



Button shedding and premature nutfall in coconut palms grown in littoral sand as influenced by the growth regulator treatments

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Abstract

An experiment was conducted at Coconut Research Station, Konark, Orissa to study the changes in carbohydrate and nitrogen content in the leaf subtending inflorescence in relation to female flower development and the effect of growth regulators on button shedding and premature nutfall in coconut palms grown in the littoral sand. Four growth regulators (GA_3 , NAA, 2, 4-D and IBA) were used alone or in combination with other growth regulator / coconut water in both tall and hybrid palms. The studies revealed that the status of carbohydrate and nitrogen content in the leaf subtending inflorescence at the time of bunch opening decreased, while the C:N ratio increased significantly after two months following the development of female flowers. The intensity of button shedding, though was quite negligible within one month of bunch opening but was more remarkable during the third and fourth fortnight of bunch opening. This was, however, more pronounced in hybrid palms than in tall. The maximum button shedding (69.62% during rainy and 64.36% during summer) was recorded in the palms treated as control and the minimum shedding (24.26 % during rainy and 23.63% during summer) was recorded in the palms treated with 2, 4-D + coconut water within first two months of bunch opening. The consistency in superiority of 2,4-D alone or in combination with coconut water in minimizing shedding of buttons and premature nuts was also observed after four months and six months of bunch opening.

Key words: Littoral sand, button shedding, premature nutfall, growth regulator.

Introduction

Coconut is an important part of the farming systems of both the East and the West Coast. A large chunk of the coconut plantation in coastal Orissa (East Coast) stands on the littoral sand. The productivity status of such plantation is quite low. The poor nutritional status of the soil and the disturbed crop physiology appear to be the pertinent contributing factors resulting in the heavy button shedding and premature nutfall in such plantations. In coconut, fertilized flowers, up to four months of maturity are usually designated as buttons. Coconut is a tree crop of indeterminate growth habit in which partitioning of metabolites happens to be a continuous process for both growth and reproductive processes and also interlinked during its entire life span. Production of more female flowers, good fruit setting and

also retention of nuts, thereafter are the important aspects to be considered for getting good yield from coconut palm. Ramadasan and Mathew (1977) and Kasturi Bai and Ramadasan (1983) were of the opinion that high carbohydrate reserve in the trunk as well as high carbohydrate: nitrogen ratio (C/N) are the prerequisites for commencement of flowering. Kasturi Bai and Khan (2002) elaborated the role of carbohydrate fractions as well as nitrogen content in subtending leaf for the development of inflorescence growing in its axil. A well balanced hormonal status is also highly essential for the development of female flowers into nuts. However, inadequate research work projecting the role of carbohydrate nitrogen ratio and plant growth regulators in the reproductive behaviour of the coconut palm paved the way to undertake the present study.

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Materials and Methods

The study was undertaken at the Coconut Research Station, Konark (OUAT, Bhubaneswar, Orissa) during June 2002 to December 2003 to observe the changes in carbohydrate and nitrogen contents in the leaf subtending inflorescence in relation to female flower production and the effect of application of exogenous growth regulators on button shedding and premature nutfall both in tall and hybrid palms grown in littoral sand. The study was conducted following a Factorial Randomized Block Design with fourteen treatment combinations comprising of two coconut varieties (tall and hybrid) and seven growth regulator treatments such as G₀ (distilled water spray as control), G₁ (GA₃ 450 ppm), G₂ (NAA 20 ppm), G₃ (2,4-D 30 ppm), G₄ (IBA 30 ppm), G₅ (2,4-D 30 ppm + IBA 30 ppm) and G₆ (2,4-D 30 ppm + coconut water). The treatments were replicated thrice. Healthy adult bearing palms of twenty one each from both the tall and hybrid palms (DXT) growing in the littoral sand were chosen for the study and each palm was treated as a single replication. The palms were well maintained with recommended cultural practices.

