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Successive cycles of soil drying and wetting improve tolerance to drought in mangabeira

Abstract – The objective of this work was to evaluate biomass accumulation and photosynthesis in mangabeira, in response to water deficit and to successive soil drying and wetting cycles. Seedlings were grown in pots and subjected to the three following water regimes: soil at 35, 70, and 100% of field capacity (FC), followed by a drying-down period until photosynthesis (measured weekly) was close to zero. Then, the seedlings were rewatered until completing four drying-wetting cycles. The control treatment was a permanently well-irrigated soil. There was a decline in biomass accumulation under water deficit conditions. Photosynthesis responded to soil rewatering only at 70 and 100% FC and was null at 35% FC. The elapsed time for photosynthesis to reach a null value after rewatering increases with successive drying-wetting cycles. In soil at 100% FC, for photosynthesis to approach zero, it takes five weeks in the first and eight weeks in the last rewatering cycle. Photosynthesis improves with progressive drying-wetting cycles, particularly in soil at 100% FC. The pre-acclimation of mangabeira to drying-wetting cycles should be considered before transplanting the seedlings in the field, and pre-acclimation should be carried out initially with soil at its FC.

Index terms: *Hancornia speciosa*, photosynthesis, stomatal conductance, water deficit.

Ciclos sucessivos de secagem e umedecimento do solo melhoram a tolerância à seca em mangabeira

Resumo – O objetivo deste trabalho foi avaliar o acúmulo de biomassa e a fotossíntese em mangabeira, em resposta ao deficit hídrico e a ciclos sucessivos de secagem e umedecimento do solo. Mudas foram cultivadas em vasos e submetidas aos três seguintes regimes hídricos: solo a 35, 70 e 100% da capacidade de campo (CC), seguidos de um período de secagem até que a fotossíntese (medida semanalmente) se aproximasse de zero. Em seguida, as mudas foram irrigadas novamente até completar quatro ciclos de secagem-umedecimento. O tratamento-controle foi um solo permanentemente bem irrigado. Houve um declínio no acúmulo de biomassa em condições de deficit hídrico. A fotossíntese respondeu à reirrigação do solo apenas a 70 e 100% da CC e foi nula a 35% da CC. O tempo decorrido para a fotossíntese atingir um valor nulo após irrigação aumenta com os sucessivos ciclos de secagem-umedecimento. Em solo a 100% da CC, para que a fotossíntese se aproxime de zero, são necessárias cinco semanas no primeiro e oito semanas no último ciclo de irrigação. A fotossíntese melhora com ciclos sucessivos de secagem-umedecimento, particularmente em solo a 100% de CC. A pré-climatização da mangabeira aos ciclos de secagem-umedecimento deve ser considerada antes do transplante das mudas no campo, e a pré-climatização deve ser realizada inicialmente com o solo em sua CC.

Termos para indexação: *Hancornia speciosa*, fotossíntese, condutância estomática, deficit hídrico.

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Introduction

Mangaba (*Hancornia speciosa* Gomes) is a Brazilian fruit tree that occurs in most regions of Brazil, particularly in the Cerrado biome (Silva et al., 2017), which comprises the largest producer states in Brazil (country's total of 2,173 tonnes in 2021): Paraíba (40% of the country’s total), Sergipe (21%), and Bahia (10.9%) (IBGE, 2021).

Drought can be defined as a condition of insufficient water supply or too large evaporation that may lead to water deficit. By altering the anatomy, morphology, physiology and biochemistry, plant water deficit (the reduction of turgor below the maximum value) affects not only photosynthesis, but also different aspects of plant growth (Kaur & Asthir, 2017). The adaptation to water deficit involves several strategies by which the plant avoids or tolerates low water supply (Kaur & Asthir, 2017; Ilyas et al., 2021). Thus, under water deficit condition, plants may either avoid transpiration or increase water uptake by often employing a combination of strategies to cope with drought stress (Kaur & Asthir, 2017). Transpiration can be lowered by stomatal closure and increased leaf shading (or reduced leaf area), while osmotic adjustments and an increase of the root/shoot ratio can improve water uptake (Goufo et al., 2017; Kaur & Asthir, 2017; Gouvêa & Marenco, 2018).

Besides the intrinsic variability among species and cultivars within species, the physiological response of plants to water deficits depends on the severity and duration of the stress (Kaur & Asthir, 2017; Ilyas et al., 2021; Pezzopane et al., 2022; Wang et al., 2022). Hence, when stress factors are gradually applied, an acclimation response to water deficit may occur (for instance, leaf area reduction and changes of biomass allocation), which protects the plant from physiological impairments caused by sudden exposure to severe water deficit (Mittler & Blumwald, 2015; Kaur & Asthir, 2017). Therefore, controlled drying and wetting may promote plant tolerance to drought, by means of a variety of mechanisms (Mittler & Blumwald, 2015).

