بسم الله الرحمن الرحيم

Title: Study of various comb-space on the Sudanese honeybee activities

By: Faiza H.M.Akasha[١], Sayid El-Bashir.M.[٢] and M.S.A El-Sarrag[٣]

Abstract:

Twelve Sudanese honeybee colonies in Langstroth hives were kept in Khartoum State during the period December 2000 to September 2002. Each colony started with 5 combs full of bees, without brood or stored food considered as artificial swarm. They were divided into four groups using different types of comb-space which was extrapolated from the results of the filed data measurement of natural nests compared with native apiaries measurements. Groups A, B, C and D were provided with comb-space 32.0, 33.0, 34.0 and 40.0 mm respectively. Colonies of groups A, B and C produced significantly larger amounts of brood area, higher population density, greater quantities of pollen, honey and wax and showed complete colony settlement 100 % compared to the control group D which was 50 % and with less production. Colonies of groups A, B and C built their combs correctly compared with group D which built poor combs. Wax weight of newly built combs 10.52 $\pm$ 0.37 gm/dm^2 and 18.51 $\pm$ 0.13 gm/dm^2 for worker and drone brood combs respectively.

Introduction:

---

[١]Part of Ph.D Thesis, University of Khartoum.

[٢] Professor (Supervisor). Department of Crop Protection, Faculty of Agriculture, University of Khartoum.

[٣] Professor (Co-supervisor) Department of Crop Protection, Faculty of Agriculture, University of Khartoum.

The present study aimed to highlight the variations of comb-space by adapting the natural measurements to improve the faults. Also to rectify the existing equipments used by the natives inorder to ease or eliminate undesirable measurements.The honeybees can thrive well in many types of natural sites and primitive types of man-made structures, it is however for best and probable future needs.

Material And Methods:

Sixteen feral colonies of Sudanese honeybee with open-mated queens were considered as artificial swarms. All brood combs and stored food were removed without wax foundation or drawn combs, they were provided with wired HM-frames (26.0mm width of top-bar) and hive-space 5.47mm, brood chambers were all empty. Each colony thus had 1.140 m^2 of empty comb surface area (CSA) then hived in Langstroth hives. The colonies were about five combs each. They were divided into four groups, four colonies/group, according to the comb-space which was extrapolated from the results of the field data measurements of natural nests.Groups were prepared as: 32.0mm, 33.0mm, 34.0mm and 40.0mm comb-space for A, B, C and D (controrl) respectively. Supers were added for each group when colony population increases.

Biological And Behavioural Techniques:

The methods used for evaluating behaviour of the honeybees were variable. Laidlaw (1958) evaluated the behaviour of the honeybee colonies in a descriptive manner. Observations or manipulations. A series of parallel columns headed by a space for the data the observations were recorded in terms of rating numbers (1 to 5); with (1) being the poorest and (5) the best. In some cases measurements were recorded in terms of combs. The following parameters were considered.

1. For estimating the rate of brood reared by each tested colony of the worker and drone brood areas were counted separately. The technique of Jeffree (1958) was adopted to measure brood area by using a wired grid (13.5 × 7.41 in.). The area (100 sq. in.) was divided by closed curves into 10 parts; these in turn were sub-divided by 10 intersecting curves giving a total of 100 areas each of 1 sq. inch. By this method, brood and pollen stored were estimated rapidly within an approximate standard error of 3.7%. Results were expressed in square dm.

2. Strength of colonies was estimated in terms of combs covered with bees (C/B) from both sides.

3. The amounts of pollen grains stored in the cells were estimated according to Jeffree (1958) and results were expressed in (dm2).

