | 0             | 19           | 0             | 13           | 0             |
| 12                | 10                                     | 1             | 10           | 0             | 12           | 0             | 9            | 0             |
| 13                | 20                                     | 0             | 7            | 0             | 19           | 0             | 15           | 0             |
| 14                | 7                                      | 0             | 9            | 0             | 12           | 0             | 4            | 0             |
| 15                | 8                                      | 0             | 5            | 0             | 12           | 1             | 15           | 0             |
| 16                | 21                                     | 1             | 5            | 0             | 7            | 0             | 6            | 0             |
| 17                | 7                                      | 1             | 3            | 0             | 2            | 0             | 3            | 0             |
| 18                | 1                                      | 0             | 1            | 0             | 1            | 0             | 1            | 0             |
| 19                | 3                                      | 0             | 0            | 0             | 2            | 0             | 1            | 0             |
| Total             | 170                                    | 3             | 110          | 1             | 147          | 1             | 127          | 2             |

Appendix 8

Ingress of the bees into the hives (bee/minutes)

Treated field

| Date July<br>1999 | Code number of the hive |     |      |     |      |     |      |     |      |     |      |     |
|-------------------|-------------------------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|
|                   | 143                     |     | 48   |     | 65   |     | 15   |     | 30   |     | 46   |     |
|                   | t                       | ro  | t    | ro  | t    | ro  | t    | ro  | t    | ro  | t    | ro  |
| 07                | 13                      | 0   | 15   | 0   | 11   | 0   | 17   | 0   | 13   | 0   | 6    | 0   |
| 08                | 11                      | 1   | 14   | 2   | 12   | 0   | 15   | 2   | 16   | 0   | 4    | 0   |
| 09                | 18                      | 2   | 17   | 6   | 20   | 12  | 15   | 11  | 13   | 2   | 15   | 6   |
| 10                | 22                      | 7   | 20   | 2   | 21   | 2   | 17   | 3   | 16   | 3   | 16   | 4   |
| 11                | 26                      | 3   | 18   | 3   | 19   | 2   | 18   | 2   | 17   | 6   | 33   | 7   |
| 12                | 39                      | 2   | 20   | 2   | 23   | 0   | 20   | 4   | 21   | 11  | 30   | 4   |
| 13                | 19                      | 0   | 26   | 1   | 18   | 1   | 20   | 2   | 16   | 4   | 47   | 0   |
| 14                | 8                       | 0   | 11   | 3   | 18   | 0   | 24   | 0   | 14   | 0   | 31   | 3   |
| 15                | 34                      | 1   | 24   | 0   | 33   | 2   | 28   | 3   | 23   | 3   | 26   | 2   |
| 16                | 38                      | 0   | 31   | 0   | 25   | 0   | 32   | 2   | 24   | 1   | 38   | 3   |
| 17                | 34                      | 0   | 33   | 0   | 35   | 0   | 31   | 0   | 28   | 1   | 37   | 0   |
| 18                | 40                      | 0   | 35   | 0   | 35   | 0   | 30   | 0   | 31   | 0   | 36   | 0   |
| 19                | 41                      | 0   | 35   | 0   | 37   | 0   | 31   | 1   | 28   | 0   | 40   | 1   |
| Total             | 343                     | 16  | 299  | 19  | 307  | 19  | 298  | 30  | 260  | 31  | 359  | 30  |
| Average           | 26.4                    | 1.2 | 23.0 | 1.5 | 23.6 | 1.5 | 22.9 | 2.3 | 20.0 | 2.4 | 27.6 | 2.3 |

Legend: t - total, ro - red-orange pollen

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Cont'd appendix 8

Ingress of the bees into the hives (bee/minutes)

