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Influence of bee pollination on quality and quantity of onion (*Allium cepa* L.) seed

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ABSTRACT

The activity of bees pollination in onion was observed throughout the day. Numerically maximum activity was observed during afternoon hours (12.00 to 2.00 PM) with 7.00 numbers in rock bee, 5.40 in Indian bees, 11.60 in little bees and 7.80 in case of dammer be, respectively. Among the four species of bees, little bees were more in entire day with highest of 111.60 bees/10 inflorescence/ minute followed by dammer bee with 9.40 bees/10 inflorescence/ minute, Among the bees major contributor was little bee, this may be due to more colonies of little bees in that area and destruction of rock bee colonies. Also, the bee acitivty was observed maximum number at 100 per cent flowering stage. The observations on number of seeds per umbel, 1000 seed weight and per cent germination under the laboratory conditions. The results clearly indicated that, maximum number of seeds per umbel was observed in open pollinated flowers with 339.30 ± 60.27 seeds per umber where all the four species of bees were made visits regularly followed by in case of pollination in mesh cloth cage with bees with 330.00±35.80 and very least number of seed set was observed in case of pollination in mesh cloth cage without bees with only 60.70 seeds/umbel. Similarly, 1000 seed weight also differed significantly in case of pollination with bees and without bees. In case of with bees it weighed around 3.37 g/1000 seeds followed by 3.10 g/1000 seeds in onion with bee cage and least in case of control with only 1.97 g/1000 seeds.

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INTRODUCTION

Honey bees are playing a major role in reducing flower abortion considerably when they pollinate flowers. A lack of pollination by honey bees brought on by increased insecticide use to control insect pests was linked to a sharp decrease in yields of many field crops, horticultural crops and some medicinal crops. About 15 per cent of animal pollinators are known to contribute with 30 per cent of global food production (Roubik, 1995).

Among different animal pollinating agents, insects make a significant contribution to seed/crop production. Many studies tell upto 90 per cent of all flowering plant species majorly depend on pollination by insects like bees (Buchmann and Nabhan, 1996). Several studies have estimated the cost value of insectpollinated crops which are dependent on honey bees (Morse and Calderone, 2000), Losey and Vaughan (2006) estimated that, native pollinators mainly honey bees may be responsible for almost 3.07 billion dollars of produce from fruits and vegetables in the United States. The value of pollination worldwide economically accounted to 153 billion euros in 2005 (Abrol, 2012).

Among many fruits and vegetables, onion is one of the most important vegetables which are highly cross pollinated crop and must need external pollinating agents which include honey bees. It is such a crop grown in almost every country as a vegetable in the World. To get the satisfied seed yield, farmers face many problems as onion is highly cross pollinated crop. So, the cross pollination becomes more critical due to the flower nature as a protandrous (Muller, 1983).

Estimates of increased seed set due to pollinators have been made in different parts of the world. Studies revealed that, the cross pollination in onion may vary from 8 to 71 per cent under different conditions (Van Der Meer and van Bennekom, 1972). Among the pollinator agents, insects played a major role. Rao and Lazar (1983) studied onion pollination and recorded only 9.8 per cent seed setting without pollinators. In another study by Chandel *et al*. (2004) stated that, poor quality seeds were produced in the absence of abundant pollinators and observed loss of bulb yield in the subsequent generations, the study indicated that the presence of pollinators increased the seed quantity and quality. A pollination study indicated as increase of 3.5 to 98.8 times more compared to control in the seed yield in onion crop (Singh, 1997). Another study by Woyke (1981) on onion under open field experiment found that plots caged without bees, caged with bees and not caged produced 2, 210 and 669 seeds per inflorescence, respectively. Similar study by Kumar *et al.* (1989) revealed greater onion seed set, seed yield and better seed germination from plots caged with bees compared to plots caged without bees and open pollination resulted seed yield of 73, 275, 97 kg/ha, respectively.

