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The effect of weather factors on the activity of peach fruit fly *Bactrocera zonata* (Diptera: Tephritidae) on guava orchards in Dakahlia and Kafr El-Shaikh Governorates

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Abstract

Peach fruit fly (PFF) *Bactrocera zonata* (Saunders) (Diptera: Tephritidae) thought about one of the most harmful pests destroying guava fruits. This study was carried out to evaluate the efficiency of weather factors on the activity of PFF in Dakahlia and Kafr El-Shaikh Governorates during 2023. The results suggested that the population of PFF noted three distinct peaks of activity during the guava fruiting season of 2023 in Dakahlia and Kafr El-Shaikh Governorates. These results showed that PFF had three peaks in the mean of infestations per fruit and percentage of infestations at Dakahlia and Kafr El-Shaikh Governorates. Data illustrated that the percentage of infestations per fruit of PFF increased by (0.128) in Dakahlia, while it increased by (0.116) in Kafr El-Shaikh Governorate. The obtained results revealed that low responses to the mean temperature and low responses to RH% in Dakahlia the correlation coefficient value was insignificant at Dakahlia (r = 0.02), % in response to RH% the correlation coefficient value was insignificant negative (r= -0.3), at Kafr El-Shaikh Governorate. Temperature degrees, whereas the correlation was significant (r= 0.76). In response to relative humidity, the correlation value was insignificantly negative (r= -0.35).

Introduction

In temperate, tropical, and subtropical regions, the peach fruit fly (PFF), *Bactrocera zonata* (Saunders) (Diptera: Tephritidae), is regarded as one of the most economically significant pests for a variety of fruits (Fletcher, 1987 and Younes *et al*., 2009). Beginning in the 1990s, *B. zonata* has become dangerous in Egypt, affecting a variety of fruits that vary when they ripen throughout the year (El-Minshawy *et al*., 1999 and Hashem *et al*., 2007a). Male Annihilation Technique (MAT) (Zaheeruddin, 2007). By eliminating male insects, the population of male insects is decreased. This throws off the insect's male-to-female, ratio, decreasing its chance of mating and resulting in relatively few offspring produced by the females. As a result, the target areas' wild population shrinks and the insects are eventually wiped out (Zaheeruddin, 2007). As part of a comprehensive pest (PFF) management plan, the benefits of

employing a variety of attractants (food, olfactory, and sex attracts chemicals) are typically taken into account (Gopaul and Price, 1999; Hanafy *et al.*, 2001; Amin, 2003 and 2008; Saafan *et al*., 2005, and Afia, 2007).

As a constituent of plant essential oil, methyl eugenol (ME), also known as 4-allyl-1,2-dimethoxybenzene, is found naturally in over 450 plant species from 80 families that are primarily tropically growing, it is also an essential nutrient for certain *Bactrocera* species (Tan, 1993; Aluja and Norrbom, 1999; Tan, 2000; Vayssieres *et al*., 2007; and Tan and Nishida, 2012).

While ME is widely used as an attractant in traps to reduce PFF, in Egypt it is used as a potent mail-specific lure (Afia, 2007; Abd El-Kareim *et al*., 2009; Ghanim *et al*., 2010; Ghanim, 2013; El-Metwally and Amin, 2015; and El-Metwally *et al*., 2017). Two variables significantly reduce the seasonal activity of the MFF population: the host fruits' comparable ripening specific temperature degrees in the climate, according to Saafan *et al.* (2005); Saafan *et al.* (2006); Ghanim and Moustafa (2009), and Moustafa *et al.* (2014). Adverse weather conditions, particularly temperature degrees, have a substantial impact on the MFF population (Ghanim and Moustafa, 2009; Ghanim, 2017; and Camargo *et al.*,1996). Agarwal *et al.*, 1999 a., and Bonne *et al.*, 2001 stated that when two species grow plentiful in comparison to their restricted resources, interspecific competition may also limit or lower population numbers; RH% plays a minimal role in the population of medflies.

The purpose of this experiment was to examine the occurrence of peach fruit fly *B. sonata* in guava orchards and its response to various ecological parameters, such as relative humidity and temperature degrees.