Freshly emerged spadix in each leaf axil was tagged for growth regulator treatment and recording the number of female flowers therein and subsequent drops for estimating percentage of button shedding and premature nutfall. The spray solutions of different growth regulators were applied alone or in combination to the individual inflorescences emerging during rainy and summer seasons in the respective treatments twice i.e. first spray about two weeks after stigma receptivity stage and second spray after seven days of the first spray. The total carbohydrate content, nitrogen content and C:N ratio in the leaves subtending inflorescences emerging during both rainy and summer seasons were estimated just at the time of opening of the inflorescence and two months after. The total carbohydrate content and nitrogen content were estimated by phenol sulphuric acid method and Kjeldhal digestion method respectively. The observation on number of functional leaves per palm was also recorded while choosing the palms for the study.

Results and Discussion

A careful analysis of the data presented in Table-1 clearly indicates that the performance of hybrid palms in littoral sand was better as compared to the tall palms with respect to number of functional leaves on the crown and number of female flowers per bunch. But the yield in terms of nut production solely depends upon the magnitude of shedding of buttons and premature nuts. This is

commonly observed in littoral sand because of its unusual poor productivity status (Sahoo *et al.*, 2004). In coconut, about 5-95% shedding of buttons has been reported by Menon and Pandalai (1958). The intensity of button shedding though was quite negligible within one month of bunch opening but was more remarkable during the third and fourth fortnight of bunch opening. This was, however, more pronounced in hybrid palms than in tall (Table-4).

As in coconut palms the female flower production and shedding of buttons are regulated through a steady carbon-nitrogen metabolism (Kasturi Bai and Khan, 2002), the investigation made in the present study on the changes in the carbohydrate and nitrogen content in the leaf subtending inflorescence clearly revealed that there was significant decrease in the total carbohydrate and nitrogen content and significant increase in C:N ratio in the subtending leaf two

Table 1. Number of leaves per palm and number of female flowers per bunch before spray operation as influenced by the varieties

Treatment	No. of functional leaves per palm		No. of female flowers per bunch	
	Rainy	Summer	Rainy	Summer
V ₁ (Tall)	25.19	23.62	22.19	17.38
V ₂ (Hybrid)	27.81	26.62	24.38	20.67
C.D. at 5%	1.17	1.17	1.38	0.63

months after opening of the inflorescence compared to initial stage during both the rainy and summer seasons (Table 2 and 3). The results obtained in the present study are in line with the findings of Kasturi Bai and Khan (2002). Hybrid palms maintained higher total carbohydrate and C:N ratio and lower nitrogen content in the leaf as compared to tall palms. This might be due to higher photosynthetic ability of hybrid palms with higher efficiency in utilizing nitrogen content than that of tall palms.

It was of interest to record that the reduction in total carbohydrate content in the leaf after two months of bunch opening was minimum when bunches were treated with growth regulators. Among different growth regulators tried, combined spraying of 2,4-D and coconut water significantly minimized the reduction of carbohydrate content in the leaf. This kind of differential behaviour of the palms could be due to the increased stimulatory action of growth chemicals in enhancing photosynthetic activities in the leaf in growth regulator treated palms. The total carbohydrate content in the subtending leaf was higher during summer than rainy season. This trend corroborates with the earlier observations of Kasturi Bai and Ramadasan (1983) who

reported higher accumulation of insoluble carbohydrate fractions during summer seasons and soluble carbohydrate fractions during rainy season. Application of plant growth regulators also significantly minimized the leaf nitrogen content in both the seasons which might be due to effective metabolism of nitrogen in the process of development of female flowers.