Control field

| Date July<br>1999 | Code number of the hive |     |      |     |      |     |      |     |      |     |      |     |
|-------------------|-------------------------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|
|                   | 75                      |     | 29   |     | 28   |     | 129  |     | 13   |     | 77   |     |
|                   | t                       | ro  | t    | ro  | t    | ro  | t    | ro  | t    | ro  | t    | ro  |
| 07                | 2                       | 0   | 35   | 0   | 46   | 3   | 19   | 0   | 10   | 0   | 27   | 0   |
| 08                | 4                       | 0   | 27   | 4   | 42   | 5   | 18   | 2   | 11   | 0   | 21   | 2   |
| 09                | 3                       | 1   | 31   | 7   | 23   | 10  | 28   | 7   | 22   | 4   | 27   | 9   |
| 10                | 9                       | 5   | 32   | 3   | 20   | 4   | 21   | 2   | 18   | 4   | 26   | 5   |
| 11                | 11                      | 5   | 38   | 0   | 24   | 2   | 38   | 0   | 33   | 7   | 16   | 1   |
| 12                | 20                      | 7   | 28   | 0   | 31   | 0   | 13   | 1   | 28   | 6   | 26   | 0   |
| 13                | 25                      | 3   | 39   | 2   | 22   | 0   | 25   | 0   | 22   | 1   | 22   | 0   |
| 14                | 24                      | 4   | 35   | 3   | 41   | 2   | 31   | 2   | 29   | 2   | 36   | 1   |
| 15                | 23                      | 7   | 40   | 2   | 37   | 2   | 31   | 2   | 22   | 0   | 30   | 0   |
| 16                | 28                      | 1   | 34   | 0   | 29   | 0   | 41   | 0   | 19   | 1   | 31   | 2   |
| 17                | 25                      | 2   | 31   | 0   | 36   | 0   | 28   | 0   | 24   | 0   | 29   | 0   |
| 18                | 21                      | 1   | 30   | 0   | 32   | 0   | 31   | 0   | 26   | 0   | 29   | 0   |
| 19                | 28                      | 0   | 41   | 0   | 38   | 0   | 21   | 0   | 27   | 0   | 30   | 0   |
| Total             | 223                     | 36  | 441  | 21  | 421  | 28  | 345  | 16  | 291  | 25  | 350  | 20  |
| Average           | 17.2                    | 2.8 | 33.9 | 1.6 | 32.4 | 2.2 | 26.5 | 1.2 | 22.4 | 1.9 | 26.9 | 1.5 |

Legend: t - total, ro - with red-orange pollenloads

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Appendix 9

Weight of the hives at the beginning and at the end of the experiment (kg)

| Treated field    |                          |  |             | Control field    |                          |  |             |
|------------------|--------------------------|--|-------------|------------------|--------------------------|--|-------------|
| Code No. of hive | At the placing (05 July) | At the end of the experiment (20 July) | Differences | Code No. of hive | At the placing (05 July) | At the end of the experiment (20 July) | Differences |
| 10               | 42.6                     | 53.3                                   | 10.7        | 13               | 35.0                     | 37.9                                   | 2.9         |
| 11               | 42.4                     | 43.6                                   | 1.2         | 28               | 41.5                     | 46.8                                   | 5.3         |
| 15               | 39.0                     | 43.0                                   | 4.0         | 29               | 38.5                     | 49.6                                   | 11.1        |
| 21               | 40.4                     | 48.8                                   | 8.4         | 33               | 41.0                     | 56.1                                   | 15.1        |
| 27               | 43.5                     | 51.9                                   | 8.4         | 45               | 40.0                     | 44.9                                   | 4.9         |
| 30               | 46.3                     | 44.6                                   | -1.7        | 64               | 47.7                     | 63.0                                   | 15.3        |
| 41               | 44.5                     | 46.8                                   | 2.3         | 69               | 37.5                     | 44.6                                   | 7.1         |
| 42               | 44.3                     | 52.1                                   | 7.8         | 75               | 43.5                     | 44.0                                   | 0.5         |
| 46               | 41.0                     | 41.4                                   | 0.4         | 77               | 44.0                     | 53.8                                   | 9.8         |
| 48               | 43.6                     | 50.6                                   | 7.0         | 94               | 37.9                     | 48.8                                   | 10.9        |
| 61               | 42.2                     | 53.5                                   | 11.3        | 109              | 38.1                     | 51.7                                   | 13.6        |
| 65               | 43.7                     | 47.7                                   | 4.0         | 122              | 41.1                     | 59.7                                   | 18.6        |
| 84               | 39.2                     | 44.2                                   | 5.0         | 129              | 42.8                     | 48.2                                   | 5.4         |
| 143              | 40.0                     | 41.7                                   | 1.7         | 137              | 42.2                     | 55.1                                   | 12.9        |
| 174              | 36.7                     | 45.0                                   | 8.3         | 175              | 37.6                     | 44.5                                   | 6.9         |
| Average          | 42.0                     | 47.2                                   | 5.3         | Average          | 40.6                     | 49.9                                   | 9.4         |
| SD               | 2.55                     | 4.25                                   |             | SD               | 3.24                     | 6.69                                   | -           |
| Total            | 629.4                    | 708.2                                  | 78.8        | Total            | 608.4                    | 748.7                                  | 140.3       |

