
Insect pollination in *Cajanus cajan* L. and its effect on fruit yield

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ABSTRACT

The present investigations are being carried out for three consecutive year at Amravati. The plant species were visited daily or on alternate day, for to count visit of pollinators in *Cajanus cajan* L. The important flower pollinators in *C. cajan* were *Xylocopa* spp., *Apis dorsata*, *A.florea*, *Trigona* spp., *A. cerana indica*, *Ceratina* spp. and moth. The effect of different treatments on the yield in terms of weight of mature fruit was measured 47.02, 42.15 and 37.40 gm in self- pollination, 60.00, 51.30 and 47.60 gm in open-pollination and 59.01, 62.88 and 70.54 gm in insect-pollination respectively.

Keywords- Amravati, *Cajanus cajan* L., pollinators, *Apis dorsata*, yield.

INTRODUCTION

Pollination is an important and essential stage in the sexual reproduction of flowering plants. It involves the transfer of pollen from anther to the receptive stigma of the flower. As such pollination is an essential prerequisite to seed and fruit set. Plants in general are classified on the basis of their floral biology as adapted to self and cross-pollination, either by wind or by animals, a majority of these being insects (Deodikar and Suryanarayana, 1977). Insect visitors are characterized as pollinator, if it transfers pollen intentionally in a foraging attempt or unintentionally (Sihag, 1988). Bees are considered to be the most important pollinators because they are the only insects whose immature stages are reared exclusively on pollen and nectar (Crane, 1990). From the pollination point of view, honey bees are the potential pollinators and their frequent visits increase their efficiency to be as pollinators (Free, 1993). Pollen collecting bees are better pollinators than nectar collectors (Free, 1993). There are three main classes of flower visiting insects, Hymenoptera (social and solitary bees and wasp), the Diptera (flies) and Lepidoptera (butterflies and moths), come across the cross pollination. India is a leader in Asia in the field of pollination research using native bees. In the recent past there is spurt in pollination research resulting in considerable advances in our knowledge about the pollination requirements of crops (Rao, 1997). During the present investigation detail study of natural insect pollinators and its role in dry fruit yield of *C. cajan* was carried out.

MATERIALS AND METHODS

The present investigations are being carried out during three consecutive year at Amravati (20⁰54' to 20⁰57' North Latitude and 77⁰43' to 77⁰48' East Longitude) situated in Amravati district of Maharashtra State. The observations were taken from different cultivated fields around Amravati city. Three different study sites were selected for study.

Pollen Load Carried Out by Insect

Pollen load carried out by insect was estimated as per method proposed by (Dafni, 1992).

Flower visitors dynamics, Census and activity

The flower visitors were observed for their visit timings at the different study sites during the flowering period of plant. During the initial, peak and final phases of the blooming period, the types and timings of the visitors were noted.

Flower visitor behaviour

The conduct of insect visitors was observed at different hours of the day during the flowering period at each study sites. The observations were also made on their mode of approach. The observations of the type of forage they collect, contact of the visitor's body with the essential organs of the flower and the activities of the forager during a visit were noted. At the time of insect visit, photographs were taken with the help of Digital Camera (Sony Make).

Yield Comparison

To compare the yield of self, open and insect pollination treatment, the mature flower buds were selected, bagged and tagged. For each type of pollination treatment, hundred flowers buds were selected from different plants for three different pollination treatments, viz., "SP" (self-pollinated), "BP" (insect pollination) and "OP" (open pollination) as per the method followed by Panda *et al.* (1988) and Rao and Suryanarayana (1979). After the maturation of fruit the average weight of dry fruit were taken.

RESULTS AND DISCUSSION

The present research work was started with the aim to know the role of insects in general in pollination of the *C. cajan* the crop plants cultivated in Vidarbha and thus to enhance the yield of crops. It was proposed to study the population of pollinators, their activity, behavior and their role in crop pollination.

To fulfill the above said objectives observations on different aspects of pollination and the flower visitors were undertaken for three consecutive years. Insect/pollinator census, period of pollinator activity, floral rewards, pollen load carried out by pollinator, were undertaken during the investigations at different study sites and seasons.

