

## COMPARATIVE ACTIVITIES OF YEMENI BEES IN DIFFERENT TYPES OF TRANSVERSE MOVABLE-FRAME HIVES

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### ABSTRACT

Three groups of Yemeni bee colonies, *Apis mellifera jemenitica* R. were housed on their native combs, in three types of movable-frame hives with different dimensions; Top-bar, Swarm box and Humyari hives, for the purpose of studying their comparative activities in brood rearing and food storage in Sanna Region, Republic of Yemen.

Colonies housed in Humyari hives gave the best daily brood rearing rates, following insignificantly by those in Top-bar and Swarm box hives. They produced broods with high rates in six periods during the year; January, February, June, August, Spetember and November with the average daily rates of 480.45-973.95, 725.31-985.32 and 730.49-976.75 worker cells / colony in Top-bar, Swarm box and Humyari hives, respectively. Colonies stored food at high rates during January, March, June, August and November for pollen and during January, March-April and September-October for honey. The colonies housed in Swarm box or Humyari hives stored more pollen and honey than those house in Top-bar hives. Therefore, both Swarm box and Hymyari hives are recommended for modern beekeeping with Yemeni bees as they are easy managed during different activities of beekeeping.

**Keywords:** Yemeni bees, *Apis mellifera jemenitica*, movable-frame hive, Top-bar hives, Swarm-box hives, Humyari hives, Brood rearing activity, Food storage, Stored pollen, stored honey.

### INTRODUCTION

According to the Agricultural statistics year book of Yemen in 1995, low production of honey per Yemeni bee colony (1.45 kg honey/colony/year) is obtained. This may be due to its small indigenous honey bee race, *Apis mellifera jemenitica* R. (Ruttner, 1975 & 1986; El-Sarrag, 1988; Khanbash, 1990 and El-Sherif *et al* 1999) and the small dimensions of their indigenous brood cells, comb thickness and spacing between mid-ribs of their fixed combs in the traditional Yemeni hives (Dutton *et al* 1981; Jaycox, 1982; El-Sarrag, 1988; Karpowicz, 1989; Jaycox and Karpowicz, 1990; Hansen, 1995 and El-Sherif *et al* 1999).

Moreover, there are many types of the fixed-comb traditional Yemeni hives, currently used in Yemen since many years ago; Log hives in Wadi Hadramout and northern Tihama, Plank hives un Huggariya, Woven hives in western mountains, southern uplands and Tihama plain, Clay hives in

\* The present data were obtained as a part of research and academic work in Sanaa University, R. of Yemen during 1992-1998.

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Radaah and Sanaa, Stone bunkers in Wadis of the central highlands, and foxed-comb box hives of various sizes (Karpowicz, 1989; Jaycox and Karpowicz, 1990 and Hansen, 1995). In the prime beekeeping areas of the central highlands and the southern upland, some non-migratory village beekeepers have started to produce more sophisticated box-hives which are built individual or constructed in groups without frames. The volume of these boxes is similar to that of deep Langstroth body. Colonies housed in these hives are left to build their combs in any way they like. In the southern uplands more exact copies of Movable-frame hives have started to appear using bees and Langstroth-type equipment of Egyptian origin (Karpowicz, 1989). Copies of Longstroth hives and Hoffman frames are used by a minority of progressive beekeepers, who unfortunately have no appreciation of the importance of the bee space and the mid-rib comb spacing. Local craftsman, although highly skilled, cannot be expected intrinsically to appreciate the need to maintain exact hive and frame measurements and they lack the experience, familiarity and financial incentive to produce hive of western type suitable for the local bee race, *Apis mellifera jementica* R. Consequently the movable frames are rather immovable and manipulations do more physical harm to the bee colony than do the traditional systems, which leave the bees alone. Recently, few Yemeni beekeepers development their beekeeping methods by using modified Movable-comb Top-bar hives for mediative Yemeni beekeeping with local bee race in the central highlands and southern uplands of Yemen (Karpowicz, 1989 and Jaycox and Karpowicz, 1990). A superficial appreciation of the benefits of Movable-frame hives has obviously played an important part in leading beekeepers to produce this type of box hives (Karpowicz, 1989).

According to El-Sherif *et al* (1999), using Western Langstroth hives and comb foundation, for local Yemeni bee colonies and their F<sub>1</sub> Carniolans, produced significantly larger Yemeni worker morphometrics and gave the largest morphometrics in the F<sub>1</sub> workers. The Yemeni bee colonies do not create a tidy brood nest when housed in Langstroth hives under prevailing conditions of nectar flows and pollen availability. The productivity of these colonies throughout the year is influenced by different factors specially queens age and egg-laying capacity and the supply of both pollen and nectar (Hussein, 1992; Khanbash, 1992; Abdella, Faiza, 1996 and Al-Humyari *et al* 1999).

The aim of the present work is to house the Yemeni bee colonies in three Movable frame hives with different dimensions for the purpose of studying their comparative activities in brood rearing and food storage in Sanaa region, Republic of Yemen.

## **MATERIAL AND METHODS**

Twelve pure Yemeni bee colonies, *Apis mellifera jementica*, relatively equal in size and strength were selected from Zaidia bee yard, Hodeida province, Yemen and transferred in their native hives at the Apiary of Agriculture college, Sanaa University. The experimental bee colonies were

devided into 3 groups; 4 replicates each. Each group of colonies was hived in one of the following experimental hives:

- I) Yemeni Top-bar (i.e. movable comb) hives.
- II) New developed Swarm box hives with transverse movable frames.
- III) New developed Humyari hives with transverse movable frames.