4. Honey reserves were estimated at 13 day intervals. The surplus honey was estimated in g/colony.

5. The amounts of produced wax were estimated according to Jeffree (1958) and the results were expressed in g/colony.

Results

1. Worker Brood Area:

Comparisons were made between the amounts of worker brood produced by the experimental colonies of groups (A), (B), (C) and (D) the results were presented in (Fig 1). All the tested colonies have in general shown a seasonal pattern in their brood rearing activity. Two colonies migrated from group (D). The overall means of the amount of brood reared were (34.59±17.40 dm^2), (33.80±18.52 dm^2), (32.26±18.72 dm^2) and (19.31±9.28 dm^2), for the groups (A), (C), (B) and (D) respectively. It is clear that the tested colonies of groups (A), (B) and (C) significantly reared the largest numbers of workers during the whole experimental period than group (D), but the differences between the three groups (A), (B) and (C)

was not significant. Colonies of group (D) reared significantly less amount of worker brood. Group (A) surpassed the other groups (B, C and D) in the amount of brood reared and in the daily worker brood rearing rate. It was found that the mean total worker brood reared by groups (A, B and C) colonies during the second year was greater than that reared by the same colonies during the 1st year.

2. Drone Brood Area

The areas of drone brood rearing were measured in the different colonies (Fig.2). The overall means of drone brood rearing were (1.93±1.59 dm^2), (1.75±1.52 dm^2), (1.50±1.33 dm^2) and (1.41±1.02 dm^2), for groups (C), (A), (B) and (D) respectively. Colonies of group (C) reared significantly higher numbers of drone brood than colonies of group (B) and (D). Colonies of group (A) reared significantly larger amounts than group (D). The differences between colonies of group (C) and group (A) was not significant. It was observed that many colonies extended the brood rearing activity to the early April/2002 but in small areas.

3. Population Density

The colony strength was estimated during the experimental period (Fig.3). All the colonies under study showed a similar trend in their population growth. The overall means of the colony strength were (7.95±2.63), (7.67±2.57), (7.55±2.56) and (5.66±1.78) combs filled with bees C/B, for groups (A), (C), (B) and (D) respectively. The population reared by colonies of groups (A), (B), and (C) was significantly larger than group (D). The differences between groups (A), (B), and (C) were not significant, but between the three groups (A, B and C) and group (D) was significant.

4. Pollen Collection:

The amounts of pollen collected and stored by the colonies under study are presented in (Fig. 4). Colonies started strongly collecting and storing pollen from *Acacia spp.* and citrus trees. They increased gradually during rainy months, reaching their peaks during winter months and drops occurred during summer months. The overall means of amount of collected and stored pollen were (6.72±4.01 dm^2), (6.68±4.57 dm^2), (5.82±4.35 dm^2) and (3.03±1.93 dm^2) for the groups (C), (A), (B) and (D) respectively. Colonies of groups (A), (B) and (C) collected and stored significantly higher quantities of

pollen than group (D), but the differences between the three groups (A, B and C) was not significant.

5. Honey Yield

Comparison of the amount of surplus honey produced by the treated colonies were determined at the end of each nectar flow period during the whole experimental period, it was observed that there were two peaks/year. The overall means of the produced honey were (2325.80 ± 7.42), (2147.86 ± 6.76), (1999.39± 7.28) and (515.03±1.22) g/colony for the groups (A), (B), (C) and (D) respectively (Fig. 5). Colonies of groups (A), (B) and (C) produced significantly higher quantities of honey compared with group (D).

6. Wax Working

The quantities of wax produced from the studied colonies are shown in (Fig. 6). It was observed that all the colonies built their natural combs after they were provided with suitable Hoffman-frame self spacing and the bee-space. No foundation was furnished to these colonies, bees built small pieces of combs started at different points (1-3 point) on the same top-bar of HM-frame self spacing (Plate 1). While colonies of group (D)

built poor combs, which tied together resulted in bad comb construction (Plate 2). The overall means of secreted wax were (10.87±6.28), (10.0±8.05), (7.73±7.18) and (7.04±7.45) CSA/dm^2 for the groups (C), (D), (B), and (A) respectively. It was observed that, there was a positive correlation between the number of workers present in a colony plus amount of incoming food and the amount of wax secreted for comb building. It was observed that wax working initiated at the beginning of study and reached its maximum during nectar flow period, and stopped during April to August.

