Pollination Efficiency of Honeybees in Sunflower (Helianthus Annuus L)

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Abstract

Studies on the pollination efficiency of honey bees in sunflower (Helianthus annuus L.) revealed that the seeds/ capitulam (1278), 1000 seeds weight (47.3), and % crinkled seeds (8.2) were maximum in six framed Apis mellifera pollinated crop followed by one colony of Apis florea pollinated crop. The six framed Apis mellifera yield in (16.4q /ha^{-1}), one colony of Apis florea (15.0 q /ha^{-1}), and% seed setting in Apis mellifera (86.9%) crop was significantly higher over the pollination without insects. Although six framed Apis mellifera pollinated crop was statistically at par with one colony of Apis florae pollinated crop but the % of germination was significantly in higher six framed Apis mellifera (94.3%) followed by open pollination (93.5%)

Keywords: Apis mellifera, Apis florae, A. indica and sunflower

Introduction

Sunflower (*Helianthus annuus* L.) is an important oil seed crop in India. Seed of sunflower contains 35% edible oil and sunflower cake has 40-45% protein. This crop is ideal for cultivation in any season because of its wider adaptability, drought tolerance, short duration, photo and thermal insensitivity characteristics. The average yield of sunflower in India is 696 kg ha^{-1} and it is far less than the world's average of 1322 kg ha^{-1}. In Maharashtra, sunflower is growing in an area of 0.22 M ha with production and productivity of 0.11MT and 521 kg ha^{-1}, katari.venkat6@gmail.com respectively (Anon. 2011). This productivity (521 kg/ha^{-1}) is also lower than national average (696 kg/ha^{-1}). Sunflower is a cross pollinated crop, honey bees plays an important role in getting higher yields. In this connection the research on foraging behavior of honey bees in sunflower is essential for increasing the yields. In Maharashtra much literature was available on this particular topic on many crops and perusal of literature available in sunflower. Keeping the above aspects in view, to identify a better pollinating in sunflower the present study was conducted.

Materials and Methods

The present experiment was carried out in *Kharif* season of 2012at Department of Agricultural Entomology, College of Agriculture, Latur. The soil was uniform with heavy black cotton having good fertility and drainage. The sunflower variety SFL-8 was sown on 30 July 2012 with spacing 60 x 30 cm.The experiment was conducted with simple randomized block design with seven treatments and three replications. The crop was raised in the plots of 4.8 x 4.8 m^2, following recommended agronomic package of practices. The treatments were T_1 open pollination (OP), T_2 Pollination without insects (PWI), T_3 Four framed *A. indica* Fab. colony (4 FAI), T_4 one *A. florae* Fab. Colony (1 AF), T_5 Six framed *A. mellifera* Linn. colony (6 FAM), T_6 sugar syrup spray 5% (SSS) and T_7 cinnamon spray 10% (CS). The cages of fine white nylon mosquito nets having 6 x 6 m^3 size (mesh 20 micron) were erected over the plots of treatment T2, T3, T4, and T5 and inside the nets 4 framed colony of *A. indica* in T3 and one colony of *A. florea* in T4 and 6 framed colony of *A.*

Mellifera in T5 treatments were kept, When 10 % of flowering was observed observations on number of seeds per capitulum, test weight, percent crinkled seed, yield of sunflower, percent germination and percent seed setting were recorded and statistically analyzed to find out the differences within the treatments .

