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APPLICATION OF BEE ATTRACTANTS FOR COCONUT POLLINATION AND PRODUCTIVITY

Agricultural Science

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ABSTRACT

Honeybees are agricultural, ecological and economically important insects. Honeybees and flowering plants are interdependent and a good example for mutualism and co-evolution. Bees are considered as most efficient pollinators in the ecosystem and utilization of bees as pollinators for various entomophilies crops. In this study, the bee attractants, Bee-Q and Fruit Boost™ in the pollination of target crop was evaluated. The bee visitations on Coconut flowers was observed for two weeks followed by estimation of yield. The different concentrations of Bee-Q and Fruit boost™ was evaluated to understand the honeybee visitation pattern of target crop for improving pollination efficiency. The observations indicate that, Bee-Q at 12.5 g/l and Fruit boost at 0.5 ml/l of Coconut plots significantly attracted higher number of bee foragers than the control plots. In addition, the plots sprayed with bee attractants significantly enhanced the total number of inflorescence fruits and copra weight of Coconut. The present investigation suggests that the bee attractants increase marginal percentage of bee visitation, number of inflorescence, fruits and copra weight on Coconut.

KEYWORDS

Apis florea, Apis dorsata, Bee-attractants, Cocos nucifera L. Bee visitation

Introduction

Coconut palm, (Cocos nucifera L.) belongs to the family Palmae, blooms throughout the year. According to McGregor (1976), both staminate and pistillate flowers produce nectar and honeybees are attracted to the flowers for both pollen and nectar. In the centre of the male flower 3 nectar glands are present which attract insects and when the stigma of the female flower is receptive, a clear sweet fluid is secreted (Suryanarayana et al., 1990). A. cerana collects pollen from Cocos nucifera L. (Bhambure, 1958a). Whitehead (1965) recorded that honeybees visited 103 flowers in one minute while foraging for nectar in Coconut flower. The production of an uneven and small fruits and low yield of fruit and seed set (Weaver, 1979) is the indication of insufficient pollination in Coconut. Thampan (1981); Louis and Chelladurai (1984) reported that honeybees are its main pollinators. Kumar et al., (1997) reported the significance of honeybee pollinator in coconut pollination. Honeybee pollination resulted in 123% increase in fruit set. Similarly the net weight showed an increase of 55.9% and kernel thickness showed an increase of 76.7% due to open pollination treatment that allowed honeybee visits to flowers of coconut. The greater yield in bee-pollinated plots was due to continuous visit of honeybees and successful transfer of pollen from staminate to pistillate flowers of coconut (Nagaraja and Reddy, 2002).

The numbers of domesticated honeybee colonies in India are decreasing due to huge number of viral diseases and pests. There is a parallel interest in improving the pollinating efficacy of bees and a pollinator deficit is especially acute if neighbouring crops must compete for limited pollinators (Levin and Anderson, 1970). However, the studies on the use of bee attractants are lacking except for the studies of a handful of tested bee attractants (Mayer et al., 1989a, b; Elm storm and Maynard, 1991; Winston and Slessor, 1993; Ambrose et al., 1995; Higo et al., 1995), those based on queen mandibular pheromone (QMP), Fruit boost and Bee-Q based on carbohydrate rich have had the most promising research record (Currie et al., 1992 a, b; Naumann et al., 1994). Pollination potentiality on experiments were performed and treatment response increased by the use of attractants on Ridge Gourd (Jayaramappa et al., 2011), on Guava (Anita et al., 2012), on Pumpkin (Jayaramappa and Sivaram, 2013) on Niger (Sivaram et al., 2013), on Pigeon pea (Sivaram and Jayaramappa, 2013), on Ridge gourd (Jayaramappa and Bhargava, 2013), on Mustard (Sivaram and Jayaramappa, 2013), on Sun flower (Jayaramappa and Bhargava, 2015), and on Water melon (Jayaramappa and Bhargava, 2015). In present situation no attempts have been made for exploring the possible use of bee-attractants to boost the productivity of target crop in India. The main objective of this work was to determine the application of honeybee attractant to attract more bees towards target crop and to evaluate the extent of their usefulness for increasing pollination efficiency, total number of fruits / inflorescence and copra weight on Coconut.