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Appendix 10

Number of inhabited combs at the beginning and at the end of the experiment

| Treated field    |                             |  |             | Control field    |                             |  |             |
|------------------|-----------------------------|--|-------------|------------------|-----------------------------|--|-------------|
| Code No. of hive | Following placing (07 July) | At the end of the experiment (20 July) | Differences | Code No. of hive | Following placing (07 July) | At the end of the experiment (20 July) | Differences |
| 10               | 18                          | 14                                     | -4          | 13               | 15                          | 15                                     | 0           |
| 11               | 8                           | 12                                     | 4           | 28               | 30                          | 30                                     | 0           |
| 15               | 20                          | 20                                     | 0           | 29               | 16                          | 16                                     | 0           |
| 21               | 20                          | 24                                     | 4           | 33               | 20                          | 20                                     | 0           |
| 27               | 20                          | 20                                     | 0           | 45               | 14                          | 15                                     | 1           |
| 30               | 20                          | 18                                     | -2          | 64               | 28                          | 30                                     | 2           |
| 41               | 12                          | 14                                     | 2           | 69               | 15                          | 15                                     | 0           |
| 42               | 25                          | 25                                     | 0           | 75               | 30                          | 28                                     | -2          |
| 46               | 25                          | 25                                     | 0           | 77               | 30                          | 30                                     | 0           |
| 48               | 20                          | 20                                     | 0           | 94               | 14                          | 20                                     | 6           |
| 61               | 25                          | 30                                     | 5           | 109              | 20                          | 25                                     | 5           |
| 65               | 20                          | 20                                     | 0           | 122              | 22                          | 30                                     | 8           |
| 84               | 15                          | 15                                     | 0           | 129              | 20                          | 16                                     | -4          |
| 143              | 20                          | 19                                     | -1          | 137              | 22                          | 25                                     | 3           |
| 174              | 16                          | 16                                     | 0           | 175              | 14                          | 15                                     | 1           |
| Average          | 18.9                        | 19.5                                   | 0.5         | Average          | 20.7                        | 22.0                                   | 1.3         |
| SD               | 4.71                        | 4.96                                   | -           | SD               | 6.21                        | 6.47                                   | -           |
| Total            | 284                         | 292                                    | 8           | Total            | 310                         | 330                                    | 20          |

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Appendix 11

Number of the combs with brood and brood composition

Treated field

| Code No. of hive | Following placing (07 July) |      |      |      | At the end of the experiment (20 July) |      |      |      | Difference |      |     |     |
|------------------|-----------------------------|------|------|------|--|------|------|------|------------|------|-----|-----|
|                  | cb                          | ccb  | ucb  | e    | cb                                     | ccb  | ucb  | e    | cb         | ccb  | ucb | e   |
| 143              | 8                           | 52   | 31   | 21   | 8                                      | 70   | 21   | 18   | 0          | 18   | -10 | -3  |
| 48               | 5                           | 38   | 11   | 16   | 10                                     | 57   | 34   | 31   | 5          | 19   | 23  | 15  |
| 65               | 3                           | 0    | 19   | 8    | 9                                      | 47   | 27   | 26   | 6          | 47   | 8   | 18  |
| 15               | 9                           | 45   | 17   | 32   | 9                                      | 65   | 31   | 22   | 0          | 20   | 14  | -10 |
| 30               | 9                           | 73   | 39   | 5    | 10                                     | 64   | 28   | 22   | 1          | -9   | -16 | 17  |
| 46               | 9                           | 63   | 23   | 21   | 9                                      | 72   | 42   | 16   | 0          | 9    | 19  | -5  |
| Average          | 7.2                         | 45.2 | 23.3 | 17.2 | 9.2                                    | 62.5 | 29.7 | 22.5 | 2.0        | 17.3 | 6.3 | 5.3 |