Result and Discussion

Results (Table 1) revealed that the crop caged with six framed *A. mellifera* colony recorded significantly higher number of seeds per head (1278 seeds per head) over PWI (1028 seeds per head) which accounted for 10.8, 24.3 and 8.0 % increase over open pollination, pollination without insect and cinnamon sprayed condition, respectively. The next best treatments were one colony of *A. florea,* SSS, CS, and open pollination which accounted for 19.2, 15.3, 15.0 and 12.1 % increase over pollination without insect. Four framed *A. indica* colony accounted for 14.4 % increase over pollination without insect. Six framed *A. mellifera* colony was at par with one *A. florea* colony treatments. The treatments *viz*., *A. indica,* OP, *A. florae* and CS were on par with each other. However, significantly lowest numbers of seeds (1028 seeds per head) were observed in the treatment pollination without insect. Present result endorses the findings of Manoj kumar and Ramasharit sing (2003) were found that pollination efficiency of *A. millifera* in seed production of sunflower reveled that number of filled seeds/capitulam (728.2), seed set (75.5), and 1000 seed weight (55.90) were maximum *A. millifera.* It is evident from the data on 1000 seeds weight that treatment with six framed *A. mellifera* recorded significantly superior test weight (47.3 g) over all the treatments. However six framed *A. mellifera* constituted 14.8, 20.1 and 11.9 % increase over OP, PWI and CS, respectively followed by the treatment, one colony of *A. florae* (45.3 g) which was significantly superior over OP, PWI and CS with 10.0 g and 15.1 g and 7.3 g, respectively. However the treatments namely four framed *A. indica* (43.3 g), CS (42.2 g) and SSS (43.1 g) were found at par with each other in respect of treatment. The treatments *viz*., four framed *A. indica*, SSS and CS also found at par with each other in recording test weight. The lowest test weight was observed in the treatment PWI.

Significant differences were found in all treatments with respect to percent of crinkled seed (Table -2). The treatment six framed *A. mellifera* (8.2 per cent) recorded significantly lowest % crinkled seed which accounted for 60.4, 76.2, and 55.8 % decrease over OP, PWI and CS condition, respectively. This was followed by one colony *A. florea* (12.2 %) which accounted for 40.9, 64.6 and 34.0 % decrease over OP, PWI and CS condition, respectively. Next to this was four framed colony of *A. indica* (15.8 %) which accounted significantly decrease % of crinkled seed and constituted 23.8, 54.3 and 14.9 % decrease over OP, PWI and CS condition, respectively. Present result endorses the findings of Luis F. Hernandez (2008) A detailed study of the foraging pattern of diurnal pollinators in the sunflower crop mainly honey bees in between percentage of area covered by foraging paths (ACP) and incompletely developed fruit (IDF). A complete limitation ofvisitation in these sectors (0-30% ACP) resulted poor seed set and IDF 9 to 17%. Partial limitation visitation of the insect visitation (30 to 59% ACP) generated 5 to 9% of IDF. The data presented on seed yield revealed that there were significant differences in all treatments. Significantly highest seed yield was recorded in the treatment *viz*., 6 framed colony of *A. mellifera* (16.4 q/ha^{-1}) which accounted for 21.0, 48.2 and 15.1 % increase over OP, PWI and CS condition, respectively, followed by treatment one colony of *A. florea* (15.0 q/ha^{-1}) which recorded significantly increase in yield to the extent of 10.4, 35.3 and 5.0 % over OP, PWI and CS respectively and found on par with *A. indica* which contributed (14.9 q/ha^{-1}) and did not differ significantly with SSS (14.4 q/ha^{-1}) and CS (14.3 q/ha^{-1}). The lowest yield was observed in case of pollination without insect (11.1 q/ha^{-1}). Similar results were also recorded by Viraktmath and Patil (2002) who reported that the Crop caged with 4 frame colony of *A. mellifera* recorded significantly heavier seeds (56.8 g/1000 seeds), highest seed filling (93.6 %) and yield (368 g/10 plants) which accounted for an increase of 55.9 and 408.0 % over unsprayed crop and control (crop deprived of pollination), respectively. The next best treatments were the crop caged with 6 frames colony of *A. cerana indica* (320.0 g) and 2 frames of *A. mellifera* (305.0 g). Spraying of Bee-Q and fruit boost proved beneficial recording higher yield parameters than the controls.

The data (Table 3.) revealed that the germination percentage was significantly higher in six framed *A. mellifera* (94.3 %) followed by open pollination (93.5 %) which were on par with each other. The lowest germination percentage was recorded in the pollination without insect condition (89.2 %). This was at par with the six framed *A. indica* (91.7 %), one framed *A.florea* (92.4 %), SSS sprayed plot (92.5 %) and CS sprayed plot (90.7 %) which were found at par with each other. The increase in seed germination of six framed *A. mellifera* was found 0.8, 5.6 and 3.9 % over op, pollination without insects and Cinnamon sprayed plots, respectively.

