Research Paper :

Studies on the influence of bee attractants on bee visition of *Apis dorsata* and *Trigona* sp. on onion (*Allium cepa* L.)

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SUMMARY

During *Rabi* season of 2008-09, a field experiment was conducted at Marathwada Agricultural University, Parbhani. The result revealed that a day before the first spray, the number of bees visiting the onion flower ranged from 1.66 to 2.50 bees/m^2/min and did not differ significantly among the treatments. However, the following day after the first spray, Bee-Q (15 g/lit) attracted the higher number of bees 5.17 bees/m^2/min. *Trigona* sp. treatment with Bee-Q (15 g/lit) (4.00 bees/m^2/min) was significantly superior in attracting more number of bees and was at par with Bee-Q (12.5 g/lit), Bee-Q (10g/lit), sugar syrup 5% and molasses 10% recorded (3.83, 3.67, 3.67 and 3.60 bees/m^2/min) on 1st day after 1st spray. Open pollination without spray recorded the lowest number of bees (2.30 bees/m^2/min).

Key words :
Onion, Honeybee, Pollination, Beeattractant, Molasses

In seed crop of onion (*Allium cepa* L.), the inflorescence of onion is an umbel. The onion flower is largely protandrous. The flowers are borne in simple umbel at the apex of a floral stem, which is a commonly hollow when mature. The number of flower per umbel may be as few as 50 to 2000 depending upon the variety. The flowers are white or bluish. The anthers of inner whorls dehiscence first all the pollen being shed over in a period of two to three days. Onion is highly cross pollinated crop due to its protandry. Insects are required to transport the heavy and sticky pollen grains in onion.

Anther dehiscence occurs in between 5 am to 9 am and anthesis starts in onion at 7 am. Honey bees are the most efficient pollinator among various insect pollinators of onion, out of which *Apis cerana, A. mellifera, A. dorsata, A. florea* and *Trigona* spp. are important.

Onion seed yield is heavily dependant on bee pollinators and for efficient pollination of this highly cross pollinated crop, honey bees are most applicable. By employing domesticated bees *viz*., *Apis cerana, A. mellifera* colonies we can get required yield but if domesticated bees are not available and colonies of wild bees are present in nature, it is therefore possible to employ these bees for pollination. Hence, it is decided to employ these wild bees by attracting them to crop by using bee attractants.

The material to increase the honey bee visit to specific crops would be of great practical value to harvest the benefits of cross pollination. Commercial and local bee attractants *viz*., bee line, Bee here, Bee scent, Bee scent plus, fruit boost and Bee – Q are being used to boost the yield of pea, peach, blue berries, watermelon and apple in the United States, Spain and Canada. However, in India, the studies on the use of bee attractants are meagre. Further, though some studied have been made on pollination of onion but no attempts have been made for exploring the possible use of bee attractants to boost productivity of onion in India.

However, Zvedenok (1996) tried geraniol, citrol, limonene and carrot seed extract as attractant, for attracting bees on onion corp Murasing (2000) reported that spraying of bee-Q at higher dosage (15.00, 12.50 and 10.00 g/l) significantly enhanced the both quantitative and qualitative parameters in mustard. Sattigi *et al*. (2001a) observed that application of Bee-Q @ 12.50 and 15.00 g/l resulted in higher yield (19.56 and 19.45 t/ha, respectively), maximum good fruits, minimum malformed fruits and higher size and weight in watermelon. Application of Bee-Q (12.50 g/l) on niger increased the number of seeds/capsule (ranged from 24.41 to 29.26) and oil content (38.10 per

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cent) as compared to the control (Sattigi *et al*., 2001b). Lingappa *et al*. (1999), reported that an increase of 21.80 and 31.80 per cent in the number of fruits formed and total yield, respectively when Bee-Q was sprayed twice on watermelon. Whereas, in safflower the seed yield was significantly enhanced to the extent of 54.84 per cent over the control. Viraktamath and Patil (1999), studied the influence of Bee-Q and Bee here on bee visitation and yield parameters of sesamum at Dharwad. Bee visitation increased significantly on the sprayed crop upto 5th day after 1st and 2nd spray. The number of pods per plant, number of seeds per pod, seed weight, seed yield and oil content increased significantly in the crop sprayed with bee attractants.

