EFFECT OF PRECONDITIONING TREATMENTS ON ROOTING OF COFFEE CUTTINGS[1] /

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Resumen

Para aumentar la capacidad para enraizar de los trasplantes de retoños en el Coffea arabica *L. cv S 795, fueron usados como procedimientos precondicionados la decoloración y el anillamiento. La decoloración se realizó cubriendo una porción del entrenudo con una tira de tela negra. El anillamiento más la decoloración formaron otro procedimiento donde un anillo de la corteza fue removido y la parte anillada se decoloró.*

Estos trasplantes de retoños precondicionados registraron el más alto porcentaje en producción de raíces, cuando el IBA 5000 ppm se dio como un procedimiento de plantación previsto (60.65%). El número de raíces primarias y sus longitudes se incrementaron significativamente con el anillado y decoloración de los trasplantes de retoños. El crecimiento de los brotes fue también vigoroso en estos trasplantes. Sin embargo, la decoloración como un procedimiento precondicionado fracasó para mejorar la producción de raíces.

El anillamiento más la decoloración de los trasplantes de retoños tratados con IBA 5000 ppm, plantados durante el mes de abril, registraron el más alto porcentaje en producción de raíces (70.30%) y un buen desarrollo del sistema para enraizar.

Introduction

The purpose of the present study was to ascertain the influence of certain preconditioning treatments on rooting of *Arabica* coffee cuttings. Pretreatments such as etiolation and girdling bring about certain physiological changes resulting in better rooting of cuttings (3, 9). Early rooting of *Robusta* coffee cuttings by ringing the suckers one month prior to layering was reported from the Central Coffee Research Institute, India (6). Advanced rooting with the application of auxins to the callused girdle has been reported in peach, apricot and apple (1) and hibiscus cuttings (2). Increased rooting of guava and mango cuttings was made possible by etiolating the shoots (5, 10).

Materials and methods

Suckers of S.795, a second generation progeny of S.288 x Kents *Arabica* (*Coffea arabica* L.) were subjected to etiolation and ringing in March and September. For etiolation, a 3 cm strip of bark about 10 cm below the second or third node from the tip of the sucker was kept covered with black cloth for one month and left on the plant itself under field conditions. In another treatment, a strip of bark about 3 cm long was removed on suckers about 10 cm below the second or third node from the tip. This ringed portion and part of the sucker above this ring were covered for one month with a strip of black cloth for etiolation. Another set of suckers of the same age, labelled and left on the plants without any preconditioning treatment, served as the control.

One month after imposing these treatments, suckers were severed from mother plants and single node cuttings were made. Only one cutting

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with an internodal length of 10 cm just above the treated portion was taken for planting Preparation of cuttings, medium used, and the method of planting were the same as those adopted earlier by Purushotham and Sulladmath (7)

The experiment was laid out in a double split plot design with two periods of planting as main treatments, etiolation, ringing plus etiolation and control as subtreatments Preplanting treatments of the preconditioned cuttings with growth regulators (GR) IBA and NAA at different concentrations (Table 1) formed the subtreatments The experiment was repeated three times

Observations regarding percentage of rooting, number and length of primary roots and number and length of sprouts were recorded four months after planting Angular transformations were made for analysis and interpretation of percentages of rooting The value of 'F' and critical differences were calculated for the double split experiment as per the procedure given by Steel and Torrie (8)

Results and discussion

Differences in percentage of rooting in cuttings planted in two different periods were not significant, but better rooting was recorded in April planted cuttings (44 50%) Rooting in ringed plus etiolated cuttings was 43.85% , while etiolation alone as a treatment recorded rooting of 41.32% Among the cuttings treated with growth regulators, IBA 500 ppm recorded the highest number of primary roots In general, it was observed that preconditioning the suckers in March and planting in April enhanced rooting (Table 1) The length of primary roots was also longer in April cuttings, 14.10 cm (Table 2). Ringing followed by etiolation was better than all other preconditioning treatments (Tables 1 to 3) Although no significant differences were found in rooting percentage of cuttings between control and ringing the root system was superior due to ringing (Table 1) The favourable effects of these preconditioning treatments were earlier reported in several other crops (3, 10, 11) This was attributed to accumulation of carbohydrates and rooting factors present in the portions above the girdle In the present studies, etiolation alone failed to enhance rooting percentage, but the roots in the rooted cuttings were longer than in other treatments. Favourable influence of etiolation on root systems has been reported by several investigators who attributed this to accumulation of auxins in the cuttings (4, 12)

The effect of pre-conditioning treatment varied with the period of planting Response to these treatments was better in suckers planted in April than those planted in October, although both periods coincided with growth phases of *Arabica*. This might be because favourable climatic conditions prevailed at the time of preconditioning, which evidently improved the biochemical status of suckers

The number of sprouts developed on the sucker cuttings four months after planting were significantly higher in April cuttings (0 48), particularly in ringed plus etiolated suckers (0.61) (Table 3) Growth of

Table 1. Rooting in preconditioned suckers of S795 planted in different periods of the year (Transformed values).

