



## Evaluation of *Apis cerana* colony strength using image - J software

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### ABSTRACT

*Evaluation of Apis cerana colony can be carried out by objective, subjective and digital mode analysis. The objective of this paper is to standardize the method to evaluate the colony strength of Apis cerana by blending these three methods. All these three methods showed similar results. In objective method colony of honeybees will be frequently disturbed. Whereas in the subjective mode of evaluation, the values where the data is less accurate. To avoid these shortcomings, the digital analysis is suitable and more appropriate which can be used as digital tool for the evaluation of colony strength for various honeybee species.*

**KEYWORDS : Honey bees, Apis cerana, Colony strength, Digital analysis, Image J software, Mysuru**

### INTRODUCTION

Insects are the most bio-diverse, eukaryotic organisms on earth representing around 75% of the worlds recorded Fauna (Loxdale, 2016). Honeybees (Hymenoptera : Apidae) are social and inseparable creatures (Oldroyd and Wongsiri, 2006). *Apis cerana* Fabricius is endemic and it occupies at different climatic conditions (Khoury et al., 2011).

Honeybee population dynamics play an important role in the honey production and pollination. The apiculture productivity depends on number of colonies and strength of individual colonies. Thus, the strength of a colony is evaluated by estimating the adult honey bee population and in some cases, the amount of brood in a hive. Counting systems have been developed for tracking specific bees using techniques such as metal detection and bar-code scanning. These methods require manipulation of individual bees and are thus infeasible in a practical setting (Campbell et al., 2013). Thus, computer assisted digital image analysis is useful for experiments, that call for measures of bee health or development but fall short of field scale colony strength assessment (Delaplane et al. 2013).

Ample scientific information has been published on the biological, ecological and behavioral characteristics of other *Apis cerana* strains from a wide range of Asian regions. Many studies have shown plasticity in biology and ecology of *Apis cerana* across its geological range. Although, literature on various aspects of *A. cerana* is available, estimations of individuals at their colony were replete. Hence, attempt has been made to analyze colony strength of *A. cerana* using computer assisted image analysis at this part of the state for the first time.

### MATERIALS AND METHODS

Periodical analysis of *A. cerana* colonies were made (monthly twice) during 2015-16. The data were recorded through digital photography. Photographs were made using digital camera (Nikon D70 - DSLR camera). Colony strength was analyzed using standard methods (Delaplane et al., 2013; Cornelissen et al., 2009). The photographs were made with and without honeybees in the colony. The bees were brushed into a holding box without harming or killing the honeybees and the combs were photographed again to expose brood, honey and pollen chambers. Photographs were made with utmost care making sure that the objects (comb frame) completely cover the picture, which will result in the highest resolution and optimal lighting conditions. The captured images were stored in JPEG format (Uncompressed files format) which will be useful in a better manner when subjected for grid count method (Yoshiyama et al., 2011). The data compilation was carried out using MS – EXCEL program. The photo-

graphs were analyzed using Image J and Adobe Photoshop software (Ver. CS).

**Table 1. Observed data in excel spreadsheet to estimate**

Colony	Frame	Side	Observation (%)	cm <sup>2</sup> covered by bees	bees per side
1	1	A	0.25	220	212.97
3	1	B	0.4	352	110.98
4	1	A	0.5	286	296.97
5	1	B	0.2	612	190.08
6	1	A	0.3	234	116.49
7	1	B	0.5	32	368.74
8	1	A	0.7	86	212.1
9	1	B	0.3	12	379.72
10	1	A	0.5	112	120.14
11	1	B	0.3	108	138.18
<b>Total</b>					<b>2146.37</b>

### A. cerana colony bee population

\* Note: So from each colony 5 frames selected for consideration.

Observation (%) = Average measurement of min. 5 grids in % value.

