



## Research Paper

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# Flowering and seeding variability in neelayamari (*Indigofera tinctoria* L.) accessions

■ S. SARADA AND B.R. REGHUNATH<sup>1</sup>

### Members of the Research Forum

#### Associated Authors:

<sup>1</sup>Department of Pomology and Floriculture, College of Horticulture, Kerala Agricultural University, Vellanikkara, THRISSUR (KERALA) INDIA

#### Author for correspondence :

S. SARADA

Department of Pomology and Floriculture, College of Horticulture, Kerala Agricultural University, Vellanikkara, THRISSUR (KERALA) INDIA  
Email : saradarajamony@gmail.com

**ABSTRACT :** Growth and yield analysis of thirty different accessions of *Indigofera tinctoria*, collected from inside and outside the state, was conducted and the comparative performance in open and partial shade ecosystem was evaluated. Selected ten accessions were raised in replicated trial in open and under shade in coconut garden. Observations on flowering and seeding were taken. Flowering in *I. tinctoria* was observed about 111 days after sowing (DAS) to 116 DAS in open condition and 117 DAS to 126 DAS under shade. *I. tinctoria* accessions IT-101 and IT-96, which dominated in shoot and leaf yield, produced more number of flowers under open condition. Early flowering and more number of flowers was obtained in IT-96 under open condition. Pod setting percentage was 20.86 and 17.58 per cent, respectively under open and shaded condition. Average number of days for pod set was 138.4 days in open and 149.0 days under shade. Average number of days for seed maturation was 239.4 DAS in open condition and 253.5 DAS under shade. Under open condition early seed set and seed maturation was observed in IT-97. Less pod setting percentage and delay in pod set and seed maturation was observed in shaded condition compared to open. *I. tinctoria* plants grown in open condition exhibited early flowering, more number of flowers, increased pod setting percentage, early seedset and early seed maturation when compared to those under shade.

**KEY WORDS :** Neelayamari, *Indigofera tinctoria* L., Floral characters, Seeding behaviour

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*Indigofera tinctoria* L. commonly known as neelayamari in Malayalam, Indian indigo in English and neelini/ neelika/ renjini in Sanskrit is a medicinally as well as commercially useful leguminous plant. It belongs to the family Leguminosae/ Fabaceae and subfamily Papilionoideae. The plant is utilized in Ayurveda as an important constituent in several hair growth promoting oils such as Neelibringadhikesathailam. The plant is also utilized in the treatment of hydrophobia, epilepsy, nervous disorders, bronchitis and also as external application for sores, old ulcers and haemorrhoids (Singh and Khan, 1990).

Species of flowering plants are most reliably identified by their flowers, the sexually reproductive organs. The knowledge of floral biology is a prerequisite for genetic improvement of any crop through conventional breeding. Tucker (2003) made a detailed study on the floral development in legumes. Eight commonly occurring species of *Indigofera* were identified in Eastern Nigeria by Nwachukwu and Mbagwu

(2006), in which the vegetative and floral morphology characters of *Indigofera tinctoria* have been described.

The present study on variability in flowering and seeding behavior of neelayamari accessions under open and shaded conditions has been taken up with a view to identify the accessions producing early flowering and pod set and to study the influence of light on flowering and pod set. Inter or mixed cropping in coconut gardens is very popular in important coconut growing states in India. The practice of inter/mixed cropping is followed in order to utilize the natural resources like light, soil nutrients and water efficiently. The transmission of light through the coconut canopy is one of the most important factors affecting the success of intercropping programmes. Maheswarappa and Anithakumari (2002) reported that in coconut plantations of more than 25 years old, 45-50 per cent of the sunlight is infiltrated on to grounds without interception by the coconut.

Sr. No.	Accession No.	Source
1.	IT-108	Neyyattinkara market, Thiruvananthapuram.
2.	IT-101	AICRP on Medicinal and Aromatic plants, KAU, Thrissur.
3.	IT-96	Seed Bank, TBG&RI, Palode, Thiruvananthapuram.
4.	IT-114	Pankajakasthuri, Thiruvananthapuram.
5.	IT-106	University of Agricultural Sciences, Bangalore.
6.	IT-104	Vrikshabandhu Social Forestry Club, Pala, Kottayam.
7.	IT-105	Aryavaidyasala, Kottakkal, Malappuram.
8.	IT-111	Aromatic and Medicinal plants Research Station, KAU, Odakkali.
9.	IT-97	Medicinal plant garden, TBG&RI, Palode, Thiruvananthapuram.
10.	IT-99	Thomas Mathew, Mundakkayam, Idukki.

