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Bee Pollination: Its Role in Yield and Quality Enhancement in Cucurbits

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ABSTRACT: Many factors influence the yield and quality of cucurbit crops, but one important consideration is successful pollination. Poor fruit set and deformed fruit are often the result of in adequate pollination. Cucumber flowers are pollinated exclusively by honeybees and other insect pollinators which is the major reason for successful pollination and increased yields. In this regard, keeping in view the pollination requirements of cucumber, a demonstration was conducted in 10 farmers' fields of Bhumangunda and Mallapura villages of Devadurgataluk of Raichur district. The prioritized problems in these regions were the low and poor quality yields in cucumber and also farmers in this region were unaware of the bee-pollination. Around 200 hectares of land was under cucurbits in this area but no farmer was aware of using bee-boxes for pollination. In order to create awareness about bee-pollination and to enhance the quality and quantity of the produce, training programmes and demonstrations were conducted by ICAR-Krishi Vigyan Kendra, Raichur. A total of 100farmers were given two consecutive training programmes well before the crop season and ten demonstrations were conducted to show the potentiality of bee-pollination in cucurbits. The results revealed considerable improvement in the quality and quantity of the produce of yield in cucumber and also farmers got extra income from the honey yield.

Keywords: Honey bees, Pollination, Cucumber, Honey, Yield, Quality.

INTRODUCTION

Pollination plays a vital role in maintaining the natural balance of ecosystems and is the corner stone of crop production, providing a link between agriculture and the cycle of life (Gill *et al.*, 2016). Consequently, pollination has a role in the economic sector owing to the improvement of quality and quantity (Breeze *et al.*, 2011; Hristov *et al.*, 2020). Cucumber flowers are pollinated exclusively by honey bees and other insect pollinators. They are not wind-or self-pollinated. Insects are required for pollen transfer be cause of the large size of the pollengrains, their stickiness, and the way they are released from the anthers. Also, since these plants typically produce only small amounts of pollen, pollinators are needed to efficiently transfer pollen from one flower to the next (Morse and Calderone 2000).

While wild bees or distant honey bee colonies may suffice for small cucumber fields, they may be in adequate for the commercial grower whose income depends on substantial yields of high quality fruit. Maximum yields harvested in a minimum number of trips across the field are economically advantageous. To accomplish this, a good pollinator is essential.

Ecologically, insects play many different roles as pests, predators and parasites, pollinators, decomposers and scavengers and so forth (Sima and Srivastava 2012).

Table 1: Insect visitors of cucumber bloom with their frequency of occurrence.

Scientific name	Common name	Order	Family
Apis cerana F.**	Indian Honey bee	Hymenoptera	Apidae
A. dorsata F.*	Rockbee	Hymenoptera	Apidae
A. mellifera L.***	Italian Honeybee	Hymenoptera	Apidae
Bombus haemorrhoidalis Smith***	Bumblebee	Hymenoptera	Apidae
Formica sp.***	Ants	Hymenoptera	Formicidae
Halictus sp.***	Solitary bee	Hymenoptera	Halictidae
Episyrphus balteatus (DeGeer)**	Syrphid fly	Diptera	Syrphidae
Scaeva pyrastri (L.)*	Syrphid fly	Diptera	Syrphidae
Aulacophora foveicollis L.*	Red pumpkin beetle	Coleoptera	Chrysomelidae
Diabrotica undecimpunctata Mann**	Spotted cucumber beetle	Coleoptera	Chrysomelidae
Coccinella septempunctata (L.)*	Ladybird beetle	Coleoptera	Coccinellidae
Mylabrispustulata T.*	Blister beetle	Coleoptera	Meloidae

*= Less frequent visitors; **=Frequent visitors; ***=Most frequent visitors (Meena and Rajender 2008)

At least one strong hive per acre is required. Bees are most efficient if they can for age within 200 yards of the hive. Honeybee colonies should be moved into position near the field about the time the first female flowers are seen. If the bees are moved in too early, they may find other attractive flowering plants in the area and not work the cucurbits. Leave colonies in cucumber fields until a day or so before the last picking (Laurie and Fred 2007).