It was found that the new built comb was unused neither for rearing nor for storing food the wax weight of worker brood was 10.52±0.15 g/dm^2 and for drone brood combs was 18.53±0.32 g/dm^2.

Discussion

The treatment based on extrapolated measurements taken from field observations .Svensson *et al* (1988) defined the comb-space as the space occupied by one comb plus the space between two combs. Naturally comb-space (width of end-bar) was found 32.0 mm (1.26 in.) in Sudan for both White Nile and Western Darfur States. Walton (1975) reported that, intentionally

accepted end-bar width of 34.90 mm (1.37 in.). This appears to be slightly greater than the natural spacing used by the bees in the Sudanese honeybee colonies. Walton (1974) claimed that, New Zealand has adopted 33.0 mm as the width HM- frame. Also he added spacing of 32.0–33.0mm between brood combs was best for Italian hybrid and Carniolan bees with few strains that had spacing of 35.0 mm. Taber and Owens (1970) said that, the bee-space plus comb thickness increased with increasing population from 31.80 –38.10 mm. The later including drone and honey combs. Guy (1975) and Fichtl (1994) stated that, African bees must be spaced 32.0 mm from centre to centre. The results obtained from colonies of groups A, B and C significantly surpassed group D in the amount of brood reared, population growth, pollen collection, honey production and wax production. Also colonies of group (A) scoring the highest results in the biological activities, however the difference between the three groups A, B and C were statically insignificant. The constructed combs were greater at the beginning of the study during nectar flow than the following period. Lee and Winston (1986) stated that, the rate of total comb production was rapid, with 90% of all combs being built within 44 days of colony hiving.

Naturally the weight of new built comb was found 10.52 ± 0.14 g/dm^2 for worker and drone combs was found 18.53 ± 0.32 g/dm^2. Showronek (1978) stated that Caucasians built combs from foundation 11.92 g/dm^2 and without foundation 9.38 g/dm^2.

References:

1. Fichtl, R. (1994). Chikka hive, *J. Apic. Res.* 6(1): 44 pp.
2. Guy, R. (1975). A simple new hive and a beekeeping system for keeping the African bee. *South Africa Bee Journal*, 47(5): 8-11.
3. Jeffree, E.P. (1958). A shaped wire gride for estimating quantities of brood and pollen in combs. *Bee World*, 39(5): 115-118.
4. Laidlaw, H.H. (1958). Organization and operation of a bee breeding program. Proc. *Tenth Inter Congr. Ent.*, 4: 1067-1078.
5. Lee, P.C. and Winston, M.L. (1986). The effect of swarm size and date of issue on combs

construction in newly founded colonies of honeybees *(Apis mellifera L.)*. *Api. Abs*. 37(4).

6. Skowronck, W. (1978). Wax production and comb building by worker honeybees of three races. *Api. Abs*. 29(2).
7. Svensson, B.; Bikonsult, H.B.; Sala, S. and Sweden (1988). Why talk about bee-space? *International Bee Research Association*. ISSN 0256-4424 *Newsletter for beekeepers in tropical and subtropical countries*, (12). P. 3.
8. Taber, S.; III and Owens, C.D. (1970). Colony founding and initial nest design of honey bees, *Apis mellifera*. L. *Anim. Behav*., 18(4): 625-632.
9. Walton, G.M. (1974). Metric measurements for the Langstroth hive. *N.Z. Beekpr*, 36(4): 12-16.
10. ---------- (1975). The metrication of beekeeping equipment. *Bee World*; 56(3): 109-118.