MATERIALS AND METHODS

Experimental layout

The experiment was conducted in an agricultural farm located 20 km from Bangalore, India. Coconut trees were found in an area of one hectare by following suitable agricultural practices recommended by the Agriculture Department. Seven inflorescences of different tress of 5x5 square meter area were set up in the farm. The commercially available bee attractants like Bee-Q was purchased from M.S Excel Industries, Bombay. Fruit boost from Phero tech Inc, Delta, BC Canada and performed attraction experiments to generate treatment response curves for each pheromone component. Altogether, we tested three concentrations of Bee-Q (10, 12.5 and 15 g/l) and three concentrations of Fruit boost (0.5, 0.75 and 1.00 ml/l) and without any spray as a control. Observations on bee visitation were recorded on the first day after spray, followed by 3rd day and 5th day after spraying the bee attaractants. The first day after the second spray (50 percent blooming) of attractants were sprayed on Coconut followed by 2nd day and 3rd day after spray. Each observer recorded by sight the number of honeybee flower visitors in respect of three species of honeybees namely, Apis cerana, Apis florea and Apis dorsata.

Harvest parameters

The earlier tagged inflorescences were harvested from each treatment and the total number of fruits / inflorescence was recorded. From these sun dried fruits the copra was weighed from each replication of treatment and data were statistically analyzed.

Climatic conditions and Statistical analysis

The meteorological data in respect of temperature, relative humidity, wind speed and Sunlight during the study period were obtained from the University of Agricultural Sciences Meteorological center. All response variables were analyzed statistically by using SPSS version 11.0 with one way ANOVA and a DMRT (Dun cans Multiple Range Test) with standard errors.

RESULTS AND DISCUSSION

The result indicated a consistent benefit of honeybee attractant in promoting pollination on Coconut. Observations pertaining to honeybee-visitation on Coconut treated with bee-attractants at 10 and 50% flowering are presented in Table-I and Fig I. Fruit boost at 0.5 ml/l and Bee-Q at 12.5 g/l sufficiently increased honeybee visitation on flowers of Coconut to improve pollination performance over that in control plots on the 5th day after 1st spray and on the 3rd day after 2nd spray. The data on the yield parameters of Coconut is given in Table-II and Fig II. Fruit boost 0.5 ml/l and Bee-Q 12.5 g/l were the most effective attractant in enhancing the total number of fruits, copra weight. The data on the climatic factors of Coconut is given in Table-III. Climatic factors showed no co-relation between the bee visitations, yield on Coconut. These results clearly indicated that, application of bee-attractants is beneficial in increasing the number of fruits / inflorescence, which was due to increased bee-visitation that caused the well distribution of pollen, which resulted in better fruit setting. It is thus evident from the present study that the Fruit boost 0.5 ml/l and Bee-Q 12.5 g/l, both marginally increased the bee visitation and these

attractants utilized the olfactory, visual and other known instinctive behavioral responses of bees. So, the attraction of honeybees is a result of cumulative effect of interactions among honeybees, target crop and applied chemicals. Thus the use of pheromone sprays and bee attractants shows great promise as a management tool for improving the efficiency and consistency of pollination. Further research in economic pollination thresholds for each crop would be of great value to maximize the long term benefits of attractants to growers.

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Table-1: Bee-attractants and honeybee-visitation, showing all 7 treatments with first (10% and second (50%) spray on Coconut.

