NOTA CIENTÍFICA

DRYING AND GERMINATION OF CUPUASSU (*Theobroma grandiflorum* (Willd. ex Spreng.) K. Schum.) SEEDS[1]

ENIEL DAVID CRUZ[2]

ABSTRACT – The objective of this study was to verify the effect of drying on germination of cupuassu (*Theobroma grandiflorum* (Willd. ex Spreng) K. Schum.) seeds. Desiccation was in forced air oven, with temperature ranging from 23 to 33ºC. Sowing was carried out at 0.5cm of depth in plastic trays in sand and sawdust mixture (1:1), previously sterilized in hot water (100ºC), during 2h. Seeds were left to germinate in a laboratory with no temperature and relative humidity control, under natural light. It was quantified the seed moisture content, in four replications of 10 seeds; the germination percentage, performed during 30 days, with daily counts of the number of germinated seeds; the germination speed index; and number of days to the germination onset. The experimental design was completely randomized with four replications of 25 seeds. The reduction of moisture content from 58.6 to 37.8% did not affect seed germination and germination speed index; however, they were affected when moisture content was reduced to values below 30.7%. It was observed that only when moisture content was 16.1% seeds demanded more days to begin germination. Cupuassu seeds are classified as recalcitrant and they can be desiccated up to 37.8% with no reduction on germination.

Index terms: Tropical fruit, recalcitrant seed, desiccation, dehydration

SECAGEM E GERMINAÇÃO DE SEMENTES DE CUPUAÇU
(*Theobroma grandiflorum* (Wiild. ex Spreng.) Schum. - STERCULIACEAE)

RESUMO – O objetivo deste estudo foi verificar o efeito da secagem na germinação de sementes cupuaçu (*Theobroma grandiflorum* (Willd. ex Spreng.) K. Schum.) A secagem foi efetuada em estufa com circulação forçada de ar sob temperatura variando de 23 a 33ºC até conteúdos de água de 58,6 a 16,1%. A semeadura, a 0,5cm de profundidade, foi efetuada em caixas plásticas em substrato constituído de mistura de areia e serragem (1:1), previamente esterilizada em água quente (100ºC) por 2h. A germinação emergência ocorreu em laboratório desprovido de controles de temperatura e de umidade relativa do ar e sob luz natural. Foi quantificado a teor de água das sementes, em quarto repetições de 10 sementes; germinação, avaliada durante 30 dias com contagem diária das sementes germinadas; índice de velocidade de germinação; número de dias para iniciar a germinação. O delineamento experimental foi inteiramente casualizado com quatro repetições de 25 sementes. A redução do teor de água das sementes de 58,6 para 37,8% não afetou a germinação e o índice de velocidade de germinação; entretanto, estas variáveis foram afetadas quando o teor de água foi reduzido para valores abaixo de 30,7%. A respeito dos dias para início da germinação foi observada que apenas quando o teor de água foi de 16,1% as sementes demandaram maior número de dias para germinarem. Sementes de cupuaçu são consideradas recalcitrantes e podem ser dessecadas até 37,8% de água sem redução da germinação.

Termos para indexação: fruteira tropical, semente recalcitrante, dessecamento, desidratação

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[2] Engº Agrº M.Sc. Embrapa Amazônia Oriental, Caixa Postal 48, 66017-970, Belém, PA, Brazil. Email: eniel@cpatu.embrapa.br

INTRODUCTION

The most important factor that influences the longevity of seeds during storage is their moisture content. The response of seeds to reduction moisture content reduction will determine whether they can be stored successfully by conventional seed storage methods (Probert e Hay, 2000). Seeds that show desiccation sensitivity are classified as recalcitrant (Roberts, 1973). Many economically important species with recalcitrant seeds are from tropical regions, such as *Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg., *Mangifera indica* L., *Theobroma cacao* L. (Hong e Elis, 1996) and *Cocos nucifera* L. (Chin et al., 1989).

The level of desiccation tolerance in recalcitrant seeds shows great variation among species. In *Eugenia stipitata* spp. *sororia* McVaugh seeds, moisture content can be reduced from 58.6% to 47.1% without affecting germination (Gentil e Ferreira, 1999), in *Myrciaria dubia* (H.B.K.) McVaugh from 46 to 35% (Gentil e Ferreira, 2000), in *Hancornia speciosa* Gom. 30% (Oliveira e Valio, 1992), in *Bactris gasipaes* 39% (Carvalho e Müller, 1998), in *Euterpe edulis* Mart. (Martins et al., 2000) and *T. cacao* L. from 35% to 33% (Hor et al., 1984), and in *Inga uruguensis* (Hook. et Arn.) from 51.4% to 41.7% (Bilia et al., 1999).

Theobroma grandiflorum (Wiild. ex Spreng.) K. Schum. seeds are classified as recalcitrant (Carvalho et al., 2001) and absence of germination was detected when moisture content ranged from 19.5% to 11.5% (Lucena, 1998).

