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Project 85-N1 - Tree and Crop Research
Resistance Mechanisms of Honeybees to the Varroan Mite

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I. OBJECTIVES:

Take two-month trip (June - July, 1985) to People's Republic of China to conduct a preliminary cooperative research project with the scientists of the Chinese Apicultural Research Institute, Academy of Agricultural Sciences at Beijing (Peking). The project will study: (1) Resistance mechanism of the Asian honeybee (Apis cerana) to the parasitic mite, Varroa jocobsoni; (2) Management of European bee (A. millifera) for mite control; and (3) Possible existance to Varroan-resistant European bees in China.

II. INTERPRETIVE SUMMARY:

(1) Resistant mechanism of the Asian Honey bee

It has been observed that the Varroan mites, when inoculated on to the adult worker bees or brood, could induce their hosts and other bees to show a series of behavioral responses. The parasitized worker bees may demonstrate an initial self-cleaning behavior in an attempt to remove the mites from their bodies. If such a self-cleaning behavior failed, the bees would perform a grooming dance to get attention from their nestmates. Other bees would examine the parasitized bees first, then were able to detect and recognize the parasites wtihin a few seconds. Subsequently, they removed the mites from the parasitized bees with their strong jaws. Our observations showed that 70% of the inoculated mites were removed from their hosts by the self-and group-cleaning behavior within 2 minutes. Furthermore, 80% of the mites, after being removed by the bees had injuries on their bodies or legs, and 98% of these mites would die on the first two days after being removed from the hive. Therefore, our observations strongly suggest that the cleaning behavior of the Asian bees play a major role in the mite resistant mechanism. Some European honey bees (Apis mellifera), although also attempted to remove the parasites by self-cleaning behavior, the frequency of performing self-cleaning behavior was significantly lower. The majority of the nestmates also failed to detect and recognize the mites or failed to remove the mites from the adult bees as well as from the brood.

(2) Mite control in the European honey bees

Numerous insecticides and miticides have been used in the past to control the Varroan mite in China. Among the more successful ones are: phenothiazine, chlorfenson (ovotran), chlordimeform (galecron), qukron and folbex. However, none of these chemicals could control the mites effectively. Amitraz is presently being tested in the field as a candidate chemical for mite control. The preliminary data obtained by the Chinese Institute of Apicultural Research appeared to be promising.

The Chinese Institute of Apicultural Research recommends that two chemical treatments should be given to each bee colony. The spring treatment is given at the first of April when the mite population begins to reach its first peak, and the second treatment should be given in the mid of August when bee population declines. The second treatment can also reduce the population of Tropilaelaps clareae, another external parasitic mite of the honey bees. Separation ofthe brood from the adult bees prior to the chemical treatment is also recommended.

(3) Varroa-resistant European bees:

The Chinese Institute of Apicultural Research has obtained interesting data suggesting that it is very likely that some mite-resistant lines of European bees might have developed along the coastal provinces in China during the past two decades when the Varroan mites rampaged through these provinces. Research effort to identify and breed these lines of bees is being considered and will probably be carried out in the near future.

III. EXPERIMENTAL PROCEDURE:

Observation colonies of both Asian and European honey bees were established in glass-observation hives and placed in the observation room. Two days before the observation was conducted, 60 worker bees in each observation hive were marked with color-and number coded tags for individual identification. Adult female mites were collected from infested European bee colonies in the field. For observing the cleaning behavior of the adult worker bees, 30 mites were inoculated on to the thoraxes of 30 adult worker bees in the observation hive. The bees' behavioral responses were observed for a period of two hours. Thirty mites were also inoculated on to 30 larvae in the brood cells for observing how the mite was removed from the lava by the adult worker bees. Small pieces of filter paper were placed on the brood and used as the control.

Hemolymph of healthy and parasitized bees in different developmental stages of both bee species were collected. The protein differences were compared by electrophoresis.

IV. RESULTS AND DISCUSSION:

The results of the experiment were summarized in Tables 1 and 2, Figures 1, 2, and 3.

Our observations clearly indicated that the Asian worker bees could effectively remove the parasitic mites from the parasitized adult bees as well as the brood by their grooming behavior. The European bees although showed a similar behavioral response generally failed to remove the mites from the bees' bodies. Since the cleaning potential does exist in the European bees, it would be possible in the future to breed resistant lines in the European honey bees for the control of the Varroan mite.

V. PUBLICATIONS:

Peng, Y. S., Fang, Y., Hsu, I., and Grei, L. The resistance mechanism of the Asian honey bee (Apis cerana Fabr.) to its ectoparasitic mite (Varroa jacobsoni Oudemans). (In preparation).