Treatments	Number of honeybees / 10 flowers / 5 min						
	First Spray (10% flowering)				Second Spray (50% flowering)		
	1 DBFS	1 DAFS	3 DAFS	5 DAFS	1 DASS	3 DASS	5 DASS
T1–Bee-Q 10 g/l	4.33 a	4.00 b	3.33 b	5.33 b	6.00 c	6.33 c	6.00 b
T2–Bee-Q 12.5 g/l	4.00 a	4.33 b	4.00 b	7.00 a	7.00 b	7.33 b	7.00 a
T3–Bee-Q 15 g/l	3.66 a	3.33 c	3.33 b	6.00 b	5.66 c	5.66 c	5.33 b
T4– Fruit boost 0.5ml/l	3.33 a	5.00 a	5.00 a	8.00 a	8.00 a	8.33 a	8.00 a
T5–Fruit boost 0.75ml/l	4.00 a	3.66 c	4.00 b	5.66 b	5.00 d	5.66 c	4.66 c
T6–Fruit boost 1ml/l	3.66 a	3.00 c	3.66 b	6.00 b	5.00 d	5.66 c	6.00 b
T7– Open pollination (control)	3.00 a	3.00 c	2.00 d	1.33 d	1.66 f	3.00 e	2.00 e
F-Value SEm ± CD at 5%	1.39 0.24 N.S.	4.90 0.238 0.702	3.58 0.270 0.796	9.90 0.364 1.073	12.94 0.30 0.885	9.25 0.264 0.778	6.87 0.370 1.091

DAFS – Day after first Spray, DASS-Day after second spray, *- Significant at P<0.05, SEm± - Standard error, NS – Non significant, CD- Critical difference, Means followed by the same letter in a column do not differ significantly

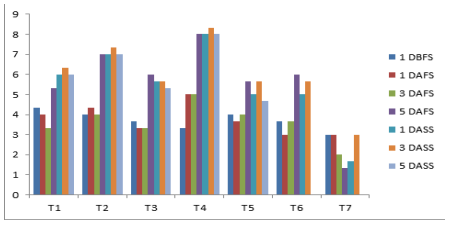

Fig-1: Bee-attractants and honeybee-visitation, showing all 7 treatments with first (10% and second (50%) spray on Coconut.

Table -2: Effect of bee attractants on the yield parameters in Coconut

Treatments	Total no. of fruits / inflorescence Mean	% Increase / Decrease over OP	Copra weight (g)	% Increase / Decrease/ over OP
T1–Bee-Q 10 g/l	12.5 d	19.04	204.0 c	0.74
T2–Bee-Q 12.5 g/l	19.0 b	80.95	217.5 a	7.40
T3–Bee-Q 15 g/l	18.0 c	71.42	209.0 c	3.20
T4– Fruit boost 0.5ml/l	21.0 a	100.00	219.0 a	8.14
T5–Fruit boost 0.75ml/l	15.0 c	42.85	216.0 b	6.66
T6–Fruit boost 1ml/l	13.5 d	28.57	212.5 b	4.93
T7– Open pollination (control)	10.5 f	-	202.5 c	-
F- value	29.63		16.95	
SEm ±	0.684		0.815	
CD at 5%	2.017		2.403	

Sem± - Standard error *- Significant at P<0.05, CD- Critical difference, Means followed by the same letter in a column do not differ significantly by DMRT

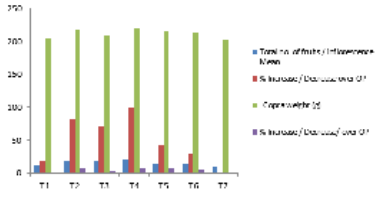

Fig -2: Use of bee attractants on the yield parameters in Coconut

Table-3: Environmental conditions (average) during seven treatments conducted on Coconut

Dates	Temperature (◦C)	Relative Humidity (%)	Cumulative wind (Km)	Sun light (Hrs)
Oct-12-2019	30.0	49	270	8.6
Oct-14-2019	29.8	58	230	5.8
Oct-16-2019	27.8	98	230	1.8
Oct-18-2019	27.2	88	90	1.9
Oct-20-2019	29.2	95	270	5.5
Oct-22-2019	29.0	95	140	7.7

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