Screening of coconut genotypes for drought tolerance

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Summary. — Twenty-three genotypes of coconut (*Cocos nucifera* L.) comprising ten talls, six dwarfs and seven hybrids were screened for their tolerance to drought using the sensitive parameters viz. stomatal resistance (rs), leaf water potential (ψ) and epicuticular wax content (ECW). Coconut palms had varying responses to the prevailing soil and atmospheric droughts during the summer months. In general, tall genotypes had relatively high rs, ψ and ECW content as compared to the dwarfs. Some of the hybrids resembled the female parent in these characters. In response to the development of water stress between November and March some of the tall palms and tall hybrids showed relatively high rs resulting in effective conservation of water in the tissues (i.e. low transpiration rate), whereas the dwarfs were sensitive to stress with a tendency to lose more water. Parametric relationships with drought tolerance based on the rank sum led to the identification of few genotypes tolerant to drought with the desirables characters.

INTRODUCTION

Among the plantation crops of tropical humid areas coconut occupies an important position in view of the commercial value of its oil on the international market. This monocot tree crop grows well in warm humid weather with an estimated 120 sunshine hours monthly (Murray, 1977). The ideal temperature is around 27 °C with a diurnal variation of 5 °C to 10 °C. Coconut is found in places where the annual precipitation is between 1,300 and 2,500 or above. An average monthly rainfall of 150 mm is ideal for good growth and high nut yield. A prolonged dry spell lasting from 5 to 7 months adversely affects the palms. Such severe droughts occur once in every 3 or 4 years in northern Kerala, where the Institute (1) is situated, and where the annual rainfall, though high (3,600 mm) is erratic in distribution with rainless months between november and may. This happens either because of low rainfall and/or early cessation of the South-West monsoon (june-september) or the failure of the North-East monsoon (october-november), or both in addition to unreliable non-seasonal, i.e. summer rains. Consequently, during the summer months, dry weather can prevail during a period with high evaporative demand, resulting in both atmospheric and soil droughts. As coconut is grown mostly on coastal sandy loam soils, plant stress can early occur under the above conditions (Rajagopal *et al.*, 1988a, Kasturibai *et al.*, 1988, Voleti *et al.*, 1988). Milburn and Zimmermann (1977) suggested that the water balance of coconut is protected in the dry season by stomatal closure.

In the literature available there are innumerable references to the screening of annual crops for drought resistance, while such information on tree crops is scare, presumably because of their perennial nature. Recently Balasimha *et al.* (1988) reported the ranking of cocoa accessions on the basis of drought tolerance characters. The main objective of the present investigation was to screen both exotic and indigenous coconut genotypes for their tolerance to drought using plant water relationship parameters.

MATERIALS AND METHODS

Six coconut palms (*Cocos nucifera* L.) in each of the 23 genotypes listed in tables 1 and 3 were selected from the randomised block design comprising three replications of four trees per replication. These 22-years old palms, planted with 7.5 × 7.5 spacing on red sandy loam soil (mapping unit 3A), are being grown under rainfed conditions and using normal crepping and agronomic practices including the application of 500 g N, 320 g P_2O_5 and 1,200 kg K_2O per tree per year with upkeep by the Division of Genetics and Plant Breeding of the Institute.

Agrometeorological parameters viz. light, temperature and relative humidity (converted into vapour pressure deficit) were measured in the vicinity of experimental trees for five consecutive days each during the prestress (november) and stress (march) periods using a portable steady state porometer (model 1,600, Li-Cor Instruments, Nebraska, USA) as des~~cribed earlier~~ (Kasturibai *et al.*, 1988). These measurements were taken between 10.00 a.m. and 12.00 along with determination of physiological parameters. The pan evaporation data was obtained with the USWB class A pan set up at the climatological station on the Institute farm.

The soil moisture content was determined gravimetrically at three depths viz. 0-25 cm, 25-50 cm and 50-100 cm in the basins (i.e. around the stem at a distance of 1 m) of two trees per genotypes during the pre-stress and stress periods. From the soil moisture content data, the soil water deficit (SWD) was calculated based on the field capacity at different depths (Dastane, 1972), as used earlier in an irrigation experiment (Rajagopal *et al.*, 1988a). Only the pooled data for the two periods is given in table 2.