Materials and methods

An area of 5 feddans (one feddan = 4200 m^2) planted with guava trees was for the prevailing study at the Experimental farm of Mansoura University, Dakahlia Governorate. The area with the same crop was selected in Kafr El-Shaikh governorate. The two Governorates are located in the north of the Delta area, Egypt.

1. Fruit samples:

Five trees of each orchard that were homogenous in size and age were chosen and labeled for this study. Fruit samples were acquired weekly, from the 8th of August till the 9th of November 2023 at Dakahlia Governorate and from the 21st of August till the 20th of November 2023 at Kafr El-Shaikh Governorate. Each sample consisted of 25 fruits (5 fruits/tree) acquired randomly from different cardinal directions (North, south, east, and west) and the middle of the trees. One fruit was collected in each direction, in addition, fruits were collected randomly from the fallen fruits under the chosen trees. Fruit samples were moved to the laboratory for examination. Each fruit was incubated separately in a plastic dish covered with a piece of muslin for two weeks. The Plastic container contained a film of sand (About 2 cm in height), for receiving the pupae from the fruit fly larvae.

After two weeks, the cultivated fruits were investigated and classified as

uninfested and infested fruits. The resulting pupae from each infested fruit were transferred to a tube and re-incubated for another two weeks under laboratory conditions until adult emergence. The resulted adults of PFF were counted for each infested fruit. The percentages of infestation were calculated as follows:

$$\text{Infestation \%} = \frac{\text{No. of infested fruits.}}{\text{Total number of the collected fruits.}} \times 100.$$

2. Trap samples:

Five white Jackson traps (Harris *et al*., 1971) were anchored in a shady side of the trees at a height of two meters (with a rate of one trap per one feddan). All traps were given with methyl eugenol (The PFF sex attractant), was given to every trap, and it was changed every four weeks. Every week, the traps were examined, and the number of captured flies on each sticky cardboard inside the trap was counted with renewal cardboard strips. The number of trapped flies per trap and day (FTD) was tallied as a quantification of the insect population.

Daily averaged temperatures and RH% were gathered from the agrometeorological stations at Dakahlia and Kafr El-Shaikh Governorates of investigations using the meteorological data. The mean weekly FTDs were associated with each weather factor using the Person simple regression ratio, and the described differences were determined as well. In addition, the relation between FTDs and infestation percentages was evaluated. All statistical analyses were done using Minitab Computer Program (1998).

Results and discussion

1. Occurrence of peach fruit fly *Bactrocera zonata* in guava orchards:

As results in Figure (1) showed, the population of PFF experienced three distinct peaks of activity during the guava fruiting season of 2023 at Dakahlia. These peaks have been recorded on the 27th of September, the 4th of October, and the 11th of October. The numbers of attracted flies per trap per day (FTD) at these peaks were (22.24, 22.38, and 21.09) at Kafr El-Shaikh. The population of PFF showed three distinct peaks of activity. These peaks were recorded on the 19th of September (FTD = 7.0), the 26th of September (FTD = 5.76), and the 3rd of October (FTD = 5.62), respectively (Figure 1).

