

COMPETITION BETWEEN DRONES AND BETWEEN SPERMATOZOA OF *APIS CERANA* AND *APIS MELLIFERA*

Jerzy WILDE¹, Jerzy WOYKE², Maria WILDE

Dabur Apicultural Centre, Jugedi, Chitwan, Nepal

¹ Apiculture Division, WM University, Sloneczna 48, 10-957 Olsztyn, Poland,
jurwild@uwm.edu.pl

² Apiculture Division, Agricultural University, Nowoursynowska 166, 02-787 Warsaw, Poland

Abstract

We investigated the result of insemination of *A. mellifera* queens with semen of *A. cerana* and *A. mellifera*. The time of drone flights of both species was observed. The number of drones leaving the hives during 5 min was counted every 15 min. Next 8 black *A. mellifera carnica* queens were instrumentally inseminated with semen of yellow (dominant) *A. mellifera ligustica* drones. Two control queens were inseminated exclusively with 4 mm³ of *A. mellifera* semen. The next 6 queens were inseminated with 1 mm³ of *A. mellifera* semen, and additionally per 2 queens with 0.2 mm³, 1.0 mm³ and 2 – 4 mm³ of *A. cerana* semen. After the queens started oviposition, the presence of eggs was checked daily during 2 weeks. The results showed that the time of drone flights of *A. cerana* and *A. mellifera* overlapped in Chitwan. The average survival rate of eggs was 94.6% in the control group of *A. mellifera* queens inseminated with semen of the same species. However, the survival was 77.5%, 76.0% and 47.6% respectively in *A. mellifera* queens inseminated additionally with 0.2 mm³, 1.0 mm³, and 2 – 4 mm³ of *A. cerana* semen. Insemination of queens with spermatozoa of two species of drones results in decreased survival of eggs.

Introduction

A. cerana and *A. mellifera* live in the same places in several Asian countries. The drone congregations areas of *Apis cerana* is different for *A. mellifera* but showed a high degree of variability (Ruttner et al. 1972, Ruttner 1973, Punchiheva et al. 1990, Fujiwara et al. 1994, Yoshida 1994, Koeniger & Koeniger 2001). Yoshida (2001) captured some *A. cerana japonica* drones in an *A. mellifera* drone congregation area. *A. cerana* exhibits also more variability in drone flight period than other *Apis* species (Koeniger & Koeniger 2001). The drone flight time for the two species, *A. mellifera* and *A. cerana*, partially overlapped (Yoshida 2001). Therefore the problem of mating competition between drones of different

species arises. According to Yoshida (2001) 11 (73%) and 17 (85%) queens mated interspecifically in years 1998 and 1999, respectively. We found also naturally mated queens at Dabur Apiculture Center in Nepal, laying eggs, which did not hatch (Wilde, unpublished data). Therefore interesting is the result of insemination of queens of one species with mixed semen of both species, on the development of honeybee colonies.

Materials and Methods

The investigations were conducted in years 1999-2000 in Nepal in Chitwan district. The time of drone flights of *A. mellifera* and *A. cerana* was observed. The number of drones leaving the hives during 5 min was counted every 15 min. Next, 8 black *A. mellifera carnica* queens were instrumentally inseminated with semen of yellow (dominant) *A. mellifera ligustica* drones. Two control queens were inseminated exclusively with 4 mm³ of *A. mellifera* semen. The next 6 queens were inseminated with 1 mm³ of *A. mellifera* semen, and additionally per 2 queens with 0.2 mm³, 1.0 mm³ and 2 – 4 mm³ of *A. cerana* semen. After the queens started oviposition, the survival of eggs was checked daily during 2 weeks. The colour of emerging workers was also determined. Sealed brood in small nuclei combs were put separately into wire mesh isolators, and were located in an incubator. Each comb were put in separately cage with mesh. All emerged workers were counted and the body colour was determined.

Results and discussion

The results showed that the time of drone flights of *A. cerana* and *A. mellifera* overlapped in Chitwan (figure). The drones flight time overlapped between 13,15 and 15,00, only. The results are similar to those presented by Yoshida (2001). Thus, drones of both species could mate queens of one species.

The average survival rate of eggs was 94.6%, ranging from 91.3 to 96.0% in the control group of *A. mellifera* queens inseminated with semen of the same species (table). The survival rate in *A. mellifera* queens inseminated additionally with 0.2 mm³ of *A. cerana* semen was 77.5% and ranged from 64.6 to 87.9%. The survival in *A. mellifera* queens inseminated additionally with 1.0 mm³ of *A. cerana* semen was 76.0%, and ranged from 66.7 to 75.7%. The lowest survival rate was found in *A. mellifera* queens inseminated additionally with 2 and 4 mm³ of *A. cerana* semen, - 53.8 and 41.0% respectively. Thus increased share of

semen of the other species resulted in decreased survival rate of eggs. Emerged workers were yellow coloured, which indicates, that their fathers were *A. mellifera ligustica* drones. We suggest that *A. mellifera* eggs, which did not survive, were fertilized by *A. cerana* spermatozoa. It is known that such eggs do not hatch. Thus, insemination of queens with spermatozoa of two species of drones results in decreased survival of eggs.