From the physiologically mature leaf, i.e. the 11th from the top, epidermal peelings were taken, stained and stomatal frequency (SF) and epidermal cell frequency (ECF) were determined for each genotype using a light microscope. From this, the stomatal index (SI) was calculated.

The stomatal resistance (rs) and the leaf temperature were determined with a steady state porometer on the 11th leaf, as described earlier for coconut (Rajagopal *et al.*, 1986). Briefly, the method consists in determining temperature and rs in two leaflets with six measurements on either side of the midrib of each leaflet, on the lower surface as coconut is a hypostomatic type. Thus, 12 measurements were quickly taken on each palm and an average of six trees per genotype was taken. This was done during both the pre-stress and stress periods. On the leaflets opposite to those used for rs, the leaf water potential (ψ) was determined only during the stress period i.e. March (as the preliminary studies revealed no significant differences in ψ during the non-stress period), using a Schollander chamber (Plant Water Consol, model

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3000, Soil Moisture Co., USA) according to the method of Milburn and Zimmermann (1977) and Rajagopal *et al.* (1987). All the determinations were made between 10.00 a.m. and 12.00, which was found to be the most appropriate time to study coconut stomatal regulation in response to dry weather (Rajagopal *et al.*, 1986).

The epicuticular wax content (ECW) was extracted from the leaflets used for the above determinations, using the method described by Ebercon *et al.* (1977) and followed for coconut (Rajagopal *et al.*, 1988a). Segments of 3 × 1 cm were cut from the leaflets and 20 of them were plunged into 15 ml chloroform, vigorously shaken for 15 seconds and then decanted. This procedure extracts the wax from both surfaces of the leaflet. The colour developed with dichromate was read at 590 nm using a Perkin-Elmer spectrophotometer. ECW estimation was carried out only during the stress period.

The analysis of variance technique was used to compare the differences between different genotypes. Intercorrelations were worked out between the characters within each group separately. Results obtained with the different genotypes were compared with the commonly grown coconut variety West Coast Tall (WCT).

RESULTS

For the individual genotypes in the three groups viz. talls, dwarfs and hybrids, the stomatal frequency (SF) and stomatal index (SI) are shown in table I. The mean SF value was higher in the dwarf genotypes (231.7 mm $^{-2}$) than either the talls (208.2 mm $^{-2}$) or the hybrids (216.1 mm $^{-2}$). A similar trend occurred in SI which was 22.5 and 22.9 in the talls and hybrids respectively as against 25.8 in the dwarfs.

The agroclimatic conditions showed distinct differences between the pre-stress and stress periods in that during the latter the temperature increased by about 4 °C and VPD by 4 mb as compared to November ; light intensity also showed an increase between november and march (Table II). All these reflected on pan evaporation, which rose from 3.3 to

TABLE I. — **Variations in stomatal frequency (SF) and stomatal index (SI) in coconut genotypes. Mean of six trees.** — *(Variations de la fréquence stomatique (SF) et de l'indice stomatique (SI) dans les génotypes de cocotiers. Moyenne de six arbres.)*

	S. No.	Genotypes	SF (mm $^{-2}$)	SI
Talls *(Grands)*				
	1	West Coast Tall (WCT) *(Grand Côte Ouest)*	210.8	21.9
	2	SS Apricot *(SS Abricot)*	234.1	23.4
	3	Andaman Ordinary *(Audaman ordinaire)*	208.9	22.4
	4	Laccadive Micro	218.8	24.5
	5	Andaman Giant *(Andaman Géant)*	220.4	22.9
	6	Federated Malaya States (FMS) *(Etats fédérés de Malaisie)*	204.8	22.5
	7	Fiji *(Fidji)*	178.3	24.1
	8	Philippines Ordinary *(Philippines Ordinaires)*	207.7	23.9
	9	Cochin China *(Cochinchine)*	194.2	17.0
	10	Java Giant *(Java Géant)*	204.3	22.5
		Mean *(Moyenne)*	208.2	22.6
Dwarfs *(Nains)*				
	11	SS Green *(SS Vert)*	228.5	27.3
	12	Malayan Green Dwarf (MGD) *(Nain Vert Malaisie)*	228.5	28.1
	13	Malayan Orange Dwarf (MOD) *(Nain Orange Malaisie)*	233.0	25.2
	14	Malayan Yellow Dwarf (MYD) *(Nain Jaune Malaisie)*	237.6	25.9
	15	Gangabondam (GB)	256.7	26.4
	16	Chowghat Orange Dwarf (COD) *(Nain Orange Chowghat)*	205.8	21.6
		Mean *(Moyenne)*	231.7	25.8
Hybrids *(Hybrides)*				
	17	WCT × COD	225.0	23.3
	18	COD × WCT	239.2	24.9
	19	WCT × WCT	183.4	23.1
	20	COD × COD	200.5	20.0
	21	WCT × GB	217.0	22.9
	22	LO × GB	230.0	23.7
	23	LO × COD	217.5	22.8
		Mean *(Moyenne)*	216.1	22.9

