STUDIES ON FLORAL ABSCISSION AND FRUIT FORMATION IN SOME BIGNONIACEAE

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Introduction

Several members of the family Bignoniaceae are planted in gardens and avenues for their beautiful foliage and blossom e. g. *Campsis grandiflora*, *Jacaranda mimosifolia* and *Millingtonia hortensis*. These plants flower normally in the Indo-Gangatic plains of India, but fruit formation is either completely or partially inhibited. Preliminary studies have revealed that a large number of floral buds, their parts, fertilized and unfertilized pistils abscise in a large number. The present study was undertaken to examine the effect of some growth substances on abscission of flowers and their parts as well as on fruit formation in some members of Bignoniaceae.

Materials and Methods

The present investigation was carried out on *Campsis grandiflora* (Syn. *Tecomella grandiflora*), *Jacaranda mimosifolia* and *Millingtonia hortensis*, growing at the Botanic garden, R. B. S. College, Agra. The concentration of various chemicals and the number of treatments made in different species are summarised in Table 1.

Results and Discussion

The effect of various chemicals on abscission of floral buds and their parts and fruit formation is described separately in the following paragraphs.
Campsis grandiflora:

A large number of young floral buds, corolla of open flowers with epipetalous stamens abscised. This was followed by the abscission of unfer-

TABLE 1. Chemicals, their concentrations and number of treatments made on different plants

Plant	Chemical	Concentration (ppm)	Treatments	Interval	Amount applied
Campsis grandiflora	Gibberellic acid (GA_3)	100, 200, 300 and 400	5	24 hours each treatment	50 ml in each treatment
(Syn. *Tecomella grandiflora*)	2-dichlorophenoxy-acetic acid (2, 4-D)	25, 50, 75 and 100	5	"	"
Jacaranda mimosifolia	Gibberellic acid (GA_3)	10, 20, 50 and 100	5	"	"
	2,4-Dichlorophenoxy acetic acid (2, 4-D)	50 and 100	5	"	"
	Naphthalene acetic acid (NAA)	10, 20, 50 and 100	5	"	"
	Indole acetic acid (IAA)	10, 20, 50 and 100	5	"	"
Millingtonia hortensis	Gibberellic acid (GA_3)	50, 100, 200, 300 and 400	5	"	"
	Indole butyric acid (IBA)	100, 200, 300 and 400	5	"	"
	Indole acetic acid (IAA)	100, 200, 300 and 400	5	"	"
	Naphthalene acetic acid (NAA)	100, 200, 300 and 400	5	"	"

TABLE 2. Effect of different growth substances on abscission and fruit formation in *C. grandiflora*

Chemical	Concentration	No. of sprays	Rate of abscission*	No. of fruits/ inflorescence	Fruit size (cm)		
					Smallest	Longest	Average
Gibberellic acid (GA_3)	100	5	–	16	1.5	1.5	4.14
	200	5	++	—	—	—	—
	300	5	+++	—	—	—	—
	400	5	++++	—	—	—	—
2-dichlorophenoxy acetic acid (2, 4-D)	25	5	+	19	0.5	2.7	1.0
	50	5	+	15	0.5	1.7	0.94
	75	5	–	23	0.5	2.2	1.15
	100	5	+	19	0.6	1.4	0.67

* Negligible (–), slight (+), moderate (++), high (+++) and highest (++++).

tilized pistils. Table 2 shows the effect of GA_3 and 2, 4-D on abscission and fruit formation in this plant.

The sprays of 100 ppm GA_3 checked abscission to a considerable extent and induced fruit formation. The size of fruits thus produced ranged from 1.6 to 6.5 cm (Fig. 1). However, higher concentrations of GA_3 failed to check abscission of flowers and also failed to induce fruit formation. It was interesting to note that the pedicel of the flowers treated with higher concentrations of GA_3 elongated to an appreciable length, and the flowers became narrow and much elongated as compared to untreated flowers (Fig. 2). These flowers abscised without bearing fruit. Applications of 2, 4-D in different concentrations helped in the formation of a large number of fruits. However, the size of such fruits was poor compared to that exhibited by fruits obtained by GA_3 treatment (Fig. 3). The size of such fruits ranged from 0.5 to 2.7 cm with an averages of 0.67-1.15 cm.

