Effects of Fruit Maturity, Storage, Presoaking, and Seed Cleaning on Germination in Three Species of Palms[1]

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Abstract

Green, half ripe and ripe fruit of queen [*Arecastrum romanzoffianum* (Cham.) Becc.], pygmy date (*Phoenix roebelenii* O'Brien) and royla palms [*Roystonea regia* (HBK) O. F. Cook] were cleaned or left uncleaned and were presoaked in 1000 mg/l gibberellic acid (GA_3) for 48 hr, water for 48 hr, were not presoaked. Queen palm seed germinated best if cleaned green or half-ripe seed was used, but pygmy date and royal palm seed germinated best when cleaned half-ripe or ripe seed was used. Cleaned seed of these palms can be stored in sealed polyethylene bags at 23°C (73°F) for 4 to 9 months. Depending on the species, and royal palm seed benefited from storage of up to 9 months, presumably due to immature seed embryos at time of harvest.

Index words: *Roystonea regia* (HBK) O.F. Cook, *Phoenix roebelenii* O'Brien, *Arecastrum romanzoffianum* (Cham.) Becc., royal palm, pygmy date palm, queen palm, gibberellic acid, propagation

Introduction

The primary method for propagating most palms is by seed, although tissue culture techniques have made it possible to asexually propagate a few important palm species (8, 9). Germination of palm seed can require from several weeks to over a year (4) and methods of accelerating palm seed germination are being sought. Presoaking seeds in gibberellic acid (GA_3) is known to accelerate germination of Macarthur Palm (*Ptychosperma macarthuri* (H. Wendl.) Nichols), alexandra palm (*Archontophoenix alexandrae* (F.J. Muell.) H Wendl. and Drude), and areca palm (*Chrysalidocarpus lutescens* H. Wendl.) (1, 5, 6, 7), but in the case of areca palm, GA_3 presoaking caused excessive elongation of seedlings and resulted in unattractive plants. Cleaning or removal of fruit pericarp also improved germination percentage and decreased germination time of areca palm seed (1).

Seed quality, as affected by fruit maturity at harvest and postharvest handling, can greatly affect germination percentage of palm seeds. Seed from areca palm fruit picked green germinated poorly if cleaned, but almost as well as mature seed if not cleaned (1). Improper storage of areca palm seed prior to planting also greatly decreased germination percentage (1). The purpose of this study was to determine the effects of fruit maturity, GA_3 presoaking, cleaning, and storage on the germination of royal palm, pygmy date palm, and queen palm seeds.

Materials and Methods

Three categories of palm seed were used to determine the effects of fruit maturity on germination. Green fruits were full sized, firm, green in color, and were selected from infructescences containing some ripening fruits. Half-ripe fruit was semi-firm and only slightly green in color. Ripe fruit was soft and showed normal mature fruit coloration for the species (orange for queen palm and reddish purple for royal and pygmy date palms). Half the fruit in each ripeness category was cleaned by removing the fleshy pericarp. Three replicate lots of 50 cleaned and unclean seeds from each species and ripeness category were presoaked in 1 g/l GA_3 for 48 hr, presoaked in deionized water for 48 hr, or not presoaked. Following treatment all seeds were planted in a Canadian peat:perlite (1:1 by vol) medium in 10 cm (4 in) polypropylene containers placed in a germination chamber maintained at 29-35 °C (85-95 °F) for germination. Seedlings germinating each week were counted and final germination percentage and germination time were calculated. Germination time was calculated as the number of days required to achieve 50% of the final germination percentage for each treatment. Green pygmy date palm seeds were not cleaned due to the difficulty of this operation and no royal palm seeds were water soaked due to a shortage of seed.

Seeds for determination of storage effects on germination were cleaned, air dried for 2 days at 80-90% relative humidity, dusted with thiram 65WP, sealed in lots of 50 seeds in polyethylene bags, and stored at 23°±1°C (73°±2°F) (1). Every month 3 lots of 50 seeds for each species were removed from storage and planted as in the first experiment. Seedlings germinating each week were counted and germination time and final germination percentage were calculated. Data for all experiments were analyzed by analysis of variance.

Results and Discussion

Fruit maturity at harvest had a significant effect on time required for germination of queen palm seeds, but did not affect final germination percentage (Table 1). Cleaned green seeds germinated more rapidly than did half-ripe or ripe seeds, or uncleaned green seeds. Seed presoaking had no effect on germination time or final germination percentage, but cleaning queen palm seeds greatly improved final germination percentage. The highest germination percentage was obtained when cleaned green or half ripe seeds were used. This con-

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Table 1. Effects of fruit maturity, seed cleaning, and presoaking on queen palm seed germination.