The objective of this study was to verify the effect of drying on germination of *T. grandiflorum* seeds.

MATERIAL AND METHODS

The experiment was carried out at Embrapa Amazônia Oriental, in Belém (01°28´S; 48°27´W), State of Pará, Brazil, in 2005. Cupuassu fruits were harvested in Tomé Açu (02°31´S; 48°22´W), Pará. Pulp was removed from seeds with the help of scissors. Afterwards, seeds were transported to the place of evaluations in a thermic recipient.

Desiccation of seeds was in an oven with forced air, with temperature ranging from 23°C (minimum) to 33°C (maximum). The treatments were obtained by following seed mass loss during desiccation. Thus, 10 samples of seeds with known masses were placed in Petri dishes (10 seeds by petri dishes), put in an oven and weighted at regular intervals. The final mass of samples with the intended moisture content was determined based on the procedure used by Cromarty et al. (1985) according to the following equation:

$$M_f = \frac{M_i(100 - U_i)}{100 - U_f}$$, where:

Mf = final mass, Mi = initial mass, Ui = initial moisture and Uf = final moisture.

Sowing was carried out at 0.5cm of depth in plastic trays (30x22x6cm) in a horizontal position in sand and sawdust mixture (1:1), previously sterilized in hot water (100°C) during two hours. Seeds were left to germinate in a laboratory with no temperature and relative humidity control (minimum and maximum temperatures of 22.7° and 33.6°C, respectively), under natural light. Trays were irrigated every two days and observed for 30 days.

The following evaluations were made:

Seed moisture content - It was determined in four replications of 10 seeds, in an oven set at 105%±3°C during 24h (Brasil, 1992). The moisture content percentage was expressed on a fresh weight basis (wb).

Germination Emergence test - It was performed during 30 days with daily counts of the number of germinated seeds. The percentage of germination was obtained 30 days after sowing. It was considered germinated seed when it showed epicotyls length of 0.5 cm above the soil surface.

EmergenceGermination speed index – It was obtained by daily counts of the number of germinated seeds quantified during the germination test based on the procedure used by Maguire (1962) according to the following equation:

$$GESI = \frac{G_1}{N_1} + \frac{G_2}{N_2} + \ldots + \frac{G_n}{N_n}$$, where:

GESI = Germination speed index; G_1, G_2 and G_n = Number of germinated seeds on the first count, second count and last count; N_1, N_2 and N_n = Number of days elapsed of the first, second and last count.

Days to the germination emergence onset – It was quantified by the number of days elapsed from sowing until germination of the first seed.

Experiment design and statistical analysis –The experimental design was completely randomized with four replications of 25 seeds. Data were subjected to the Bartlett homogeneity of variance test (Statsoft, 1999). No data transformations were necessary. The statistical analysis consisted of analysis of variance. Treatments means were compared by Tukey test (P£0.05). All analyses were performed by the software Statistica (Statsoft, 1999).

RESULTS AND DISCUSSION

The reduction of moisture content from 58.6% to 30.8% did not affect seed germination and germination speed index. However, starting from 30.8% of moisture content, it was observed a significant reduction on seed germination and on germination speed index (Table 1). Lucena (1998) found that cupuassu seeds may be desiccated to 25% of moisture content without reduction of germination. That value is lower than the one reported in our experiment (30.8%); this difference is likely to be due to the methodology of seed preparation (after pulp removal seeds were washed and dried with absorbent paper). The desiccation sensitivity of cupuassu seeds suggests that this species has recalcitrant behavior during storage (Carvalho et al., 2001).

It was observed that only when moisture content was 16.1%, seeds demanded more days to begin germination, fact also observed by Carvalho et al. (1999) in cupuassu seeds, when moisture content was 23.1% and 18.8%. For the tropical species, *B. gasipaes* Kunth and *Micropholis* cf. *venulosa* (Mart. & Eichler) Pierre, Carvalho and Muller (1998) and Cruz and Carvalho (2003), also reported the effect of reduction of moisture content on the delay of germination. This fact probably is caused because desiccated seeds need additional time for re-hydration until they reach a suitable moisture content level for germination to occur.

The germination curves of the treatments are showed on Figure 1. For treatment (moisture content) 58.6%, 55.6%, 50.1%, 45.9%, 40.8%, and 37.8% the germination curve was more accentuated comparing with treatments 30.7%, 24.5%, 20.9% and 16.1%, particularly with the treatments 20.9% and 16.1%.

CONCLUSION

Seed moisture content reduction to 37.8% does not affect germination of cupuassu seeds.

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TABLE 1. Moisture content (U), desiccation time (DT), germination (G), number of days to germination emergence onset (DGO) and germination emergence speed index (GSI) in *Theobroma grandiflorum* seeds.