Fig. 1. Monthly means of sealed worker brood area reared by honeybee colonies under study

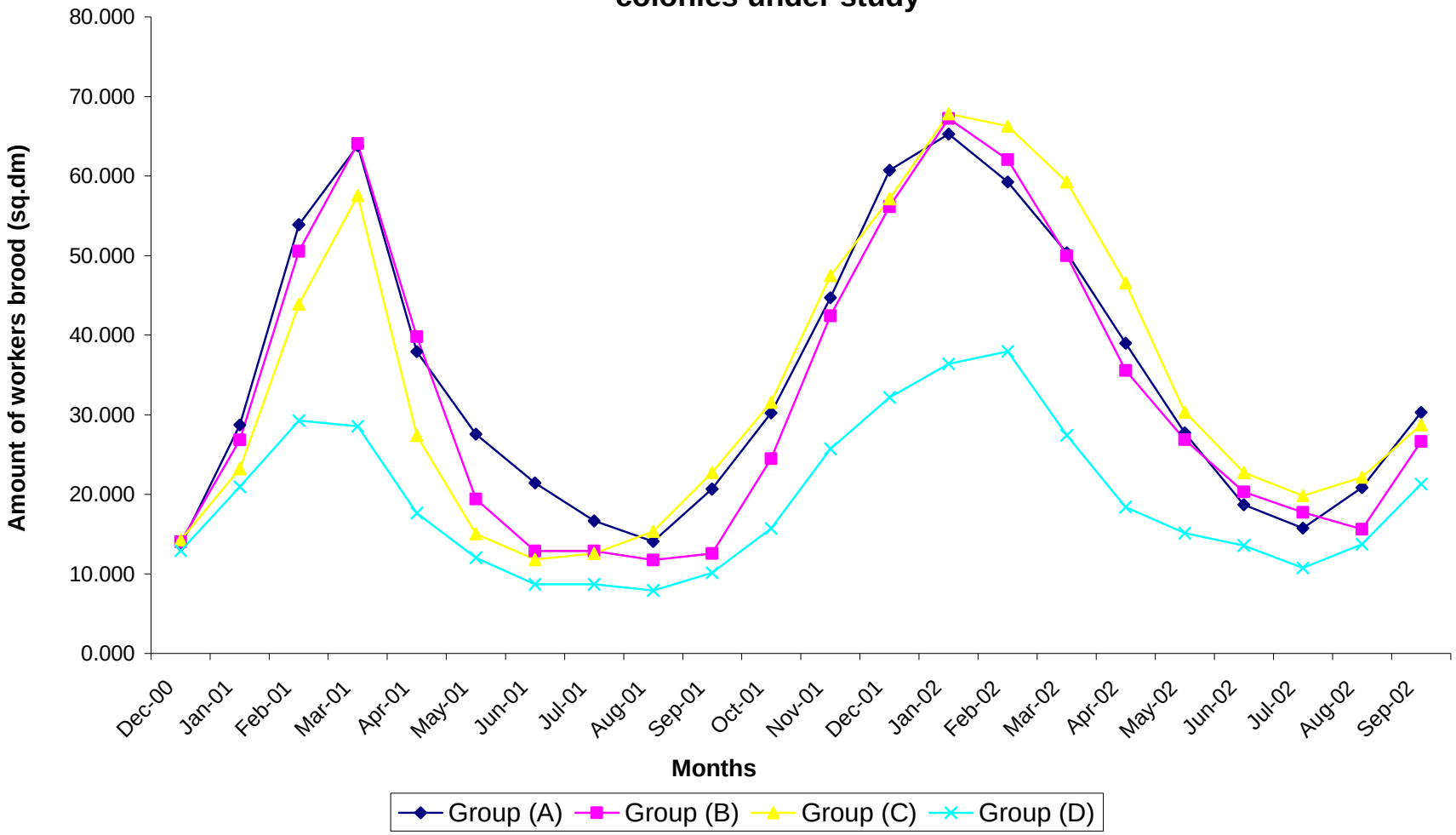

Fig. 2. Monthly means of sealed drone brood area reared by honeybee colonies under study