S.E. plot *(Ecart-type/parcelle)* : 19.98

C.V. (%) : 9.22

General mean *(Moyenne générale)* : 216.74

C.D. (p = 0.05) : 32.63

TABLE II. — Agroclimatic conditions and soil water deficit during the pre-stress (november) and stress (march) periods. Measurements were taken near the experimental palms on five consecutive days in the above two periods. — *(Conditions agroclimatiques et déficit en eau du sol durant les périodes de pré-stress (novembre) et de stress (mars). Les mesures ont été effectuées près des palmiers expérimentaux sur cinq jours consécutifs dans les deux périodes.)*

Parameters *(Paramètres)*	Pre-stress *(Pré-stress)*	Stress
Agroclimatic conditions *(Conditions agroclimatiques)* :		
Air temperature (°C) *(Température de l'air)*	31.1	35.4
Vapour pressure deficit (mb) *(Déficit de pression de vapeur d'eau)*	22.9	27.2
Light (W·m^{-2}) *(Luminosité)*	268	283
Pan evaporation (mm·day^{-1}) *(Evaporation au bac)*	3.3	5.1
Soil water deficit (mm) *(Déficit en eau du sol)* :		
Soil depth *(Profondeur)* *0 to 25 cm*	6.89	11.05
25 to 50 cm	9.20	12.14
50 to 100 cm	14.76	24.07
Total profile *(Total du profil)*	30.87	47.26

1 mm per day between the two periods. The soil water ficit increased by 17 mm in the total soil profile between e stress and pre-stress periods.

The variations in rs during the development of stress tween November and March in the individual genotypes ong the talls, dwarfs and hybrids are plotted in figure 1. the talls the overall differences between the genotypes, e-stress and stress periods and their interactions were und to be significant. Although all the genotypes were on par during pre-stress, with the onset of stress in March the ferences between the genotypes were found to be significant with Andaman Giant (S.No. 5) recording the maximum Among the dwarfs, differences due to the genotypes and tween the periods were significant but not their interacn. The genotype Gangabondam, GB (S.No. 15) recorded nificantly higher rs than the other genotypes. The value of was significantly higher during the stress period than ring the pre-stress period. In the case of hybrids, the ferences due to the genotypes, pre-stress and stress periods d their interaction was significant. The rs during stress was nificantly higher than in the pre-stress period in all the brids except COD × WCT (S.No. 18). It may be noted t even during pre-stress the WCT × WCT hybrid No. 19) recorded significantly higher rs and maintained trend during the stress period. It was found that seven s and five hybrids had rs higher than that of WCT 99 s·cm^{-1}) during the period of stress.

The mean leaf temperature during november was 31.1 °C, .1 °C and 31.4 °C respectively in the talls, dwarfs and brids and it increased to 33.3 °C, 32.8 °C and 33.6 °C pectively during the period of stress.

The ψ determined during March varied from − 1.10 to 1.48 MPa among the talls, from − 1.01 to − 1.52 MPa ong the dwarfs and − 1.15 to − 1.36 MPa among the brids (Table III). Compared to WCT palms with 1.48 MPa, eleven genotypes had significantly higher ψ, le the lowest ψ was recorded by MOD (− 1.52 MPa). e ECW content during the stress period ranged from 91.9 116.7 µg·cm^{-2} among the talls, from 77.0 to 9 µg·cm^{-2} among the dwarfs and from 109.2 to 2.6 µg·cm^{-2} among the hybrids. The dwarfs showed er ECW content than either the talls or hybrids. The brids LO × GB and LO × COD had significantly higher W than WCT (109.0 µg·cm^{-2}).