The periodic observations on button shedding (Table-5) indicated that the maximum shedding (69.62 % during rainy and 64.36% during summer) was observed in the palms treated as control and the minimum shedding (24.26% during rainy and 23.63% during summer) was recorded in the palms, where combined application of 2,4-D and coconut water was made within two months of bunch opening. This very treatment was found to be

Table 2. Changes in total carbohydrate, nitrogen content and C : N ratio in the leaf subtending inflorescence during rainy season (at the time of opening of the inflorescence i.e. initial and 2 months after opening i.e. final) as influenced by the varieties and growth regulators.

Treatment	Total carbohydrate content (%)		Nitrogen content (%)		C. N. ratio	
	Initial	Final	Initial	Final	Initial	Final
<i>Varieties</i>						
V ₁ (Tall)	7.84	7.59	1.97	1.78	3.99	4.28
V ₂ (Hybrid)	7.87	7.64	1.78	1.64	4.45	4.67
C.D. at 5%	NS	0.04	0.07	0.06	0.08	0.09
<i>Growth regulators</i>						
G ₀ (Control)	7.85	7.44	1.87	1.83	4.20	4.08
G ₁ (GA ₃)	7.68	7.40	1.76	1.61	4.39	4.61
G ₂ (NAA)	7.90	7.69	1.96	1.73	3.03	4.45
G ₃ (2,4-D)	7.91	7.81	1.95	1.65	4.07	4.74
G ₄ (IBA)	7.76	7.49	1.84	1.81	4.24	4.15
G ₅ (2,4-D+IBA)	7.92	7.57	1.77	1.69	4.51	4.55
G ₆ (2,4-D+CW)	8.01	7.93	1.96	1.65	4.10	4.81
C.D. at 5%	NS	0.08	NS	0.12	NS	0.17
<i>Interaction (Varieties × Growth regulators)</i>						
V ₁ × G ₀	7.86	7.45	1.99	1.87	3.97	3.95
V ₁ × G ₁	7.67	7.44	1.89	1.68	4.08	4.43
V ₁ × G ₂	7.92	7.72	2.06	1.80	3.84	4.30
V ₁ × G ₃	7.86	7.78	2.05	1.65	3.85	4.71
V ₁ × G ₄	7.75	7.43	1.93	1.92	4.03	3.87
V ₁ × G ₅	7.86	7.46	1.87	1.78	4.22	4.20
V ₁ × G ₆	7.96	7.87	2.02	1.74	3.95	4.53
V ₂ × G ₀	7.84	7.44	1.76	1.77	4.44	4.21
V ₂ × G ₁	7.68	7.36	1.64	1.54	4.70	4.79
V ₂ × G ₂	7.87	7.66	1.87	1.67	4.22	4.59
V ₂ × G ₃	7.96	7.83	1.86	1.64	4.28	4.77
V ₂ × G ₄	7.76	7.54	1.74	1.70	4.46	4.43
V ₂ × G ₅	7.98	7.67	1.67	1.60	4.79	4.91
V ₂ × G ₆	8.06	7.99	1.89	1.57	4.26	5.09
C.D. at 5%	NS	0.12	NS	NS	NS	0.24

CW : Coconut water

statistically superior to the rest of the treatments tried. The consistency in the superiority of 2,4-D alone or in combination with coconut water in minimizing shedding of buttons and premature nuts was also observed within four months and six months of bunch opening. The reason of which might be attributed to the availability of more carbohydrate fractions

(Table 2 and 3) and efficient utilization of nitrogen content for the development of female flowers into nuts through the efficient interaction of auxin and cytokinin available in 2,4-D and coconut water.

The effect of interaction between the cultivars and growth regulators was also significant in reducing the intensity of button shedding and premature nutfall in littoral sand.

Table 3. Changes in total carbohydrate, nitrogen content and C : N ratio in the leaf subtending inflorescence during summer season (at the time of opening of the inflorescence i.e. initial and 2 months after opening i.e. final) as influenced by the varieties and growth regulators.