Fruit maturity	Presoak	Cleaned	Germination time (days)	Final germ. %)
green	none	no	78.3	14.0
green	none	yes	41.7	45.3
green	H_2O	no	77.6	5.3
green	H_2O	yes	33.7	57.3
green	GA_3	no	87.7	2.7
green	GA_3	yes	48.0	27.3
half-ripe	none	no	81.3	4.7
half-ripe	none	yes	75.3	38.7
half-ripe	H_2O	no	——	0.0
half-ripe	H_2O	yes	77.7	73.3
half-ripe	GA_3	no	81.5	6.0
half-ripe	GA_3	yes	99.0	10.0
ripe	none	no	78.0	4.7
ripe	none	yes	86.5	20.0
ripe	H_2O	no	85.0	1.3
ripe	H_2O	yes	99.3	23.3
ripe	GA_3	no	——	0.0
ripe	GA_3	yes	102.7	27.3
Significant Effects				
Fruit Maturity			***[z]	NS
Presoak			NS	NS
Cleaning			NS	***
Maturity X Presoak			NS	NS
Maturity X Cleaning			***	NS
Presoak X Cleaning			NS	NS
Maturity X Presoak X Cleaning			NS	NS

[z]NS, and *** indicate not significant, or significant at 0.1% level, resp.

trasts with results obtained for areca palms where cleaned ripe or half-ripe seeds had the highest germination percentage and required the least time for germination (1). The fact that ripe queen palm seeds germinated more slowly and that very few uncleaned seeds germinated suggests the presence of a germination inhibitor in the pericarp of ripe fruit.

Fruit maturity, presoaking, and cleaning all had significant effects on time required for germination of pygmy date palm seeds, with cleaned ripe or half ripe seed germinating the fastest (Table 2). Final germination percentage was also affected by fruit maturity, with cleaned ripe seeds germinating best.

Germination time was affected only by fruit maturity in royal plam (Table 3). Ripe seed generally germinated more slowly than half ripe or green seed, but differences were slight. Final germination percentage was greatest for cleaned ripe seed which was not presoaked or cleaned half ripe seed presoaked in GA_3. Poorest germination occurred in green or uncleaned ripe or half ripe seed.

Although previous studies have shown that GA_3 presoaking can accelerate seed germination in Macarthur, alexandra, and areca palms (5, 6, 7), there did not appear to be any value in using this material on queen, pygmy date, and royal palms. Palm seedlings from GA_3 presoaked seeds showed excessive elongation, and in pygmy date palms leaves were twisted with a corkscrew-like appearance. This undesirable elongation was also observed in areca palms from GA_3 soaked seed (1) and affected leaves of such palms for up to 1 year after germination.

Germination percentage of queen palm seed declined rapidly after 4 months of storage at 23°C (73°F) (Fig. 1). Pygmy date palm seed rapidly lost its viability after 8 months of storage, but germination of royal palm seeds stored for 9 months or less exceeded that of freshly planted seed. Approximately 1% of royal palm seeds planted immediately germinated within 6 weeks, but no additional germination occurred until about 8 months after harvest when most seeds germinated. Seed which had been stored in sealed polyethylene bags did not germinate until 8 months after harvest, regardless of storage time. This may be due to immature embryos in these seeds at harvest time (3). Desiccation is known to be a primary cause for loss of palm seed viability (1). Stored royal palm seed probably germinated better than seed planted immediately because seed stored in sealed polyethylene bags is less subject to desiccation than that which is planted and subjected to periodic partial drying. Palm seed stored without special preparation is estimated to remain viable for a maximum of 2 weeks to 3 months (2), so viable seed storage for up to 9 months using this method represents an improvement in palm seed storage technology.

Significance to the Nursery Industry

This study shows that fruit maturity and seed cleaning can greatly affect palm seed germination. Optimum germination percentage for queen palm seed occurred when

Table 2. Effects of fruit maturity, seed cleaning, and presoaking on pygmy date palm seed germination.

Fruit maturity	Presoak	Cleaned	Germination time (days)	Final germ. %)
green	none	no	79.5	9.0
green	H_2O	no	79.5	6.0
green	GA_3	no	101.5	4.0
half-ripe	none	no	82.0	48.0
half-ripe	none	yes	50.5	59.0
half-ripe	H_2O	no	66.0	58.0
half-ripe	H_2O	yes	37.0	49.0
half-ripe	GA_3	no	72.5	40.0
half-ripe	GA_3	yes	55.0	59.0
ripe	none	no	63.0	51.3
ripe	none	yes	54.0	74.0
ripe	H_2O	no	74.0	65.0
ripe	H_2O	yes	43.7	77.3
ripe	GA_3	no	67.3	67.3
ripe	GA_3	yes	56.0	87.0
Significant Effects				
Fruit Maturity			***[z]	***
Presoak			*	NS
Cleaning			***	**
Maturity X Presoak			NS	NS
Maturity X Cleaning			NS	NS
Presoak X Cleaning			NS	NS
Maturity X Presoak X Cleaning			NS	NS

[z]*, **, and ***, and NS indicate significance at 5%, 1%, and 0.1% levels, or not significant, resp.