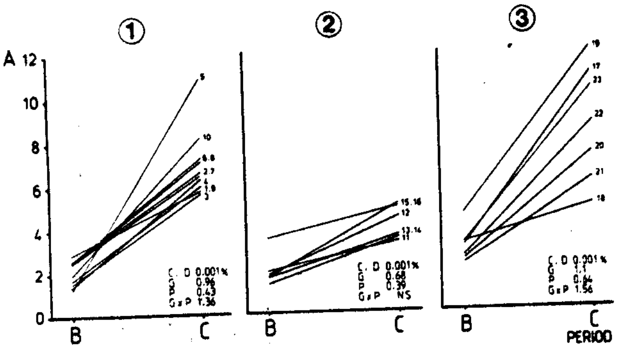

FIG. 1. — Effect of moisture stress on stomatal resistance in coconut genotypes. *(Effet du stress hydrique sur la résistance stomatique chez les génotypes de cocotier.)*

1. Talls *(Grands)*
2. Dwarfs - *(Nains)*
3. Hybrids — *(Hybrides)*

A = Stomatal resistance — *(Résistance stomatique)*
B = Prestress — *(Pré-stress)*
C = Stress — *(Stress)*

The measurements were taken on five consecutive days during the pre-stress (November) and the stress (March) periods on six trees per genotype with six measurements per leaflet on either side between 10.00 a.m. and 12.00. The tall, dwarf and hybrid genotypes are indicated by the same serial number as in Table I. The statistical data is incorporated lover righ-hand corner in each case (C.D. = 0.005 ; G = Genotype : P = Periods : G × P = Interaction).

(Les mesures ont été réalisées sur cinq jours consécutifs durant les périodes de pré-stress (novembre) et de stress (mars) sur six palmiers par génotype avec deux folioles par palmier et six mesures pour chaque foliole d'un côté ou de l'autre de la nervure médiane, entre dix heures et midi. Les génotypes des Grands, Nains et Hybrides sont indiqués par les mêmes numéros que sur le tableau I. Les données statistiques sont reportées dans le coin en bas à droite dans chaque cas — C.D. = 0,005 ; G = Génotypes ; P = Périodes : G × P = Interaction.)

DISCUSSION

Cell size and number, stomatal frequency, stomatal resistance, epicuticular wax content and water potential components are the essential anatomical and physiological indicators for assessing moisture stress in annuals and biennials (Parsons, 1979). In coconut palm there are both group and genetic differences in the SF and Si (Table I) as reported in sorghum (Ciha and Brun, 1975). In dwarf coconut palms SF was found to be higher than that in talls and hybrids. SF and its behavior play a major role in water conservation in many species. A direct relationship between the SF and transpiration rate was shown in eight barley lines by Miskin *et al.* (1972). Since SF is influenced by light, temperature and water stress, Ciha and Brun (1975) and Henzel *et al.* (1976) suggested than stomatal sensitivity to moisture stress be taken as an indicator rather than SF. Thus, sensitivity to water stress, specifically the humidity gradient between the environment and leaf surface brings about the tolerance capacity in any given species under adverse condition (Hall and Kaufman, 1975 ; Schulze *et al.*, 1972). The significance of leaf-atmosphere interface for stomatal regulation in crop plant is well documented (Rajagopal and Sinha, 1979 ; Schulze, 1986).