The outer and inner dimensions as well as volumes of these hives, their frames dimensions, comb spacing, number of combs and their areas are recorded in Table 1.

The bee colonies were housed in each of these types of hives on their natural combs which were taken from their traditional hives (Log hives with fixed combs), and fixed by rupper bands in the movable top-bars or the frames of the experimental hives. The areas of worker sealed brood cells and those of stored food (Pollen or honey) were measured in centimeter at 12 day intervals for one year, starting from October 5, 1997 till September 30, 1998. The measured areas were transferred into number of cells by multiplying their values by 5.27 cells/cm<sup>2</sup> (El-Sherif *et al* 1999). Averages of daily brood rearing rates and counts of stored food cells, were calculated and recorded in Tables 1 and 3. Statistical analysis were occurred by F-test on the seasonal and annual daily rates of brood cells (Table 2).

## RESULTS AND DISCUSSION

### I. Experimental hives:

The outer and inner dimensions of different types of experimental hives as well as their frames and combs are given in Table (1). The Top-bar hive recommended by Karpowicz (1989) and Jaycox and Karpewicz (1990) for mediative beekeeping with Yemen bees, has 21 transverse top-bars (2 x 35 x 3.3 cm each) with hunged combs [15 x (30 x 6) x 2 cm each] and hive volume of about 30600 cm<sup>3</sup>. Meanwhile, the newly developed Swarm box and Humyaris hives were suggested in the present study for modern beekeeping with Yemeni bees as they are easy managed during different activities of beekeeping (inspection, feeding, dividing, queen rearing, brood rearing and honey harvesting). The Swarm-box hive contains 14 transverse movable frames, each is consisted of four bars; top-bar (2 x 22 x 2.4 cm), two side-bars (20 x 1.0 x 3.3 cm each) and ventral bar (1.0 x 14 x 2.4 cm), with comb dimensions of 20 x 14 cm and hive volume of 20304 cm<sup>3</sup>. On the other hand, the Humyari hive has the same volume and number of combs reported in the Top-bar hive, but each comb is hunged in the movable frames as in the Swarm box hive. The wax comb thickness, bee space and comb mid-rib spacing are similar in the three experimental hives and averaged 2.5, 0.8 and 3.3 cm, respectively. The width, depth and number of cells / inch<sup>2</sup> of worker brood cells are also similar in the three experimental hives and averaged 0.48 and 1.25 cm and 34 worker cells / square inch. Meanwhile, the width and depth and number of cells / inch<sup>2</sup> of drone brood cells are also similar in the three experimental hives and averaged 0.62 and 1.25 cm and 18 drone cells / square inch, respectively.

**Table (1):Dimensions (cm) of three types of hives with their transverse movable frames and wax combs, used for Yemeni bee colonies.**

| Characters                   | Types of hives      |                |              |
|------------------------------|---------------------|----------------|--------------|
|                              | Top-bar hive        | Swarm-box hive | Humyari hive |
| <b>Hive dimensions</b>       |                     |                |              |
| Outer                        | 18 x (34 & 20) x 76 | 25 x 22 x 51   | 21 x 26 x 76 |
| Inner                        | 17 x (32 & 18) x 72 | 24 x 18 x 47   | 20 x 22 x 72 |
| Volume cm <sup>3</sup>       | 30600               | 20304          | 31680        |
| <b>Frame dimensions</b>      |                     |                |              |
| Top-bar                      | 2 x 35 x 3.3        | 2 x 22 x 2.4   | 2 x 24 x 2.4 |
| Side-bars                    | —                   | 20 x 1 x 3.3   | 16 x 1 x 3.3 |
| Ventral-bar                  | —                   | 1 x 14 x 2.4   | 1 x 18 x 2.4 |
| <b>Wax Comb</b>              |                     |                |              |
| Thickness                    | 2.5                 | 2.5            | 2.5          |
| Bee space                    | 0.8                 | 0.8            | 0.8          |
| Comb mid rib spacing         | 3.3                 | 3.3            | 3.3          |
| Number                       | 21                  | 14             | 21           |
| Surface dimensions           | 15 x (30 & 16)      | 20 x 14        | 16 x 18      |
| Surface area cm <sup>2</sup> | 345                 | 280            | 288          |
| <b>Worker cell</b>           |                     |                |              |
| Width                        | 0.48                | 0.48           | 0.48         |
| Depth                        | 1.25                | 1.25           | 1.25         |
| Number / inch <sup>2</sup>   | 34                  | 34             | 34           |
| <b>Drope cell</b>            |                     |                |              |
| Width                        | 0.62                | 0.62           | 0.62         |
| Depth                        | 1.25                | 1.25           | 1.25         |
| Number / inch <sup>2</sup>   | 18                  | 18             | 18           |

## II. Activities of Yemeni bees in experimental hives

The activities of Yemeni bee colonies in different types of experimental hives were studied by counting their sealed worker brood cells and stored pollen and honey cells during the period from October 5, 1997 till September 30, 1998 at 12 day intervals.

According to Al-Humyari *et al* (1999) this period could be divided into three successive flowering seasons as main sources of nectar and /or pollen in Sanaa region; the following season of *Acacia* and *Eucalypt* trees in Winter (from the beginning of October till late February), the following season of *Acacia*, Peach, Apple and Apricot trees in Spring (from late February till the beginning of May) and the following season of *Zizyphus* in Summer and late Autumn (from beginning of May till beginning of October).