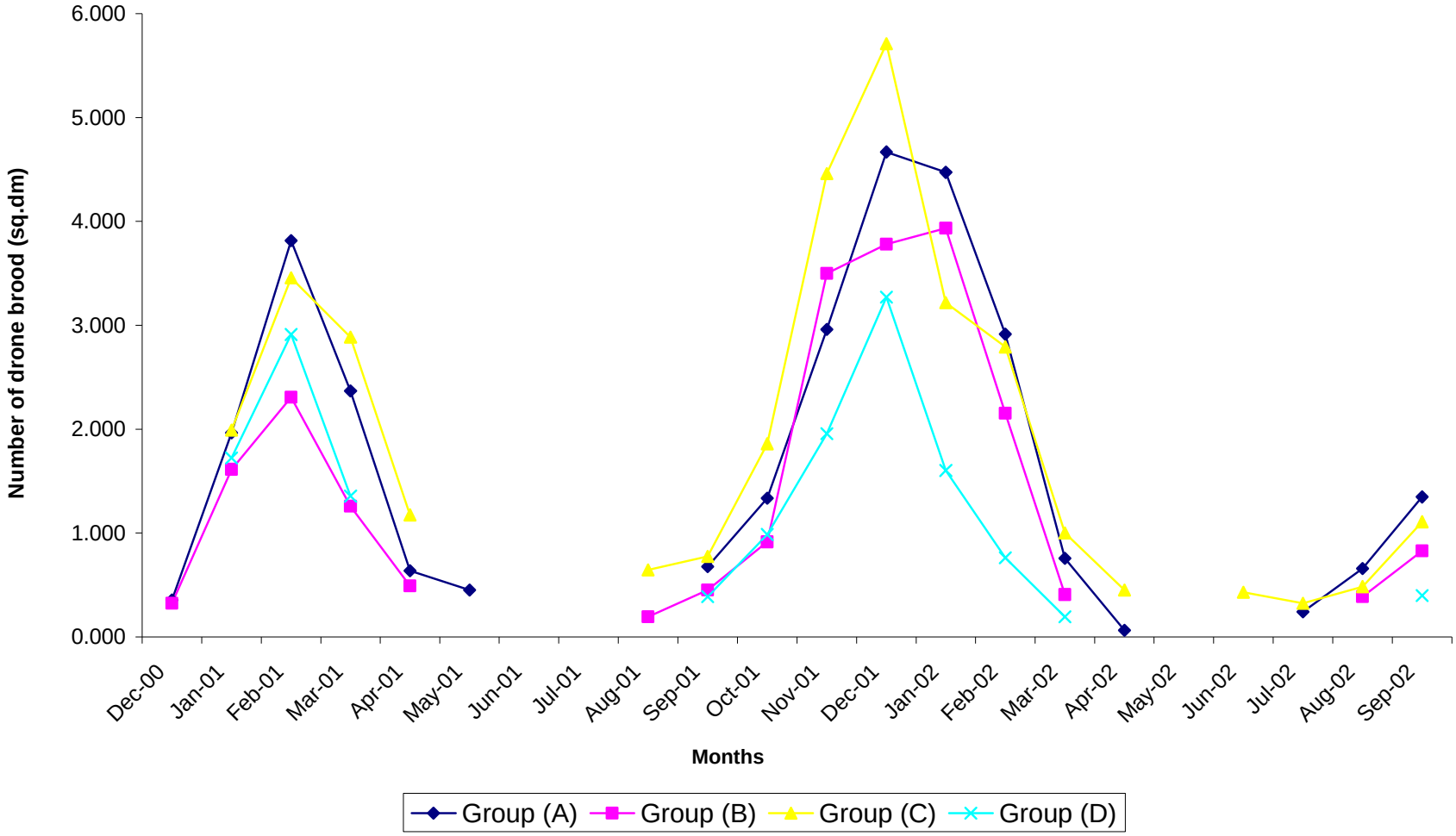

Fig. 3. Monthly means of population growth by the Sudanese honeybee colonies under study