The changes in agroclimatic conditions and soil water deficit before stress (november) and during stress (march) revealed the extent of atmospheric and soil drought (Table II). High evaporative demand existed in the atmosphere during march which resulted in high soil water deficits at all depths. In response to these conditions, coconut genotypes showed variations in stomatal resistance. Figure 1 clearly indicates the variations in the slope for rs between November and March among the groups viz. talls, dwarfs and hybrids. Under normal water availability during November the rs showed the least variation among the genotypes except WCT × WCT (S.No. 19) which alone exhibited rs higher than $4.0\,\mathrm{s\cdot cm^{-1}}$. With the onset of drought the rs was found to be high in the hybrids ($8.57\,\mathrm{s\cdot cm^{-1}}$), followed by the talls ($7.10\,\mathrm{s\cdot cm^{-1}}$), whereas the dwarfs had almost 50 % less rs ($4.11\,\mathrm{s\cdot cm^{-1}}$) than the hybrids. From the slopes in figure 1 it is clear that all the dwarfs and the hybrid COD × WCT (S.No. 18) had significantly lower rs (i.e. less than $5.0\,\mathrm{s\cdot cm^{-1}}$) which reflected on a higher loss of water through transpiration, than the talls and hybrids.

This was further confirmed by leaf temperature, which showed a difference of only 1.7 °C among the dwarfs as against 2.2 °C and 2.3 °C respectively among the talls and hybrids between the pre-stress and stress periods. The relationship between leaf temperature and diffusive resistance is well documented (Raschke, 1975). Thus, with the onset of drought in March caused by both atmospheric and soil conditions (Table II) the genotypes showed differences by closing their stomata to different degrees as a mechanism of adaptability to low water availability. The present results support the suggestion that closure of stomata occurs in coconut during stress as reported in other crops (Turner, 1974 ; Davies, 1977).

Moisture stress during March affected the ψ to different degrees among the coconut genotypes (Table III). The ψ was relatively high (> -1.20 MPa) in FMS, Andaman Giant, SS Apricot among the talls, COD among the dwarfs and WCT × GB and WCT × WCT among the hybrids. The sensitivity of stomata appears to have affected the ψ to a great extent. For instance, low rs resulting in high transpiration rate led to lowering of ψ in the dwarfs ; conversely high rs was associated with high ψ among the hybrids, as in WCT × WCT. This bears out with the suggestion that stomata play an important role in regulating the water balance in coconut (Milburn and Zimmermann, 1977 ; Rajagopal *et al.*, 1986). While some of the hybrids and talls exhibited a protective mechanism through effective stomatal regulation, the dwarfs seemed to lack this mechanism. The ψ showed variations in coconut genotypes depending on water availability in the soil (Rajagopal *et al.*, 1988a) and soil type (Voleti *et al.*, 1988). The authors were able to find a dwarf × tall hybrid withstanding the drought better in the lateritic soil than in sandy loam soil. Preliminary studi revealed less variation in leaf osmotic potential in cocon genotypes (unpublished).

ECW is another important factor for combating stres through reducing cuticular loss of water from the leaf surface when stomata are closed (Hall and Jones, 1961). LO × GB, LO × COD, WCT × WCT and WCT × COD among the hybrids, the talls like Java Giant, FMS, Philippines Ordinary and Cochin China had higher ECW content than the other genotypes, including the dwarfs (Table III). During stress under natural field conditions accumulation of ECW was shown in sorghum, oats and cocoa (Ebercon *et al.*, 1977 ; Bengston *et al.*, 1978 ; Balasimha *et al.*, 1987). The high temperature during the dry season (March) probably resulted in high ECW, as both light intensity and temperature influence ECW (Skoss, 1975).

Thus all the aforesaid parameters showed clear differences between the groups and among the genotypes within the group. Intercorrelations calculated between different parameters indicate a significant negative correlation between rs and the transpiration in all the three groups viz. talls : − 0.6484*, dwarfs : − 0.8330* and hybrids : − 0.8210*. In the case of dwarfs transpiration is negatively correlated with ψ (− 0.4727*) and ECW (− 0.2820*). In hybrids, rs was positively correlated with ECW (+ 0.3509*). Parametric relationships were worked out and the genotypes were given a rank for each character. Rank was alloted from the highest rs, ψ and ECW in decreasing order and from the lowest SF in increasing order. The rank sum of the genotypes revealed the degree of water loss through stomatal and epicuticular transpiration. When the rank sum was the same in more than one genotype, the same rank was allotted to both the genotypes. Thus LO × COD and Andaman Giant shared the 5th ranking, while 11th ranking was shared by LO × GB and WCT. From table III it is clear that all the dwarfs performed badly, with 13th to 21st ranking. Conversely, all the hybrids except COD × WCT and all the talls except SS Apricot, Andaman Ordinary and Laccadive Micro were within the 11th rank, exhibited by the commonly grown variety WCT. Thus coconut genotypes could be identified for relatively low transpiration response to drought. Recent studies on changes in ψ and the activity of enzymes such as acid phosphatase and glutamate oxaloacetate transaminase in the dehydrated leaves of eight coconut genotypes indicated that the hybrids LO × COD and LO × GB are more tolerant to drought than either parents (LO and GB) or the hybrid COD × WCT (Rajagopal *et al.*, 1988b), thus indicating that low transpiration could reflect a certain tolerance to drought.