There is plenty of evidence that one of the earliest indications of water deficit is a decline of stomatal conductance, which causes a reduction of photosynthesis (Kaur & Asthir, 2017; Oliveira & Marenco, 2019; Nóia Júnior et al., 2020). Under severe water deficit, however, photosynthesis is inhibited not only by stomatal closure, but also by nonstomatal mechanisms, such as the decline of mesophyll conductance, electron transport, and enzyme activity (Flexas et al., 2012; Kaur & Asthir, 2017). Evidently, if a plant is subjected to severe drought stress for too long, it may collapse because of the effects of carbon starvation (photosynthesis impairment) and dehydration (limiting water supply), depending on the intensity and severity of stress (McDowell et al., 2011). In addition to photosynthesis and stomatal conductance, changes in the chlorophyll fluorescence can be used to assess the effects of water deficit on leaves, as the photochemical efficiency of a leaf may vary under drought stress (Flexas et al., 2012; Barboričová et al., 2022; Wang et al., 2022).

Most studies carried out on mangaba have been devoted to study agronomic, genetic, and pharmacological traits (Silva et al., 2017; Almeida et al., 2019). The effect of water deficit on photosynthesis and plant growth has been the subject of many studies (Marenco et al., 2014; Nóia Júnior et al., 2020; Wang et al., 2022). However, the combined effects of water deficit and rewatering have received less attention. Understanding how mangabeira responds to the variation of soil water content and rewatering is important in face of the ongoing climatic change, as it seems that droughts may become more frequent in Northeastern Brazil and part of the Amazon region (Cai et al., 2020). We hypothesized that the tolerance to water deficit would improve in a manner consistent with the initial soil water deficit, and we expected that tolerance to water stress would be greater under moderate to severe soil water deficit.

The objective of this work was to evaluate biomass accumulation and photosynthesis in mangabeira, in response to water deficit and to successive soil drying and wetting cycles.

Materials and Methods

The experiment was conducted at the Instituto Nacional de Pesquisas da Amazônia - INPA (03°05'30"S, 59°59'35"W), in the municipality of Manaus, in the state of Amazonas (AM), Brazil, under greenhouse conditions, from August 2019 to February 2020. In the greenhouse, mean temperature was 27.8°C, and mean relative humidity was 74.5%, while mean irradiance was 200 μmol m^{-2} s^{-1} – that is, 8.6 mol

m^{-2} day^{-1} on a daily basis, according to Silveira et al. (2023).

Mangaba fruit were randomly collected from naturally-occurring trees (07°31’49.51” S , 63° 03’14.62” W) found at the Fazenda Experimental Mangabeira, of the Universidade Federal do Amazonas, located in the municipality of Humaitá, AM, Brazil. Mangabeira seed were extracted and germinated in nonautoclaved vermiculite. When seedlings were 15 cm tall (50 day-old), they were transplanted to 5 L pots containing 4 kg of nonautoclaved forest soil – Latossolo Amarelo (Oxisol), in the Brazilian classification by Santos et al. (2018) – amended with 0.7 g NPK fertilizer kg^{-1} soil (N, 10%; P_2O_5, 10%; K_2O, 10%). After transplanting the seedlings were grown for six months under well-watered conditions in the greenhouse – that is, the pots were watered daily to maintained the soil at field capacity (FC). Thereafter, they were assigned to three water regimes (followed by a drying-down period up to photosynthesis approached zero, see Results), as follows: T_1, initial soil water content (SWC) at 100% FC; T_2, SWC at 70% FC; and T_3, SWC at 35% FC. Besides the three water deficit treatments, we had a control (T_0), in which the soil was maintained permanently at 100% FC over time.

To determine the amount of water to be added to each treatment (from 35% to 100% FC), we measured the volume of water that a given mass of dry soil could hold at field capacity (100% FC) and, then, the amount of water at 35% and 70% FC was calculated, as previously described (Silveira et al., 2023). Once the soil had reached the water content defined by treatments (35% – 100% FC), we measured the net photosynthesis (P_N). Then, by withholding irrigation, the soil was let to dry-down and, during this period, we measured P_N at weekly intervals until it approached a null value (it took up to eight weeks for P_N to approach zero, see Results). Then, a new drying-wetting cycle was restarted (that is, the SWC was replenished to its initial target value: 35–100% FC). Overall, there were four drying-wetting cycles (except at 35% FC, in which there were only three cycles, as the seedlings were unable to recovery after rewatering).

At each cycle, we measured P_N, stomatal conductance (g_s), intrinsic water-use efficiency (WUE_i), the variable to maximum fluorescence ratio (F_v/F_m), and the SPAD values (a unitless measure of the relative chlorophyll content). We also measured the relative water content (RWC) and the relative water deficit (RWD) in the first two cycles and, at the end of the last drying-wetting cycle, we determined the leaf area and plant biomass.