Whereas, next to that the open pollination plots were found superior over pollination without insects and cinnamon sprayed plots by 4.7 and 3.0 %, respectively. Rao and suryanarayan (1989) reported that in addition to quantity, the insect pollination in general also brought about high germination in onion seeds. The data in per cent seed setting revealed that six framed *A. mellifera* colony (86.9 %) recorded significantly highest % of seed setting which accounted for 14.5, 31.3 and 8.1 % increase over OP, PWI and CS, respectively, but found at par with treatments one colony of *A. florea* and SSS. The treatment one colony of *A. florea* (82.9 %) was next significant treatment which accounted for 9.3, 25.2 and 3.2 % increase over OP, PWI and CS, respectively and did not differ significantly with four framed *A. indica*, SSS and CS. Whereas, four framed *A. indica* (81.0 %), CS (80.3 %), OP (75.9 %) were on par with each other. The lowest % seed setting was recorded in the treatment PWI (66.2 %). Mehmet Oz *et al*. (2009) also reported that the use of honey bees for sunflower hybrid seed production improved seed ratio, 1000 seed weight, number of filled seed per head and seed yield per head.

Conclusion

Based on the above results it can be concluded that the six framed colony *A. mellifera* were found effective increasing both quantity and quality parameters viz. higher number of seeds per head (1278), test weight (47.3 gm), % of crinkled seeds (8.2%), yield in (16.4 q/ha), % of germination (94.3 %) and % of seed setting (86.9 %) of the sunflower. One colony *A. florea* were also found effective after *A. mellifera*.

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Table 1: Effect of Honey bees Pollination on Number of Seeds/ Capitulam and 1000 seeds Weight

Treatments	No. of seeds/ Capitulam	% increase over			1000 seeds weight	% increase over		
		OP	PWI	CS		OP	PWI	CS
Open pollination	1153	-	12.1	-	41.2	-	4.6	-
Pollination without insects	1028	-	-	-	39.3	-	-	-
4 framed *A. indica*	1177	2.0	14.4	-	43.3	5.3	10.1	2.6
One colony of *A.florea*	1226	6.3	19.2	3.6	45.3	10.0	15.1	7.3
6 framed *A. mellifera*	1278	10.8	24.3	8.0	47.3	14.8	20.1	11.9
SSS	1186	2.8	15.3	0.2	43.1	4.8	9.6	2.1
CS	1183	2.6	15.0	-	42.2	2.5	7.3	-
SE±	24.9				0.6			
CD (P = 0.0 5)	76.9				1.9			
CV	3.7				2.5			

Table 2: Effect of different Treatments of Pollination in Sunflower per Cent Crinkled Seeds and Seed Yield

Treatments	% of Germination	% increased over			% seed setting	% increased over		
		OP	PWI	CS		OP	PWI	CS
Open pollination	93.5	-	4.7	3.0	75.9	-	14.6	-
Pollination without insects	89.2	-	-	-	66.2	-	-	-
4 framed *A. indica*	91.7	-	2.7	1.1	81.0	6.7	22.3	0.8
One colony of *A.florea*	92.4	-	3.5	1.8	82.9	9.3	25.2	3.2
6 framed *A. mellifera*	94.3	0.8	5.6	3.9	86.9	14.5	31.3	8.1
SSS	92.5	-	3.6	1.9	82.4	8.6	24.4	2.5
CS	90.7	-	1.6	-	80.3	5.9	21.3	-
SE±	0.5				1.8			
CD (P = 0.05)	1.7				5.6			

Table 3: Effect of Different Treatments of Pollination on Percent Germination and Percent Seed Setting

Treatments	% Crinkled seeds	% decrease over			Yield in (q /ha)	% increase over		
		OP	PWI	CS		OP	PWI	CS
Open pollination	20.8	-	-40.0	-	13.6	-	22.4	-
Pollination without insects	34.6	-	-	-	11.1	-	-	-
4 framed *A. indica*	15.8	-23.8	-54.3	-14.9	14.9	9.91	34.6	4.5
One colony of *A.florea*	12.2	-40.9	-64.6	-34.0	15.0	10.49	35.3	5.0
6 framed *A. mellifera*	8.2	-60.4	-76.2	-55.8	16.4	21.07	48.2	15.1
SSS	17.7	-14.9	-48.9	-4.9	14.4	5.72	29.4	0.5
CS	18.6	-10.4	-46.3	-	14.3	5.13	28.7	
SE±	1.0				0.2			
CD (P = 0.05)	3.2				0.7			
CV	10.1				2.8			