U (%, w.b.)	DT (Hours)	G (%)	DGO (Number)	GSI
58.6	0	99.0 a	14.2 a	1.52 a
55.6	17	93.0 ab	14.5 a	1.34 ab
50.7	27	92.0 ab	14.5 a	1.43 a
45.9	60	97.0 a	13.5 a	1.58 a
40.8	103	97.0 a	13.0 a	1.53 a
37.8	120	95.0 ab	13.5 a	1.47 a
30.7	138	80.0 b	14.2 a	1.10 b
24.5	146	61.0 c	14.0 a	0.81 c
20.9	170	28.0 d	15.8 a	0.38 d
16.1	195	10.0 e	19.8 b	0.13 d

Means followed by the same letter are not different by Tukey (P³0.05).

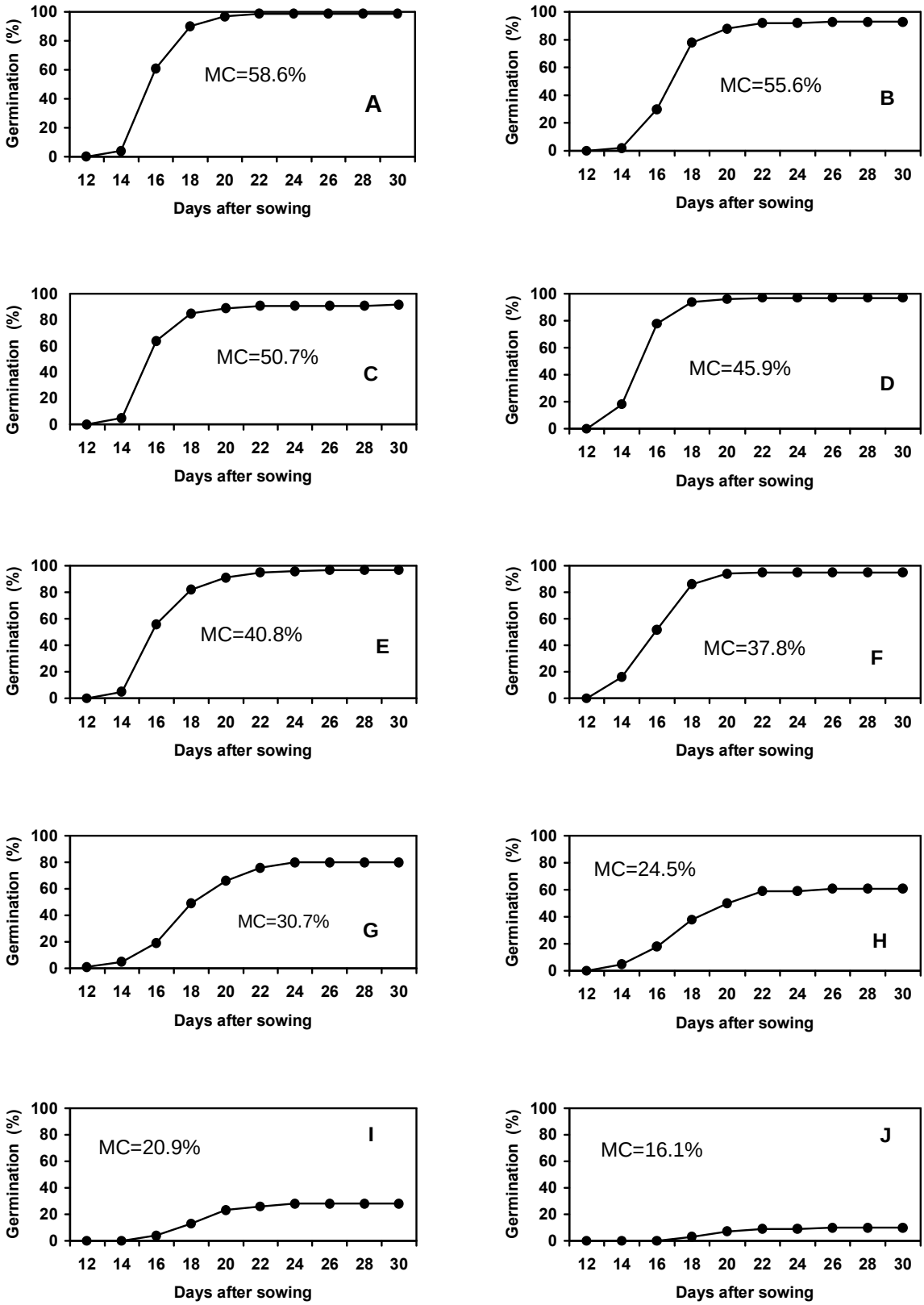

FIGURE 1. Germination of *Theobroma grandiflorum* seeds before (A) and after (B, C, D, E, F, G, H, I and J) desiccation at different moisture content.

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