### A) Brood rearing :

As shown in Table (2) and Fig. (1), the Yemeni bee colonies in different types of hives, started to rear workers at high rates in six periods within the year; being in early January, late February, early June, August, late September and early November with averages of 973.95, 480.45, 744.29, 657.15, 955.37 and 948.55 worker brood cells / day / colony, respectively in Top-bar hive. The corresponding figures were 794.31, 725.37, 958.39, 940.68, 985.32 and 948.55 worker brood cells for Swarm box hive. Meanwhile, the averages were 972.31, 730.49, 97675, 977.72, 888.69 and 780.42 worker brood cells for Humyari hive, respectively.

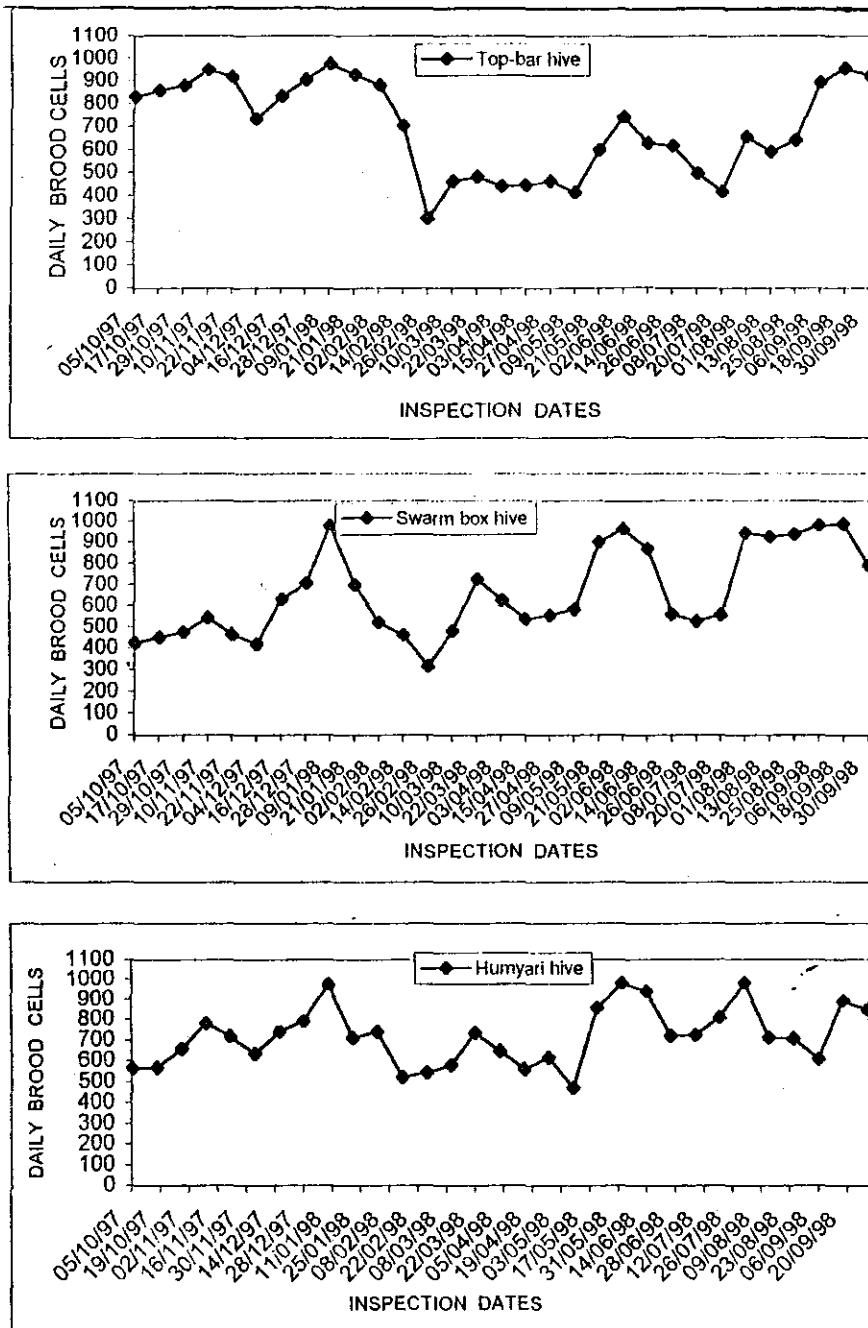


Fig. ( 1 ): Daily worker brood cells at 12 day intervals throughtout the year of Yemeni bee colonies reared in different types of movable frame hives.

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These findings coincide with those of Hussein (1992) who stated that *Apis mellifera jemenitica* in Oman produced broods with at high rates in January-February and November and at low rates in June-August, Abdalla, Faiza (1996) who found that the Yemeni bee queens produced higher rates of egg-laying in March and November and Al Humyari *et al* (1999) who reported that the maximum daily rate of Yemeni worker broods were recorded in late January, March, October and mid December and those of F<sub>1</sub> Carniolan-Yemeni worker broods were recorded in late March, early June, August and December.