Honey bees are important pollinators of many entomophilous crops and they play very significant role in increasing productivity of these crops. Bee pollination, a cheap and chief natural resource is totally neglected and unexploited. Very less research has been done on use of bee attractants on bee visitation and there is lack of literature also.hence present investigation was undertaken.

MATERIALS AND METHODS

The present investigation was carried out in *Rabi* season of 2008-2009 at Department of Horticulture, Marathwada Agricultural University, Parbhani. The sowing was done on 11th November 2008 by using onion hybrid AFLR with plant to plant distance 15 cm and row to row distance was 45 cm. The experiment was conducted with simple randomized block design with seven treatments and three replications. T_1 Open pollination (OP)T_2 Pollination without insects (PWI) T_3 Bee-Q, @ 12.5 gm/lit, T_4Bee-Q, @ 15 gm/lit T_5Bee-Q, @ 10 gm/lit T_6 Sugar syrup spray 5 % (SSS) T_7 Molasses @ 10 per cent.

The crop which did not recieve any spray of attractant (T_1) served as unsprayed control and the crop which was caged with nylon (mesh 20 u) from initiation of flowering to seed set (T_2) served as PWI. In each plot, one meter square area randomly demarkated by bamboo sticks in each plot and number of pollinators visiting these flowers per min was recorded throughout the day from 0600 to 1800 hrs. at two hourly intervals. Such observations were made a day before the first spray and later 1st, 3rd, 5th, 7th, days after 1st and 2nd spray. Means of all the observations of a day were pooled for *A. dorsata, A. florea, A. cerana* and *Trigona* spp. and other pollinators separately. The data from individual crop and pooled data from both the crops were subjected to statistical analysis. For recording foraging period of various bee species, when bees started foraging pollen and nectar on onion flower the time was keenly observed and noted. Pollen foragers were recognized by observing pollen load situated on hind leg baskets. For recording nectar foragers when bees protruded their proboscis for collecting nectar at the base of ovary, such bees were recognized as nectar forager. The pollen and nectar foraging time was noted for various bee species.

RESULTS AND DISCUSSION

Observation was recorded on *Apis dorsata* visitation on onion treated with different bee attractants at 10 and 50 per cent of flowering (Table 1).

First spray:

A day before the first spray, the number of bees visiting the onion flower ranged from 1.66 to 2.50 bees/m^2/min and did not differ significantly among the treatments. However, the following day after the first spray, Bee-Q (15 g/lit) attracted higher number of bees 5.17 bees/m^2/min and significantly superior over treatments sugar syrup 5 %,molasses 10 % and open pollination without spray. Further, this treatment was at par with Bee-Q (12.5 g/lit) and Bee-Q (10 g/lit) wherein both treatments recorded 5.00 bees/m^2/min and 4.83 bees/m^2/min, respectively. This was followed by the treatment with sugar syrup (5%) recorded 4.50 bees/m^2/min. It was at par with molasses (10%) (4.33 bees/m^2/min). Least number of bees were recorded in open pollination without spray (2.66 bees/m^2/min).

On 3rd day after first spray, Bee-Q (15 g/lit) recorded maximum number of bees (7.00 bees/m^2/min) and found superior over molasses 10% and open pollination without spray and found at par with Bee-Q (12.5 g/lit), Bee-Q (10 g/lit) and sugar syrup treatment (5%) recorded 6.83, 6.30 and 6.10 bees/m^2/min, respectively. Further, rest of the treatments including open pollination without spray were inferior as they recorded less number of bees than above treatments which ranged from 4.33 to 5.60 bees/m^2/min.

Five day after first spray, treatment Bee-Q (15 g/lit) was significantly superior over treatments Bee-Q 10g/lit, sugar syrup 5%,molasses 10% and open pollination without spray in attracting Bees for pollination (6.67 bees/m^2/min), and found at par with Bee-Q (12.5 g/lit) (5.83 bees/m^2/min). The plot which received Bee-Q (10 g/lit) was the next best treatment (5.30 bees/m^2/min) which was at par with sugar syrup (5%) and molasses (10%) and were recorded 5.17 bees/m^2/min and 5.00 bees/m^2/min, respectively. Open pollination without spray recorded lowest number of bees.