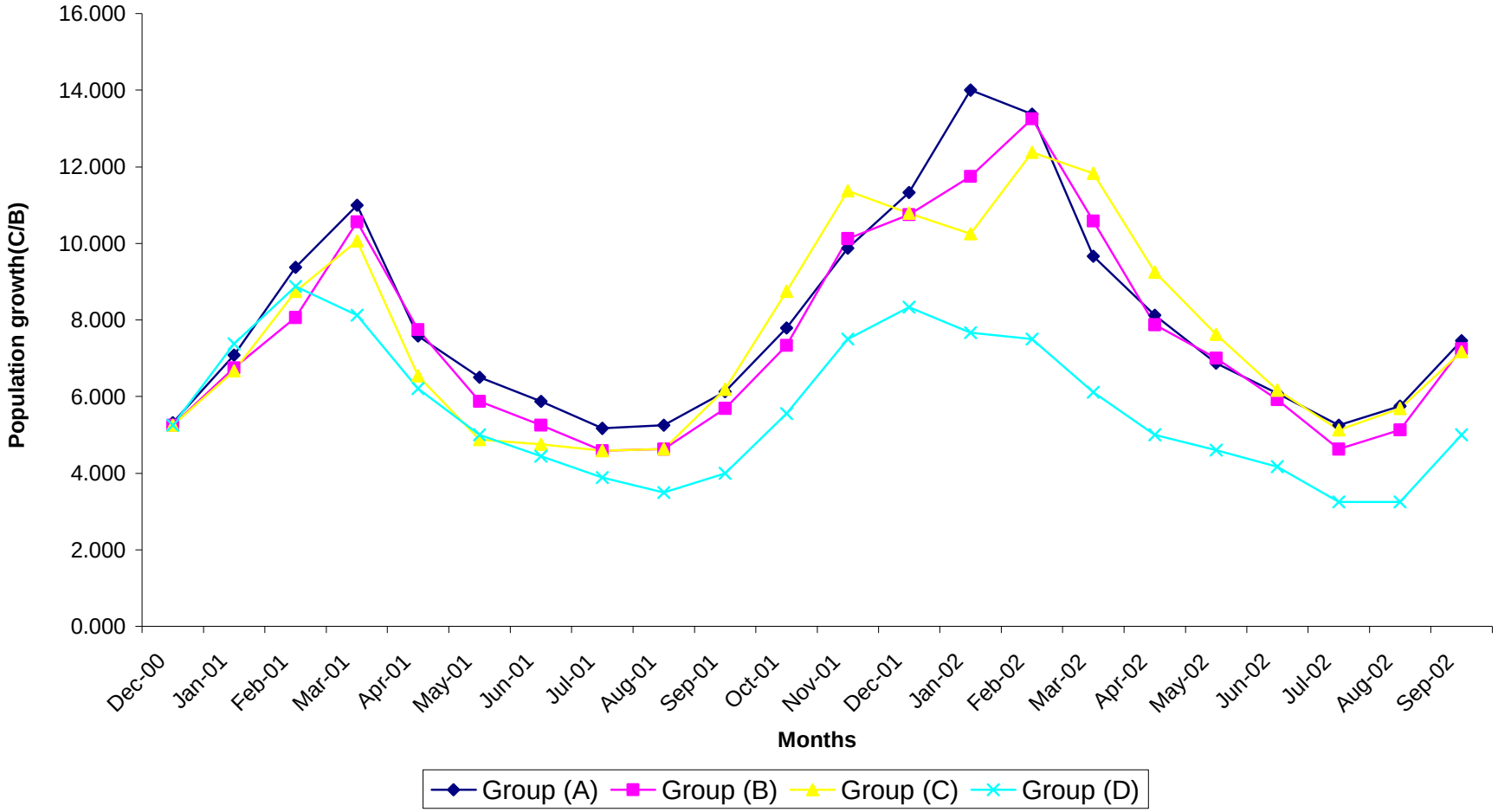

Fig. 4. Monthly means of stored pollen grains by the Sudanese honeybee colonies under study