Acknowledgements

We would like to thank very much the chairman of Dabur Enterprise Mr A. C. Burman for providing us the facilities and Mr R. Kolasiński for organizing our stay.

References

- Fujiwara S., Miura H., Kumagai T., Sawaguchi T., Naya S., Goto K.T. Suzuki K. 1994. Drone congregation of *Apis cerana japonica* in an open area over larger tree (*Zelkovia serrata*). *Apidologie* 25: 331-337.
- Koeniger N., Koeniger G. 2001. Behavioral mating barriers among sympatric species of the genus *Apis*. Proceedings of the 7th IBRA Conference on tropical Bees: Management and Diversity & 5th Asian Apiculture Association Conference. 19-25 march 2000, Chiang Mai, Thailand. IBRA: 79-85.
- Punchiheva R.W.K., Koeniger N., Koeniger G. 1990. Congregation of *Apis cerana indica* drones in the canopy of trees in Sri Lanka. *Apidologie* 16: 201-208.
- Ruttner F. 1973. Drohenen of *Apis cerana* auf einem Drohenensammelplatz. *Apidologie* 4: 41-44.
- Ruttner F., Woyke J., Koeniger N. 1972. Reproduction in *Apis cerana*. 1. Mating behaviour. *Journal of Apicultural Research* 11: 141-146.
- Yoshida T. 1994. Differences in drone congregation areas of native *Apis cerana japonica* Rad. and introduced *A. mellifera* L. *Japanese Journal of Applied Entomology and Zoology* 39: 85-90.
- Yoshida T. 2001. Coexistence of introduced *Apis mellifera* and indigenous *Apis cerana japonica* adaptation of European honeybees to new habitat. Proceedings of the 7th IBRA Conference on tropical Bees: Management and Diversity & 5th Asian Apiculture Association Conference. 19-25 march 2000, Chiang Mai, Thailand. IBRA: 113-114.

Table. Survival rate of eggs of *A. mellifera* queens inseminated with semen of *A. cerana* and *A. mellifera*

Tape of insemination	Queen No	No layed eggs	No disappeared eggs	Survival rate
Control - with semen of <i>A. mellifera</i>	1	1082	43	96.0
	2	714	62	91.3
	Total	1796	105	
	Average	898	52.5	94.2
additionally with 0.2 mm ³ of <i>A. cerana</i> semen	57	543	192	64.6
	59	1633	197	87.9
	Total	2176	389	
	Average	1088	194.5	82.1
additionally with 1.0 mm ³ of <i>A. cerana</i> semen	56	996	242	75.7
	58	865	288	66.7
	Total	1861	530	
	Average	930.5	265	71.5
additionally with 2 mm ³ of <i>A. cerana</i> semen	16	1431	661	53.8
additionally with 4 mm ³ of <i>A. cerana</i> semen	18	1414	834	41.0
	Total	2845	1495	
	Average	1422.5	747.5	47.5

Each queen was inseminated with 1 mm³ of semen from yellow (dominant) *A. mellifera ligustica* drones. Queens of the control group were inseminated with 4 mm³ *A. mellifera* semen

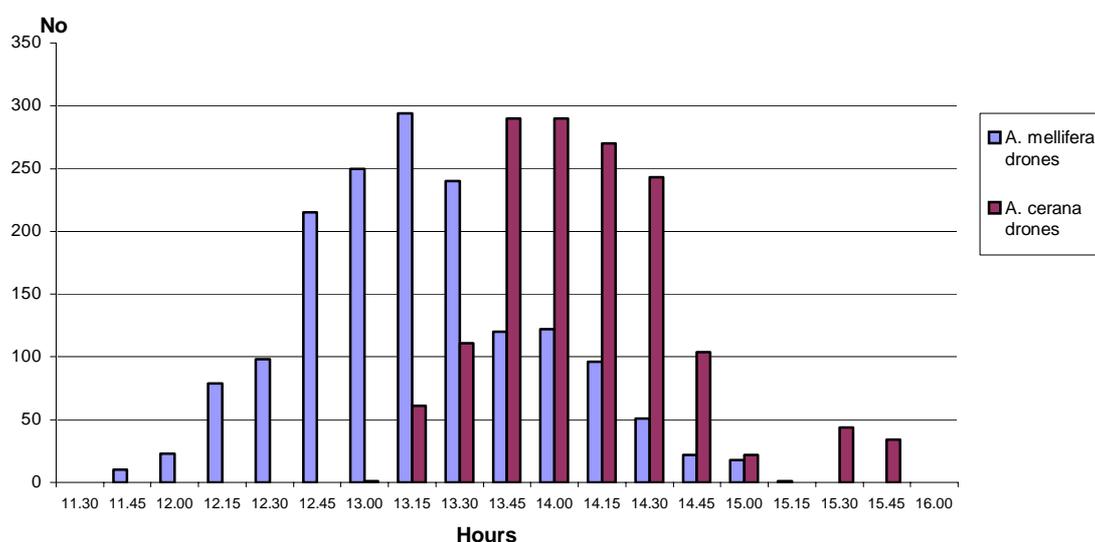


Figure. Drones of *Apis mellifera* and *Apis cerana* flying out of hives in Chitwan District, Nepal, during 8-18 November 1999