Table 1 : Influence of attractants on visitation of *A. dorsata* on onion

Treatments	Bee visitation per square meter per minut									
	First spray (10 per cent flowering)					Second spray (50 per cent flowering)				
	1 DBS	1 DAS	3 DAS	5 DAS	7 DAS	1 DBS	1 DAS	3 DAS	5 DAS	7 DAS
Bee–Q 10 g/l	2.00	4.83	6.30	5.30	5.13	5.00	7.00	5.53	4.20	3.50
	(1.55)	(2.23)*	(2.64)	(2.40)	(2.09)	(2.19)	(2.70)	(2.39)	(2.13)	(1.70)
Bee–Q 12.5 g/l	1.66	5.00	6.83	5.83	5.70	5.50	7.20	5.70	4.30	3.66
	(1.46)	(2.34)	(2.71)	(2.52)	(2.19)	(2.23)	(2.75)	(2.49)	(2.19)	(1.79)
Bee–Q 15 g/l	2.50	5.17	7.00	6.67	6.33	5.66	7.90	5.90	4.50	3.90
	(1.71)	(2.38)	(2.72)	(2.68)	(2.27)	(2.27)	(2.90)	(2.53)	(2.23)	(1.80)
Sugar syrup 5%	2.30	4.50	6.10	5.17	4.83	4.60	6.90	5.40	3.90	3.40
	(1.67)	(2.08)	(2.57)	(2.38)	(2.06)	(2.11)	(2.68)	(2.37)	(2.10)	(1.66)
Molasses 10%	2.50	4.33	5.60	5.00	4.78	4.40	6.80	5.20	3.80	3.10
	(1.72)	(1.96)	(2.34)	(2.26)	(2.04)	(1.99)	(2.53)	(2.30)	(2.05)	(1.59)
Open pollination	2.33	2.66	4.33	3.67	3.30	3.30	5.60	4.10	2.50	1.80
	(1.68)	(1.78)	(2.20)	(2.04)	(1.94)	(1.94)	(2.44)	(2.00)	(1.71)	(1.51)
S.E. $\pm$	0.11	0.059	0.09	0.06	0.08	0.088	0.14	0.17	0.139	0.13
C.D. (P=0.05)	0.34	0.18	0.27	0.18	0.24	0.28	0.42	0.51	0.42	0.41

*Figures in the parenthesis are transformed values DAS = Days after spraying DBS = Days before spraying

On 7th day after first spray, Bee-Q (15 g/lit) (6.33 bees/m^2/min) was significantly superior over open pollination an found at par with Bee-Q (12.5 g/lit), Bee-Q (10g/lit), sugar syrup 5% and molasses 10% which recorded (5.70, 5.13, 4.83 and 4.78 bees/m^2/min, respectively. Open pollination without spray was least effective in attracting bees (3.30 bees/m^2/min).

Second spray:

One day before second spray, Bee-Q (15 g/lit) was significantly superior over open pollination without spray and found at par with rest of the treatments. Number of bees varied from 3.30 to 5.66 bees/m^2/min.

A day after second spray treatment with Bee-Q (15 g/lit) (7.90 bees/m^2/min) was significantly superior over open pollination without spray. It was found at par with Bee-Q (12.5 g/lit, Bee-Q (10 g/lit), sugar syrup (5%) and molasses (10%) which recorded (7.20, 7.00, 6.90 and 6.80 bees/m^2/min).Open pollination without spray found to be the least efficient in attracting more number of bees.

On third day after second spray, same trend was observed as in case of a day after second spray, wherein treatment Bee-Q (15 g/lit) (5.90 bees/m^2/min) was significantly superior over open pollination without spray and it was at par with treatment Bee-Q (12.5 g/lit), Bee-Q(10g/lit), sugar syrup5%nd molasses 10% which recorded (5.70, 5.53, 5.40 and 5.20 bees/m^2/min). Open pollination without spray recorded least number of bees (4.10 bees/m^2/min).