It is important to study the process of pollination and pollinators in crop plant because more than 80 % of all flowering plants species rely on different animals for pollination (Torchio, 1990 and Nabhan and Buchmann, 1997).

C. cajan is a shrub, widely cultivated in states of Madhya Pradesh, Bihar, Andhra Pradesh, Maharashtra, Uttar Pradesh and Karnataka. It is commonly known as "Pigeon Pea". Leaves are trifoliate, 8-10 cm long. Leaflets elliptic, lanceolate or oblong, 4-8 cm long and 1 – 2.5 cm broad. Cuneate, entire, acute or apiculate. Flower in terminal panicles and in axillary racemes. Calyx hairy, corolla yellow. Seeds used in form of "Dal". It is the second important pulse crop of India. Both immature and ripe seeds are used for human food as a good source of protein

During the present investigation the important flower visitors were foraging on *C. cajan* were *Xylocopa* spp., *Apis dorsata* (Fig. No.1), *A. florea* (Fig. No.4), *Trigona* spp. (Fig. No.2), *A. cerana indica*, *Ceratina* spp. (Fig. No.3) and moth (Fig. No.5). Occasionally, wasp and house fly (Fig. No.6) also visited the flower. The activity of visitors was more from 09.30 hrs. to 13.30 hrs. The flower visitor activity was less during the afternoon time, however, from 15.30 hrs. onwards towards the evening hours activity was again more. *Xylocopa* spp. visited the flower regularly through out the day time. *Xylocopa* spp. visited one to ten

flowers in a single bout. Duration of the visit was two to eighteen seconds per flower. Bees visited one to seven flowers in a single bout and the duration was four to sixty seconds per flower (Table No.1).

Bees visit the flower to collect pollen and nectar is found to be most valuable process in the pollination. Their frequent visit from one flower to other flower may perhaps help transfer of pollen (Deodikar and Suryanarayana, 1977). During the present investigation several insect foragers were found to be visiting on *C. cajan*.

Flowers of *C. cajan* are yellow, having landing platform on petals. A number of insect species were visited the flowers (Table No.1). The activity of pollinators starts after the opening of the flowers. The insect activity diminished during cloudy days. The bright yellow flowers represent flag type blossom. Insect visits the flower to collect pollen and nectar. According to Deodikar and Suryanarayana (1977) red gram (Tur) is a very important honey source in several states of India and frequently visited by bees as a food resources.

In *Cajanus cajan* the effect of different treatments on the yield in terms of weight of mature fruit was recorded to be 47.02, 42.15 and 37.40 gm in self- pollination, 60.00, 51.30 and 47.60 gm in open-pollination and 59.01, 62.88 and 70.54 gm in insect-pollination for site 1, 2 and 3 respectively during the first year (Table No.2.) and it was found to be 28.20, 32.63 and 36.45 gm in self-pollination, 42.56, 43.50 and 47.18 gm in open-pollination and 57.23, 54.72, 26.23 gm in insect-pollination respectively for three different study sites during the second year 2006 (Table No.2). However, it was observed to be 33.11, 32.75 and 38.67 gm in self-pollination, 48.87, 41.56 and 53.37 gm in open-pollination and 65.42, 57.31, 54.12 gm in insect-pollination for site 1, 2 and 3 respectively in third year. (Table No.2).

Deodikar and Suryanarayana (1977) roughly estimated the data on yield parameters. The effect of different bee species on yield shows that there is a gradual increase in number of seeds and seed weight per pod in order of *A. florea*, *A. cerana* and *A. dorsata* visited flowers. Sinha and Chakrabarti (1995) reported the effect of two pollination modes on seed yield and weight. In the present investigation it was found higher seed yield in insect-pollination and open-pollination over self-pollination.

Table No. 1: Visitor censuses during three consecutive year.