Chemical treatments (Sub-sub treatments)	April				October				Grand Mean
	Control	Etiolated	Ringed + etiolated	Mean	Control	Etiolated	Ringed + etiolated	Mean	
Without GR	39.23	35.22	43.08	39.18	33.00	37.22	39.23	36.48	37.83
IBA 5000 ppm	52.78	48.85	57.00	52.88	50.85	46.92	50.77	49.51	51.20
IBA 3000 ppm	50.77	43.08	50.77	48.21	50.85	41.15	46.92	46.31	47.26
IBA 1000 ppm	43.08	41.15	37.22	40.48	41.15	39.23	33.21	37.86	39.17
NAA 2500 ppm	52.78	41.15	50.77	48.23	50.85	37.22	43.08	43.72	45.98
NAA 1500 ppm	45.00	41.15	46.92	44.36	39.15	39.23	41.15	39.84	42.10
NAA 500 ppm	39.23	37.22	43.08	39.84	37.22	35.22	39.23	37.22	38.53
IBA + NAA 2500 ppm	45.00	54.78	43.08	47.62	41.15	52.78	41.15	45.03	46.33
IBA + NAA 1500 ppm	43.08	41.15	46.92	43.72	39.23	37.22	39.23	38.56	41.14
IBA + NAA 500 ppm	39.23	39.23	43.08	40.51	39.15	37.22	41.15	39.17	39.84
Mean	45.02	42.30	46.19		42.26	40.34	41.51		
Mean for precondition treatments	43.64	41.32	43.85						
Mean for seasons		44.50				41.37			

Table 2. Number and total length (cm) of primary roots in preconditioned sucker cuttings of S.795 planted in different periods of the year.

Chemical treatments (Sub-sub treatments)	April				October				Grand Mean
	Control	Etiolated	Ringed + etiolated	Mean	Control	Etiolated	Ringed + etiolated	Mean	
Without GR	0.77	0.77	1.87	1.14	0.37	0.50	1.17	0.68	0.91
	(3.79)	(3.61)	(13.13)	(6.84)	(1.62)	(2.56)	(8.18)	(4.12)	(5.48)
IBA 5000 ppm	1.95	2.70	4.10	2.91	0.87	1.30	1.37	1.18	2.05
	(12.14)	(15.19)	(34.17)	(20.74)	(6.09)	(7.54)	(10.43)	(8.02)	(14.38)
IBA 3000 ppm	2.43	1.40	3.27	2.37	1.43	0.77	1.00	1.07	1.72
	(14.46)	(11.42)	(17.49)	(14.46)	(5.83)	(5.09)	(11.43)	(7.46)	(10.96)
IBA 1000 ppm	1.37	1.53	1.33	1.41	1.00	0.77	0.83	0.87	1.14
	(6.30)	(6.62)	(5.86)	(6.26)	(3.06)	(3.30)	(3.70)	(3.35)	(4.81)
NAA 2500 ppm	2.60	1.10	2.37	2.02	1.27	0.63	1.13	1.01	1.52
	(16.07)	(7.06)	(15.11)	(12.75)	(6.20)	(3.59)	(11.73)	(7.17)	(9.96)
NAA 1500 ppm	1.87	1.00	2.77	1.88	0.83	0.67	2.10	1.20	1.54
	(10.29)	(6.75)	(14.84)	(10.63)	(4.98)	(3.09)	(11.11)	(6.39)	(8.51)
NAA 500 ppm	1.03	1.33	1.87	1.41	0.83	0.67	1.10	0.87	1.14
	(5.50)	(7.13)	(7.33)	(6.65)	(2.67)	(4.62)	(4.93)	(4.07)	(5.36)
IBA + NAA 2500 ppm	1.43	2.60	1.60	1.88	0.90	1.43	0.90	1.08	1.48
	(10.15)	(18.56)	(5.64)	(11.45)	(4.66)	(11.05)	(1.90)	(5.87)	(8.66)
IBA + NAA 1500 ppm	1.50	1.87	2.13	1.83	1.10	1.60	0.87	1.19	1.51
	(10.21)	(12.18)	(13.67)	(12.00)	(5.93)	(6.33)	(9.61)	(7.29)	(9.65)
IBA + NAA 500 ppm	1.30	1.00	2.67	1.66	0.70	0.67	0.67	1.01	1.34
	(5.46)	(4.68)	(13.86)	(8.00)	(2.47)	(2.38)	(10.91)	(5.25)	(6.63)
Mean	1.62	1.53	2.40		0.93	0.90	1.21		
	(9.44)	(9.39)	(14.10)		(4.35)	(4.96)	(8.40)		
Mean for precondition treatments	1.28	1.22	1.81						
	(6.90)	(7.18)	(11.25)						
Mean for seasons		1.85				1.01			
		(10.98)				(5.90)			