Hence it was felt show the potentiality of bee-pollination in cucurbits wherein considerable improvement in the quality and quantity of and practice of yield in the cucumber could be noticed. Therefore, the study was undertaken to create awareness about bee-pollination, importance of quality and quantity of cucumber, yield and income of the farming families by conducting demonstrations and training programmes

MATERIAL AND METHODS

Two training programmes were organized on "bee-pollination yield in cucumber" for fifty farmers from Bhumangunda and Mandalgera villages of Devadurgataluk of Raichur district and 10 farmers were selected from both the villages to implement demonstrations in their fields. Ten demonstrations were conducted wherein each farmer was given one bee-colony along with bee-safety kit as critical inputs so as to implement the demonstrations in their respective fields. Critical observations *viz*., parameters on pest incidence like percent malformed fruits (misshapened), yield parameters like crop and honey yield, per cent increase in yield was worked out, and economic parameters like cost of cultivation, gross and net yield and B:C were taken from each demonstrated farmers field. Farmers' feedback was also taken at the end of the crop period.

RESULTS AND DISCUSSION

Economic success of cucumbers depends upon large yields of good quality fruits. One of the most important factors which influence the yield and quality of cucumber crop is successful pollination. Due to the presence of male and female flowers separately on the same plant, the flowers are not wind or self-pollinated. Insects, mainly honeybees are the major pollinators of cucumber (Connor and Martin 1969). The pollen grains being large and sticky need an external agent for transfer of pollen between flowers (Sedgley and Scholefield 1980).

Table 2: Percent malformed fruits in the farmers' field.

Particular/Farmer	% Malformed fruits	
	Demonstration	Check
Farmer 1	7.00	7.40
Farmer 2	6.80	7.20
Farmer 3	6.50	7.50
Farmer 4	6.90	7.20
Farmer 5	5.70	7.50
Farmer 6	6.10	7.30
Farmer 7	5.70	7.80
Farmer 8	7.00	7.40
Farmer 9	5.90	8.10
Farmer 10	7.00	8.00
Mean	**6.46**	**7.54**
SD	**0.56**	**0.32**
SEM	**0.18**	**0.10**
t-value	**5.32**	

n=10

It is clearly depicted by Table 2 that, the malformed fruits were more in the check fields wherein no bee-boxes were kept, while the malformed fruits were less in the bee-box placed demonstration fields. The per cent malformed fruits ranged from 5.7 to 7 in the demonstration fields, meanwhile, in the check, it ranged from 7.2 to 8.1 per cent. The average per cent malformed fruit was 6.46 in demonstration and 7.54 in the check farmers' fields. The t-test showed that the two-tailed P-value is less than 0.0001. By conventional criteria, this difference is considered to be extremely statistically significant.

Adequate pollination usually assures uniform and perfectly formed fruits with even maturity (McGregor, 1976), while incomplete pollination results in improperly formed fruits (Hodges and Baxendale 1991) which are small and misshapen, thus leading to low yield of marketable fruits. The demonstration of the bee-pollination in the cucumber fields of the farmers' have clearly depicted the effect of insect pollination on quality and quantity of the yield produced (Morse and Calderone 2000).

Table 3: Yield parameters.

Particular/Farmer	Crop Yield (t/ha)			Honey Yield (kg)	
	Demonstration	Check	% increase in crop yield	Demonstration	Check
Farmer 1	22.55	15.89	41.91	2.11	—
Farmer 2	25.91	17.11	51.43	1.72	—
Farmer 3	21.28	14.78	43.98	2.25	—
Farmer 4	25.48	18.15	40.39	1.05	—
Farmer 5	19.58	13.81	41.78	2.11	—
Farmer 6	27.89	20.55	35.72	2.55	—
Farmer 7	22.15	15.58	42.17	1.78	—
Farmer 8	23.09	16.05	43.86	1.59	—
Farmer 9	21.18	15.55	36.21	2.14	—
Farmer 10	23.58	16.02	47.19	2.00	—
Mean	**23.27**	**16.35**	**42.33**	**1.93**	—
SD	**2.52**	**1.88**	—	—	—
SEM	**0.79**	**0.59**	—	—	—
t-value	**6.95**		—	—	—

t=ton; ha=hectare; kg=kilogram; n=10

The crop yield in the demonstration field ranged from 19.58 to 27.89 t/ha, while in the check fields, the crop yield ranged from 13.81 to 20.55 t/ha. The average highest crop yield (23.27 t/ha) was recorded in the bee-box demonstrated farmers' fields and less crop yield (16.35 t/ha) was recorded in the fields where no bee-boxes were kept. There was an increase of 42.33 per cent in the crop yield in the demonstrated fields (Table 3). The t-test showed that the two-tailed P-value is less than 0.0001. By conventional criteria, this difference is considered to be extremely statistically significant.

