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On-Station Evaluation of Different Colored Light Source Batteries for Night Time Colony Management at Andassa Livestock Research Centre, Amhara Region, Ethiopia

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Abstract
The test of different colored light was carried out Apiculture apiary site of Andassa livestock research center with the aim of evaluating the response of the local honey bees to different colored light source batteries to be used during night time internal colony inspections and to select less attractive colored light sources to the local honeybees during night time internal colony operations. The experiment was conducted with three different colored light, the first was produce ordinary white light and the other were modified to emit red light and blue light by fitting (covering) the round glass covers of each of the torches with a round piece of red and blue polythene sheets respectively. Three sheets of white cloth measuring 100 cm2 were obtained. This experiment was conducted RCBD design with six replications. Inspected honeybee colonies were selected and grouped as medium, strong and very strong based on the worker bee population and total internal hive area (number of combs) covered by the honey bees. The mean numbers of honey bees attracted to each colored light were: white light (263), blue (246.83) and red (89.33). The analysis of variance showed that there were a highly significance difference (0.0001, $p \leq 0.05$) among different colored lights and Least significance difference (LSD) showed that no significance difference between white and blue light in relation to the number of honey bees attracted to each light. However, the number of honey bees attracted to the red light shows a highly significance difference as compared to white and blue light source batteries at $p \leq 0.05$ significance level. The result also shown that the number of honey bees attracted to different colored light source batteries in medium, strong and very strong colonies were significant. Therefore, the use of red torch/battery/ light during colony management at night reduces the bee sting and aggressiveness of bees.
Keywords: Torchlight, colored light, night time colony Management

1. Introduction

Internal colony inspection, as an important tool to understand and monitor colony's performances and progresses, will be done by opening the hives and checking all the combs and the internal environment in the hive. It has been an established fact that this activity will let the beekeeper know what is going on inside the hive and check whether honey is being prepared and caped, the colony is getting ready to swarm, there is an incidence of honey bee diseases and pests or not (Adjare, 1990).

In most parts of the World, bee hive opening for inspection is done at night. It is because of the fact that the higher temperature during the day makes the bees active and difficult to handle (Aidoo, 2009). Furthermore, it has been believed that worker bees become less active during the cooler times of the day and especially at night hours (Yasuyuki, 2009). Most beekeepers, therefore, do hive inspection to their colonies during late in the evening when temperatures is low and the bees are relatively calm, less defensive and easier to manipulate.

At nights, the use of torch lights is common to beekeepers in order to see the different parameters during hive inspection. However, the aggressive African honey bees, in general, launch attack towards the direction of the light sting the beekeeper. At the time of hive opening, bees sting painfully, and sometimes tropical bees can kill a beekeeper. Thus, is very safe to work with bees with no or less honey bee attacks. Moreover, every bee that stings dies afterwards. Thus, as more bees strike, in fact they will die, and the field force worker bees reduction will be the consequence due to death of stung honey bees resulting in lower honey production (Adjare, 1990).

In this process, a potential drawback in the use of torches, however, is that bees (and most insects) are attracted to lights at night. When torch light is used, worker bees are observed moving in high numbers to sections of the hive where the light is shown. Of course, beekeepers are applying smoke to move bees away but the bees keep coming back to the illuminated area. In some cases, angry bees will attack the beekeeper and stung even the gloves of the person who is carrying the torch which is emitting white light.

According to our experiences with honey bees, the aggressiveness of African honey bees in general and local honey bees in particular did makes day time honey harvesting and other important hive inspections impossible for most beekeepers, that is why in most tropical climate areas with tropical honey bee species, these activities are done at night when the bees are less aggressive. Even though our bees are mostly inspected at night, still there is high level of stinging incidences on beekeepers, and the death of more worker bees'. Mostly this phenomenon has been believed to be initiated by the use of white light sourced batteries after smoking and the opening of the hive for different purposes. Thus, those kinds of light sources have been observed to attract the bees significantly to the

light sources (beekeepers) which makes the work load heavier. A possible thought solution against this problem is set based on the fact that insects are less attracted to certain colored lights. Thus, the use of different colored light sources during night time colony inspection and honey harvesting could be an alternative to have fewer or no stings from the honey bees. This study was, therefore, initiated to test the response of the local honey bees to the use of different colored light sources during night time colony inspection as an alternative to better colony management and honey harvesting with fewer or no honey bee stings. Therefore the objective of the study were to evaluate the response of the local honey bees to different colored light source batteries to be used during night time internal colony inspections and to select less attractive colored light sources to the local honeybees during night time internal colony operations.