Jacaranda mimosifolia :

Flowering in this ornamental tree occurs during summers, but it remained

TABLE 3. Effect of various growth substance on abscission of fertilized pistils in *J. mimosifolia*

Chemical	Concentration (ppm)	No. of sprays	Rate of abscission of fertilized pistils*	No. of fruits/plant
Gibberelic acid (GA_3)	10	5	+	4- 5
	20	5	++	—
	50	5	++	—
	100	5	+++	—
	50	5	−	60-80
2 4-dichlorophenoxy acetic acid (2, 4-D)	100	5	—	30-45
	10	5	+	—
	20	5	+	—
	50	5	+++	—
	100	5	++++	—
Indole acetic acid (IAA)	10	5	+	4- 5
	20	5	++	—
	50	5	++	—
	100	5	+++	—
Control	—	—	++++	1- 3

* Negligible (−), slight (+), moderate (++), high (+++) and highest (++++).

more or less seedless as only 1-3 fruits per plant developed. During the early flowering period normal development of anthers and ovules was observed. This was followed by normal fertilization[5]. The fertilized pistils abscised in a large number of plants to make them seedless. The effect of various chemicals on abscission of fertilized pistils is shown in Table 3. It is clear from Table 3 that the sprays of low concentration of IAA prevented abscission of pistils to some extent and only 4 to 5 fruits per plant developed. However, the sprays with higher concentrations of IAA failed to check abscission of fertilized pistils. The extent of abscission in plants treated thus was even higher than that of control. Lower concentrations of NAA also checked abscission of pistils to some extent and only 3-4 fruits per plant developed. Higher concentrations of GA_3 also failed to

TABLE 4. Effect of some growth substances on abscission and fruit-set in *Millingtonia hortensis* L.

Chemicals	Concentration (ppm)	No. of treatments	No. of fruits/branch	Rate of abscission*	Fruit size (cm)		Average (cm)
					Smallest	Longest	
Gibberellic acid (GA_3)	50	5	2	++	1.2	1.5	1.35
	100	5	7	–	2.4	3.0	3.74
	200	5	8	–	2.0	7.0	3.48
	300	5	7	–	2.4	4.0	3.32
	400	5	8	–	1.7	6.7	4.15
Indole butyric acid (IBA)	100	5	2	++	1.2	1.5	1.35
	200	5	2	+	2.0	2.5	2.25
	300	5	—	++	—	—	—
	400	5	—	+++	—	—	—
Indole acetic acid (IAA)	100	5	—	+	—	—	—
	200	5	—	++	—	—	—
	300	5	—	++	—	—	—
	400	5	—	+++	—	—	—
Naphthalene acetic acid (NAA)	100	5	—	+++	—	—	—
	200	5	—	+++	—	—	—
	300	5	—	+++	—	—	—
	400	5	—	+++	—	—	—
Control		5	—	+++	—	—	—

* Negligible (–), lowest (+), moderate (++), highest (+++).

check abscission and there was no fruit formation. The most significant results were obtained by the sprays of 2, 4-D. The sprays of 50 and 100 ppm 2, 4-D not only checked the rate of abscission of fertilized pistils to a considerable extent, but a significantly higher number of fruits 30-80 fruits per plant developed (Fig. 4).

Millingtonia hortensis:

A large number of young floral buds, open flowers, their corolla and unfertilized pistils abscised. Table 4 shows the effect of various chemicals on abscission of floral buds and fruit formation in *M. hortensis*.

It is clear from Table 4 that NAA was completely ineffective in checking abscission of floral parts and failed to induce fruit formation. Higher concentrations of IAA checked abscission of unfertilized pistils to some extent but failed to induce fruit formation. Application of IBA in lower concentrations hepled in checking abscission to a considerable extent and resulted in fruit formation. The size of fruits in 100 ppm IBA treatment was 1.2 to 1.5 cm and in 200 ppm treatment, it ranged from 2 to 2.5 cm. On the other hand, GA_3 at all concentrations not only prevented abscission but also induced fruit formation (Fig. 5). The size of fruits obtained by 200 and 400 ppm treatments ranged from 2 to 7.0 cm and from 1.7 to 6.7 cm respectively.