Control field

| Number of hive | Following placing (07 July) |      |      |      | At the end of the experiment (20 July) |      |      |     | Difference |     |      |      |
|----------------|-----------------------------|------|------|------|--|------|------|-----|------------|-----|------|------|
|                | cb                          | ccb  | ucb  | e    | cb                                     | ccb  | ucb  | e   | cb         | ccb | ucb  | e    |
| 75             | 11                          | 69   | 36   | 17   | 3                                      | 18   | 17   | 5   | -8         | -51 | -19  | -12  |
| 29             | 7                           | 44   | 15   | 20   | 8                                      | 54   | 23   | 8   | 1          | 10  | 8    | -12  |
| 28             | 10                          | 67   | 39   | 23   | 10                                     | 87   | 35   | 10  | 0          | 20  | -4   | -13  |
| 129            | 7                           | 24   | 31   | 10   | 9                                      | 53   | 17   | 7   | 2          | 29  | -14  | -3   |
| 13             | 9                           | 51   | 36   | 17   | 9                                      | 65   | 24   | 4   | 0          | 14  | -12  | -13  |
| 77             | 14                          | 67   | 30   | 24   | 9                                      | 51   | 29   | 21  | -5         | -16 | -1   | -3   |
| Average        | 9.7                         | 53.7 | 31.2 | 18.5 | 8.0                                    | 54.7 | 24.2 | 9.2 | -1.7       | 1.0 | -7.0 | -9.3 |

Legend: cb - number of combs with brood, ccb - number patches with capped brood, ucb - number of patches with uncapped brood, e - number of patches with eggs

Remark: area of one patch is 1/8 part of the total comb area (cca 0,8 dm<sup>2</sup>)

Appendix 12

Number of dead bees in traps

Treated field

| Date<br>July 1999 | Code number of the hive |     |     |     |     |     |     |     |      |     |     |     |
|-------------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|------|-----|-----|-----|
|                   | 143                     |     | 48  |     | 65  |     | 15  |     | 30   |     | 46  |     |
|                   | w                       | d   | w   | d   | w   | d   | w   | d   | w    | d   | w   | d   |
| 07                | 10                      | 0   | 8   | 0   | 29  | 0   | 1   | 0   | 39   | 0   | 11  | 3   |
| 08                | 5                       | 0   | 7   | 0   | 13  | 0   | 5   | 0   | 44   | 7   | 2   | 0   |
| 09                | 2                       | 1   | 5   | 2   | 4   | 0   | 2   | 0   | 4    | 0   | 3   | 0   |
| 10                | 30                      | 0   | 9   | 0   | 9   | 0   | 2   | 0   | 0    | 0   | 10  | 0   |
| 11                | 2                       | 0   | 1   | 0   | 1   | 0   | 1   | 0   | 9    | 0   | 0   | 0   |
| 12                | 5                       | 0   | 4   | 0   | 1   | 1   | 6   | 0   | 1    | 0   | 2   | 0   |
| 13                | 6                       | 0   | 14  | 0   | 0   | 0   | 5   | 0   | 3    | 1   | 0   | 2   |
| 14                | 11                      | 0   | 24  | 0   | 7   | 0   | 7   | 0   | 0    | 0   | 8   | 0   |
| 15                | 9                       | 0   | 3   | 0   | 0   | 0   | 8   | 0   | 11   | 1   | 4   | 0   |
| 16                | 11                      | 0   | 2   | 0   | 0   | 0   | 8   | 0   | 17   | 0   | 0   | 0   |
| 17                | 0                       | 0   | 0   | 0   | 1   | 0   | 15  | 0   | 13   | 1   | 0   | 0   |
| 18                | 0                       | 2   | 1   | 0   | 1   | 0   | 3   | 0   | 3    | 0   | 0   | 1   |
| 19                | 0                       | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 4    | 0   | 1   | 0   |
| Total             | 91                      | 3   | 78  | 2   | 66  | 1   | 63  | 0   | 148  | 10  | 41  | 12  |
| Average           | 7.0                     | 0.2 | 6.0 | 0.2 | 5.1 | 0.1 | 4.8 | 0.0 | 11.4 | 0.8 | 3.2 | 0.9 |