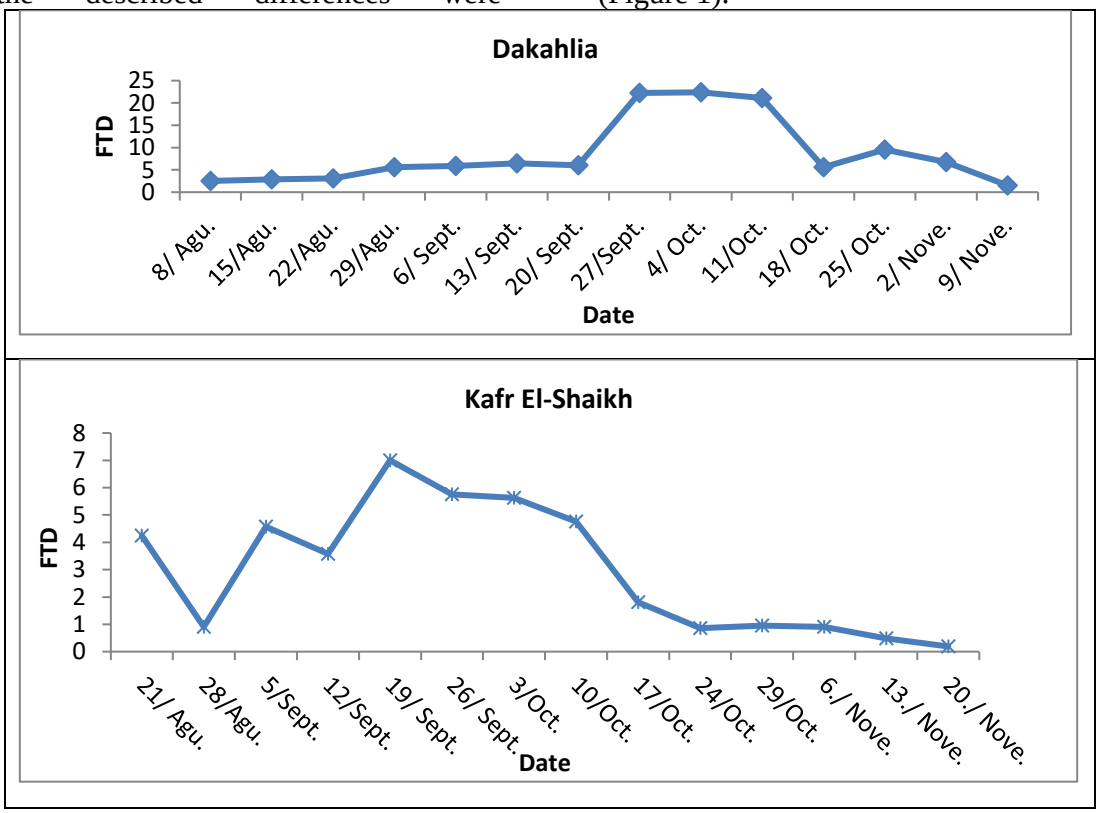

Figure (1): Occurrence of population of *Bactrocera zonata* in guava orchard during fruiting seasons of (2023) at Dakahlia and Kafr El-Shaikh Governorates.

2. Occurrence of the mean of infestation per fruit and percentage of infestation:

Data in Figure (2) indicated that *B. zonata* recorded three peaks of the mean of infestations per fruit and percentage of infestations in Dakahlia on 14th September (6.47, 16.41%), 11th October (6.18, 17.52%), and 25 October (5.87, 16.63%). While Kafr El-Shaikh Governorate recorded three peaks on (28th September and 11th, 15th October), the percentage of infestation was 18.81%, 16.92 and 16.97%, respectively.