2. Materials and Methods

The study was conducted at Andassa livestock research center apiary site. Three identical batteries were used as a light source for night time hive inspection. The first battery was designed to produce ordinary white light and the others were modified to emit red and blue lights respectively. Different color emissions from each of these two batteries was designed by fitting (covering) the round glass covers of each of the torches with a round piece of red and blue polythene sheets respectively. Three sheets of clothes measuring 100 cm2 were prepared and used to detect the number of honey bees coming out with the presence of different colored light source batteries. This experiment was conducted RCBD design with six replications. Inspected honeybee colonies were selected and grouped as medium, strong and very strong based on the worker bee population and total internal hive area (number of combs) covered by the honey bees. Two medium, strong, and very strong colonies were randomly assigned to each of the treatments Thus, each of the treatments were replicated six times and a total of 6 transitional and 9 frame hives were used during the honey flow (flowering) season of the year for the experimental site. Each of the prepared pieces of clothes with 100 cm2 area were hanged 20 centimeters away from the hive entrance just with the same direction to foraging flight direction of the colony and each of the different colored light source batteries were adjusted to be shown on the pieces of clothes to each of the colonies separately. Each of the experimental colonies were then disturbed at about 8:00 pm in the evening when the day becomes darker, by tapping the side of the hive close to the entrance by the data collector being at the back side of the hive. As a result, the number of bees attracted to the spot light shown on the piece of cloth (hanged in front of the hive) in five minutes were counted and recorded and documented. The experiments was repeated on each of the experimental honey bee colonies using each of the different colored light source batteries designed in the same procedure.

Materials that have been used in this experiment

Figure 1. Ethiopian honeybee colonies hived in frame and transitional hives

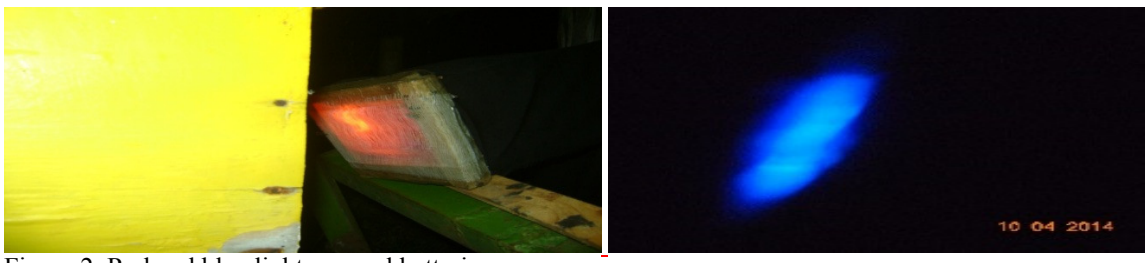


Figure 2. Red and blue light sourced batteries

3. Results and Discussion

According to the results from the analysis of variance (ANOVA) targeted to test the degree of variation in *Apis mellifera* local honey bee races attracted to the different colored light sources, there was significant differences in the number of honey bees attracted to the different colored lights sources (Table 1).

This indicated that the local honey bee races *(Apis mellifera monticola)* were attracted with different

intensities to the three different colored lights sources shown on a white piece of cloth mounted close to the bee hive entrance at night. The total numbers of worker bees attracted to white, blue and red lights within five minutes has varied accordingly. In this case, results from the experiment showed that differences have been observed in the number and rate of honey bee individuals attracted to each of the light sources as shown in table 2.

Figure 3. The intensities (rates) of honey bee individuals attracted to the blue, white and red light sources batteries respectively

Table 1. Analysis of Variance number of honey bees attracted to different colored battery lights

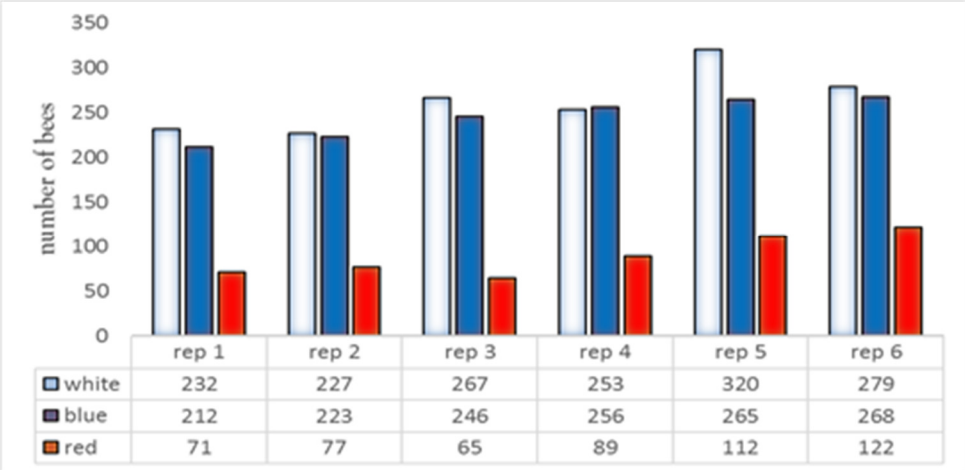
Source of variation	DF	Sum of squares	Mean squares	F Value	sig
Treatments	2	110455.4444	55227.7222	70.38***	0.0001
Error	15	11770.1667	784.6778		
Total	17	122225.6111			
CV=14.02553					