In recent years onion seed yields are drastically reduced may be due to insecticide use, which are repelling or killing bee pollination, which are important pollinators of onion crop. Specially the insecticides used for the management of thrips in onion crop. Failure of the onion flower to set full-capacity seeds seems to be associated with mainly the external pollinating agents like bees. So, in this regards a study was made on importance and significance of bee pollination in onion to confirm the quality and quantity of seed production with higher seed yields.

MATERIAL AND METHODS

The study was conducted at Agricultural Research Station during the season in 2020 to know the effect of bee pollinators on onion seed production of Bhima Super variety. Medium sized onion bulbs (150 to 200 g) were planted during the month of October with 30 cm spacing between the rows and 10 cm gap between the bulbs. The crop management practices were made as per the package of practice.

In one objective, insect pollinators were recorded from the experimental site to confirm the activity of bees in the morning 8.00 to10.00 AM, afternoon 12.00 to 2.00 PM and evening 4.00 to 6.00 PM and the bees visits were observed during the flowering period at 25, 50, 75 and 100 per cent flowering time at 12.00 to 2.00 PM. During the study, the bees were collected and identified for further categorization.

A week before the initiation of flower, 3 groups of 10 individual inflorescences were selected randomly and marked as block replications of each treatment combination, one group of onion plants were left uncovered for free pollination, whereas the other ones were isolated from insect pollinators using net cage made of cloth. The harvesting was made when about 10-15 per cent of black seeds were visibly exposed in the umbels. In each group, 10 umbels with stalk were cut, dried properly by placed in individually small cloth bags and kept them for further observations in the laboratory. After drying, number seeds per umbel, weight of seeds produced per umbel and 1000 seed weight were noted in each group. After one month, the 100 seeds germination was tested under laboratory to know the per cent germination in each group by using method of Wilkaniec *et al.* (2004) by keeping 100 seeds in 5 replicates from different groups and incubated under normal room temperature for 10 days. The germination

per cent was calculated based on the number of seeds sprouted in each treatment.

RESULTS AND DISCUSSION

The results on the activity of bees pollination on entire day of morning, afternoon and evening, we observed that entire day the bees were actively pollinating throughout the day. But numerically maximum activity was observed during afternoon hours (12.00 to 2.00 PM) with 7.00 numbers in rock bee, 5.40 in Indian bees, 11.60 in little bees and 7.80 in case of dammer bee on 10 inflorescence observed for 1 minute compared to morning and evening time during the month of December and Janaury. The results were in confirmation with the studies of Mortaza *et al.* (2013), who reported that highest bee activities were found in the afternoon hours. Among the four species of bees it is interesting to know that the number of little bees were more in entire day with highest of 111.60 bees/10 inflorescence/ minute followed by dammer bee with 9.40 bees/10 inflorescence/ minute, rock bee with 7.00 bees/10 inflorescence/ minute and least in Indian bee with 6.20 bees/10 inflorescence/ minute in evening hours. Among the bees major contributor was little bee, this may be due to more colonies of little bees in that area and destruction of rock bee colonies (Table 1).

In another objective, the bee activity was observed at different stages of flower *i.e.,* 25, 50, 75 and 100 per cent flowering stage. The results clearly indicated that, initially all the bees activity was poor and slowly the population increased and reach maximum number at 100 per cent flowering stage. Here also interestingly, we found that little bee was dominant with 10.20 bees/10 inflorescence/ minute followed by 10.00 bees/10 inflorescence/ minute in case of dammer bee, followed by rock bee with 8.00 bees/10 inflorescence/ minute and Indian bee with 7.40 bees/10 inflorescence/ minute. The results are in confirmation with Saurabh and Mandal (2018) who reported that, *Apsi mellifera* was dominant pollinator in onion seed production. Among the four species recorded, again the little bee contributed more numbers from stating to end of the flowering season in seed production compared to the other three species (Table 2).

