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Original Research Paper

Agricultural Economics

ATTRACTION OF HONEYBEES TO CUCUMBER WITH BEE ATTRACTANTS

K.V. Jayaramappa*

Department of Botany, KLE College, Rajajinagar, Bangalore-560 010, India
*Corresponding Author

ABSTRACT

In this study, The usage of bee attracts like Bee-Q and Fruit Boost™ in the pollination of Cucumber was evaluated. The bee visitations on target crop flowers were made for two weeks, followed by estimation of yield parameters. The different concentrations of Bee-Q and Fruit boost™ was evaluated to understand the honeybee visitation pattern of the target crop for improving pollination efficacy. The observations indicate that, Bee-Q at 12.5 g/l and Fruit boost at 0.5 ml/l of Cucumber plots meagerly attracted a number of bee foragers than the control plots. In addition, the plots sprayed with bee attractants marginally enhanced the fruits/plant, length and diameter fruits. The present investigation suggests that the bee attractants increases certain amount of bee visitation, in turn, leads to increase in fruits/plant, length and diameter of fruits on Cucumber.

KEYWORDS : Bee visitation, Bee attractants, *Cucumis sativa L. Apis florea, Apis dorsata.*

INTRODUCTION

Cucumber mainly depend on insects for pollination, because the male and female parts do not occur in the same flower and pollen grains are large and sticky to be carried by wind, therefore, it needs to be transferred to the pistillate flowers for fruit set. Among insect pollinator agents, honeybees are known to be the most efficient pollinating agents of cucumber for many years (Grewal and Sidhu, 1979; McGregor, 1976, Free, 1970). Honeybees are known to increase the yield of Cucurbitaceous crops by 100 to 150% (Mel'nichenko, 1977). According to Shemetkov (1957) a cucumber flower should be visited by insect pollinators 8 to 10 times for satisfactory fruit set, but the number of seeds and weight of fruit increases by 40-50% of honeybee visits. Coleman (1979) caged the cucumber plants before bloom to illustrate that female blossoms need to be pollinated by insect to set fruit and placed a strong colony of *Apis mellifera* to supplement a limited supply of wild pollinators. A number of scientists claim to ensure cucumber pollination and fruit set, the bee must visit 8 to 10 times per flower (McGregor et al., 1965 and Conner, 1969) On the contrary, Collison (1976) claimed that 15 to 20 bee visits were needed to get uniform cucumbers and multiple bee visits increased the average number of seeds which resulted in better and maximum fruit weight and yield.

In the present study, more pollinators are required for better fruit set on target crop and it is too difficult attract honeybees to the target crop, because of all neighboring crops also compete for limited pollinators (Levin and Anderson, 1970). Under conditions of compromised pollinator efficacy, honeybee attractants may help focus limited pollinators of the crop of interest (Delaplane and Mayer, 2000). 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). Impact of bee attractants in increasing marginal pollination and yield on Ridge Gourd has been reported (Jayaramappa et al., 2011), on Guava (Anita et al., 2012), on Pumpkin (Jayaramappa and Sivaram, 2013) on Niger (Sivaram et al., 2013), pigeon pea (Sivaram and Jayaramappa, 2013), Ridge gourd (Jayaramappa and Bhargava, 2013), Mustard (Sivaram and Jayaramappa, 2013), Sun flower (Jayaramappa and Bhargava, 2015), and Water melon (Jayaramappa and Bhargava, 2015). The objective of this study was to determine the use of bee attractants to cucumber during bloom promotes pollination by honey bees under conditions of requirement of more pollinators to the target crop for better fruit set.

MATERIALS AND METHODS

The experiment was conducted in an agricultural farm located in 20 km from Bangalore, Karnataka, India, during 2019-2021. Cucumber crop was raised in an area of one hectare by following suitable agricultural practices recommended by the Agriculture Department. Seven experimental plots of 5x5 square meter area with row spacing of 2 meters were set up in the farm. The commercially bee attracts like Bee-Q was purchased from M.S Excel Industries, Bombay. Fruit boost from Phero tech Inc, Delta BC Canada. Bee attraction experiments to generate treatment response curves for each pheromone component. Altogether, 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 control.

Treatment assignments

From each plot, 10 branches with flowers randomly selected (three plots per treatment) and were labeled with tags separately. The crop area was introduced with two colonies of *Apis cerana* each having eight frame populations of honey bees and also there were few natural colonies of *Apis dorsata* and *Apis florea* were found in the vicinity of experimental site. Bee attractants were sprayed on the bloom of Cucumber with a standard sprayer.