## RESEARCH METHODS

The study was conducted at College of Agriculture, Vellayani, Thiruvananthapuram. Seeds of thirty different accessions of *I. tinctoria* were collected from inside and outside the state. Growth and yield analysis of the accessions as pure crop in open and as an intercrop in shaded situation in a coconut garden was conducted. From the results, best 10 accessions were selected based on leaf yield and indigo content (Table A). Selected 10 accessions were raised in replicated trial in open and under shade in coconut garden consisting of palms of 35 years of age, with three replications and at a spacing of 45 x 45 cm. Eight plants from each replication was utilised for sampling, the following observations were taken and the mean value recorded.

### Number of days for flowering:

Total number of days required for commencing flowering from the date of sowing in fifty per cent of plants in a plot was recorded in each accession.

### Total number of flowers produced per plant:

The total number of flowers produced per plant was counted and recorded.

### Time of anthesis:

Ten mature flower buds in every accession in each replication were tagged at 6 am and the time of flower opening was noted and the mean value recorded.

### Time of anther dehiscence:

Ten inflorescence in every treatment in each replication were cut in the evening and dipped in a vessel containing water and kept for observation. Mature but unopened flower buds were observed with a hand lens at night for anther dehiscence. Appearance of longitudinal split in the pollen sac indicated the commencement of anther dehiscence. Observations were taken and the mean value recorded.

### Percentage of pod set:

The total number of pods produced in an inflorescence in each replication in an accession was noted in the observational plants. The percentage of pod set was calculated using the total number of flowers produced per inflorescence.

### Number of days for seed set:

Total number of days required for 50 per cent of plants in a plot to attain seed set from the date of sowing was recorded in each accession.

### Number of days for seed maturation:

Total number of days required for 50 per cent of plants in a plot to attain seed maturation from the date of sowing was recorded in each accession.

## RESEARCH FINDINGS AND DISCUSSION

The data on flowering and seeding behaviour of selected accessions of *I. tinctoria* are given in Table 1. Flowers of *I. tinctoria* are numerous and sessile, racemes, 5 -10 cm long with 20 to 40 flowers/ inflorescence. The corolla is pink in colour, consisting of a rounded standard petal, brownish and pubescent at the back and two wing petals adherent to the two keel petals which are greenish in colour. Pods are 2-3.2 cm long, linear, straight or slightly curved, pale greenish grey when young and dark brown on ripening with 8-12 seeds.

### Number of days for flowering:

There was no significant difference among the accessions in the number of days for flowering both under open and shaded conditions. Under open condition, IT-96 was found to flower earlier (111 days) than other accessions and under shade, IT-104 flowered earlier (117 days).

### Total number of flowers produced per plant:

The accessions differed significantly for the total number of flowers produced per plant only under shaded condition.

IT-101 produced more number of flowers (10764.21) in shaded condition which was at par with IT-97, IT-99, IT-111, IT-108, IT-96, IT-106 and IT-114.

#### Time of anthesis:

Significant difference was found among the accessions for the time of anthesis only under shaded condition. Time of anthesis was recorded earliest in the accession IT-108 (8.46 a.m.) under shade.

#### Time of anther dehiscence:

There was significant difference among the accessions for the time of anther dehiscence both under open and shaded condition. Earliest anther dehiscence was recorded in the accession IT-108, both in the open (10.57 p.m.) and under shade (11.16 p.m.). Under shade, IT-108 was at par with IT-105 (11.33 p.m.), IT-101, IT-104 and IT-99 (11.41) and IT-97 (11.43 p.m.) (Table 2).

#### Percentage of pod set:

The accessions differed significantly for the percentage

of pod set only under shaded condition. IT-114 recorded the highest percentage of pod set (21.04%) which was at par with IT-97 (20.35%), IT-96 (19.88%), IT-108 (19.33%) and IT-104 (18.74%). Percentage of pod set was least in IT-111 (13.55%) (Table 3).

#### Number of days for seed set:

There was no significant difference among the accessions in the number of days for seed set both under open and shaded conditions. Under open condition, seed setting was earlier in IT-97 (133 days) and in shaded condition, earlier seed setting was observed in IT-96 (144 days).

#### Number of days for seed maturation:

There was significant difference among the accessions for the number of days for seed maturation both under open and shaded condition. Under open condition, seed maturation was earliest in IT-104 (234 days) which was at par with IT-97 and IT-99 (235 days), IT-96 (236 days), IT-108 (237 days) and IT-114 (238 days). Under shade, IT-96 recorded less number of days for seed maturation (242 days) which was at par with