Finally, when we observed for the quantity and quality parameters of the seed like, number of seeds per

Table 1: Activities of bees at different times in a day on onion inflorescence

Sr. No.	Bee species recorded	Number of bee activity and time (Mean ± SD)		
		8.00 to 10.00 AM	12.00 to 2.00 PM	4.00 to 6.00 PM
1.	Rock bee	5.00±1.00	7.00±1.41	6.80±1.10
2.	Indian bee	4.20±0.84	5.40±1.14	6.20±1.92
3.	Little bee	8.80±1.48	11.60±1.95	8.00±2.24
4.	Dammer bee	7.40±2.79	9.40±2.61	7.80±2.39

*Bees sitting on a 10 inflorescence for 1 minute, Mean of 5 observation

Table 2: Activities of bees at flowering stage on onion inflorescence

Sr. No.	Bee species recorded	Number of bee activity and per cent flowering			
		25	50	75	100
1.	Rock bee	1.20±0.84	3.40±1.14	7.20±0.84	8±0.71
2.	Indian bee	1.40±0.89	3.80±1.48	6.60±1.52	7.4±1.14
3.	Little bee	2.80±0.84	8.40±2.41	9.60±1.34	10.2±1.10
4.	Dammer bee	3.80±1.30	9.20±1.30	9.80±1.64	10±1.58

*Bees sitting on a 10 inflorescence for 1 minute (12.00 to 2.00 PM), Mean of 5 observation

Table 3: Influence of bees on quality and quantity attributes of onion seeds

Sr. No.	Category	Number of seeds/Umbel	1000 seed weight	Seed germination (%)
1.	Open pollination	339.30±60.27	3.37±0.52	95.40±2.22
2.	Pollination in mesh cloth cage with Indian bees	330.00±35.80	3.10±0.28	94.00±1.89
3.	Pollination in mesh cloth cage without bees	60.70±23.95	1.97±0.33	50.60±10.37

(Mean ± SD)

umbel, 1000 seed weight and per cent germination under the laboratory conditions. The results clearly indicated that, maximum number of seeds per umbel was observed in open pollinated flowers with 339.30±60.27 seeds per umber where all the four species of bees were made visits regularly followed by in case of pollination in mesh cloth cage with bees with 330.00±35.80 and very least number of seed set was observed in case of pollination in mesh cloth cage without bees with only 60.70 seeds/ umbel. These results are in confirmation with the studies of Singh (1997) pollination study indicated as increase of 3.5 to 98.8 times more compared to control in the seed yield in onion crop. Another study by Woyke (1981) on onion under open field experiment found that plots caged without bees, caged with bees and not caged produced 2, 210 and 669 seeds per inflorescence, respectively (Table 3).

Similarly, 1000 seed weight also differed significantly in case of pollination with bees and without bees. In case of with bees it weighed around 3.37 g/ 1000 seeds followed by 3.10 g/1000 seeds in onion with bee cage and least in case of control with only 1.97 g/ 1000 seeds. These results are in confirmation with the similar studies of Kumar *et al*. (1989) revealed greater onion seed set, seed yield and better seed germination from plots caged with bees compared to plots caged without bees and open pollination resulted seed yield of 73, 275, 97 kg/ha, respectively.

At last, finally, when we observed for the seed germination, similar trend was noticed with highest germination of 95.40 per cent in case of open pollination followed by 94.00 per cent in case of bee colony and least was found in case of no pollination with only 50.60 per cent germination. The results are in confirmation with the studies of Saurabh and Mandal (2018) with only 14.00 per cent in case of no palliation.

Finally it was concluded that, onion is a being highly cross pollinated which is in need of external pollinating agent like insect pollinators specially honeybees for pollination and good quality/quantity seed setting. Among the four different pollinators, little bees are the most efficient pollinator along with equally other three species. but, the concern is, as the natural honey bee population is reducing day by day due to pesticide usage, reduction in the bee flora, human activities etc. So, it is the time to enhance the bee population by reducing pesticide usage, by enhancing the natural bee flora in and around the seed production area to obtain better quality and more quantity of onion seeds to ensure the availability of quality onion seeds for commercial bulb production.

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