Bee-Q was applied in the concentrations of 10, 12.5 and 15 g/l/ plot separately. Similarly, Fruit boost was applied in the concentrations of 0.5, 0.75 and 1.00 ml/l. Different concentrations between two attractants, was used because the composition of the two bee attractants differs. However, no bee attractants were applied to the control plots (Op). These attractants were sprayed on flowers of Cucumber during different intervals.

The number of honeybees visiting the Cucumber flowers sprayed with bee attractants was counted through visual observation. One observer was assigned to each plot and observations were synchronized to run between 08.00 to 16.00 hrs at two hourly intervals in a day (Rao and Suryanarayana (1990). Each observer walked down each row for five minutes, recording the number of honeybee flower visits (5min x 3 replicas = 15 min per plot, 7 rows x 3 replicas = 21min, 21min x 5min = 105 min for all plots with two hourly intervals).

A bee landing on an open flower for about 5 to 10 seconds was considered to be a 'visit'. Observations on bee visitation were recorded on the first day after spray (18 Oct, 2014), followed by the 3rd day (20 Oct) and 5th day (22 Oct) after spraying the bee attractants. The first day after the second spray (50 percent blooming) of attractants were sprayed on Cucumber (24 Oct) followed by 2nd day (26 Oct) and 3rd day (28 Oct, 2014) 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 tagged branches with fruits were harvested from each treatment and the number of fruits per plant was recorded. From these fruit length and diameter were measured from each replication of treatment and data were statistically analyzed.

Climatic conditions and Statistical analysis

The meteorological data on the same days of bee visitation with respect of Temperature, Relative humidity, Wind speed and Sunlight for the experimental period was obtained from the University of Agricultural Sciences, Meteorological center located about two km from the experiment station. 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

First spray (10% flowering) and bee visitation

Observations on honeybee visitation on Cucumber treated with bee attractants at 10 and 50% flowering of the crop are presented in Table-I and Fig I. The spray with Fruit boost 0.5 ml/l and Bee-Q 12.5 g/l attracted the maximum number of bees on the 1st, 3rdand the 5th day after 1st spray. A second spray (50% flowering) and bee visitation. First, 3rd and 5th day after the 2nd spray with Fruit boost 0.5 ml/l and Bee-Q 12.5 g/l attracted more number of bees.

Harvest parameters

The data on the yield parameters of Cucumber is given in Table-II and Fig II. More number of fruits / plant, higher fruit length and diameter were recorded in the plot treated with Fruit boost 0.5 ml/l and Bee-Q @ 12.5 g/l.

Climatic conditions

The data on the climatic factors of Cucumber is given in Table-III. This data showed there is temperature eco-relation between the bee visitation on 20th and 28th October is favorable for frequent bee visitation on Cucumber.

DISCUSSION

The study shows a consistent benefit of honeybee attractant in promoting pollination on Cucumber. Fruit boost at 0.5 ml/l and Bee-Q at 12.5 g/l sufficiently increased honeybee visitation on flowers of Cucumber to improve pollination performance over that in control plots. Among the bee attractants Fruit boost 0.5 ml/l and Bee-Q 12.5 g/l were recorded as the most effective on honeybee visitation on Cucumber on 3rd day after 1st spray and 3rd day after 2nd spray, These results are in close agreement with Pateel and Sattagi (2007) who reported spraying of bee attractants attracted maximum number of bees. The data on the climatic factor like temperature is favorable for bee visitation this leads to better fruit set on target crop. On contrary to Conner (1969) made observations of the cucumber flowers are found that bee visits began when the temperature was about 17°C but flights were not abundant until the temperature reached 21°C. 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 per plant, fruit length, fruit diameter. These results are in close line with Schulthesis et al., (1994) and Viraktamath and Anagoudar (2002) evaluated two commercial bee attractants on cucumber and watermelon. They found that these attracts increased the yield and also bee visitation.

In conclusion, it appears that Fruit boost at 0.5 ml/l and Bee-Q at 12.5 g/l significantly increased honeybee visitation on flowers of Cucumber to improve pollination performance over that in control plots. The bee visitation on this plant translated into a greater increase of yield parameters. It is because Fruit boost sprayed plots increased both the forager number and inter floral pollen movement. In case of Bee-Q, since it is a food attractant rich in carbohydrate content, it had a phagostimulatory effect, which attracted more bees to flowers that makes greater increase in yield in Cucumber. More broadly, this study suggests that the use of bee attractants shows numeric promise as a management tool for improving the efficiency and consistency of pollination and productivity.