On 5th day after second spray, the treatments Bee-Q (15 g/lit) (4.50 bees/m^2/min) which was though proved to be best but found at par with rest of the treatments except open pollination without spray.

On 7th day after second spray, the treatment Bee-Q (15 g/lit) was successful in attracting highest number of bees (3.90 bees/m^2/min) but it was at par with rest of the treatments including open pollination without spray.

When compared between different days of observations, in all the treatments the effectiveness of attractants was high on 3rd day of first spray and 1st and 3rd day of second spray and declined drastically thereafter.

It is evident from the present study that bee-Q at different rates had significantly more phagostimulatory and olfactostimulatory effects attracting more *Apis dorsata* upto 5th day after 1st spray and 1st and 5th day after second spray.

Results obtained on the efficacy of Bee-Q and sugar syrup 5% are in close agreement with the reports of Virakthamath and Patil (1999), Lingappa *et al.* (1999), Patil *et al.* (2000), Murasing (2000) and Guruprasad (2001).

Influence of attractants on visitation of *Trigona* sp. on onion:

First spray:

A day before spraying of attractants the bees activity which varied from 2.33 to 2.83 bees/m^2/min did not differ significantly among the treatments (Table 2).

Treatment with Bee-Q (15 g/lit) (4.00 bees/m^2/min) was significantly superior in attracting more number of

Table 2 : Influence of attractants on visitation of *Trigona* spp. on onion

Treatments	Bee visitation per square meter per minut									
	First spray (10 per cent flowering)					Second spray (50 per cent flowering)				
	1 DBS	1 DAS	3 DAS	5 DAS	7 DAS	1 DBS	1 DAS	3 DAS	5 DAS	7 DAS
Bee–Q 10 g/l	2.50	3.67	5.33	8.67	4.70	4.36	7.60	7.50	6.73	4.30
	(1.66)	(1.83)*	(2.19)	(2.98)	(2.08)	(1.95)	(2.84)	(2.81)	(2.30)	(1.83)
Bee–Q 12.5 g/l	2.83	3.83	5.50	9.00	4.80	4.50	8.00	7.57	6.90	4.68
	(1.82)	(1.84)	(2.37)	(3.03)	(2.08)	(2.00)	(2.90)	(2.83)	(2.53)	(2.07)
Bee–Q 15 g/l	2.33	4.00	5.83	9.33	5.50	4.80	8.30	8.40	7.40	4.80
	(1.68)	(1.87)	(2.52)	(3.11)	(2.10)	(2.08)	(2.93)	(2.98)	(2.63)	(2.10)
Sugar syrup 5%	2.33	3.67	5.20	7.33	4.66	4.60	7.50	7.30	6.70	3.83
	(1.69)	(1.78)	(2.10)	(2.79)	(2.04)	(1.95)	(2.80)	(2.79)	(2.30)	(1.82)
Molasses 10%	2.83	3.60	5.13	6.50	4.50	4.46	6.97	7.20	6.66	3.70
	(1.82)	(1.68)	(2.03)	(2.64)	(2.02)	(1.88)	(2.72)	(2.73)	(2.11)	(1.78)
Open pollination	2.50	2.30	3.67	4.00	3.53	3.33	5.10	5.70	4.40	2.50
	(1.71)	(1.59)	(1.99)	(2.11)	(1.86)	(1.85)	(2.65)	(2.48)	(1.97)	(1.46)
S.E. ±	0.17	0.078	0.11	0.186	0.07	0.136	0.09	0.14	0.14	0.19
C.D. (P=0.05)	0.53	0.24	0.34	0.57	0.21	0.42	0.28	0.41	0.43	0.60

*Figures in the parenthesis are transformed values DAS = Days after spraying DBS = Days before spraying

bees and was at par with Bee-Q (12.5 g/lit), Bee-Q (10g/lit), sugar syrup 5% and molasses 10% recorded (3.83, 3.67, 3.67 and 3.60 bees/m^2/min) on 1st day after 1st spray. Open pollination without spray recorded lowest number of bees (2.30 bees/m^2/min).