Net photosynthetic rate (P_N) and stomatal conductance (g_s) were measured (08:00–12:00 h) with a portable gas exchange system Li-6400XT (Li-Cor, Lincoln, NE, USA) in two fully expanded leaves (on the upper third of the stem) per plant. Gas exchange was measured at light saturation (PAR of 1000 μmol m^{-2} s^{-1}), ambient temperature (27°C), and relative humidity of 70 ± 5%. The PAR value at light saturation was determined as previously described (Silveira et al., 2023), while the WUEi was obtained as P_N/g_s ratio measured at light saturation and 400 ppm CO_2. The SPAD values (SPAD-502, Minolta Camera Co., Osaka, Japan) was measured on two leaves per plant and five points per leaf, to obtain a mean value. The RWC was measured only in the first two watering cycles, due to limited availability of leaves, as the plant lost leaves during the soil drying-down period. The RWC was determined in one leaf per plant, according to the equation described by Bueno et al. (2019), as follows:

$$\mathrm{RWC}(\%) = 100 \times \frac{\mathrm{LFM} - \mathrm{LDM}}{\mathrm{LTM} - \mathrm{LDM}},$$

where LFM represents the leaf fresh mass; LTM, leaf turgid mass, and LDM, leaf dry mass.

The dry mass was measured after oven-drying at 72°C (until constant mass was attained), and LTM was obtained after cutting the tip of the fresh leaf petiole under water. There the excised fresh leaf remained for 24 hours to reach full hydration, under humid and dark conditions. From RWC, the relative water deficit (RWD) was obtained according to the description by Bueno et al. (2019), as follows:

$$\mathrm{RWD} = 100 - \mathrm{RWC}$$

Just before gas-exchange measurements and on the same leaves, the maximum (F_m) and minimum fluorescence (F_0) were measured over a disc of 4 mm diameter, using a hand-held fluorometer Fluor Pen FP100 (Photon System Instruments), Brno, Czech Republic). Prior to measuring F_m, leaf samples were dark-adapted for 20 min and, after that a light pulse of 4,500 μmol m^{-2} s^{-1} was applied. The F_v/F_m ratio was computed after Björkman & Demmig (1987), as follows:

$$\frac{F_v}{F_m} = \frac{[F_m - F_0]}{F_m},$$

where: F_v represents the fluorescence (F_m minus F_0). At the end of the last watering-drying cycle, leaf area and plant biomass were determined. Leaf area was measured using a leaf area integrator (LI-3050, Li-Cor, NE, USA), while the biomass of plant organs (leaf, stem, and root dry mass) was obtained after oven-drying the plant material (72°C, until constant mass was attained).

To assess the effect of treatments on biomass accumulation, we used a completely randomized design with four treatments: three watering regimes (soil at 35%, 70%, and 100% FC), and a control (soil permanently well-irrigated). We started the experiment with seven seedlings per treatment; however, as some of them collapsed (due to dehydration) during the experiment, we ended the experiment with only four seedlings in treatments T_1 and T_2 (SWC 100% and 70% FC), and three seedlings in T_3 (SWC 35% FC). Before applying the statistical analyses, data were tested for normality by the Shapiro–Wilk's test (α=0.05) and log-transformed when necessary. Because we had unequal number of replicates per treatment, we inferred the effect of treatments by using the p-values from the analysis of variance and standard errors. The effect of the progressive water stress on photosynthetic traits, during the soil drying-down period, the fluorescence and the relative chlorophyll content were inferred by observing the standard errors. For the statistical analyses we used the Sigma Plot 11.0 software (Systat Software, Inc., San Jose, CA, USA).

Results and Discussion

Net photosynthetic rate (P_N) and stomatal conductance (g_s) sharply decreased with the progressive soil drying at each drying-wetting cycle (Figure 1). Taking treatment 1 (SWC at 100% FC followed by soil drying-down) as the baseline, it can be seen that the maximum values of P_N slightly decreased in seedlings subjected to mild water deficit SWC at 70% FC (7.62 µmol m^{-2} s^{-1} *versus* 6.65 µmol m^{-2} s^{-1}) (Figures 1 A and 1 B), whereas it greatly decreased under severe water deficit (SWC 35% FC) (Figure 1 C). In fact, under severe water stress, except for values recorded during the first measurements (week 1), P_N was null over time.