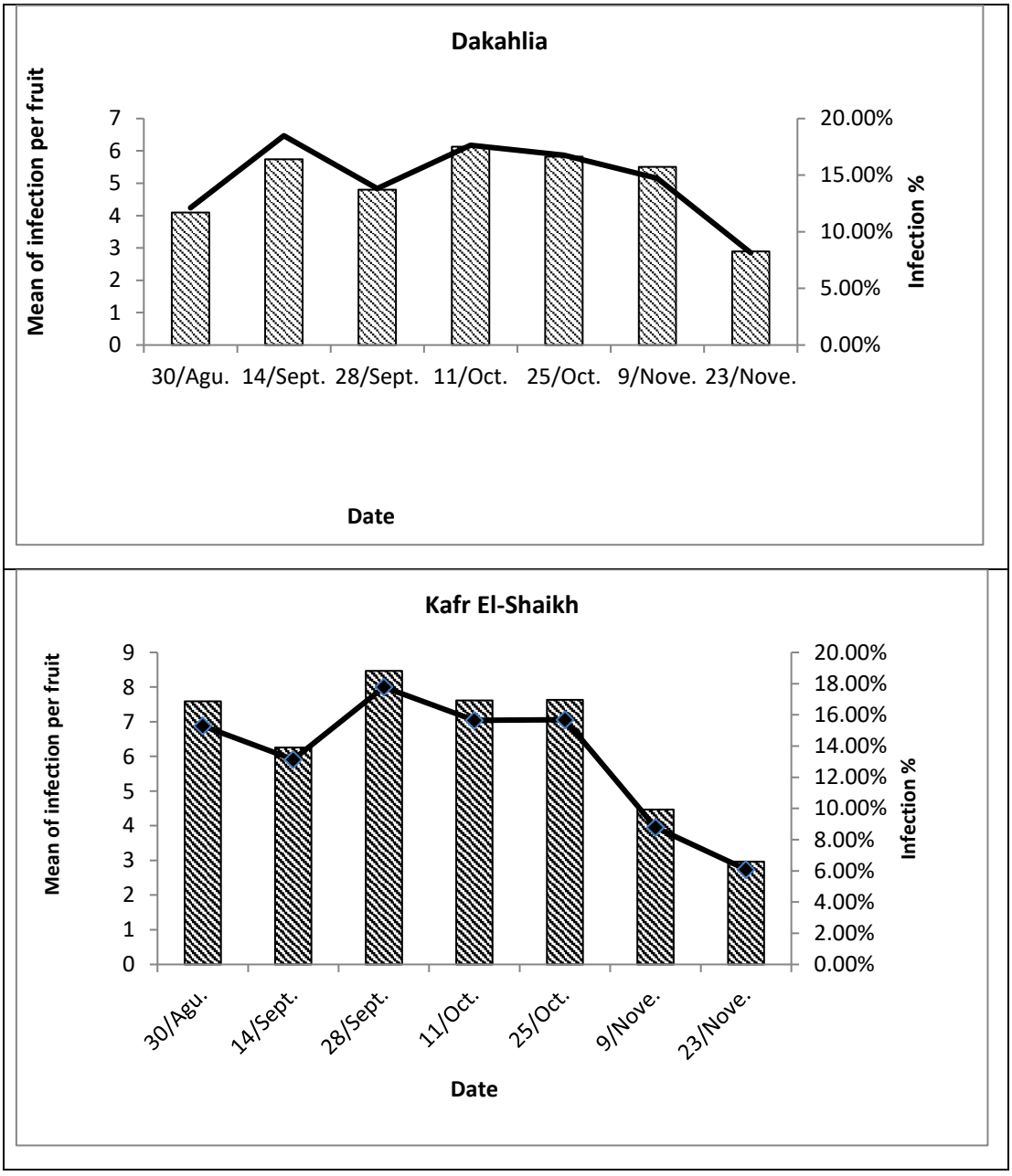

Figure (2): Mean of infestations per fruit and percentage of infestations in guava orchard during 2023 at Dakahlia and Kafr El-Shaikh Governorates.