Forager	Forage type	Length of visit in sec	Time of visit	Pollen load			visit per bout	Visit frequency
				1 st year	2 nd year	3 rd year		
(Site-1)								
<i>Xylocopa</i> spp.	P	02 - 03	09.00-	28487.	101722.	99346.5	01 – 10	VF
<i>A. dorsata</i>	P/N	05 - 10	17.30	8	5	27531.9	02 - 03	VF
<i>A. florea</i>	P/N	05 - 08	09.30-	12604.	26700.3	15741.0	01 - 04	VF
<i>Trigona</i> spp.	P/N	04 - 06	17.30	5	15147.0	3663.0	02 - 04	VF
Wasp	P	03 - 04	08.30-	3583.8	3366.0	-	01 - 03	VO
<i>Ceratina</i> spp.	P	04 - 09	17.30	11923.	-	-	01 - 03	VF
House fly	N	02 - 04	09.30-	5	-	-	1	VO
<i>A.cerana</i>	P/N	04 - 07	17.30	-	-	-	02 - 04	VF
<i>indica</i>	N	02 -	10.00-	-	-	-	02 – 03	VF

Moth		04	17.30	-					
			08.30-	-					
			17.30	-					
			10.00-						
			17.30						
			09.30-						
			17.30						
			09.30-						
			17.30						
(Site-2)									
<i>Xylocopa</i> spp.	P	02 - 03	10.00-	97729.	99727.5	94279.4	03 - 08	VF	
<i>A. dorsata</i>	P/N	04 - 10	17.30	5	29769.3	26541.9	01 - 04	VF	
<i>A. florea</i>	P/N	04 - 09	10.00-	27343.	14517.1	13591.4	01 - 03	VF	
<i>Trigona</i> spp.	P/N	05 - 08	17.30	8	4768.3	6478.4	01 - 04	VF	
Wasp	P	04 - 06	10.00-	17451.	-	-	01 - 04	VO	
<i>Ceratina</i> spp.	P	04 - 08	17.30	1	-	-	01 - 03	VF	
House fly	N	02 - 03	09.00-	3467.8	-	-	1	VO	
<i>A. cerana</i>	P/N	04 - 08	17.30	-	-	-	01 - 04	VF	
<i>indica</i>	N	02 - 04	09.30-	-	-	-	02 - 03	VF	
Moth			17.30	-					
			08.30-	-					
			17.30	-					
			10.00-						
			17.30						
			09.30-						
			17.30						
			09.30-						
			17.30						
(Site-3)									
<i>Xylocopa</i> spp.	P	02 - 03	09.00-	94589.	85699.7	89695.7	04 - 05	VF	
<i>A. dorsata</i>	P/N	02 - 09	17.30	7	26258.5	27581.9	01 - 04	VF	
<i>A. florea</i>	P/N	04 - 09	09.30-	25841.	19675.2	16675.5	01 - 03	VF	
<i>Trigona</i> spp.	P/N	03 - 07	17.30	9	3468.7	3675.2	01 - 04	VF	
Wasp	P	03 - 05	10.00-	16957.	-	-	01 - 04	VO	
<i>Ceratina</i> spp.	P	04 - 08	17.30	2	-	-	01 - 03	VF	
House fly	N	02 - 03	10.00-	4678.	-	-	1	VO	
<i>A. cerana indica</i>	P/N	03 - 08	17.30	3	-	-	01 - 04	VF	
Moth	N	02 -	10.00-	-	-	-	02 - 03	VF	
		04	17.30	-					
			08.30-	-					
			17.30	-					
			10.00-	-					
			17.30						
			09.30-						
			17.30						
			09.30-						
			17.30						

Table No. 2: Effect of different pollination treatment on the yield (in grams) in *Cajanus cajan*

Year	Site	Self pollination	Open pollination	Insect pollination
I	1	47.02	60.00	59.01
	2	42.15	51.30	62.88
	3	37.40	47.60	70.54
II	1	28.20	42.56	57.23
	2	32.63	43.50	54.72
	3	36.45	47.18	61.49
III	1	33.11	48.87	65.42
	2	32.75	41.56	57.31
	3	38.67	53.37	54.12



Fig.-1 *A. dorsata* foraging on the flower



Fig.-2 *Trigona* spp. visiting the flower



Fig.-3 *Ceratina* spp. Foraging on flower



Fig.-4 *A. florea* foraging on flower



Fig.-5 Moth collecting nectar from flower

Fig.-6 Housefly visiting the flower

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