Table 3. Effects of fruit maturity, seed cleaning, and presoaking on royal palm seed germination.

Fruit maturity	Presoak	Cleaned	Germination time (days)	Final germ. %)
green	none	no	287.7	24.0
green	none	yes	259.3	24.0
green	GA_3	no	262.3	24.0
green	GA_3	yes	276.7	20.7
half-ripe	none	no	281.3	18.7
half-ripe	none	yes	261.7	37.5
half-ripe	GA_3	no	281.0	18.7
half-ripe	GA_3	yes	263.7	46.7
ripe	none	no	301.7	18.0
ripe	none	yes	331.0	52.0
ripe	GA_3	no	306.3	11.3
ripe	GA_3	yes	297.7	28.7
Significant Effects				
Fruit Maturity			**[z]	**
Presoak			NS	**
Cleaning			NS	***
Maturity X Presoak			NS	***
Maturity X Cleaning			NS	***
Presoak X Cleaning			NS	NS
Maturity X Presoak X Cleaning			NS	**

[z]NS, **, and *** indicate not significant or significance at 1%, and 0.1% levels resp.

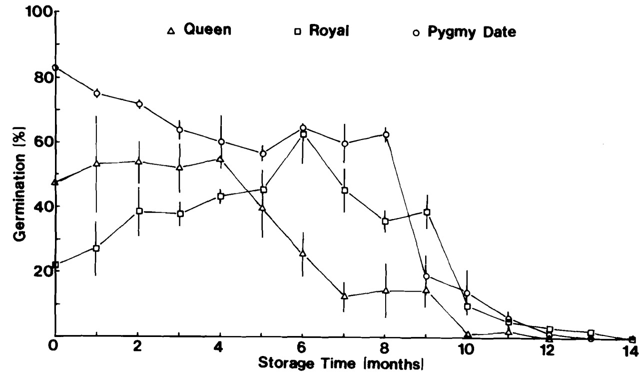

Fig. 1. Effects of storage on germination of queen, pygmy date, and royal palm seed. Points represent means ± SE.

cleaned green or half-ripe seed is used. Cleaned ripe or half-ripe seeds germinated best for pygmy date and royal palms. Cleaned palm seed can be stored for 4 to 9 months in sealed polyethylene bags and royal palm seed stored in this manner germinated better than seed planted immediately. Gibberellic acid presoaking is not recommended.

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Effect of Vigorous Shoot-Tip-Removal on Increased Fruiting of Young 'Western' Pecan Trees[1]

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Abstract

Tip removal pruning of long vigorous shoots of young 'Western' pecans, *Carya illinoensis*, (Wang) K. Koch, growing in the Rio Grande Valley in El Paso County, Texas, increased lateral buds persisting and growing through the season, decreased growth per lateral bud forced, and increased fruiting of shoots from buds forced from pruned shoots during both years. Total yield per tree was increased the second year. A useful role for tip-pruning in controlling vigor and converting vigorous shoot growth to fruiting shoots is indicated.

Index words: *Carya illinoensis*, (Wang) K. Koch, tree size control, apical dominance, fruiting, pruning

Introduction

The pecan, *Carya illinoensis*, (Wang) K. Koch, is a long-lived tree which is often grown as a landscape tree across the southern and southwestern United States for both shade and fruit. The tree can reach considerable size, and often outgrows its planting site. It is a terminal fruiting species, and thus does not adapt to most methods of tree size control by pruning. The young tree has a vigorous growth habit, strong apical dominance, and a minimum of branching and production for the first few years. Dwarfing rootstocks are not yet available for pecans, so the homeowner is faced with a long delay before fruiting commences. Any practice that would shorten this period is desirable.

According to Sitton (8), the initial stage of growth in budded pecan trees consists of long, strongly vegetative shoot growth, with no production observed until the second stage, when shorter shoots in the lower interior portion of the tree began to fruit.

Several early researchers also noted the relationship of terminal growth to physiological age and maximum fruiting (1, 3, 4). Isbell (4) found that each pecan cultivar appeared to have a typical intermediate range of shoot growth associated with flowering, and that neither longer, strong growing shoots nor very short, weak growing shoots were productive. Any cultural treatment that prolonged the initial vegetative growth stage delayed fruiting (2).

Several attempts to suppress annual shoot growth increments have been made using hedging and tip pruning with apparently conflicting results. Kuykendall (5) made a detailed study of regrowth and fruiting patterns on vigorous

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