It is remarkable that in soil at 100% FC, during the last watering, it took eight weeks for photosynthesis to approach a null value (weeks 15 to 23, Figure 1 A), whereas it took only four weeks to have similar results during the first rewatering (weeks 5 to 9, Figure 1 A). In soil at 70% FC, a similar trend was observed, but it took less time for photosynthesis to become null (Figure 1 B). Likewise, the maximum values of g_s were also lower in seedlings subjected to mild water stress (SWC at 70% FC) (Figure 1 E). Also, under severe water deficit, the stomatal conductance was unresponsive to rewatering (Figure 1 F). In both SWC at 100% and 70% FC, the stomatal conductance tended to increase after rewatering (Figure 1 D, E) and, over treatments, P_N clearly increased with the increase of stomatal conductance (R^2= 0.95, inset in Figure 1 C). The intrinsic water use efficiency (WUE_i) tended to increase during the drying-wetting cycles, particularly in treatments 1 and 2 (soil at 100% and 70% FC) (Figures 2 A and 2 B), whereas, under severe water stress (soil at 35% FC) WUE_i was neutral to rewatering, as neither P_N nor g_s responded to soil wetting after the first week. Both P_N and stomatal conductance decreased with an increase of the relative water deficit (Figure 3 A, B), and both, with few exceptions, became very low (or null) when water deficit decreased to about 40%.

Besides genetic traits, plant response to water deficit depends on the severity of drought stress (Flexas et al., 2012; Hameed et al., 2013; Kaur & Asthir, 2017; Wang et al., 2022). This fact explains the profound decrease of P_N and stomatal conductance under severe water deficit (soil at 35% FC), as well as the decline of stomatal conductance and photosynthesis with soil drying within a drying-wetting cycle. There is plenty of evidence showing that under mild water deficit, the decline of P_N is due to stomatal closure, while the photosynthetic capacity is impaired under severe drought stress (Flexas et al., 2012; Oliveira & Marenco, 2019; Nóia Júnior et al., 2020). Stomatal closure can be induced by several environmental factors, including sub-optimal temperature (Marenco et al., 2014), soil water deficit, low leaf water content, and high vapor pressure deficit (Li et al., 2020; Pezzopane et al., 2022). Under water deficit, stomata can sense both hydraulic signals (change in cell turgor under severe drought stress) and chemical signals (for instance, signals intermediated by abscisic acid, under moderate drought stress), which ultimately lead to stomatal closure (Kaur & Asthir, 2017; Li et al., 2020). The relatively good performance of the seedlings in T_1 and T_2 occurred because P_N and stomatal conductance were able to recover upon rewatering in soil at 100% FC and 70% FC, while the weak performance of seedlings grown in soil at 35% FC shows that, at that point, the SWC was very close to the permanent wilting point (soil moisture at which roots are unable to extract water).

A decline in leaf number may have contributed to reduce plant transpiration, which can also help to explain why it took more time (for instance, eight weeks in the first rewatering, against four weeks during the first rewatering in T_1) for P_N to approach zero. However, it cannot be ruled out that in addition to the reduction of leaf area, acclimation to drought may also involve the synthesis of compatible osmolytes (Kaur & Asthir, 2017; Goufo et al., 2017). Irrespective of the mechanisms involved, subjecting the seedlings to drying-wetting cycle have shown to improve the performance of mangabeira under water deficit.

In comparison with P_N values recorded in T_1 (SWC at 100 FC), it took less time for P_N to reach a null value in T_2, and, as mentioned above, photosynthesis was unresponsive to rewatering under severe water stress (SWC at 35% FC). These results negate our working hypothesis, as we had expected that acclimation to drought stress would increase under moderate water deficit. It is evident that, at SWC of 35% FC, by holding rewatering for a week, seedlings reached