When leaf diffusive resistance of low and high rank sum genotypes was compared, irrespective of group, it was found that the average resistance was $3.9\,\mathrm{s\cdot cm^{-1}}$ ranks 17 to 21 (MGD, SSG, GB, MOD and MYD) as against 9.22 s·cm for ranks 1 to 5, such as WCT × WCT, FMS, Java Giant, Fiji, Andaman Giant and LO × COD.

The fact that stomatal sensitivity might be genetically transmitted to progenies through the female parent is indicated in the case of WCT × WCT, WCT × GB and COD × WCT though such indications are not apparent in other hybrids. The relatively high yield performance of genotypes such as LO × COD, LO × GB and WCT over the years under rainfed conditions and the susceptibility of COD × WCT (Bavappa, 1986) to drought could corroborate the present data on the drought tolerance capability of the first two hybrids. As in the case of cereals such as sorghum or rice and pulses with a genetic variability in drought

TABLE III. — Effect of moisture stress (march) on the leaf water potential (ψ) and épicuticular wax content (ECW) in coconut genotypes. Values are mean of six palms. Ranking of genotypes was done on the basis of SF, rs, ψ and ECW and rank sum computed to allot rankings. — *(Effet du stress hydrique (mars) sur le potentiel hydrique foliaire (ψ) et les teneurs en cires épicuticulaires (ECW) chez les génotypes de cocotiers. Les valeurs sont les moyennes de six arbres. Le classement des génotypes a été effectué sur la base de SF, rs, ψ et ECW et la somme des rangs calculée pour attribuer le classement.)*

	S. No.	Genotypes	− ψ (MPa)	ECW (μg·cm⁻²)	Rank *(Classement)*
Talls ***(Grands)***					
	1	West Coast Tall (WCT) *(Grand Côte Ouest)*	− 1.48	109.0	11
	2	SS Apricot *(SS Abricot)*	− 1.14	102.1	12
	3	Andaman Ordinary *(Andaman ordinaire)*	− 1.24	91.9	14
	4	Laccadive Micro	− 1.41	96.2	15
	5	Andaman Giant *(Andaman Géant)*	− 1.13	99.2	5
	6	Federated Malaya States (FMS) *(Etats fédérés de Malaisie)*	− 1.10	116.7	2
	7	Fiji *(Fidji)*	− 1.23	104.7	4
	8	Philippines Ordinary *(Philippines Ordinaires)*	− 1.32	113.4	6
	9	Cochin China *(Cochinchine)*	− 1.27	110.4	8
	10	Java Giant *(Java Géant)*	− 1.41	116.2	3
		Mean *(Moyenne)*	− 1.27	105.9	
Dwarfs ***(Nains)***					
	11	SS Green *(SS Vert)*	− 1.32	98.4	17
	12	Malayan Green Dwarf (MGD) *(Nain Vert Malaisie)*	− 1.36	94.0	18
	13	Malayan Orange Dwarf (MOD) *(Nain Orange Malaisie)*	− 1.52	77.0	21
	14	Malayan Yellow Dwarf (MYD) *(Nain Jaune Malaisie)*	− 1.49	79.0	20
	15	Gangabondam (GB)	− 1.46	90.3	19
	16	Chowghat Orange Dwarf (COD) *(Nain Orange Chowghat)*	− 1.01	87.6	13
		Mean *(Moyenne)*	− 1.36	87.8	
ybrids ***(Hybrides)***					
	17	XCT × COD	− 1.19	116.7	10
	18	COD × WCT	− 1.25	110.5	16
	19	WCT × WCT	− 1.17	117.4	1
	20	COD × COD	− 1.36	109.2	7
	21	WCT × GB	− 1.16	109.6	9
	22	LO × GB	− 1.32	132.6	11
	23	LO × COD	− 1.26	120.7	5
		Mean *(Moyenne)*	− 1.24	116.7	
		S.E./plot *(Ecart-type/parcelle)*	1.82	15.49	
		General mean *(Moyenne générale)*	− 1.29	104.5	
		C.V. (%)	1.41	14.83	
		C.D. (p = 0.05)	2.08	11.42	