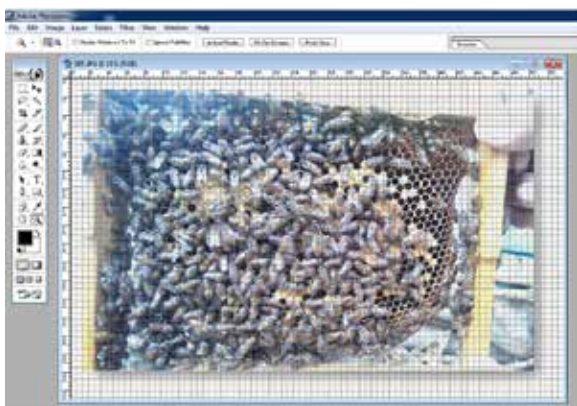
cm<sup>2</sup> covered by bees = Bees counted based on grid analysis (cms)

**Table 2. Strength of A. cerana colonies**

Sl. No	Colonies	Colony Population
1.	1	2146.37
2.	2	1900.21
3.	3	2167.18
4.	4	2060.10
<b>Total</b>		<b>8273.86</b>

Average	2068.465
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**Note: Average value is a mean of 20 observations(4 colonies X 5 sites in each frame)**



**Fig. 1. Estimation of *A. cerana* colony strength using grid method in adobe photoshop software (Ver. CS)**

## RESULTS AND DISCUSSION

*Apis cerana* colony strength estimations were carried out and results were presented in the form of Tables (1 and 2) and figure 1. The side A in the frame one, 0.25 % honey bees spreaded over the A side of frame 1. The total area of A side is 220 square cm. This much of area has 212.97 bees, so the percentage of distribution of bees on the A side is 96.8 %. The side B of frame 1 has 0.4 % observation and has 352 square cm area. This area has 110.98 bees, the percentage distribution of bees is 31.52 %.

The side A in the frame two, 0.6 % honey bees spreaded over the A side of frame two. The total area of A side is 286 square cm. This much of area has 296.97 bees, so the percentage of distribution of bees on the A side is 103.8 %. The side B of frame two has 0.2 % observation and has 612 square cm area. This area has 190.08 bees, the % of distribution of bees is 31%.

The side A in the frame three, 0.3% honey bees spreaded over the A side of frame three. The total area of A side is 234 square cm.. This much of area has 116.49 bees , so the percentage of distribution of bees on the A side is 49.7 %. The side B of frame three has 0.5 % observation and has 32 square cm area. This area has 368.74 bees, the % of distribution of bees is 1152 %.

The side A in the frame four, 0.7% honey bees spreaded over the A side of frame four. The total area of A side is 86 square cm. This much of area has 212.1 bees, so the percentage of distribution of bees on the A side is 246.6 %. The side B of frame four has 0.3 % observation and has 12 square cm area. This area has 379.72 bees, the % of distribution of bees is 3164 %.

The side A in the frame five , 0.5% honey bees spreaded over the A side of frame five. The total area of A side is 112 square cm.. This much of area has 120.14 bees, so the percentage of distribution of bees on the A side is 107.2%. The side B of frame five has 0.3 % observation and has 108 square cm area. This area has 138.18 bees, the % of distribution of bees is 127.94 %.

From table 2, total bees estimated in the colonies 1,2,3, and 4 are 2146.37, 1900.21, 2, 2167.18 and 2060.10 respectively. From the four colonies the total bees counted 8273.86, so the average number of bees per colony is 2068.465. The area covered by each honeybee in each side of a frame is estimated by using Image J software. The area covered by total honeybees in the each side of a frame is estimated by grid analysis using adobe Photoshop software (Fig 1).

Colony strength assessments are an important method for the evaluation of the development and health of Asian honeybee colonies in *A. cerana*. However, recent computer methodologies using software such as image J offer less time consuming and accurate evaluations in estimating *A. cerana* colony strength. Understanding, the evaluation

process help make to estimate colony strength and productivity better with various honeybee species too. Therefore, colony strength estimations could be done by applying current computer based method, which is economically viable, less time consuming and more accurate. However, this is an attempt to standardize the estimation of colony strength by applying softwares. To have a standardized method such works should be repeated by different researchers.

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