Figures in parentheses indicate total length of primary roots per cutting.

these sprouts did not vary significantly between the periods, but longer ones (2 cm) were recorded in ringed plus etiolated suckers (Table 3). Vigorous growth of sprouts in the ringed suckers could be due to the availability of required carbohydrates and other endogenous substances accumulated above the ring. Further studies are being conducted to determine the interrelationship between the biochemical status of preconditioned suckers and their rooting capacity.

Summary

To increase the rootability of sucker cuttings in *Coffea arabica* L cv S.795 etiolation and ringing were tried as preconditioning treatments. Etiolation was done by covering a portion of the internode with a strip of black cloth. Ringing plus etiolation made up another treatment wherein a ring of bark was removed and the ringed portion was etiolated. These preconditioned sucker cuttings recorded the highest percentage of rooting when IBA 5000 ppm was given as a preplanting treatment (60.65%). The number of primary roots and their length were significantly increased in ringed and etiolated sucker cuttings. Sprout growth was also vigorous in these cuttings. However, etiolation alone as a preconditioning treatment failed to enhance rooting.

Ringed plus etiolated sucker cuttings treated with IBA 5000 ppm planted during April recorded the highest percentage of rooting (70.30%) and had well developed root systems.

Table 3. Number and total length (cm) of sprouts in preconditioned sucker cuttings of S.795 planted in different periods of the year.

Chemical treatments (Sub-sub treatments)	April				October				Grand Mean
	Control	Etiolated	Ringed + etiolated	Mean	Control	Etiolated	Ringed + etiolated	Mean	
Without GR	0.40	0.27	0.53	0.40	0.43	0.10	0.43	0.32	0.36
	(1.25)	(0.85)	(2.23)	(1.44)	(0.97)	(0.80)	(2.08)	(1.28)	(1.36)
IBA 5000 ppm	0.87	0.80	0.53	0.73	0.73	0.47	0.33	0.51	0.62
	(3.27)	(2.22)	(1.88)	(2.46)	(2.82)	(1.79)	(1.44)	(2.02)	(2.24)
IBA 3000 ppm	0.63	0.37	0.70	0.57	0.40	0.17	0.67	0.41	0.49
	(1.95)	(0.86)	(2.10)	(1.64)	(1.26)	(0.77)	(1.97)	(1.33)	(1.49)
IBA 1000 ppm	0.37	0.30	0.53	0.40	0.17	0.23	0.40	0.27	0.34
	(1.18)	(0.87)	(1.55)	(1.90)	(1.11)	(0.77)	(1.52)	(1.13)	(1.17)
NAA 2500 ppm	0.57	0.27	0.57	0.47	0.30	0.13	0.13	0.19	0.33
	(1.85)	(0.67)	(1.60)	(1.37)	(1.56)	(0.54)	(1.29)	(1.13)	(1.25)
NAA 1500 ppm	0.37	0.13	0.77	0.42	0.13	0.17	0.83	0.38	0.40
	(1.35)	(0.41)	(2.74)	(1.50)	(1.18)	(0.30)	(2.17)	(1.22)	(1.36)
NAA 500 ppm	0.30	0.20	0.57	0.36	0.10	0.27	0.33	0.23	0.30
	(0.98)	(0.43)	(2.02)	(1.14)	(0.83)	(0.23)	(1.51)	(0.86)	(1.00)
IBA + NAA 2500 ppm	0.60	0.33	0.63	0.52	0.17	0.27	0.47	0.30	0.41
	(3.49)	(1.22)	(1.87)	(2.19)	(2.92)	(0.96)	(1.60)	(1.83)	(2.01)
IBA + NAA 1500 ppm	0.53	0.27	0.67	0.49	0.17	0.13	0.33	0.21	0.35
	(1.11)	(0.98)	(2.26)	(1.45)	(0.81)	(0.77)	(2.06)	(1.21)	(1.33)
IBA + NAA 500 ppm	0.47	0.23	0.60	0.43	0.17	0.10	0.30	0.19	0.31
	(1.09)	(0.79)	(1.71)	(1.20)	(0.85)	(0.76)	(1.26)	(0.96)	(1.08)
Mean	0.51	0.32	0.61		0.28	0.20	0.42		
	(1.75)	(0.93)	(2.00)		(1.43)	(0.77)	(1.69)		
Mean for seasons		0.48				0.30			
		(1.56)				(1.30)			
Mean for precondition treatments	0.50	0.26	0.52						