Legend: w - worker, d - drone

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Cont'd appendix 12

Number of dead bees in traps

Control field

| Date<br>July 1999 | Code number of the hive |     |     |     |     |     |     |     |      |     |      |     |
|-------------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|------|-----|------|-----|
|                   | 75                      |     | 29  |     | 28  |     | 129 |     | 13   |     | 77   |     |
|                   | w                       | d   | w   | d   | w   | d   | w   | d   | w    | d   | w    | d   |
| 07                | 4                       | 0   | 5   | 0   | 0   | 0   | 15  | 0   | 22   | 3   | 1    | 0   |
| 08                | 0                       | 0   | 4   | 0   | 5   | 0   | 1   | 0   | 13   | 1   | 0    | 0   |
| 09                | 0                       | 1   | 1   | 0   | 2   | 0   | 12  | 0   | 6    | 0   | 6    | 0   |
| 10                | 2                       | 0   | 4   | 0   | 3   | 0   | 9   | 0   | 12   | 0   | 3    | 0   |
| 11                | 5                       | 1   | 7   | 0   | 0   | 0   | 8   | 0   | 7    | 1   | 14   | 0   |
| 12                | 3                       | 0   | 2   | 0   | 0   | 0   | 0   | 0   | 8    | 0   | 2    | 0   |
| 13                | 5                       | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 82   | 3   | 238  | 0   |
| 14                | 2                       | 0   | 3   | 0   | 3   | 0   | 0   | 0   | 2    | 0   | 3    | 0   |
| 15                | 0                       | 0   | 3   | 0   | 0   | 0   | 2   | 0   | 0    | 0   | 2    | 0   |
| 16                | 5                       | 0   | 12  | 0   | 5   | 0   | 1   | 0   | 9    | 0   | 12   | 0   |
| 17                | 9                       | 1   | 2   | 0   | 2   | 0   | 16  | 0   | 8    | 0   | 6    | 0   |
| 18                | 2                       | 0   | 2   | 0   | 1   | 0   | 4   | 0   | 17   | 0   | 4    | 0   |
| 19                | 0                       | 0   | 1   | 0   | 0   | 0   | 3   | 0   | 5    | 0   | 1    | 0   |
| Total             | 43                      | 3   | 46  | 0   | 21  | 1   | 74  | 0   | 191  | 8   | 447  | 0   |
| Average           | 3.3                     | 0.2 | 3.5 | 0.0 | 1.6 | 0.1 | 5.7 | 0.0 | 14.7 | 0.6 | 34.4 | 0.0 |

Legend: w - worker, d - drone

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Appendix 13

Meteorological data and soil moisture

Treated field

| Date<br>1999 | Temperature<br>(°C) | Relative<br>humidity (%) | Rain fall<br>(mm) | Wind velocity<br>(m/s) | Cloud cover<br>(%) | Soil moisture<br>(%) |
|--------------|---------------------|--------------------------|-------------------|------------------------|--------------------|----------------------|
| June 18      | -                   | -                        | 55                | -                      | -                  | -                    |
| June 19      | -                   | -                        | 0                 | -                      | -                  | -                    |
| June 20      | -                   | -                        | 0                 | -                      | -                  | -                    |
| June 21      | -                   | -                        | 25                | -                      | -                  | 32.53                |
| June 22      | -                   | -                        | 24                | -                      | -                  | -                    |
| June 23      | -                   | -                        | 5                 | -                      | -                  | -                    |
| June 24      | -                   | -                        | 0                 | -                      | -                  | -                    |
| June 25      | -                   | -                        | 0                 | -                      | -                  | -                    |
| June 26      | -                   | -                        | 0                 | -                      | -                  | -                    |
| June 27      | -                   | -                        | 0                 | -                      | -                  | -                    |
| June 28      | -                   | -                        | 0                 | -                      | -                  | 26.38                |
| June 29      | -                   | -                        | 0                 | -                      | -                  | -                    |
| June 30      | -                   | -                        | 0                 | -                      | -                  | -                    |
| July 01      | -                   | -                        | 0                 | -                      | -                  | -                    |
| July 02      | -                   | -                        | 0                 | -                      | -                  | -                    |
| July 03      | -                   | -                        | 0                 | -                      | -                  | -                    |
| July 04      | -                   | -                        | 0                 | -                      | -                  | -                    |
| July 05      | 22.6                | 81                       | 0                 | 0.00                   | 0                  | 19.83                |
| July 06      | 23.9                | 77                       | 0                 | 0.11                   | 0                  | -                    |
| July 07      | 28.1                | 65                       | 0                 | 0.61                   | 40                 | -                    |
| July 08      | 25.4                | 87                       | 17                | 0.47                   | 70                 | -                    |
| July 09      | 23.2                | 68                       | 0                 | 0.00                   | 100                | -                    |
| July 10      | 24.1                | 73                       | 64                | 0.03                   | 100                | -                    |
| July 11      | 25.3                | 73                       | 1                 | 0.13                   | 40                 | -                    |
| July 12      | 25.4                | 86                       | 0                 | 1.07                   | 30                 | 30.26                |
| July 13      | 27.2                | 79                       | 4                 | 0.90                   | 25                 | -                    |
| July 14      | 25.4                | 75                       | 0                 | 0.90                   | 10                 | -                    |
| July 15      | 24.6                | 57                       | 3                 | 1.97                   | 40                 | -                    |
| July 16      | 24.1                | 81                       | 0                 | 0.82                   | 0                  | -                    |
| July 17      | 26.3                | 60                       | 0                 | 0.06                   | 10                 | -                    |
| July 18      | 26.8                | 58                       | 0                 | 0.06                   | 10                 | -                    |
| July 19      | 28.3                | 52                       | 0                 | 0.01                   | 10                 | 17.12                |
| July 20      | 23.9                | 80                       | 0                 | 0.00                   | 10                 | -                    |