Treatment	Total carbohydrate content (%)		Nitrogen content (%)		C. N. ratio	
	Initial	Final	Initial	Final	Initial	Final
<i>Varieties</i>						
V ₁ (Tall)	8.25	8.02	1.93	1.77	4.31	4.57
V ₂ (Hybrid)	8.46	8.19	1.91	1.77	4.48	4.68
C.D. at 5%	0.08	0.07	NS	NS	0.08	NS
<i>Growth regulators</i>						
G ₀ (Control)	8.36	7.95	1.97	1.93	4.32	4.37
G ₁ (GA ₃)	8.37	8.27	1.87	1.81	4.51	4.59
G ₂ (NAA)	8.31	8.04	1.81	1.75	4.61	4.61
G ₃ (2,4-D)	8.28	8.28	1.92	1.65	4.33	4.89
G ₄ (IBA)	8.25	7.81	1.95	1.83	4.25	4.16
G ₅ (2,4-D+IBA)	8.44	8.14	1.95	1.76	4.32	4.39
G ₆ (2,4-D+CW)	8.47	8.25	1.94	1.64	4.42	5.04
C.D. at 5%	NS	0.14	NS	0.18	NS	0.23
<i>Interaction (Varieties × Growth regulators)</i>						
V ₁ × G ₀	8.49	8.16	1.97	1.87	3.99	4.14
V ₁ × G ₁	8.41	8.23	2.05	1.93	4.12	4.27
V ₁ × G ₂	8.16	7.97	1.73	1.64	4.73	4.86
V ₁ × G ₃	8.25	8.24	1.88	1.63	4.39	5.05
V ₁ × G ₄	7.98	7.48	2.13	1.97	4.06	4.01
V ₁ × G ₅	8.31	8.12	1.88	1.78	4.44	4.60
V ₁ × G ₆	8.15	7.93	1.85	1.55	4.41	5.13
V ₂ × G ₀	8.23	7.74	1.98	1.99	4.65	4.60
V ₂ × G ₁	8.32	8.31	1.70	1.69	4.90	4.91
V ₂ × G ₂	8.46	8.12	1.89	1.86	4.49	4.36
V ₂ × G ₃	8.32	8.32	1.95	1.68	4.27	4.73
V ₂ × G ₄	8.53	8.13	1.77	1.68	4.43	4.31
V ₂ × G ₅	8.57	8.17	2.02	1.74	4.20	4.17
V ₂ × G ₆	8.79	8.56	2.04	1.73	4.43	4.96
C.D. at 5%	NS	0.19	NS	0.25	NS	0.33

CW : Coconut water

Table 4. Intensity of button shedding in the palm during third and fourth fortnight of bunch opening as influenced by the varieties and growth regulators.

Treatment	Shedding of buttons during third fortnight (%)		Shedding of buttons during fourth fortnight (%)	
	Rainy	Summer	Rainy	Summer
<i>Varieties</i>				
V ₁ (Tall)	16.50	16.86	20.26	17.24
V ₂ (Hybrid)	20.04	17.39	19.47	18.49
C.D. at 5%	0.49	0.67	NS	0.11
<i>Growth regulators</i>				
G ₀ (Control)	38.03	34.28	25.31	23.88
G ₁ (GA ₃)	19.68	18.87	23.61	20.40
G ₂ (NAA)	14.71	13.36	18.66	15.96
G ₃ (2,4-D)	8.40	8.17	16.73	13.95
G ₄ (IBA)	22.34	21.68	26.11	20.37
G ₅ (2,4-D+IBA)	16.10	17.05	18.83	18.97
G ₆ (2,4D+C)	8.63	6.48	9.83	11.57
C.D. at 5%	0.91	1.25	0.18	0.20
<i>Interaction (Varieties × Growth regulators)</i>				
V ₁ × G ₀	37.68	33.34	25.01	23.81
V ₁ × G ₁	16.67	21.06	23.31	18.57
V ₁ × G ₂	13.27	12.66	19.23	16.14
V ₁ × G ₃	5.99	6.25	18.82	13.56
V ₁ × G ₄	19.22	22.13	27.28	19.51
V ₁ × G ₅	12.84	17.65	20.62	17.37
V ₁ × G ₆	9.54	4.90	7.54	11.75
V ₂ × G ₀	38.38	35.22	25.61	23.94
V ₂ × G ₁	22.40	16.67	23.90	22.22
V ₂ × G ₂	16.15	14.09	18.08	15.78
V ₂ × G ₃	10.80	10.09	14.63	14.34
V ₂ × G ₄	25.46	21.22	24.93	21.23
V ₂ × G ₅	19.35	16.44	17.04	20.56
V ₂ × G ₆	7.71	8.05	12.11	11.39
C.D. at 5%	1.29	1.76	0.26	0.29