**Table(2): Daily workers broad cells at 12 day intervals throughout the year of Yemeni bee colonies reared in different types of movable frame hives.**

| Inspection dates | Types of hives |                |              |
|------------------|----------------|----------------|--------------|
|                  | Top-bar hive   | Swarm box hive | Humyari hive |
| 05/10/97         | 827.71         | 424.36         | 563.73       |
| 17/10/97         | 856.69         | 448.42         | 566.72       |
| 29/10/97         | 876.74         | 473.46         | 655.48       |
| 10/11/97         | 948.55         | 541.50         | 780.42       |
| 22/11/97         | 915.46         | 462.27         | 715.74       |
| 04/12/97         | 734.15         | 417.14         | 632.27       |
| 16/12/97         | 834.32         | 628.03         | 741.45       |
| 28/12/97         | 905.94         | 705.46         | 790.21       |
| 09/01/98         | 973.95         | 974.31         | 972.31       |
| 21/01/98         | 926.32         | 694.82         | 709.34       |
| 02/02/98         | 880.17         | 519.85         | 738.38       |
| 14/02/98         | 702.96         | 460.41         | 518.75       |
| 26/02/98         | 299.25         | 313.64         | 539.17       |
| 10/03/98         | 462.70         | 478.87         | 576.66       |
| 22/03/98         | 480.45         | 725.37         | 730.49       |
| 03/04/98         | 440.25         | 623.62         | 645.58       |
| 15/04/98         | 443.75         | 536.83         | 557.72       |
| 27/04/98         | 463.47         | 553.62         | 612.73       |
| 09/05/98         | 413.21         | 581.65         | 468.30       |
| 21/05/98         | 598.95         | 897.44         | 854.05       |
| 02/06/98         | 744.29         | 958.39         | 976.75       |
| 14/06/98         | 629.96         | 866.37         | 937.95       |
| 26/06/98         | 617.48         | 557.69         | 716.23       |
| 08/07/98         | 496.72         | 523.64         | 718.39       |
| 20/07/98         | 416.03         | 556.83         | 806.47       |
| 01/08/98         | 657.15         | 940.68         | 977.72       |
| 13/08/98         | 592.01         | 922.02         | 709.62       |
| 25/08/98         | 639.12         | 934.33         | 702.02       |
| 06/09/98         | 892.54         | 977.84         | 603.67       |
| 18/09/98         | 955.35         | 985.32         | 888.69       |
| 30/09/98         | 921.39         | 788.34         | 845.91       |

Table (3) shows the seasonal and annual averages of total worker sealed brood cells and their daily rates in different types of movable-frame hives. As regard to the general averages of different seasons, the highest number of worker sealed brood cells were recorded during Summer and Autumn *Zizyphus* blooms and Winter *Acacia* blooms, representing 44.01 and 40.43% of the annual worker brood production (250668.56 worker cells/colony) with no significant difference between their daily rates (750.52 and 703.83 worker cells/day/colony, respectively). Meanwhile, the low number of worker brood cells was observed during blooming period of *Acacia* in the Spring, representing 15.56% of the annual brood production and 526.90 worker cells / colony / day.

**Table (3): Seasonal and annual averages of total worker sealed brood cells and their daily rates of Yemeni bee colonies reared in different types of movable frame hives.**

| Hive type                             | Seasonal sequential periods                         |                                    |  | Annual average |
|---------------------------------------|---|------------------------------------|--|----------------|
|                                       | Late Autumn and Winter<br><i>Acacia</i><br>144 days | Spring<br><i>Acacia</i><br>74 days | Summer and early Autumn<br><i>Zizyphus</i><br>147 days |                |
| Top-bar hive<br>Brood cells / hive    | 124596.00   | 31942.10                           | 96953.85   | 253491.95      |
| %                                     | 49.15   | 12.60                              | 38.25  | 100            |
| Daily rate                            | 865.25±23.51  | 431.65±27.15                       | 659.55±49.05   | 694.50±40.37   |
| Swam box hive<br>Brood cells / hive   | 78840.00  | 39860.84                           | 118623.12  | 237323.96      |
| %                                     | 33.22   | 16.80                              | 49.98  | 100            |
| Daily rate                            | 547.50±36.63  | 538.66±56.72                       | 808.96±50.58   | 650.20±40.74   |
| Humyari hive<br>Brood cells / hive    | 100617.12   | 45168.86                           | 115403.82  | 261189.80      |
| %                                     | 38.52   | 17.29                              | 44.18  | 100            |
| Daily rate                            | 698.73±35.68  | 610.39±25.60                       | 785.06±41.75   | 715.60±61.15   |
| General average<br>Brood cells / hive | 101351.52   | 38990.60                           | 110326.44  | 250668.56      |
| %                                     | 40.43   | 15.56                              | 44.01  | 100            |
| Daily rate                            | 703.83±91.76  | 526.90±51.93                       | 750.52±45.92   | 686.76±19.27   |

F value of daily brood cells between seasons = 20.25\* and LSD = 77.28 brood cells.

F value of daily brood cells between types of hives = 0.34

F value of daily brood cells between seasons and types of hives = 8.76\* and LSD =133.85 brood cells.

These finding coincide with those reported by Al Humyari *et al* (1999) who stated that in pure Yemeni colonies, the highest numbers of worker brood cells were recorded during blooming season of *Zizyplus* in both Summer and Autumn as well as *Acacia* in Winter with no significant difference in their daily rates (438.84 and 440.06 worker cells / colony / day, respectively).