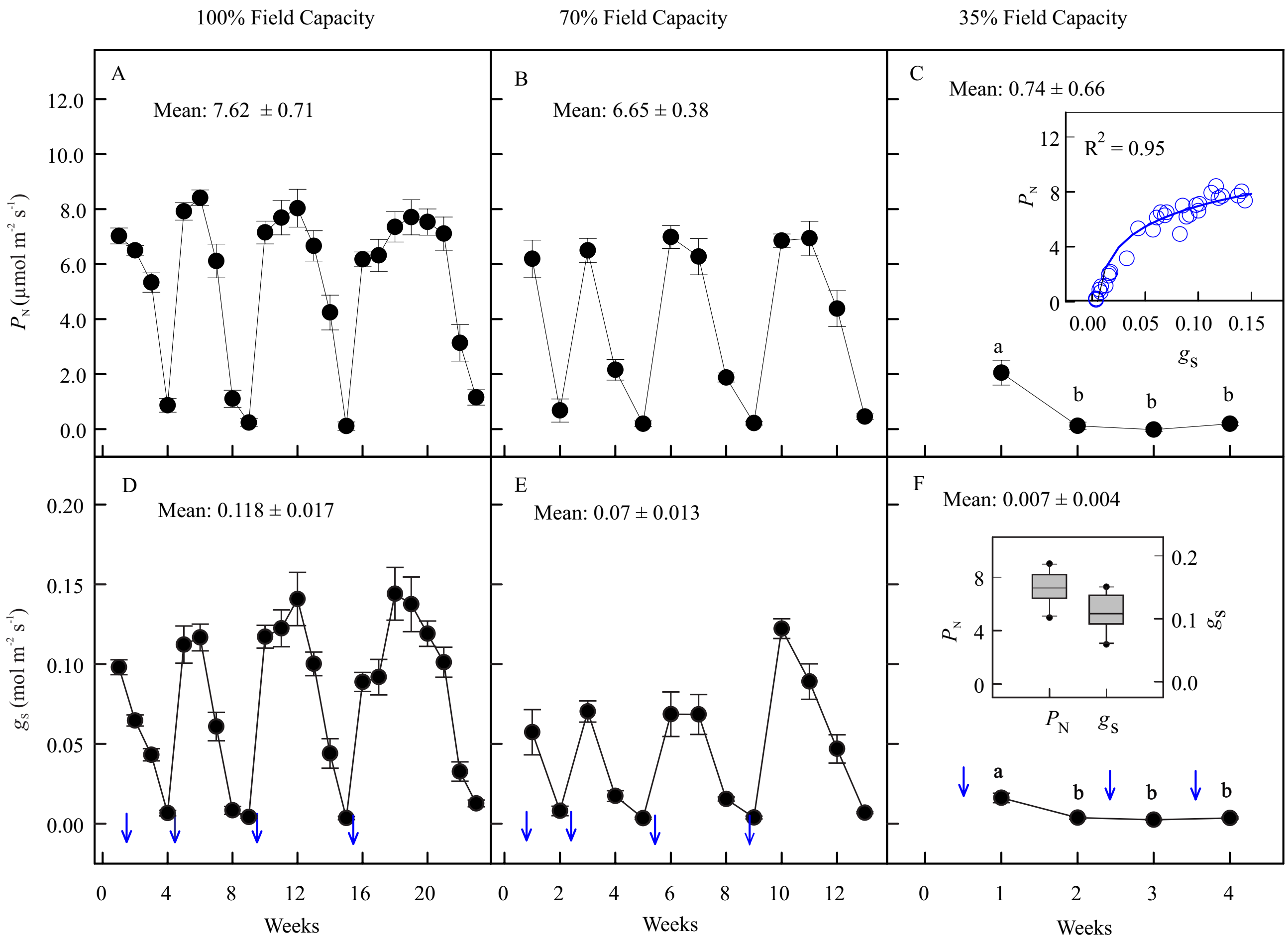

Figure 1. Photosynthesis (P_N) and stomatal conductance (g_s) in mangabeira (*Hancornia speciosa*), in response to wetting and drying cycles. The mean maximum values (± SE) at each (re)watering (indicated by arrows) are also shown. The inset in panel F shows the P_N and g_s (units as in panels A an D) recorded in the control treatment (well-watered plants). The inset in panel C shows the P_N to g_s ratio over treatments (soil at 35%, 70%, and 100% field capacity, FC) and $P_N = 11.87 + 2.1775\ln(g_s)$. Photosynthesis was recorded at ambient temperature, 400 ppm CO_2, and 1000 µmol m^{-2} s^{-1} irradiance.

a point of extreme dehydration, which prevented them from recovering after rewatering (Figure 1 C and 1 F). During drought, it is often reported that the accumulation of reactive oxygen species, the decrease of cellular volume, protein denaturation, and loss of integrity of membrane can lead to cell death, particularly in non drought-tolerant species (Hoekstra et al., 2001; Hameed et al., 2013).

The plant biomass decreased in seedlings subjected to water deficit (Table 1). Thus, in comparison with the control (well-irrigated plants), the whole plant biomass was reduced by about 42% in seedlings subjected to