It was observed that the color differences created from different colored batteries have resulted with a highly significant difference (0.0001 at $p \leq 0.05$) in the number honey bee and rate of attractions. This indicated that the effect of different colors in attracting honey bees when disturbed at night are not equal (the same) further illustrating the use of appropriate color types shall be encouraged for minimum disturbance (number of stings) to the beekeepers when working with bees. LSD multiple mean comparison (Table 1) results have also revealed the presence of significant differences within various colored light sources and colony strengths. The number of honey bees attracted to the white and blue light source batteries didn't show significant difference comparatively. However the number of honey bees attracted to the red light shows a highly significance difference as compared to white and blue light source batteries at $p \leq 0.05$ significance level. The result also shown that the number of honey bees attracted to different colored light source batteries in medium, strong and very strong colonies were significant. This indicates that defensive strength of the colony depends on the colony strength or the worker bee population.

Table 2. LSD multiple comparisons of bees attracted to different colored lights

	Number of bees counted	
	LS mean	Sig
Treatment	199.72±13	***
White light	263±5.42 [b]	
blue light	246.83±5.42[b]	
Red light	89.33±5.42 [a]	
Block		***
Very strong colony	234±8.643 [a]	
Strong colony	199±7.057 [b]	
Medium colony	170±7.057 [c]	

Means with different superscripts in a column are significantly different at $P \leq 0.05$



	rep 1	rep 2	rep 3	rep 4	rep 5	rep 6
white	232	227	267	253	320	279
blue	212	223	246	256	265	268
red	71	77	65	89	112	122

Fig 4. Number of honey bees attracted to the different colored battery lights

Beekeeping plays a great role to contribute to poverty reduction and environmental protection including forest conservation through pollination activities of the bees (Gronenberg, 2001). Studies have shown that honey bees are extremely visual animals, with a large portion of their brain dedicated to visual processing (Gronenberg, 2001). For this reason, honey bees have a well-developed color vision (Werner et al., 1988). On the other hand, most researches used different light traps for the monitoring of moths, and literatures revealed that little is known about the attraction of beneficial insects such as honey bees to different colored lights sources, (Henda et al., 1999b). Traditionally, internal honey bee colony inspection and honey harvesting activities have been done at night when it gets cool and darker in order to avoid sting attacks from honeybees (Yasuyuki, 2009). The efficiency of the three different colored light source batteries in attracting the honey bees, targeting improved night time hive inspection, showed that red colored light source batteries have attracted the least number of bees (89.33±5.42) than the blue (246.83±5.42) and white color light source (263±5.42) batteries. This result, thus has been line with the results of Aidoo (2009) who has found that African honey bees are least attracted to red light than white lights when disturbed in dark times. This finding has also found to be in the assertion of Henda et al., (1999c) stating that blue and cool white lights are about highly and equally attractive to moths than red light at night in Missouri, USA.

The results of this experiment generally has suggested that the local honey bees races can be managed less aggressively during night operations using red colored light source batteries. This, in turn, is believed to reduce the fear and danger of being stung by the local honey bee race. A potential fear to honey bee sting has been identified as a major impediment in bee keeping in Uganda (Mujuni, 2012). Of course, the case is also true in our country in general and in the Amhara region (the study area) in particular (Adebabay et al., 2008).

Conclusion and Recommendations

Results has shown that the fear and danger of African honeybee sting in apiculture can be reduced to the minimum if red colored light sources is used during night time hive inspection and management of the honeybee colonies in different hives. Thus, the use of red colored light source battery at times of internal operation in local honey bees at night reduces the number of bee stings and found to be effective to calm down the aggressiveness of the bees. However, during splitting queen rearing and other intensive activities, which needs clear observation of the combs and comb contents, use of white colored light source batteries is advisable. The use of red colored light source battery might also contribute to the production of increased honey volume through minimizing the death of worker bees during the use of white colored light source batteries. However, further research is needed to show the productivity differences between the use of different light source batteries during local honeybee's internal inspection and managemental operations.

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