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Intensity of bee visits during peak period on safflower (*Carthamus tinctorius* L)

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Abstract
Investigation on bee visits per meter square per minute during peak intensity periods (10:00 AM-12:00 PM) was undertaken at Department of Agril. Entomology, VNMKV, Parbhani, M.S. (India). It was observed that the activity of bees differed significantly depending on the bee species. Three wild honey bee species, *A. dorsata, A. cerana, A. florea*, and other pollinators were observed in open pollination, SSS, and CS pollination. On all days of observation, the activity of bee visits was much higher in the SSS colony, followed by CS and open pollination circumstances. The 7th and 14th days following flowering were when the activity peaked. On the seventh day following flowering, the activity of wild bees in the open environment, as well as domesticated bees in the SSS, was much higher.

Keywords: Peak period, *Carthamus tinctorius*, Parbhani, M.S

Introduction
Safflower (*Carthamus tinctorius* L.) is a thistle-like annual plant with a lot of branches. It is grown commercially for the extraction of vegetable oil from the seeds. Plants range in height from 30 to 150 cm (12 to 59 in) and have globular flower heads with yellow, orange, or red blooms. Each branch will typically have one to five flower heads, each with 15 to 20 seeds. Safflower is a plant that grows in desert climates with seasonal rain. It has a deep taproot that allows it to survive in such conditions. Oelke *et al.* (2004) [4].

Plants attract pollinators from afar through fragrances and odours, as well as the amount of blooms on display, which is known as floral display. Other characteristics including floral form, blossom color(s), and nectar sugar concentration may operate as short-distance attractants. (Waser and Ollerton 2006; Ebeling *et al.* 2008) [6]. Plants may attract more floral visitors and, as a result, increase fruit and seed production by presenting a larger floral display. (Kearns and Inouye 1993; Mayfield *et al*. 2001) [3]. Herein, we present data about the foraging behavior of several bee species and evaluate the visitation rates of the most frequent species.

Materials and methods
With eight treatments and three replications, the experiment was performed with Randomised Block Design. Following the suggested agronomic set of practises, the crop was grown in plots of 3×1.8 m^2.

These observations were reported on the 1st, 7th, 14th and 21st days of each week after 10 percent flowering. In addition to the respective domesticated bees, the abundance of various honey bees and other pollinators from the respective safflower crop treatments were also reported.

The data obtained/recorded under foraging behavior of honey bees as well as safflower aphid were subjected to $\sqrt{x+0.5}$ transformation (Poison formula). The data on safflower seed yield was also analyzed statistically.

Results and discussion
In the case of open pollination, the intensity of bee visits on the 7th day after blooming (6.54 bees/m^2/min) was considerably higher than all treatments, followed by the 14th and 21st days after flowering (5.17 and 4.96 bees/m^2/min). Bee visits steadily decreased after the 14th day of flowering on the 21st day of flowering (4.96 bees/m^2/min) and the similar pattern was noted on the 28th day following flowering (4.46 bees/m^2/min). The intensity of bee visits was maximum on the 7th day after flowering (3.84 bees/m^2/min) in a six-framed *Apis mellifera* colony, compared to the 1st and 14th days after flowering (2.61 and 3.48 bees/m^2/min).

Maximum bee visits were seen in seven framed *Apis cerana* on the 7th and 14th days after blooming (26.66 and 15.33 bees/m^2/min respectively). On the first day after blooming, the intensity of bee visits in the treatment of six frames *Apis mellifera* (2.61 bees/m^2/min) was at par with treatments of molasses 5% (3.23 bees/m^2/min) and molasses 10% (3.41 bees/m^2/min). On the 7th day after blooming, the intensity of bee visits in the molasses 5% treatment (3.43 bees/m^2/min) was at par with the molasses 10% treatment and 6 frames *Apis mellifera* (3.84 and 3.84 bees/m^2/min). On the 14th day after blooming, the intensity of bee visits in the molasses 05 percent (3.33 bees/m^2/min) treatment was at par with that in the 6 frames *Apis mellifera* and molasses 10 percent (3.48 and 3.62 bees/m^2/min) treatments.

The intensity of bee visits in the 10% molasses treatment (3.62 bees/m^2/min) was comparable to that of the 7 framed *Apis cerana* treatment. (3.96 bees /m^2/min). On the 21st day after blooming, the intensity of bee visits in the treatment of 6 frames *Apis mellifera* (2.31 bees/m^2/min) was found at par with the treatment of molasses 05 percent (3.24 bees/m^2/min). The intensity of bee visits in the molasses 5% (3.24 bees/m^2/min) treatment was found to be comparable to the molasses 10% and 7 frames *Apis cerana* (3.47 and 3.60 bees/m^2/min) treatments. The intensity of bee visits on the 28th day after flowering (4.83 bees/ m^2/min) was found to be comparable to the 21st and 14th days after flowering (5.27 and 5.62 bees/ m^2/min) in the case of sugar syrup spray.