Sr. No.	Accession No.	No. of days for flowering		Total no. of flowers produced/ plant		Time of anthesis (a.m.)		Time of anther dehiscence (p.m.)	
		Open	Shade	Open	Shade	Open	Shade	Open	Shade
1.	IT- 108	115	124	18872.42	10171.67	8.30	8.46	10.57	11.16
2.	IT- 101	116	121	22382.17	10764.21	9.12	10.03	11.41	11.41
3.	IT- 96	111	120	20825.09	10104.04	9.05	10.05	11.25	11.58
4.	IT- 114	113	124	18005.50	9824.38	9.08	10.01	11.50	12.03
5.	IT- 106	114	126	14378.84	10016.29	8.35	9.27	11.18	12.18
6.	IT- 104	113	117	19542.29	8625.71	8.43	9.21	11.16	11.41
7.	IT- 105	115	124	17506.67	8977.13	8.50	9.48	11.16	11.33
8.	IT- 111	116	123	19995.50	10225.71	9.01	10.08	11.04	11.53
9.	IT- 97	112	126	12797.50	10545.84	8.27	9.10	11.24	11.43
10.	IT- 99	115	122	19261.21	10403.75	8.44	10.00	11.31	11.41
CD (P=0.05)		NS	NS	NS	1053.48	NS	0.57	0.44	0.29

NS=Non-significant

Sr. No.	Accession No.	Percentage of pod set (%)		No. of days for seed set		No. of days for seed maturation	
		Open	Shade	Open	Shade	Open	Shade
1.	IT- 108	21.17	19.33	139	148	237	252
2.	IT- 101	18.03	14.93	141	147	241	246
3.	IT- 96	19.60	19.88	136	144	236	242
4.	IT- 114	22.46	21.04	136	149	238	258
5.	IT- 106	23.78	16.09	142	149	246	252
6.	IT- 104	20.63	18.74	136	148	234	251
7.	IT- 105	21.38	15.44	142	152	244	260
8.	IT- 111	21.24	13.55	143	151	248	257
9.	IT- 97	21.55	20.35	133	152	235	259
10.	IT- 99	18.81	16.52	136	150	235	258
CD (P=0.05)		NS	4.25	NS	NS	6.07	6.27

NS=Non-significant

IT-101 (246 days).

Flowering in *I. tinctoria* was observed about 111 days after sowing (DAS) to 116 DAS in open condition and about 117 DAS to 126 DAS under shade. Profuse flowering occurred about 150 DAS, which was fixed as the second stage of plant growth. According to Benvenuti *et al.* (1994), shading caused species dependant delay in the onset of flowering in *Datura stramonium*. *I. tinctoria* accessions IT-101 and IT-96, which dominated in shoot and leaf yield produced more number of flowers under open condition. Early flowering and more number of flowers was obtained in IT-96 under open condition. In a study on the effect of light intensity on plant growth in *Eryngium foetidum*, a medicinal herb, Casey *et al.* (2004) reported that greatest number of flowers was obtained in 0% shade.

*I. tinctoria* flowers open early in the morning, closed before noon and fell in the same day. Anthesis was spread over from 8.27 a.m. to 9.12 a.m. under open condition and from 8.46 a.m. to 10.08 a.m. under shade. Swarnapiriya *et al.* (1995) stated that temperature and relative humidity (RH) had influence on anthesis in *Gloriosa superba*. When the temperature is low and RH is high, the flower opening is delayed for a few hours in *G. superba*. Lower temperature and higher RH under shade compared to open condition may be the reason for the delay in anthesis in shade. In *I. tinctoria*, anthers matured and started dehiscing about 7-8 hours before the time of opening of corolla. The peak anther dehiscence was between 10.57 to 11.50 p.m. in open condition and between 11.16 to 12.18 p.m. under shade, the day before anthesis. Anther dehiscence was completed in 1 to 2 hours. Increased temperature caused earlier dehiscence and lower temperature delayed the dehiscence.

In *I. tinctoria*, the flower shedding percentage was high. This led to a poor pod setting percentage of 20.91 and 17.30 per cent, respectively under open and shaded condition. Average number of days for pod set was 138 days in open and 149 days under shade. *I. tinctoria* pods were harvested when they turn brown. It will not split longitudinally on attaining maturity. Hence, seed dehiscence does not occur. Average number of days for seed maturation was 239.4 DAS in open condition and 253.5 DAS under shade. Under open condition early seed set and seed maturation was observed in IT-97. Less pod setting percentage and delay in pod set and

seed maturation was observed in shaded condition compared to open. Hence, flowering behaviour in *I. tinctoria* was found better under open condition compared to shade under coconut garden. Reduced light intensity of 220 to 700 foot candles have been reported under coconut plantation by Venugopal *et al.* (2008).

*I. tinctoria* plants grown in open condition exhibited early flowering, more number of flowers, early anthesis and anther dehiscence, increased pod set percentage, early seed set and early seed maturation when compared to those under shade in coconut plantations consisting of palms of 35 years age. Increased light intensity under open condition favoured flowering in *I. tinctoria*. Variation could also be observed among the accessions for these characters.

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