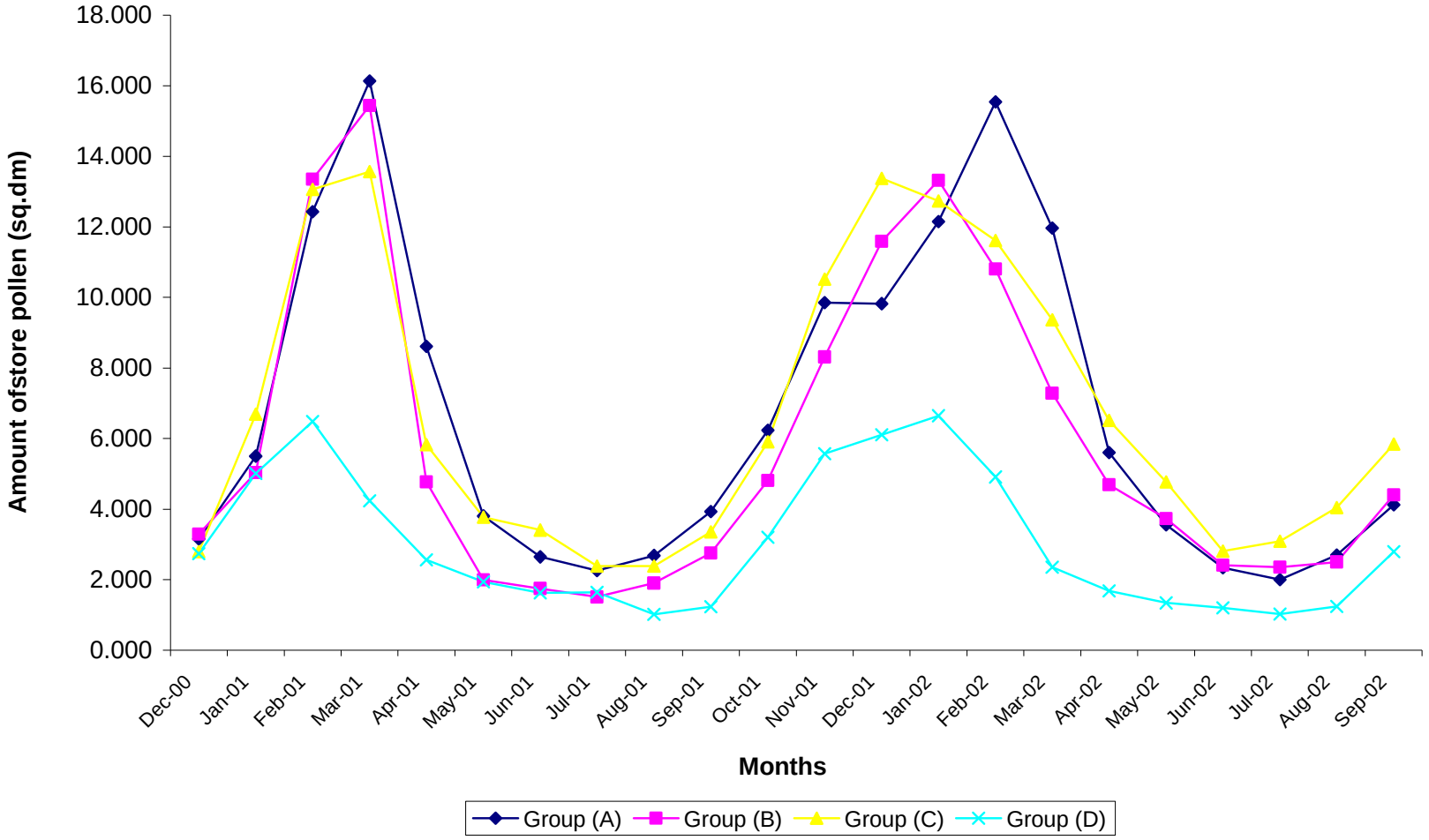

Fig. 5. Monthly means of honey produced by the Sudanese honeybee colonies under study