Premature abscission of flowers and their parts is one of the important reasons for fruitlessness in large numbers of plants. Mostly premature abscission has been attributed to damage by frost, drought, high temperature and attacks of fungi, insects, birds and mammals[3,4]. According to BRAMELETT (1972), abscission of floral buds and their parts caused by change in the environmental condition is known as physiological drop. Abscission of flowers and their parts prior to anthesis, between anthesis and fertilization caused by various environmental factors resulting into fruitlessness in a large number of plants has been reported by several investigators.[7] Recently, CHAUHAN and YADAV (1984) have also made similar observations in *Crescentia cujete*, a member of the family Bignoniaceae. According to them abscision of young floral buds, open flowers, corolla with epipetalous stamens, fertilized and unfertilized pistils renders this plant seedless at Agra. According to JAIN and CHAUHAN (1985), the abscission of fertilized pistils in *Jacaranda mimosifolia* at Agra is mainly due to a considerable rise in temperature combined with a fall in relative humidity.

It is clear from the foregoing description that all the treatments with GA_3 checked abscission and induced fruit formation. Recently, GA_3 has been successfully used to help in the checking the abscission of floral parts and inducing fruit formation in some Bignoniaceae[6,9,12,13]. The essentiality of gibberellic acid for fruit formation as well as for checking abscission seems clear but the exact role of GA_3 is not well known. However, according to KRISHNAMOORTHY (1981) gibberellins may trigger auxin production, which in turn controls fruit development. Present observations support this view. This is largely because sprays of IAA failed to induce fruit formation but a large number of fruits developed by GA_3 treatment. This, in the opinion of present authors, might have helped in increasing endogenous levels of IAA. The deficiency of GA-like substances in the pistils of some members of Bignoniaceae at Agra may also be due to reversible and irreversible formation of GA conjugates and irreversible other 'bound GA_5' due to high temperature.[10] This view is supported by the fact that the sprays with high concentrations of GA_3 failed to check the rate of abscission of pistils to any considerable extent in *J. mimosifolia*.

IAA's role in furit formation and abscission is also well known. The sprays of high concentrations of IAA checked the rate of abscission in *M. hortensis* but failed to induce fruit formation. This may be due to IAA destruction caused by IAA oxidase due to the high temperature at Agra. Observations[14] have revealed that IAA checks the rate of abscission of flowers to a considerable extent but fruit formation was not observed in several cultivars of sweet cherry.

It was interesting to note that the sprays of different concentration of 2, 4-D checked the rate of abscission of fertilized pistils in *J. mimosifolia* to a considerable extent and also helped in production of fruits. It also induced fruit formation in *C. grandiflora*, although while the number of fruits was high, their size poor as compared to GA_3 treated plants. 2, 4-D is one of the best known synthetic auxins and according to MOOR (1979) it is active and widely used in experimentation instead of naturally occurring hormone IAA, 2, 4-D is less liable to the oxidation by IAA. The possibility of the formation of conjugates of 2, 4-D with the amino acids is also rare.

Thus during the course of the present investigation, sprays of 2, 4-D might have enhanced the quantity of endogenous levels of auxins which in turn prevented abscission and induced fruit formation in *C. grandiflora* and in *J. mimosifolia*.

Summary

Members of the family Bignoniaceae flower normally in the Indo-Gangatic plains but remain seedless. This is largely due to the abscission of young floral buds, open flowers, corolla with epipetalous stamens, unfertilized and fertilized pistils. A study was made of the effect of various growth substances

on abscission and fruit formation in *Campsis grandiflora* (syn. *Tecomella grandiflora*), *Jacaranda mimosifolia* and *Millingtonia hortensis*. Applications of 100 ppm GA_3 and all the concentrations (25–100 ppm) of 2, 4-D induced fruit formation in *C. grandiflora*. The fruits obtained by GA_3 treatment were appreciably longer, while fruits in 2, 4-D treatments were small in size. The abscission of fertilized pistils of *J. mimosifolia* was prevented by sprays of 50 and 100 ppm, 2, 4-D. In such treated plants a large number of fruits developed. Sprays with 10 ppm GA_3 and 10 ppm IAA also checked the abscission of pistils to some extent and only a limited number of fruits developed. Treatments with GA_3 induced the formation of considerably longer fruits in *M. hortensis*. Lower concentrations (100 and 200 ppm) of indole-butyric acid also induced a limited number of fruits.