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

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	1.66 a	1.66 d	3.33 b	2.66 c	2.33 c	3.00 c	2.66 c
T2–Bee-Q 12.5 g/l	1.66 a	4.66 a	5.66 a	5.00 a	4.33 a	5.33 a	4.66 a
T3–Bee-Q 15 g/l	1.66 a	3.33 b	3.00 c	3.00 b	3.33 b	3.66 b	3.66 b
T4–Fruit boost 0.5ml/l	2. 00 a	5.00 a	6.33 a	5.00 a	4.66 a	5.33 a	5.33 a
T5–Fruit boost 0.75ml/l	1.33 a	3.66 b	4.00 b	3.66 b	3.66 b	4.33 b	4.00 b
T6–Fruit boost 1ml/l	1.66 a	2.66 c	3.33 b	3.00 b	3.66 b	3.33 c	3.00 c
T7– Open pollinated (control)	1.33 a	1.66 d	1.33 d	1.33 d	1.33 d	1.66 d	1.66 d
F -Value	15.17	41.86	82.24	38.78	32.39	60.78	42.12
SEm±	0.081	0.157	0.162	0.153	0.171	0.184	0.173
CD at 5%	0.239	0.468	0.478	0.451	0.504	0.543	0.510

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 by DMRT.

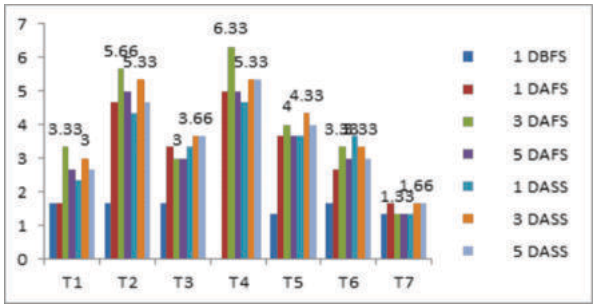

Fig-I: Bee-attracts and honeybee-visitors, showing all 7 treatments with first (10% and second (50%) spray on Cucumber

Table -II: Effect of bee attractants on the yield parameters in Cucumber

Treatments	Total no. of fruits / plant Mean	% Increase / Decrease over OP	Fruit Length (cm) Mean	% Increase / Decrease over OP	Fruit Diameter (cm) Mean	% Increase / Decrease over OP
T1–Bee-Q 10 g/l	2.66 b	19.81	20.5 c	13.88	4.50 b	6.63
T2–Bee-Q 12.5 g/l	2.81 a	26.57	21.5 b	19.44	4.85 a	14.92

T3–Bee-Q 15 g/l	2.60 c	17.11	19.5 d	8.33	4.65 b	10.18
T4–Fruitboost 0.5ml/l	2.86 a	28.82	22.5 a	25.00	4.92 a	16.58
T5–Fruitboost 0.75ml/l	2.57 c	15.76	21.5 c	19.44	4.65 b	10.18
T6–Fruit boost 1ml/l	2.48 c	11.71	19.5 d	8.33	4.50 b	6.63
T7– Open pollination (control)	2.22 e	-	18.0 e	-	4.22 c	-
F-value	14.85		74.67		11.74	
SEm±	0.161		0.152		0.167	
CD at 5%	0.475		0.448		0.492	

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

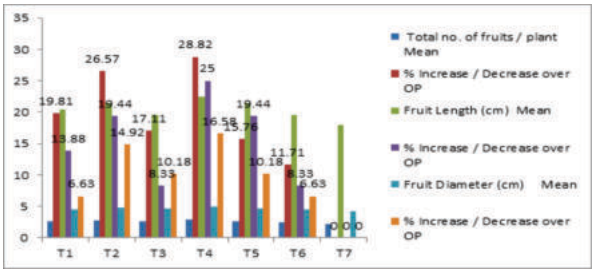

Fig II: Usage of bee attractants on the yield parameters in Cucumber

Table-III: Environmental conditions (average) during seven treatments conducted on Cucumber

Dates	Temperature (OC)	Relative Humidity (%)	Cumulative wind (Km)	Sun light (Hrs)
Oct-18-2020	30.0	49	270	8.6
Oct-20-2020	18.8	58	130	6.8
Oct-22-2020	27.8	98	230	1.8
Oct-24-2020	27.2	88	90	1.9
Oct-26-2020	29.2	95	270	5.5
Oct-28-2020	18.4	91	130	6.8

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Plate 1. *Apis cerena* visiting the flowers of Cucumber

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