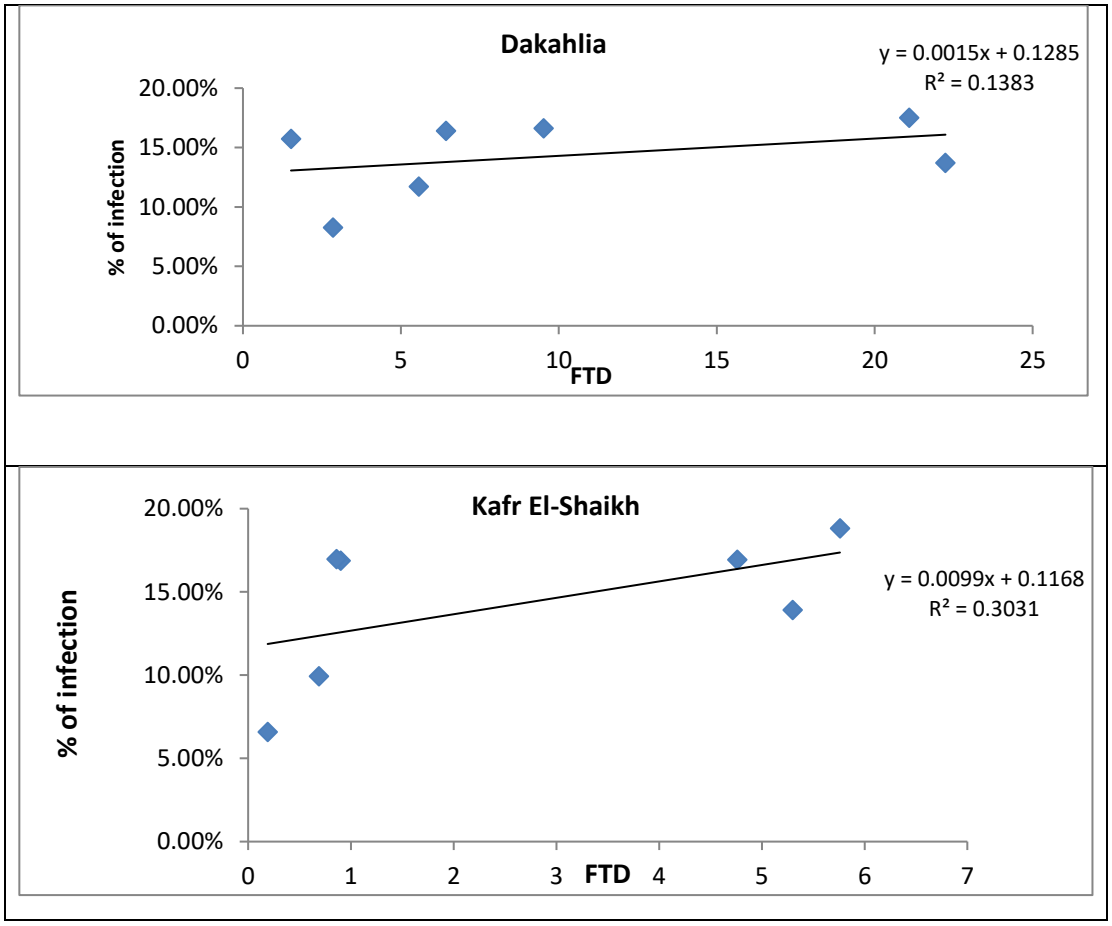

Figure (3): The relation between flies per trap and day and percentage of infestation per fruit of *Bactrocera zonata* in guava orchards during 2023, at Dakahlia and Kafr El-Shaikh Governorates.

Data in Figure (3) indicated that percentage of **infestations** per fruit of PFF increased by (0.128) at Dakahlia, while it increased by (0.116) at Kafr El-Shaikh Governorate.

4. The effect of certain ecological factors on *Bactrocera zonata* in guava orchards:

According to Table (1), the population of PFF showed low reactions to the mean temperature and low responses to RH% at data in Figure (3) indicated that percentage of infestations per fruit of PFF increased by (0.128) at Dakahlia, while it increased by (0.116) at Kafr El-Shaikh Governorate. These responses have been at the lowest values with temperature degrees, whereas the correlation coefficient value was insignificant at Dakahlia (r = 0.02). In addition, the determination coefficient value (R2) was (0.0%) in response to RH%, the correlation coefficient value was insignificantly negative (r= -0.3) at Kafr El-Shaikh Governorate. Temperature degrees, whereas the correlation coefficient value was significant (r= 0.76) and (R^2) was (58.7 %). In response to relative humidity, the correlation value was insignificantly negative (r= -0.35), respectively. The typical impact of all the examined factors represented by 10.7 % and 59.6 % of the total elements impacting on the *B. zonata* population at Dakahlia and Kafr El-Shaikh Governorates.

Table (1): Correlation and regression ratios between *Bactrocera zonata* population and each of temperature degrees and relative humidity in guava orchards at Dakahlia and Kafr El-Sheikh Governorates during (2023).

Governorate	Factors	Correlation and regression				Multi regression		
		R	B	P	R^2	B	P	E.V%
Dakahlia	Temperature degree	0.02	0.04	0.94	0.0%	- 0.21	0.76	10.7%
	Relative humidity	-0.3	- 0.56	0.27	9.9%	- 0.61	0.27	
Kafr El-Sheikh	Temperature degree	0.76	0.51	0.001	58.7%	0.49	0.004	59.6%
	Relative humidity	-0.35	- 0.31	0.21	12.5%	- 0.09	0.61	

The relationship between percentage of infestations per fruit and the prevailing climate factors (Mean temperature and RH%) was studied at Dakahlia and Kafr El-Shaikh Governorates during the 2023 season (Table 2). At Dakahlia, % of infestations per fruit exhibited a significant positive correlation (r= 0.58) response of mean temperature, while the effect of RH % was insignificantly positive (r= 0.41). At Kafr El-Shaikh Governorate, the static analysis showed a significant positive correlation between the percentage of infestations per fruit and mean temperature (r= 0.90) and insignificant negative (r= - 0.17) between the mean RH%, respectively (Table 2).