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Legend for Plate

Figs. 1–5. Untreated pistils and fruits obtained by treatments with various chemicals.

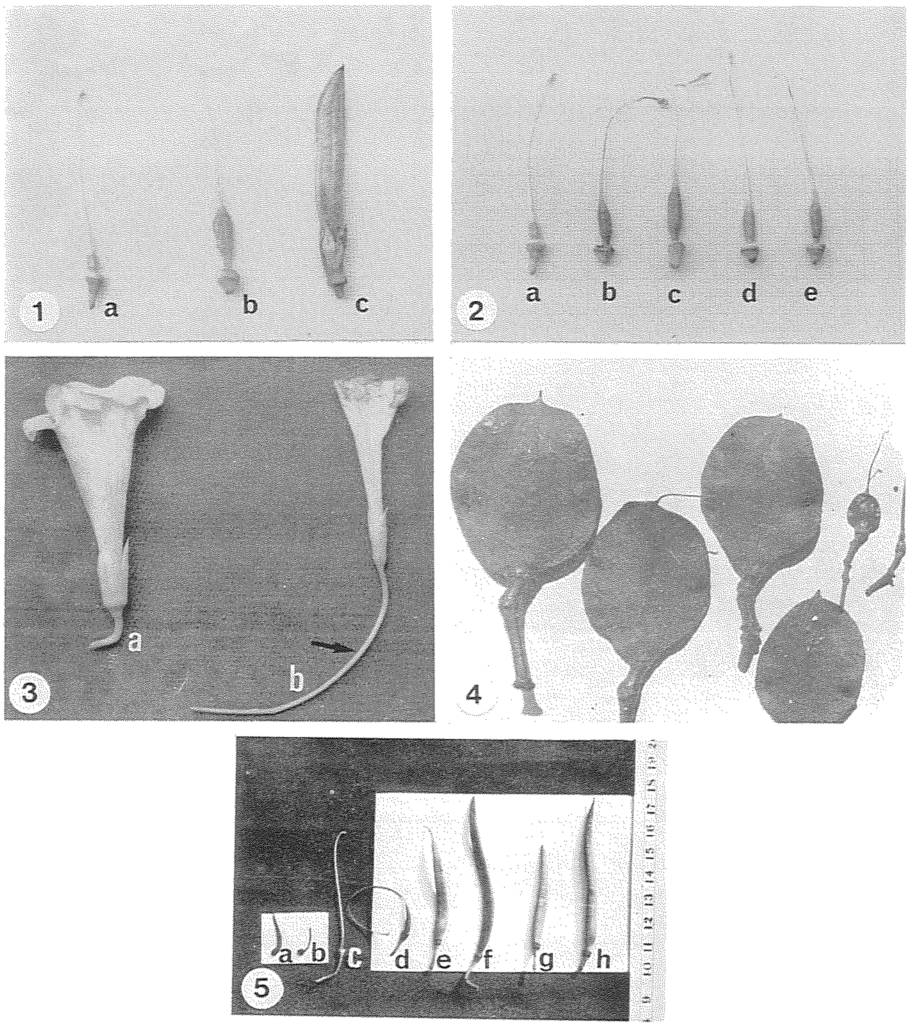
Fig. 1. *C. grandiflora* a. untreated pistil, b. young fruit and c. mature fruit obtained by treatment with 100 ppm GA_3.

Fig. 2. *C. grandiflora.* fruits treated with a. 25 ppm, b. 50 ppm, c. 75 ppm and d. e. 100 ppm 2, 4-D.

Fig. 3. *C. grandiflora.* a. untreated flower and b. flower treated with 300 ppm GA_3.

Fig. 4. *J. mimosifolia.* untreated pistil and fruits treated with 2, 4-D.

Fig. 5. *M. hortensis.* a. fruit 200 ppm IBA, b. 100 ppm IBA, c. untreated pistil, d. 50 ppm GA_3, e. 100 ppm GA_3, f. 200 ppm GA_3, g. 300 ppm GA_3 and h. 400 ppm GA_3.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