Basing upon the findings of the present study the coconut growers may be advised to spray 2,4-D (30 ppm) alongwith coconut water on the inflorescence once two weeks after stigma receptivity condition and once more a week after. Further intensive studies on this line are necessary.

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Table 5. Intensity of shedding of buttons and premature nuts within 2, 4 and 6 months of bunch opening in coconut palm grown in littoral sand as influenced by the varieties and growth regulators.

Treatment	Shedding of buttons within 2 months of bunch opening (%)		Shedding of buttons within 4 months of bunch opening (%)		Shedding of buttons and premature nuts within 6 months of bunch opening (%)	
	Rainy	Summer	Rainy	Summer	Rainy	Summer
<i>Varieties</i>						
V ₁ (Tall)	42.82	39.79	58.50	58.34	64.32	60.37
V ₂ (Hybrid)	45.61	41.63	59.74	62.29	65.03	65.27
C.D. at 5%	0.69	0.36	NS	0.95	0.65	0.73
<i>Growth regulators</i>						
G ₀ (Control)	69.62	64.36	76.44	76.45	81.65	78.02
G ₁ (GA ₃)	49.37	44.86	67.13	70.37	72.72	70.37
G ₂ (NAA)	39.11	34.59	53.61	56.24	59.28	58.87
G ₃ (2,4-D)	31.02	27.84	44.47	45.86	53.34	50.58
G ₄ (IBA)	55.00	47.87	75.00	70.15	80.16	75.15
G ₅ (2,4-D+IBA)	41.12	41.82	58.62	64.62	62.36	65.32
G ₆ (2,4D+C)	24.26	23.63	40.31	38.52	43.25	41.44
C.D. at 5%	1.28	1.18	1.82	1.77	1.22	1.36
<i>Interaction (Varieties × Growth regulators)</i>						
V ₁ × G ₀	68.75	63.48	72.46	74.62	81.25	77.76
V ₁ × G ₁	46.57	45.60	63.64	65.39	72.59	66.68
V ₁ × G ₂	38.46	34.08	54.23	51.05	61.90	51.05
V ₁ × G ₃	30.57	25.00	45.77	41.69	48.22	47.94
V ₁ × G ₄	53.05	47.24	71.86	74.52	78.77	74.52
V ₁ × G ₅	39.67	41.18	60.06	60.76	64.12	60.76
V ₁ × G ₆	22.65	21.97	41.48	39.06	43.41	43.89
V ₂ × G ₀	70.50	65.23	80.42	78.28	82.04	78.28
V ₂ × G ₁	52.17	44.12	63.64	74.06	72.84	74.06
V ₂ × G ₂	39.76	35.10	52.98	61.42	56.66	66.68
V ₂ × G ₃	31.48	30.67	43.17	50.02	58.45	53.22
V ₂ × G ₄	56.95	48.50	78.13	65.77	81.55	75.77
V ₂ × G ₅	42.57	42.46	57.18	68.48	60.60	69.87
V ₂ × G ₆	25.87	25.29	39.14	37.98	43.09	38.98
C.D. at 5%	NS	1.67	2.58	2.50	1.72	1.92

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