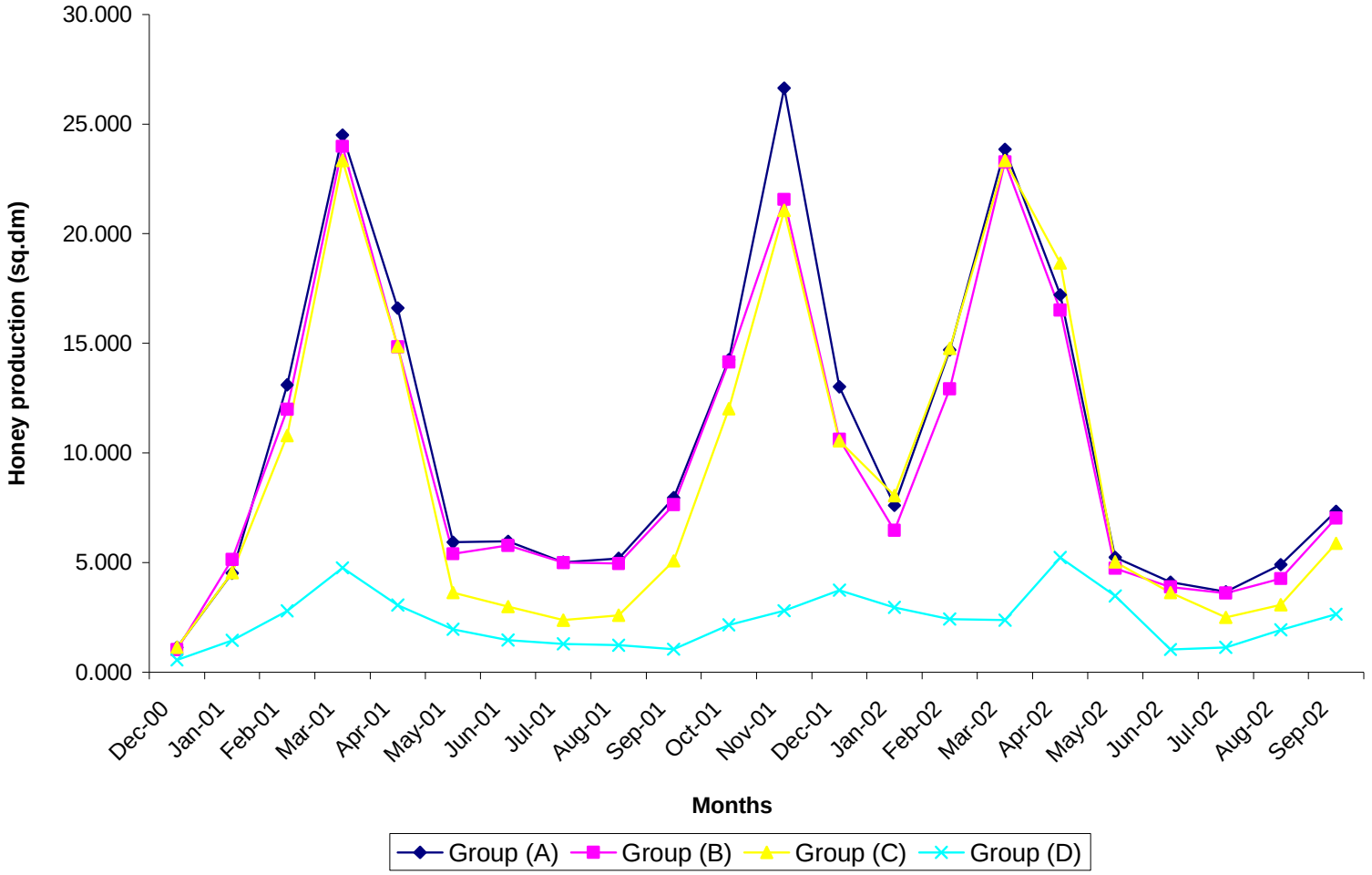

Fig. 6. Monthly means of wax produced by the Sudanese honeybee colonies under study