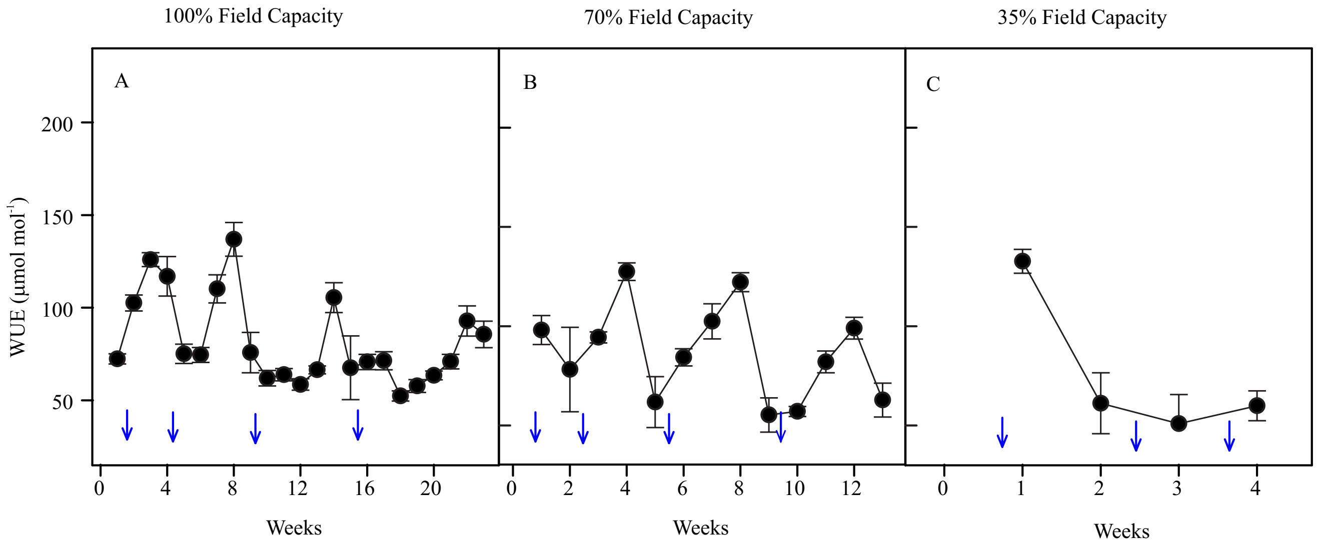

Figure 2. Intrinsic water use efficiency (WUE$_i$) in mangabeira (*Hancornia speciosa*), in response to drying and wetting cycles. Further information as described in Figure 1.

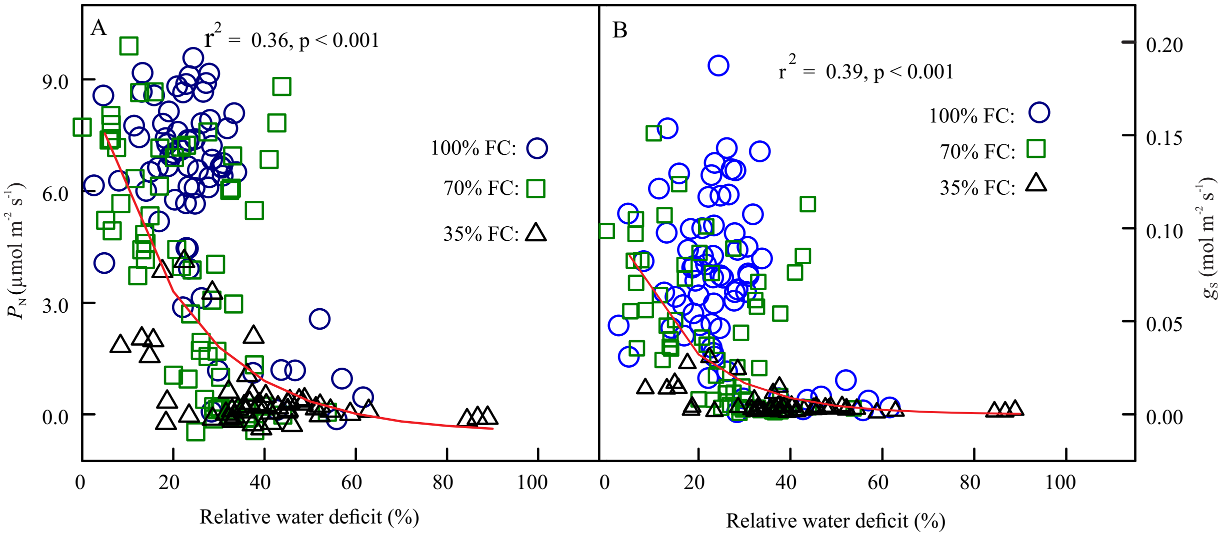

Figure 3. Photosynthesis (P$_N$) and stomatal conductance (g$_s$) in mangabeira (*Hancornia speciosa*), as a function of the relative water deficit (RWD) during the drying-wetting cycles of soil at 35%, 70%, and 100% FC. The P$_N$ (over treatments) = -0.5 + [10.332 exp (–0.05 RWD], $R^2 = 0.36$, $p<0.001$, and $g_s = 0.1181\exp(–0.065 \text{ RWD})$, $R^2 = 0.39$. Further information as described in Figure 1.

water deficit (that is, seedlings under water deficit accumulated on average only about 58% of biomass in the control treatment). This effect can be attributed to the fact that cell division, leaf expansion, and protein synthesis are inhibited by water stress, as water deficit may induce the accumulation of abscisic acid, which promotes changes in gene expression (Kaur & Asthir, 2017; Mittler & Blumwald, 2015). Even in circumstances in which drought stress is not quite severe to cause plant death, it has been found that drought stress may lead to a decrease of leaf area and plant biomass, thus reducing growth (Kaur & Asthir, 2017; Gouvêa & Marenco, 2018; Nóia Júnior et al., 2020).