_____ The control of Varroan mite in China. (In prepartation).

Table 1. The behavioral responses of *A. mellifera* adult worker bees to the innoculated mites (mite/bee) *V. jacobsoni*

Behavioral Responses	% Mite				
	Hive 1	Hive 2	Hive 3	Hive 4	Average
1. Cleaning behavior					
a. attempts	26.32	12.00	12.12	16.00	16.61
b. success	0.00	0.00	0.00	0.00	0.00
2. Mite move to other bees or on comb	31.58	8.00	0.00	0.00	8.25
3. Found at end of observation	68.42	72.00	63.64	70.00	68.52
4. Mites lost at end	0.00	20.00	36.36	30.00	
Total no. observed	19	25	33	20	
Observation time (min)	60	140	140	140	

Table 2. Data of mites which had been bitten by worker *A. cerana* and collected from hives.

Observation	Observation Hives		Field Colonies	
	No. Mites	%	No. Mites	%
1. Total no mites observed	42		30	
2. Died on 1st day	19	45.24	16	53.33
3. Injured mites	31	73.81	24	80.00
a. Genital shield	15	35.71	3	10.00
b. Other ventral shields	8	19.06	1	3.33
c. Appendages	2	4.76	7	23.33
d. Dorsal Idosoma	5	11.90	9	30.00
e. Bleeding	1	2.38	4	13.33
4. Without noticeable injury and alive on 1st day	11	26.19	6	20.00
5. Died on 2nd day	21	50.00%	13	43.33
6. Mite alive on 2nd day	2	4.75%	1	3.33