sistance with wide implications for breeding programmes Blum, 1982 ; Change *et al.*, 1982 ; Alluri *et al.*, 1982), the present study helps in breeding coconut for drought tolerance.

To include, higher SF ans less stomatal activity with low ECW content during stress appear to have caused the dwarfs to lose more water through transpiration, while some of the alls and hybrids with low SF react differently to drought through the adaptative mechanism provided by high leaf iffusive resistance, further aided by high ECW levels, which gether helped in good water conservation in the tissues. ecently Rajagopal *et al.* (1988c) compared the soil moisture traction capacity and the rate of transpiration in six notypes from both the drought tolerant and susceptible oups. The data clearly revealed that the most tolerant notypes such as WCT × WCT and LO × COD showed t only efficient soil water extraction but also effective omatal regulation which ultimately resulted in well balanced water economy, whereas in the susceptible genotypes such as MOD and COD × WCT, besides poor soil moisture extraction there was greater loss of water through transpiration leading to destabilised water relations. Thus tolerant genotypes could conserve water for the metabolic processes better than susceptible ones. But it is not certain that lower water loss, particularly via stomatal closing, is always advantageous for the plant in drought periods.

The highlight of the investigation was that it was possible to identify desirable of drought tolerance characters in coconut genotypes under field conditions. The phenomenon of osmoregulation would also have to be taken into account, since this is the mechanism whereby the plant can reduce its water potential whilst maintaining cell turgidity. With a view to selecting drought-resistant material, as well as the aspects covered in this study, stomatal regulation, but also the osmoregulation and resistance abilities of cell compartments, should be examined.

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RÉSUMÉ

Sélection des génotypes de cocotier pour la tolérance à la sécheresse.

V. RAJAGOPAL, K. V. KASTURIBAI et S. R. VOLETI. *Oléagineux*, 1990, **45**, N° 5, p. 215-223.

Vingt-trois génotypes de cocotier (*Cocos nucifera* L.), comprenant dix grands, six nains et sept hybrides ont été testés pour leur tolérance à la sécheresse en mesurant des paramètres pertinents, à savoir la résistance stomatique (rs), le potentiel hydrique foliaire (ψ) et la teneur en cires épicuticulaires (ECW). Les cocotiers ont répondu de manière différente aux conditions de sécheresse du sol et de l'atmosphère durant les mois d'été. En général, les génotypes Grands avaient des rs, ψ et ECW relativement élevés par rapport aux Nains. Certains hybrides se rapprochaient de l'arbre-mère pour ces caractères. En réponse au développement du stress hydrique de novembre à mars, certains Grands et hybrides de Grands ont

RESUMEN

Selección de los genotipos de cocotero por su tolerancia a la sequía.

V. RAJAGOPAL, K. V. KASTURIBAI y S. R. VOLETI. *Oléagineux*, 1990, **45**, N° 5, p. 215-223.

Veintitrés genotipos de cocotero (*Cocos nucifera* L.) integrados por diez Grandes, seis Enanos y siete hibridos, se probaron por su tolerancia a la sequia, midiendo parámetros adecuados, o sea la resistencia estomática (rs), el potencial hibrido foliar (ψ) y el contenido de ceras epicuticulares (ECW). Los cocoteros respondieron de modo distinto a las condiciones de sequia del suelo y de la atmósfera durante los meses de verano. Los genotipos de Grandes tenian por lo general rs, ψ y ECW relativamente altos con relación a los Enanos. Algunos hibridos se asemejaban al genitor femenino para estos caracteres. Correspondienco al desarrollo del stress hibrico de noviembre a marzo, algunos Grandes e hibridos de