We have reported that photosynthesis improved with drying-wetting cycles (that is, the elapsed time for P_N to approach a null value increased with successive rewatering cycles, particularly in T_1) and, also that a decrease of biomass was found under water deficit, in comparison with the control treatment (permanently well-irrigated plant). At first sight, these results seem contradictory, but actually they are not, as photosynthesis greatly decreased during the drying-down period, which also led to leaf shedding, while the control plants were permanently maintained under well-watered conditions, and hence biomass accumulation was the greatest one. Except for T_3 (SWC 35% FC, in which seedlings almost collapsed), we found that the SPAD values remained rather constant over the experimental period, even when the number of leaves declined (Figure 4 A and 4 B). This fact can be explained by considering that, over time, leaf shedding was associated with the production of new leaves, which were acclimated to the prevalent conditions.

Most of the time the F_v/F_m ratio remained above 0.73 (Figure 4 D, 4 F). The exceptions were F_v/F_m values recorded at the end of three watering cycles (Figure 4 D, 4 E). In this regard, an F_v/F_m value of 0.83 is considered optimal for most plant species (Björkman & Demmig, 1987). The relatively high F_v/F_m values recorded in the present study, especially in T_1 (soil at 100% FC), show that the F_v/F_m ratio is rather resistant to water stress, as reported by Flexas et al. (2012) and Oliveira & Marenco (2019). Besides, it can be noted that during the first drying-watering cycles, the F_v/F_m ratio tended to decrease with soil drying, and this decline was more evident in soil at 100% FC, in the weeks 9th and 15th (Figure 4 D), and at 70% FC only in the 5th week (Figure 4 E). However, at the end of the last watering cycle, the F_v/F_m ratio increased, which is probably associated with the production of new leaves adapted to the new ambient conditions, as stated above. The sharp decline in the F_v/F_m ratio recorded in the 9th and 15th week (SWC100% FC) and in the 5th week (SWC 70% FC) clearly indicates that the seedlings were under severe water deficit (Flexas et al., 2012; Barboričová et al., 2022). In this respect, it has been reported that, under severe stress, there is a decrease of the photochemical efficiency and of the activity of some enzymes (for

Table 1. Plant traits of mangabeira subjected to treatments of water deficit in soil at 100, 70, and 35% field capacity (FC). Each value represents the mean (± standard error, SE) recorded at the end of the experimental period. The control corresponded to soil maintained permanently at 100% FC. The F (from Fisher) and probability (p) values from the analysis of variance are also shown.

Treatment	n	Ds (mm)	TDM (g)	SDM (g)	RDM (g)	LDM (g)	LS (cm^2)	NL	PM (%)
Control	7	2.9±0.16	4.79±0.56	2.58±0.30	1.48±0.24	0.73±0.16	10.22±0.78	22.0±3.4	0.0
100% FC	4	2.0±0.09	2.89±0.40	1.27±0.09	0.94±0.09	0.69±0.22	11.44±1.34	12.3±1.4	42.8
70% FC	4	2.1±0.04	2.85±0.22	1.38±0.14	1.14±0.06	0.34±0.04	9.92±0.78	11.8±1.3	42.8
35% FC	3	2.2±0.10	2.62±0.57	1.43±0.20	0.93±0.35	0.27±0.04	9.08±0.58	9.3±0.9	57.1
Mean	-	2.30±0.41	3.29±1.0	1.67±0.61	1.12±0.26	0.51±0.24	10.2±0.98	13.9±5.6	-
F		10.83	4.40	7.13	1.59	2.39	0.84	7.80	
p-value		< 0.001	0.021	0.004	0.236	0.112	0.49	0.001	
Percentage	of	Control							
100% FC		69.0	60.3	49.1	63.3	93.6	111.9	55.9	
70% FC		72.4	59.5	53.4	76.8	45.8	97.1	53.6	
35% FC		75.9	54.7	55.3	62.7	36.8	88.8	42.3	

Parameters: Ds, stem diameter; DM, dry matter per plant; TDM, total DM; SDM, stem DM; RDM, root DM; LDM, leaf DM; LS, leaf size; NL, number of leaves per plant; PM, plant mortality; and n, number of replicates.