The findings of this study are consistent with those of Patil *et al*. (2010) [5] who found that the intensity of *Apis dorsata*, *Apis cerana*, and *Apis mellifera* visits to onions peaked around 10.00 hrs. While *Apis florea* and *Trigona spp*. visits peaked at 11.00 hrs. *Apis dorsata's* foraging activity began at 8.00 h with an average of 0.70 bees/ m^2/min and gradually rose, reaching a high at 10.00 h (3.30 bees/ m^2/min). *Apis florae* foraging activity was observed from 8.00 a.m. to 16.00 p.m., peaking at 12.00 a.m. (4.77 bees/ m^2/min). *Apis cerana* activity was measured from 8 a.m. to 16 p.m., with a peak at 10 a.m. (3.30 bees/ m^2/min).

Table 1: Bee visits during peak period (10:00AM-12:00AM) meter square per minute

Tr. No	Treatments	Days After 10% flowering				
		1st	7th	14th	21st	28th
T1	Open pollination	21.33 (4.67)	42.67 (6.54)	26.33 (5.17)	24.33 (4.96)	19.66 (4.46)
T2	6 Framed *Apis mellifera*	6.33 (2.61)	14.33 (3.84)	11.66 (3.48)	5.00 (2.31)	3.33 (1.95)
T3	7 framed *Apis cerana*	12.0 (3.52)	26.66 (5.19)	15.33 (3.96)	12.66 (3.60)	10.00 (3.23)
T4	SSS	28.33 (5.32)	49.66 (7.05)	31.33 (5.62)	27.33 (5.27)	23.00 (4.83)
T5	CS	25.66 (5.09)	45.33 (6.76)	29.33 (5.46)	25.00 (5.03)	22.33 (4.77)
T6	Molases 05%	10.00 (3.23)	11.33 (3.43)	10.66 (3.33)	10.33 (3.24)	9.66 (3.18)
T7	Molases 10%	11.33 (3.41)	14.33 (3.84)	12.66 (3.62)	11.66 (3.47)	11.00 (3.37)
	SE	0.26	0.28	0.19	0.28	0.22
	CD@5%	0.82	0.86	0.60	0.87	0.67
	CV	11.71	10.21	12.70	12.32	11.33

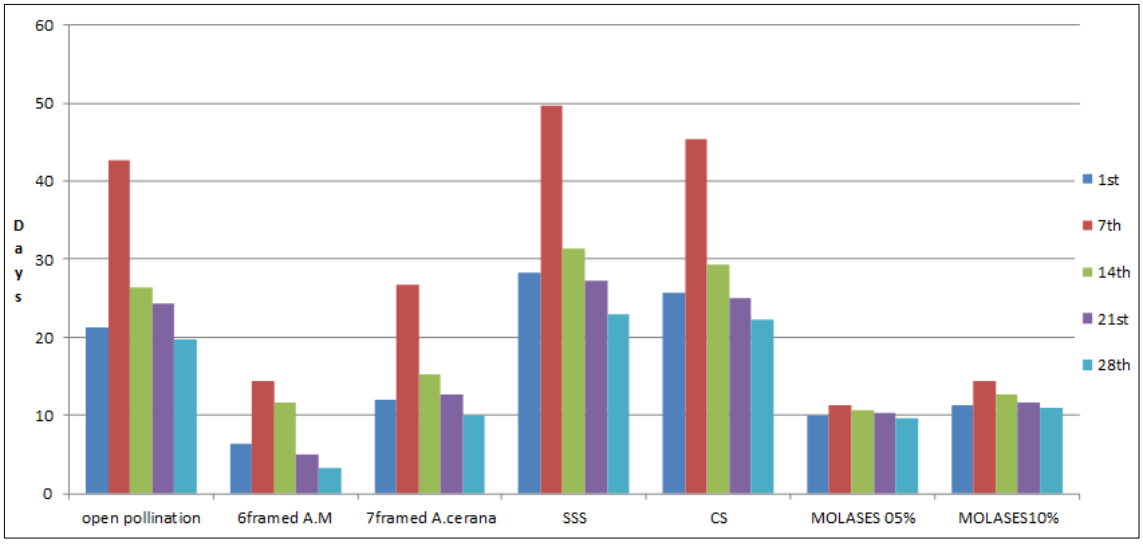

Fig 1: Intensity of bee visits during peak period (10:00 am-12:00 pm) on safflower (*Carhthamus tinctorius* L).

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