The data clearly show that colonies hived in Humyari type gave the largest amount of worker brood cells throughout the year (261189.80 worker cells / colony) with an annual daily rate of 715.6 worker cells / colony / day), followed insignificantly by those hives in Top-bar and Swarm box hives in the annual amounts of worker brood cells (2583491.95 and 237323.96 worker cells / colony) and their annual daily rates (694.50 and 650.20 worker cells / colony / day). These findings coincide with those reported by Khanbash (1995) who stated that the Yemeni queen bee laid means of 845.6 and 858.8 eggs / day within 1990 and 1991, respectively, and surpassed those reported by Al-Humyari *et al* (1999) who stated that the annual worker brood

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productions of Yemeni bees and their F<sub>1</sub> Carniolans hived in Langstroth type were 147771.04 and 394075.56 worker cells / colony with annual daily averages of 405.96 and 1082.63 worker cells / colony / day).

The interaction effects of seasons and types of hives on the brood rearing activity had been worked out. The bee colonies housed in the Top-bar hives significantly gave the best daily rates during the blooming period of *Acacia* in Winter (865.25 worker cells / colony /day). Meanwhile, those hives in both of Swarm box and Humyari hives significantly gave the best daily rates during the blooming period of *Zizyphus* within Summer and Autumn seasons (806.96 and 785.06 worker cells / colony / day, respectively). The least daily rates of brood cells were, however, recorded during blooming period of *Acacia* in Spring in the Top-bar hive (431.65 worker cells/colony/day) and during the blooming period of the same tree in Winter and Spring in Swarm box hive (547.50 and 538.66 worker cells / colony / day, respectively).

**B. Food storage:**

**a) Stored pollen cells:**

Table (4) and Fig. (2) show that Yemeni bee colonies stored pollen at high rates in five periods of the year; in early January, late March, at beginning of June, August and November, being 885.60, 661.56, 381.11, 468.13 and 401.31 pollen cells / colony for Top-bar hive, 1329.22, 1292.50, 570.14, 486.37 and 932.39 pollen cells / colony for Swarm box hive) and 855.48, 764.80, 661.01, 917.58 and 932.39 pollen cells / colony for Humyari hive, respectively.

On the other hand, colonies housed in Humyari hive stored pollen with less rates (by 2.15-87.85% decrease) in Winter and Spring seasons during *Acacia* blooming period and with high rates (by 18.06-123.36% increase) in Summer and Autumn seasons during flowering period of *Zizyphus*, than those housed in Swarm box hive.

The minimum numbers of stored pollen cells were recorded at the beginning of May, in late June and at the beginning of September when 100.12, 102.13 and 116.15 pollen cells / colony for Top-bar hive, 228.83, 118.12 and 140.91 pollen cells / colony for Swarm-box hive and 232.99, 174.43 and 208.3 pollen cells/colony for Humyari hive, respectively, were recorded.

These finding coincide with those of Hussein (1992) who stated that foraging activity of *Apis mellifera jemenitica* in Oman was greater in pollen collection in January-February and November and lowest in June-August and Al-Humyari *et al* (1999) who reported that the maximum counts of stored pollen cells in Yemeni bee colonies were recorded in mid-January, early May and November, meanwhile, those of F<sub>1</sub> Carniolan-Yemeni bee colonies were recorded in late January, early May, late July and early October and disagree with Khanbash and Bin Ghodel (1994) who reported that the maximum number of pollen collecting bees was recorded in May and the minimum was, however, obtained in January.