Table (2): Correlation and regression coefficients between percentage of infestations per fruit and each of temperature degrees and relative humidity in guava orchards at Dakahlia and Kafr El-Shaikh Governorates during (2023) season.

Governorate	Factors	Correlation and regression				Multi regression		
		r	B	P	R^2	B	P	E.V%
Dakahlia	Temperature degree	0.58	0.21	0.16	34.5%	0.22	0.13	56.2%
	Relative humidity	0.41	0.13	0.35	17.4%	0.15	0.23	
Kafr El-Shekh	Temperature degree	0.90	0.46	0.01	81.1%	0.51	0.00	97.8%
	Relative humidity	-0.17	- 0.12	0.71	3.0%	- 0.29	0.01	

The results that were found showed the PFF population recorded three activity peaks. The results concur with Ghanim (2012); Moustafa *et al*. (2014); Ghanim (2016 and 2017), and Amara (2017); they stated that in Dakahlia and El-Beheira Governorates, the population of MFF displayed two to four peaks of seasonal abundance in orchards of persimmon, apple, guava, grape, peach, and citrus. Also, Hashem *et al.* (2001) noted that the MFF population had one to two peaks of seasonal abundance. While Ghanim and Moustafa (2009) said that there were four seasonal abundance peaks for medflies. Agarwal *et al.* (1999a) investigated *B. zonata* population dynamics in India from April to August. The third week of June saw the highest fly populations, while the last week of August saw the lowest number. According to Agarwal *et al.* (1999b), an average of flies per trap per week, as the number of adult male *B. zonata* were reported between April and August. Additionally, Chaudhry and Jamal (2000) discovered that the task of adult males of *B. zonata* attained a peak between August and October, which matched with the maturity of their host plant (Guava fruits). Data indicated that *B. zonata* recorded three peaks of the mean of infestations per fruit and percentage of infestations in Mansoura district on 14th September (16.41%), 11th October, and 25th October (17.52% and 16.63%).

While Kafr El-Shaikh Governorate recorded three peaks at (28th September 11th, and 15th October) (18.81%,16.92 and 16.97%), this is consistent with Ghanim (2009). The percentages of PFF adults that appeared from the fallen fruits of peach were 36.89 and 61.68% of the total emerged adults from all collected fruits during 2005 and 2006 seasons. Data showed that the percentage of infestations per fruit of PFF increased by (0.128) at Dakahlia, while it increased by (0.116) at Kafr El-Shaikh governorate. This agrees with Ghanim (2009); he found that regression analysis showed that the increase of fruit infestation was insignificantly (b = 5.68) and highly significant (b = 5.52) associated with the increase of CTDs in Jackson traps in the first and second seasons. In the current study, the PFF population showed low reactions to the mean temperature and low responses to RH% at Dakahlia. These reactions have been at the lowest values with temperature degrees; whereas the correlation coefficient value was insignificant at Mansoura district, in response to RH% the correlation coefficient value was insignificant negative at Kafr El-Shaikh Governorate. Temperature degrees, whereas the correlation coefficient value was significant. In response to relative humidity, the correlation value was insignificantly negative; this agrees with Ghanim (2009), who indicated that temperature plays a significant role in the buildup of the population of *B. zonata*, especially in the summer season, and Hashem *et al.* (2007 b) revealed meteorological conditions, particularly mean temperature, have a significant impact on *B. zonata* population density. According to Amin (2008), the number of PFF adults released correlated with temperature increases to (30°C), which is its ideal range. According to Amin (2008) PFF was observed to be impacted by temperature increases over the optimal range (30°C) throughout the summer. In Pakistan, Chaudhry and Jamal (2000) recorded that the highest activity of PFF adult males was noted at (31.4, 19.2°C and 76.7R.H).

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