On 3rd day after first spray the treatment Bee-Q (15 g/lit) (5.83 bees/m^2/min) was significantly superior in attracting more bees which was at par with Bee-Q (12.5 g/lit) (5.50 bees/m^2/min) and Bee-Q (10 g/lit) (5.33 bees/m^2/min).Sugar syrup 5% was the next best treatment (5.20 bees/m^2/min) which was followed by molasses (10%) (5.13 bees/m^2/min). Open pollination without spray attracted lowest number of bees (3.67 bees/m^2/min).

On 5th day after first spray, the treatment Bee-Q (15 g/lit (9.33 bees/m^2/min) was significantly superior over open pollination without spray. This was followed by Bee-Q (12.5 g/lit) (9.00 bees/m^2/min). Bee-Q (10 g/lit) (8.67 bees/m^2/min) and sugar syrup (5%) (7.33 bees/m^2/min). Open pollination without spray recorded lowest number of bees (4.00 bees/m^2/min).

On 7th day after first spray, the Bee-Q (15 g/lit) (5.50 bees/m^2/min) was found significantly superior in attracting more number of bees and was at par with Bee-Q (12.5 g/lit), Bee-Q (10 g/lit), sugar syrup (5%), molasses (10%) (4.80, 4.70, 4.66 and 4.50 bees/m^2/min). Lowest number of bees were recorded in open pollination without spray (3.53 bees/m^2/min).

Second spray:

One day before second spray, treatment with Bee-Q (15 g/lit) (4.80 bees/m^2/min) recorded highest number of bees and found significantly superior, followed by Bee-Q (12.5 g/lit) (4.50 bees/m^2/min) and Bee-Q (10 g/lit) (4.36 bees/m^2/min). Lowest number of bees were recorded in open pollination without spray (3.33 bees/m^2/min).

One day after second spray treatment Bee-Q (15 g/lit) (8.30 bees/m^2/min) attracted highest number of bees followed by Bee-Q (12.5 g/lit) (8.00 bees/m^2/min), Bee-Q (10 g/lit) (7.60 bees/m^2/min). Open pollination without spray was inefficient in attracting more number of bees over rest of the treatments(5.10 bees/m^2/min).

On 3rd day after second spray treatment Bee-Q (15 g/lit) (8.40 bees/m^2/min) found significantly superior over open pollination without spray, and was at par with Bee-Q (12.5 g/lit), Bee-Q (10 g/lit), sugar syrup (5%) and molasses 10 % (7.57, 7.50, 7.30 and 7.20 bees/m^2/min), respectively. Open pollination without spray recorded lowest number of bees (5.70 bees/m^2/min).

On 5th day after second spray the treatment Bee-Q (15 g/lit) recorded highest number of bees (7.40 bees/m^2/min) which was at par with Bee-Q (12.5 g/lit), Bee-Q (10 g/lit) and sugar syrup (5%) recorded (6.90, 6.73, and 6.70 bees/m^2/min), respectively. Open pollination without spray recorded lowest number of bees than rest of the treatments (4.40 bees/m^2/min).

On 7th days after second spray treatment Bee-Q (15 g/lit) (4.80 bees/m^2/min) found significantly superior over open pollination without spray and found at par with Bee-Q (12.5 g/lit) (4.68 bees/m^2/min),Bee-Q (10 g/lit) (4.30 bees/m^2/min), sugar syrup (5%) (3.83 bees/m^2/min) and molasses (10%)(3.70 bees/m^2/min).

In all the treatments, the effectiveness of attractants was high at 3rd and 5th day after first spray and 3rd day after second spray.

The present study revealed that higher doses of Bee-Q (10 g, 12.5 g and 15 g/l) and sugar syrup (5%) had significant phagostmulatory effect which lasted for 5 days after the first and second spray. Patil (1999) and Patil *et al.* (2000) also reported that higher doses of Bee-Q (10 g, 12.5 g/l) attracted significantly more *Trigona* sp. on sesamum.

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