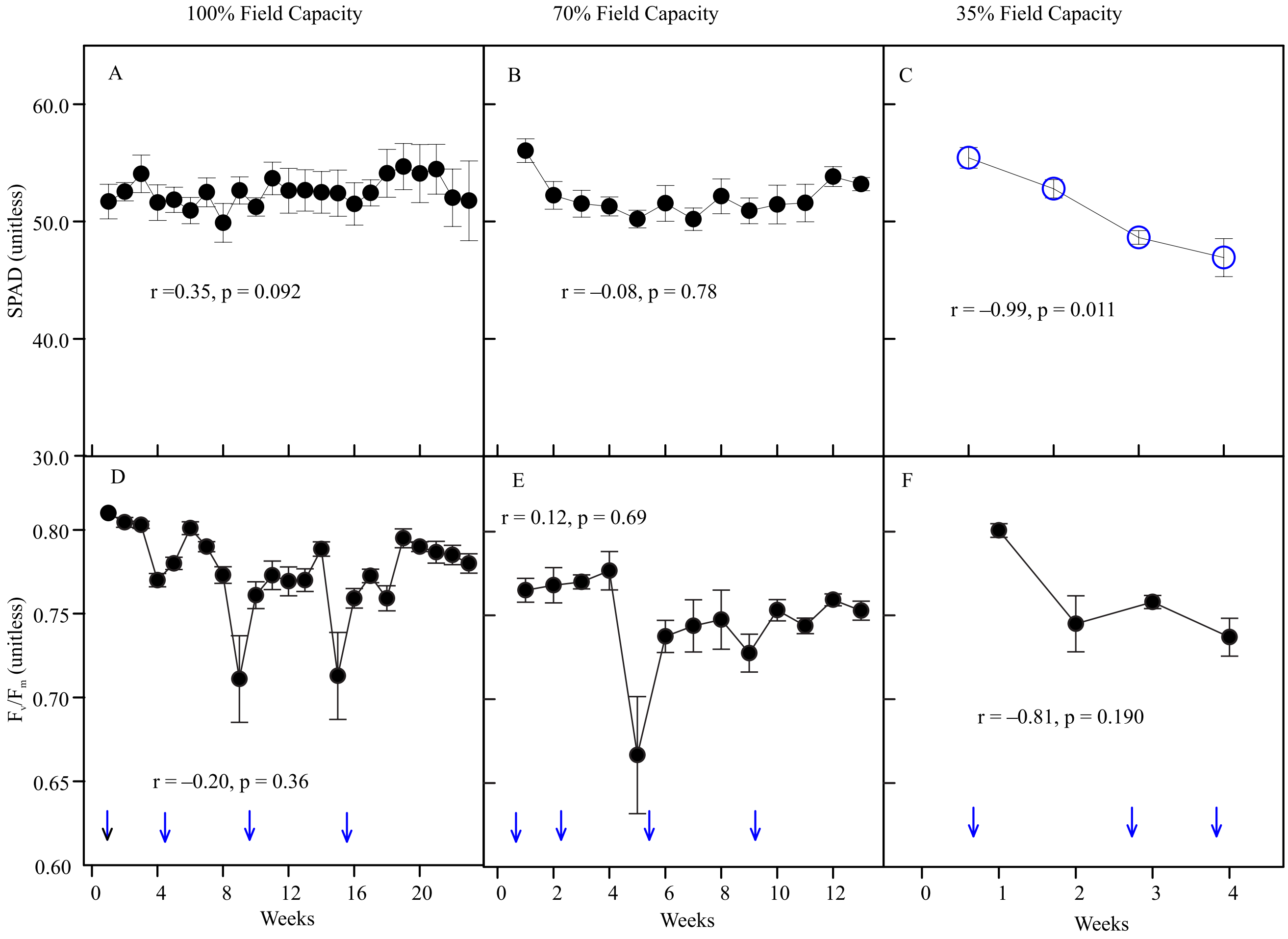

Figure 4. Values of soil plant analysis development (SPAD – a measure of the relative chlorophyll content) and the F_v/F_m ratio in mangabeira (*Hancornia speciosa*), in response to drying and wetting cycles. Further information as described in Figure 1.

instance, ribulose-bisphosphate carboxylase, fructose bisphosphatase, sucrose phosphate synthase); there is also the accumulation of reactive oxygen species and the increase of photorespiration, as stomatal closure reduces CO_2 availability in intercellular spaces (Mittler & Blumwald, 2015; Kaur & Asthir, 2017). Compared with the control treatment (soil permanently well-irrigated), the other treatments showed plant mortality from 43% (soil at 70-100% FC) to 57%, soil at 35% FC (Table 1). This results indicate that, within a given drying-watering cycle, the plants reached a point of severe dehydration, according to McDowell et al. (2011).

These results are important in face of ongoing climate changes, as prolonged droughts are expected to occur more frequently than in past years.

Conclusions

1. Compared with permanently well-irrigated plants, the total biomass and the number of leaves decrease in seedlings of mangabeira (*Hancornia speciosa*) subjected to water deficit.
2. Despite the decrease of biomass under water deficit, the exposure of mangabeira to drying-wetting cycles improves the photosynthetic performance of seedlings, as the elapsed time for photosynthesis to reach a null value after rewatering increases with successive wetting-drying cycles (from five to eight weeks, in soil at 100% field capacity).
3. Seedlings subjected to drying-wetting cycles can improve the performance of mangabeira under water deficit.

4. The pre-acclimation of mangabeira to drying-wetting cycles can be considered before transplanting the seedlings in the field, and the pre-acclimation should be carried out initially with soil at its field capacity.

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