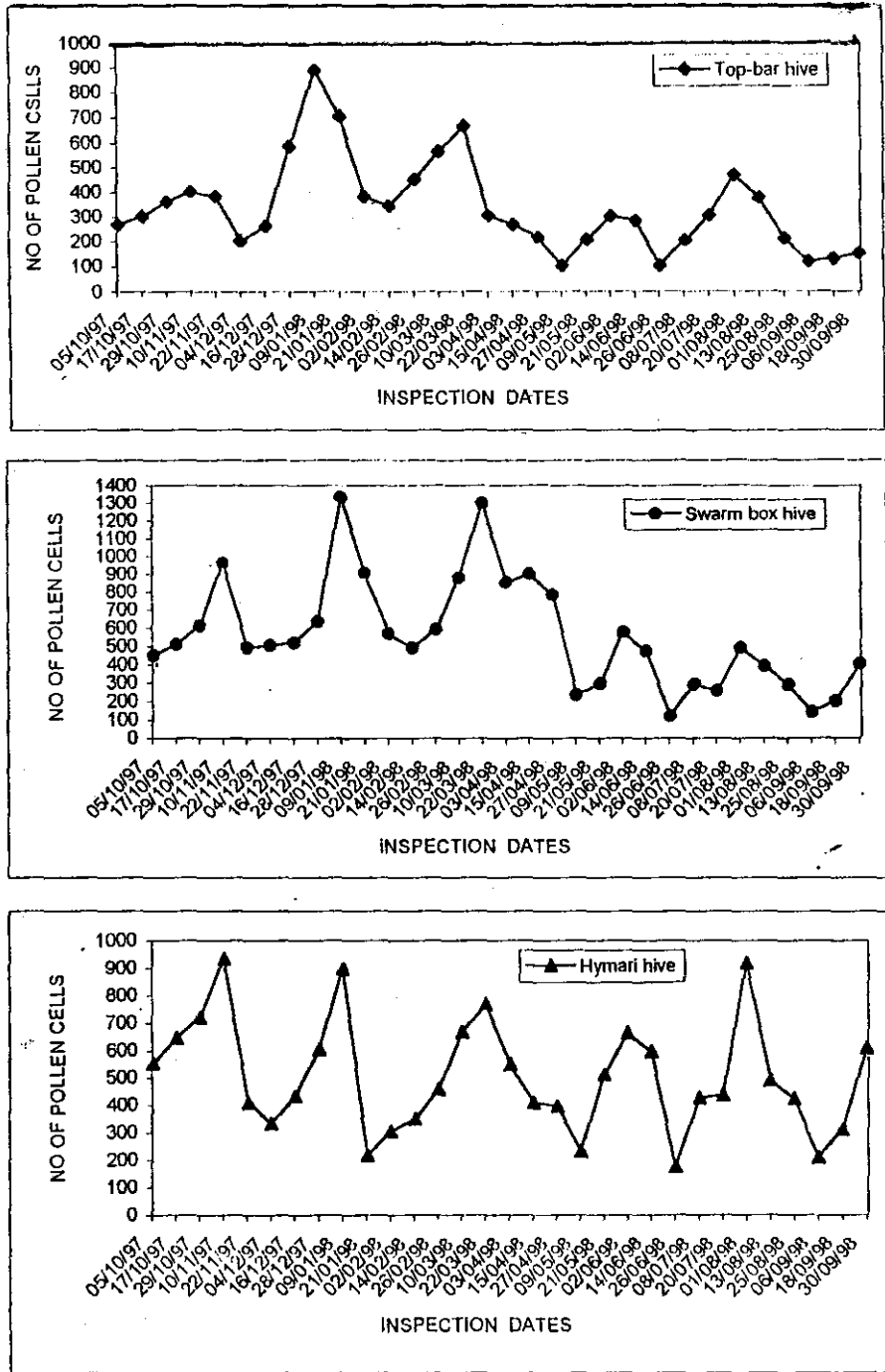


Fig. (2): Counts of stored pollen cells at 12 day intervals throughout the year of Yemeni bee colonies hived in different types of movable frame hives.

**Table (4): Counts of stored pollen and honey cells at 12 day-intervals throughout a year of Yemeni bee colonies hived in different types of movable frame hives.**

| Inspection dates | Stored food      |             |               |             |                  |             |                        |          |          |          |
|------------------|------------------|-------------|---------------|-------------|------------------|-------------|------------------------|----------|----------|----------|
|                  | (A) Top-bar hive |             | (B) Swarm box |             | (C) Humyari hive |             | % increase or decrease |          |          |          |
|                  | Pollen cells     | Honey cells | pollen cells  | Honey cells | pollen cells     | Honey cells | (B-A) /A               |          | (C-A) /A |          |
|                  |                  |             |               |             |                  | Pollen      | Honey                  | Pollen   | Honey    |          |
| 05/10/97         | 267.32           | 2050.29     | 446.81        | 3408.53     | 552.58           | 7078.42     | +67.14                 | +66.25   | +106.71  | +245.24  |
| 17/11/97         | 301.30           | 2358.51     | 506.20        | 3952.09     | 644.88           | 6901.29     | +68.01                 | +67.57   | +114.03  | +192.61  |
| 29/10/97         | 362.20           | 867.54      | 608.91        | 4022.78     | 718.88           | 7011.00     | +68.11                 | +67.57   | +98.48   | +708.15  |
| 10/11/97         | 401.31           | 966.31      | 959.89        | 4673.30     | 932.39           | 6803.06     | +139.19                | +383.62  | +132.34  | +604.02  |
| 22/11/97         | 381.25           | 969.76      | 489.84        | 39912.85    | 410.00           | 3645.19     | +28.48                 | +303.49  | +7.54    | +275.89  |
| 04/12/97         | 201.26           | 971.01      | 498.44        | 3901.60     | 332.82           | 2467.14     | +147.66                | +301.81  | +65.37   | +154.08  |
| 16/12/97         | 261.13           | 931.27      | 516.45        | 4240.96     | 433.14           | 1844.56     | +97.78                 | +355.40  | +65.87   | +98.07   |
| 28/12/97         | 582.23           | 318.41      | 632.34        | 3454.84     | 603.27           | 1090.04     | +8.61                  | +985.03  | +3.61    | +242.34  |
| 09/01/98         | 885.60           | 210.52      | 1329.22       | 2926.16     | 895.48           | 1064.82     | +50.09                 | +1289.97 | +1.12    | +405.80  |
| 21/01/98         | 698.40           | 230.70      | 903.52        | 3883.09     | 218.25           | 3447.79     | +29.37                 | +1583.18 | -68.75   | +1394.49 |
| 02/02/98         | 381.00           | 540.87      | 562.85        | 2638.23     | 304.00           | 2108.18     | +47.73                 | +387.78  | -20.21   | +289.78  |
| 14/02/98         | 343.41           | 1539.39     | 485.89        | 2829.07     | 349.48           | 1488.14     | +41.48                 | +83.78   | +1.77    | -3.33    |