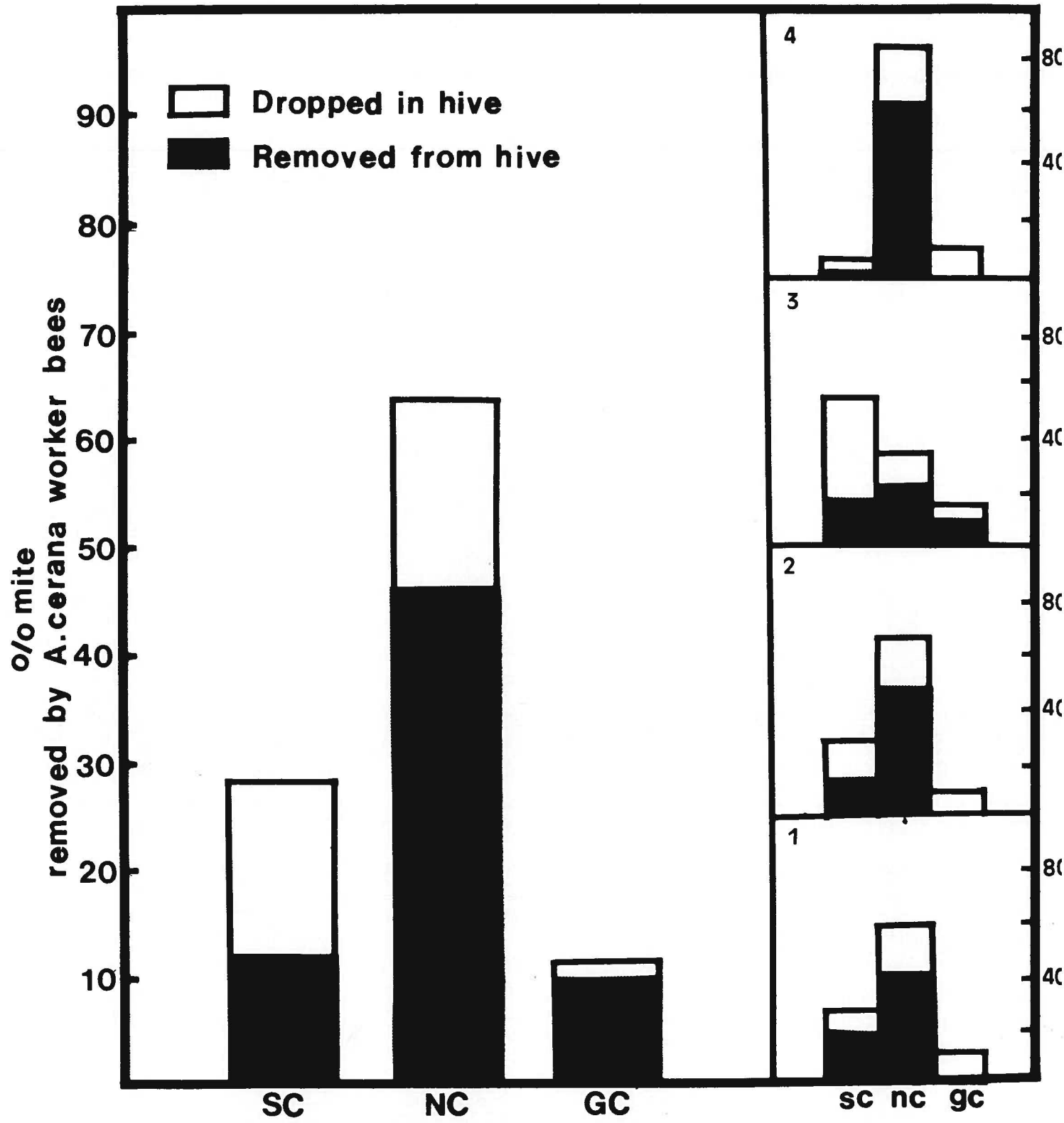
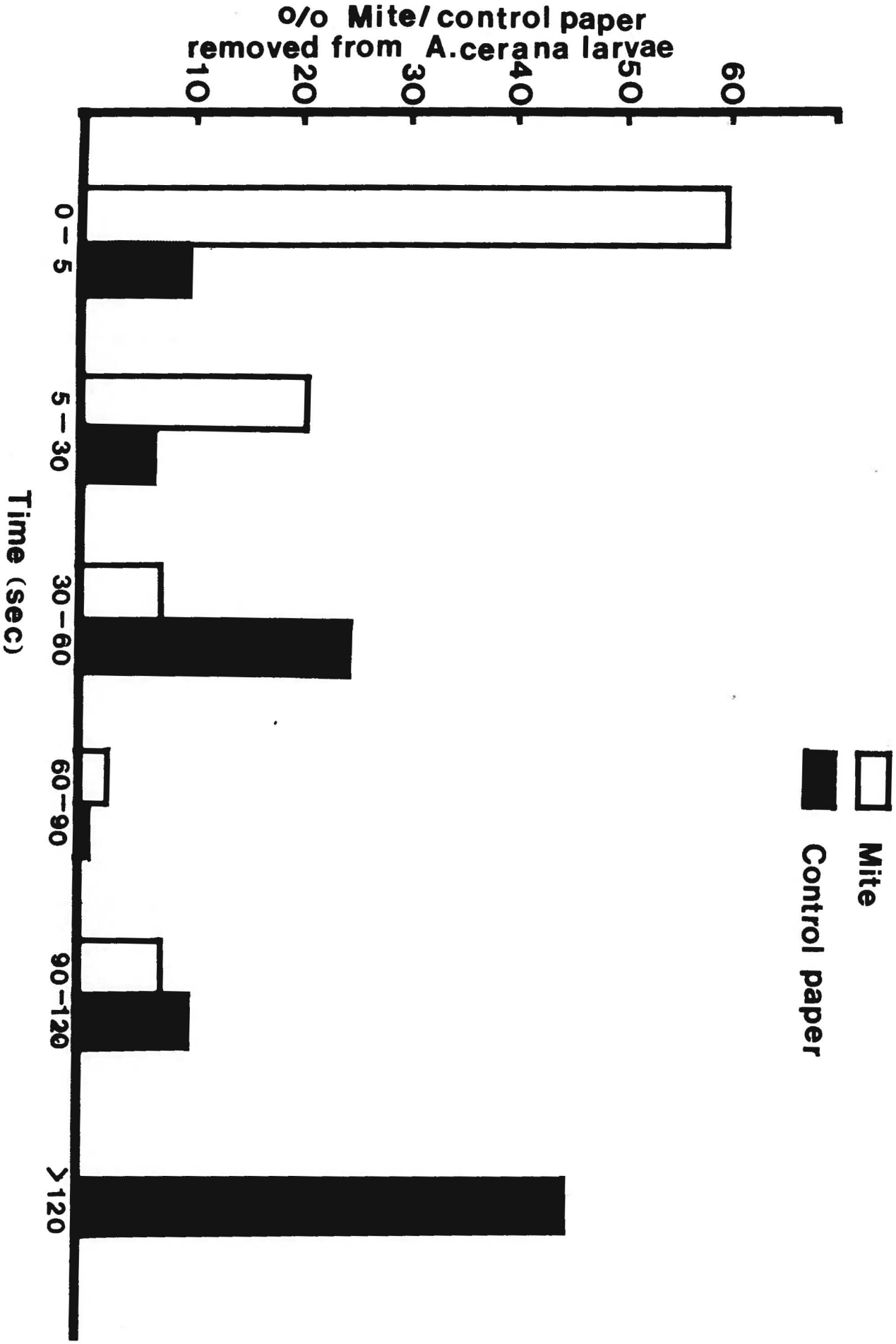
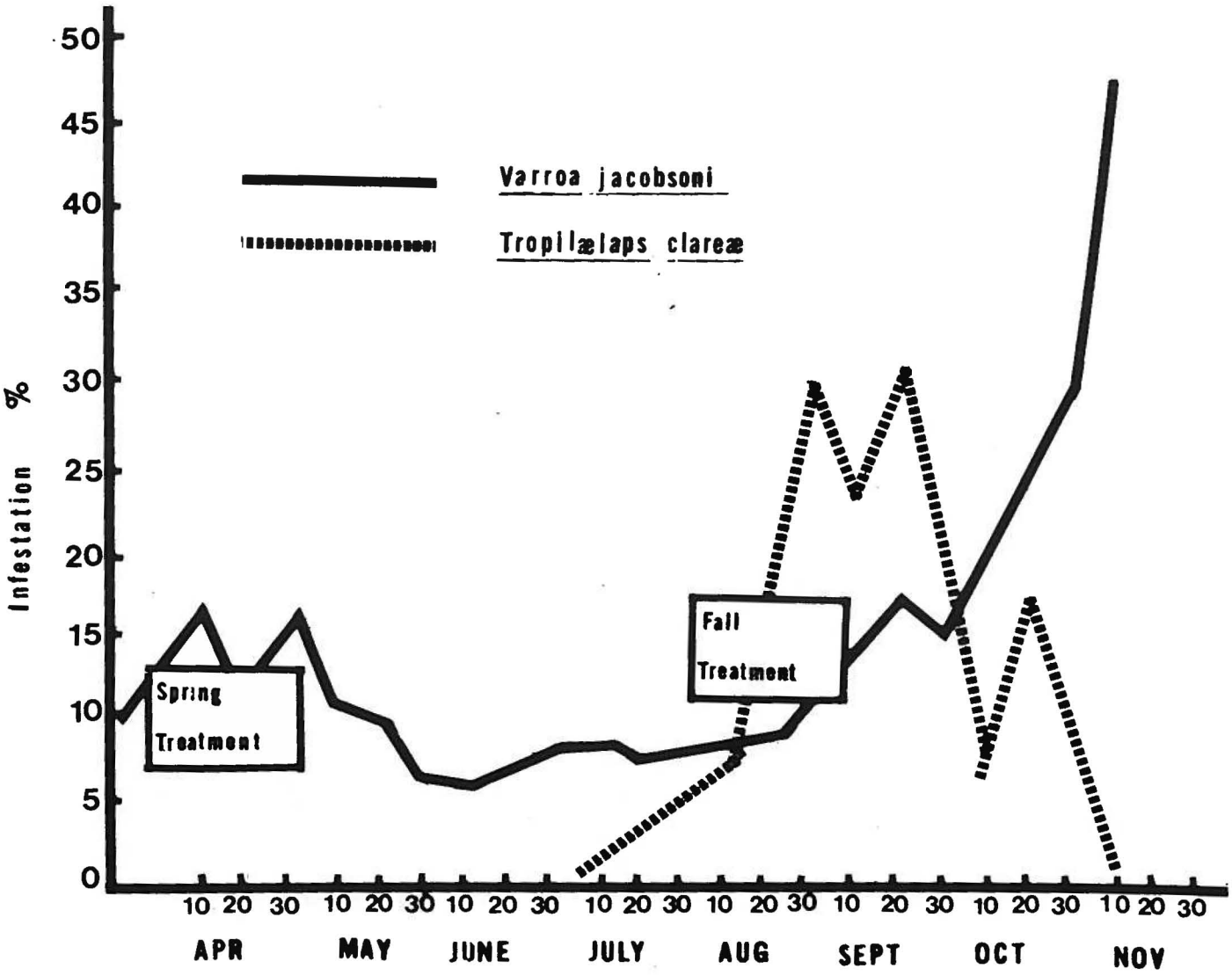

Dropped in hive
Removed from hive
o/o mite removed by A.cerana worker bees
90
80
70
60
50
40
30
20
10
SC
NC
GC
4
3
2
1
sc nc gc

Fig. 1.

Fig. 2.


% Mite/ control paper removed from A.cerana larvae
10
20
30
40
50
60
0 — 5
5 — 30
30 — 60
60 — 90
90 — 120
>120
Time (sec)
Mite
Control paper



Mite population in Apis mellifera colonies

Fig. 3.