Figures in parentheses indicate total length of sprouts per sucker cutting

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Notas y comentarios

Los camellos como ganado lechero

Investigadores en Israel están aplicando tecnologías avanzadas para mejorar la productividad del camello beduino Reuven Yagil, de la Universidad de Ben Gurion, en Beersheba, cree que el camello es idealmente apropiado para resolver las necesidades de la gente en las partes áridas de Africa.

La leche de camella es rica en minerales y vitaminas, relativamente de bajo contenido de grasa y fácilmente digerible. Paradójicamente, cuanto más tiempo esté sin tomar agua una camella, más aguada se vuelve su leche.

Las camellas de Yagil, en el desierto de Negev y en unas fincas en Pakistán, rinden unos 40 litros de leche por día, con una dieta de seis a ocho kilogramos de forraje. Esto es mucho más de lo que podrían producir vacas en un ambiente similar; la leche de camella también dura mucho más

Tradicionalmente un rebaño de camellos cubre enormes distancias, comiendo sólo una pequeña porción de vegetación de cualquier lugar. Debido a que pueden alcanzar mayor altura y pueden comer los brotes más amargos y espinosos, dejando lo suficiente para una regeneración, no compiten con las ovejas en el pastoreo.

Yagil opina que los camellos podrían ponerse en corrales, proporcionándoles forraje cortado. Arbustos del desierto, de crecimiento rápido, que los animales apetecen, podrían ser plantados en una superficie grande. Yagil ha experimentado con plantas halófilas, como el *salt bush* (**Atriplex**), una quenopodácea, en el Negev. Esto permitiría que los pastores se establecieran como cultivadores intensivos.

Yagil tiene algún apoyo de gente de experiencia en la Comisión de Investigaciones de Alimentos y Agricultura (siglas en inglés, FARM), fundada recientemente en Kenya por un antiguo médico aviador, Sir Michael Wood. Este organismo está auspiciando un proyecto para instalar una finca experimental de camellos en el noroeste de Kenya. Los investigadores realizarán primero un censo para encontrar núcleos de camellos apropiados para la cría y entonces formar un hato. Finalmente podrán iniciarse fincas y una estación genética

El adiestramiento será esencial si las técnicas de Yagil para la cría de camellos van a ser puestas en marcha. Normalmente una camella no se reproduce hasta que tiene cinco a seis años de edad y, entonces, sólo tiene crías cada dos años. Inyectando hormonas la cría puede iniciarse después de los tres años y repetirse cada 18 meses (la gestación dura más de un año). La separación del hijo de su madre, cuando tiene sólo dos meses de edad, hace posible una producción y reproducción más continuas.

Para acelerar la reproducción de las mejores camellas, Yagil emplea la fertilización *in vitro* y la implantación de embriones. Los medicamentos farmacéuticos que aumentan la fertilidad hacen que una camella produzca 50 óvulos, de tal manera que 10 camellas pueden (teóricamente) engendrar 500 hijos en 18 meses. Sólo se necesita un macho. El resto puede ser beneficiado, cuando está todavía joven y tierno, para obtener carne.

A los críticos que dicen que las nuevas tecnologías destruirán una entera forma de vida, Yagil les dice que la sequía y la hambruna la han destruido ya. Las fincas ganaderas de camellos pueden proveer muchos productos. Además de la leche y la carne, con la lana se pueden hacer alfombras y frazadas, y, con el cuero, tiendas de campaña y productos de tenería y talabartería. Adalberto Gorbitz.

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