The number of fruits and larger fruit size in bee pollinated plants might be attributed to the sufficient number of pollen grains received by the flowers which were best provided by honey bees (Cervancia and Bergonia 1991; Hernandez and Lemus 1999).

Table 4: Economics parameters.

Particular/Farmer	Demonstration				Check			
	COC (Rs/ha)	GR (Rs/ha)	NR (Rs/ha)	BCR	COC (Rs/ha)	GR (Rs/ha)	NR (Rs/ha)	BCR
Farmer 1	48200	180400	132200	3.74	60500	127120	66620	2.10
Farmer 2	50100	207280	157180	4.14	57200	136880	79680	2.39
Farmer 3	45800	170240	124440	3.72	58900	118240	59340	2.01
Farmer 4	50200	203840	153640	4.06	61200	145200	84000	2.37
Farmer 5	51500	156640	105140	3.04	58500	110480	51980	1.89
Farmer 6	49800	223120	173320	4.48	58900	164400	105500	2.79
Farmer 7	48200	177200	129000	3.68	60400	124640	64240	2.06
Farmer 8	51100	184720	133620	3.61	61200	128400	67200	2.10
Farmer 9	47900	169440	121540	3.54	61000	124400	63400	2.04
Farmer 10	50500	188640	138140	3.74	57800	128160	70360	2.22
Average	49330	186152	136822	3.77	59560	130792	71232	2.20

Price of Cucumber is Rs. 8000/t, COC = Cost of Cultivation, GR = Gross Returns, NR = Net Returns, BCR = Benefit Cost Ratio

The economic parameters like cost of cultivation, gross and net returns, and benefit cost ratio were worked out in both the bee-boxes demonstrated farmers' fields as well as check farmers' fields.

Overall cost of cultivation was less in the demonstration fields as the farmers' of those fields were made aware not to use many chemicals since they had kept bee-boxes in their fields. And also the farmers' of the bee-box demonstration fields did use only the botanicals and bio-control agents for pests and disease management, and meager insecticides were used in these fields.

Meanwhile, the farmers of the check fields wherein there were no bee-boxes, they used chemical insecticides more to manage the pests and diseases. This led in the increase in the cost of cultivation. Considered the price of the cucumber was Rs.8000 per ton, an average of Rs. 1,86,152/-gross returns was obtained in the bee-box demonstrated farmers' fields, meanwhile, an average gross returns of Rs. 1,30,792/- was rendered from the check farmers' fields where no bee-boxes were placed. The benefit cost ratio was also more in the bee-box demonstration field (3.77) when compared to the check fields (2.20) (Table 4).

Implications of the study:

— A considerable level of farmers understood that the incorporation of bee-boxes especially for insect pollinated crops was profitable.

— There was a significant improvement in their quality as well as quantity of the produce.

— This study helps the policy makers to incorporate the topic of bee-keeping as a subsidiary and yield enhancing occupation in the educational text books.

— This demonstration clearly reveals that the farmers can be made aware of the pollination and its importance in quality yield production.

CONCLUSIONS

Bee pollination provides a wide variety of benefits to humanity, contributing to food processing, raw materials, medicines, fibers, social, cultural values, and the maintenance of biodiversity and environmental protections. Fertilized soil, irrigated crops and pest control may not be enough to produce a quality cucurbit crop, if you've also had poor pollination. The present demonstration results showed that there was a substantial boost in the yield as well as quality of the produce of cucumber. Not only the farmers were happy about their yields but they also got additional income from the honey obtained from the beehives. At the same time, the pre-season training programmes were also effective in creating awareness and enhancing knowledge of farmers in rural areas regarding bee-pollination.

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