| 26/02/98         | 449.48           | 2712.65     | 585.91        | 3115.99     | 457.66           | 2024.45     | +30.35                 | +14.87   | +1.82    | -25.37   |
| 10/03/98         | 561.23           | 3180.75     | 874.54        | 2541.73     | 664.43           | 1776.55     | +55.83                 | -20.09   | +18.39   | -44.15   |
| 22/03/98         | 661.56           | 4108.92     | 1292.50       | 3822.30     | 764.80           | 3887.71     | +95.37                 | -6.98    | +15.61   | -5.38    |
| 03/04/98         | 302.72           | 5225.47     | 852.90        | 4730.00     | 546.96           | 5239.37     | +181.75                | -9.48    | +80.68   | -39.16   |
| 15/04/98         | 265.83           | 1798.89     | 898.35        | 3103.47     | 409.11           | 3998.71     | +232.94                | +72.52   | +53.90   | +16.10   |
| 27/04/98         | 215.61           | 1189.90     | 782.18        | 2855.10     | 397.30           | 4051.75     | +262.78                | +139.94  | +84.27   | +240.51  |
| 09/05/98         | 100.12           | 944.43      | 228.83        | 1869.41     | 232.99           | 3407.85     | +128.56                | +97.94   | +132.71  | +260.84  |
| 21/05/98         | 204.01           | 919.47      | 291.22        | 1611.48     | 511.12           | 1988.80     | +42.75                 | +75.25   | +150.54  | +116.99  |
| 02/06/98         | 301.11           | 1223.19     | 570.14        | 2731.61     | 661.01           | 4334.03     | +84.35                 | +123.32  | +119.52  | +254.32  |
| 14/06/98         | 282.52           | 10777.57    | 467.99        | 1950.97     | 594.95           | 2817.89     | +65.65                 | +81.05   | +110.59  | +161.50  |
| 26/06/98         | 102.13           | 465.98      | 118.12        | 1821.67     | 174.43           | 2025.92     | +15.66                 | +290.93  | +70.79   | +334.77  |
| 08/07/98         | 202.11           | 1668.36     | 287.22        | 2333.93     | 426.40           | 2167.62     | +42.11                 | +39.89   | +110.97  | +29.93   |
| 20/07/98         | 303.58           | 1264.80     | 251.77        | 2530.16     | 436.85           | 4189.58     | -17.07                 | +100.04  | +43.90   | +231.24  |
| 01/08/98         | 468.13           | 1830.62     | 486.37        | 1956.42     | 917.58           | 1719.72     | +3.90                  | +6.87    | +96.01   | -6.06    |
| 13/08/98         | 374.89           | 915.31      | 384.16        | 3613.06     | 489.40           | 2606.14     | +2.47                  | +294.74  | +30.54   | +184.73  |
| 25/08/98         | 210.13           | 748.59      | 284.40        | 2300.68     | 424.8            | 1700.20     | +35.34                 | +207.34  | +102.16  | +127.12  |
| 06/09/98         | 116.15           | 7838.62     | 140.91        | 4308.92     | 208.03           | 3458.73     | +21.32                 | +135.38  | +79.10   | +91.12   |
| 18/09/98         | 128.17           | 1664.20     | 196.91        | 3134.34     | 310.75           | 3069.85     | +53.63                 | +24.39   | +142.45  | +84.46   |
| 30/09/98         | 150.10           | 1497.78     | 397.66        | 434.45      | 607.43           | 2480.10     | +164.43                | +189.86  | +304.68  | +65.59   |