cont'd Appendix 13

Meteorological data and soil moisture

Control field

| Date<br>1999 | Temperature<br>(°C) | Relative<br>humidity (%) | Rain fall<br>(mm) | Wind velocity<br>(m/s) | Cloud cover<br>(%) | Soil moisture<br>(%) |
|--------------|---------------------|--------------------------|-------------------|------------------------|--------------------|----------------------|
| June 18      | -                   | -                        | 56                | -                      | -                  | -                    |
| June 19      | -                   | -                        | 0                 | -                      | -                  | -                    |
| June 20      | -                   | -                        | 0                 | -                      | -                  | -                    |
| June 21      | -                   | -                        | 25                | -                      | -                  | 34.08                |
| June 22      | -                   | -                        | 25                | -                      | -                  | -                    |
| June 23      | -                   | -                        | 5                 | -                      | -                  | -                    |
| June 24      | -                   | -                        | 0                 | -                      | -                  | -                    |
| June 25      | -                   | -                        | 0                 | -                      | -                  | -                    |
| June 26      | -                   | -                        | 0                 | -                      | -                  | -                    |
| June 27      | -                   | -                        | 0                 | -                      | -                  | -                    |
| June 28      | -                   | -                        | 0                 | -                      | -                  | 22.57                |
| June 29      | -                   | -                        | 0                 | -                      | -                  | -                    |
| June 30      | -                   | -                        | 0                 | -                      | -                  | -                    |
| July 01      | -                   | -                        | 0                 | -                      | -                  | -                    |
| July 02      | -                   | -                        | 0                 | -                      | -                  | -                    |
| July 03      | -                   | -                        | 0                 | -                      | -                  | -                    |
| July 04      | -                   | -                        | 0                 | -                      | -                  | -                    |
| July 05      | 23.1                | 82                       | 0                 | 0.00                   | 0                  | 19.11                |
| July 06      | 24.2                | 78                       | 0                 | 0.02                   | 0                  | -                    |
| July 07      | 27.3                | 61                       | 0                 | 0.65                   | 40                 | -                    |
| July 08      | 23.3                | 81                       | 18                | 0.00                   | 80                 | -                    |
| July 09      | 29.3                | 69                       | 1                 | 0.60                   | 100                | -                    |
| July 10      | 25.3                | 67                       | 68                | 0.33                   | 100                | -                    |
| July 11      | 26.5                | 66                       | 9                 | 1.45                   | 40                 | -                    |
| July 12      | 25.9                | 83                       | 7                 | 1.02                   | 100                | 28.37                |
| July 13      | 28.2                | 58                       | 9                 | 1.12                   | 35                 | -                    |
| July 14      | 27.2                | 83                       | 0                 | 1.10                   | 60                 | -                    |
| July 15      | 25.5                | 59                       | 3                 | 2.45                   | 40                 | -                    |
| July 16      | 24.6                | 64                       | 0                 | 2.55                   | 10                 | -                    |
| July 17      | 26.9                | 62                       | 0                 | 0.11                   | 30                 | -                    |
| July 18      | 26.9                | 55                       | 0                 | 0.09                   | 10                 | -                    |
| July 19      | 26.2                | 70                       | 0                 | 0.02                   | 10                 | 16.26                |
| July 20      | 29.8                | 35                       | 0                 | 0.13                   | 10                 | -                    |