**b) Stored honey cells:**

Table (4) and Fig. (3) show that Yemeni bee colonies stored honey at high rates in three main periods during the year, January, March-April and September-October. In Top-bar hives, the colonies stored honey with high rates in late March-early April and in early September-late October with the averages of 4108.92-5225.47 and 1838.62-2358.51 honey cells / colony, respectively. Meanwhile, in Swarm-box and Humyari hives, the colonies stored honey at high rates in late January as well as in late March-early April and in early September-late October. They averaged 3883.09, 3822.30-4730.00 and 4308.92-4673.30 honey cells / colony in Swarm-box hive and 3447.79, 3887.71-3179.37 and 3498.73-7011.00 honey cells / colony in Humyari hive, respectively.

The minimum numbers of stored honey cells were recorded at the beginning of January, in late May, June and August, being 210.52, 919.47, 465.98 and 748.59 honey cells / colony for Top-bar hive, 2926.16, 1611.48, 1821.67 and 2300.68 honey cells / colony for Swarm box hive and 1064.82, 1988.8, 2025.92 and 1700.20 honey cells / colony for Humyari hive, respectively.

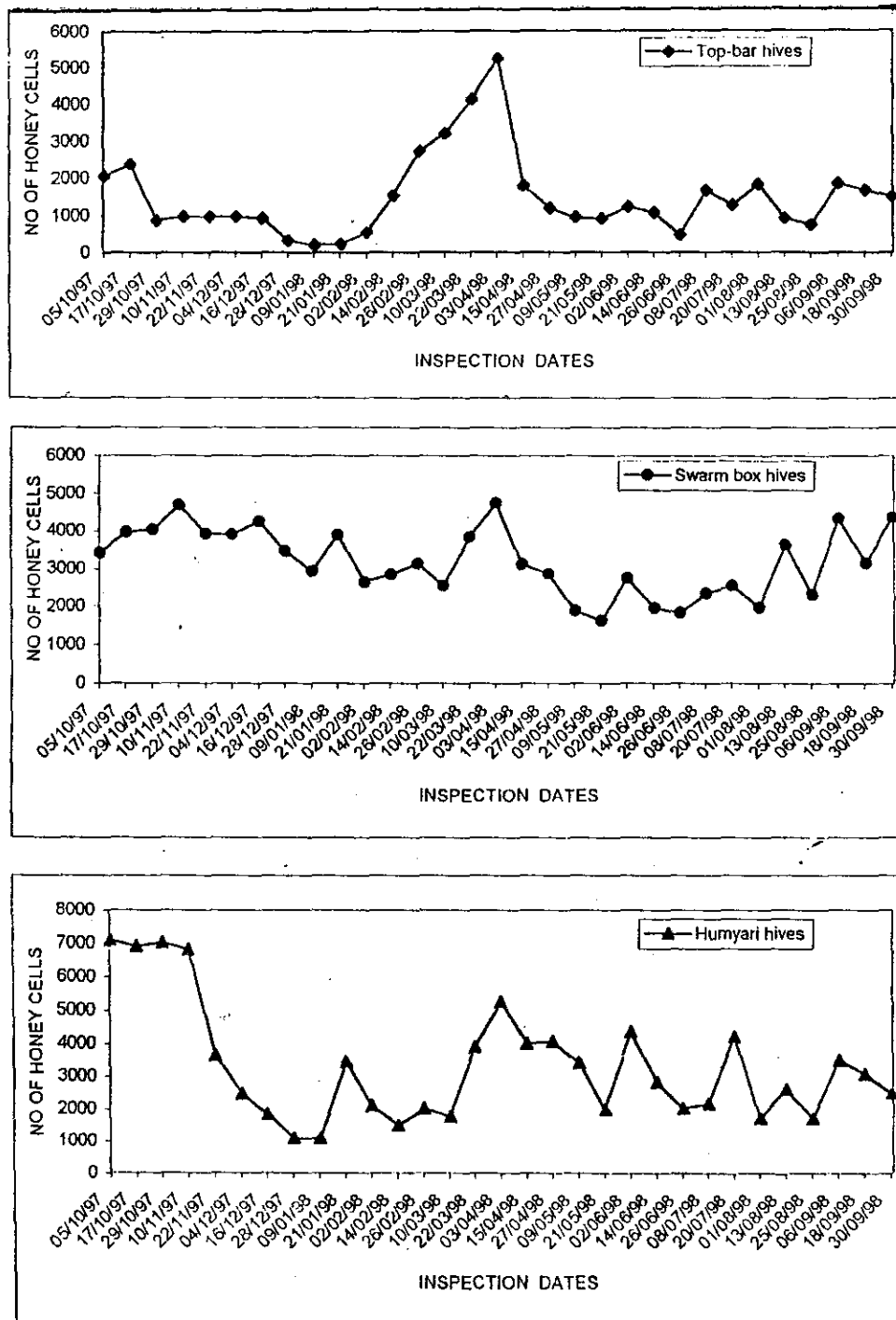


Fig. (3): Counts of stored honey cells at 12 day intervals throughout the year of Yemeni bee colonies hived in different types of movable frame hives.

These findings coincide with those of Al-Humyari *et al* (1999) who reported that the Yemeni bee colonies hived in Langstroth type on their native combs gave two main honey flows in late of September and October, meanwhile, the F<sub>1</sub> Carniolan-Yemeni colonies gave three main honey flows, in early February, August and November.

From the fore mentioned results, it could be concluded that both Swarm box and Humyari hives are recommended for modern beekeeping with Yemeni bees as they are easy managed during different activities of beekeeping.

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### "مقارنة أنشطة النحل اليمني في أنماط مختلفة من الخلايا ذات الإطارات العرضية المتحركة"

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في هذه الدراسة ، تم تقسيم أنثى عشر طائفة من النحل اليمني إلى ثلاث مجموعات ثم سكنت كل مجموعة على أقراصها الأصلية في ثلاثة نماذج من الخلايا ذات الإطارات المتحركة مختلفة المقاييس وهي الخلية علوية الإطار ، خلية صندوق الطرد والخلية الحميرية ، وذلك بمنحل كلية الزراعة - جامعة صنعاء بالجمهورية اليمنية بغرض إجراء دراسة مقارنة لنشاط كل مجموعة في تربية الحضنة وتخزين الغذاء (حبوب اللقاح والعسل).

وقد أظهرت النتائج أن طوائف النحل اليمنية في الخلايا الحميرية قد أعطت أفضل المعدلات اليومية لتربية الحضنة ، يليها الطوائف المرباه في الخلايا علوية الإطار ، ثم المرباه في خلايا صندوق الطرد. ومن جهة أخرى فقد أنتجت طوائف النحل اليمنية حضنة شغالات بمعدلات عالية في الست فترات التالية خلال السنة:

يناير ، فبراير ، أغسطس ، سبتمبر ، ونوفمبر ، وتراوح متوسط معدل إنتاج هذه الحضنة اليومية ما بين ٤٥،٤٥-٩٧٣،٩٥ ، ٣٧،٧٢٥-٩٨٥،٣٢ ، ٤٩،٧٣٠-٩٧٦،٧٥ عين سداسية بها حضنة شغالات / يوم / في الطائفة الموجودة في كل من الخلية علوية الإطار ، وخلية صندوق الطرد والخلية الحميرية على الترتيب. وقد خزنت هذه الطوائف وبمعدلات عالية كل من حبوب اللقاح في خمس فترات خلال العام وهي : يناير ، مارس ، يونيو ، أغسطس ، ونوفمبر ، والعسل في ثلاث فترات فقط وهي يناير ، مارس - أبريل ، سبتمبر-أكتوبر ، وقد تفوقت الطوائف المسكنة في كل من صندوق الطرد والخلايا الحميرية في تخزين نوعي الغذاء بمعدلات أعلى من الطوائف المسكنة في الخلايا علوية الإطار. وبذلك يمكن التوصية بكل من خلية صندوق الطرد والخلية الحميرية في النحلة الحديثة للنحل اليمني لسهولة إدارة الطوائف بهما خلال الأنشطة المختلفة للنحلة.