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Papaya Seedlings Production from Soil and Formosa Group Genotypes under Water Levels in Soil

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Abstract: An experiment was carried out in order to evaluate the effects of water levels in soil on seedlings formation papaya tree from group Soil and Formosa. The treatments were distributed in delineation completely randomized using the factorial design 5x2 (60, 70, 80,90 and 100% field capacity of the soil and two genotypes of papaya Soil and Formosa group). The plants irrigation was made by weighing process supplying daily. The substratum was constituted of a mixture of soil material + earthworm humus in the proportion of 1:1 v/v. At 55 days after sowing were evaluated height, stem diameter, number of leaves, dry matter of the aerial part, of roots and total of the plants and relationship between dry matter date of root and aerial part. From results the highest values of height, diameter of stem and leaves emitted were obtained from the substrate with humidity between 85 and 100% of field capacity in both genotypes.The values of dry biomass of shoots, roots and dry biomass ratio of root / shoot increased with moisture in the substrate, with supremacy of the Solo on the Formosa papaya. Papaya Formosa develops more shoot and yields root dry matter less than the genotypes Solo.

Key words: *Carica papaya* · Growth of seedlings · Water in the soil.

INTRODUCTION

Papaya (*Carica papaya* L.) occupies an outstanding position in the national fruit and the states of Bahia, Espírito Santo and Rio Grande do Norte were the largest producers and exporters in the country.

The cultivars most commonly planted in Brazil belong to Solo and Formosa groups, being used with conventional, integrated and organic practices [1]. Productivity and quality of papayas depend on the cultivation of plants exempted from obtaining seed to seedling production. Among the factors that may affect the production of seedlings of good quality, are the control or irrigation, seed quality, fertilizer and substrate used, since they contribute to better development and health of plants [2].

Even assuming the expressiveness of the experiments related to management of seedlings in a greenhouse, there is still no conclusive information about some factors limiting the production of seedlings such as control of irrigation and nutrient demand. The nutrient supply is directly associated with the water supplied need for irrigation since excess promote rinsing of the substrate and consequent leaching of nutrients. On the other hand, insufficient irrigation influence seedling growth due to the nutritional imbalances and may also increase the salinity of the substrate by increasing the concentration of the fertilizer [3]. Irrigation is an essential technique in the greenhouse; however, inadequate management of the water supply can impair the production of seedlings. Thus, the production of quality seedlings in the Paraiba

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State depends on the application of an appropriate volume to genotype Solo and Formosa during the initial growth for the sustainable production of seedlings. The adoption of irrigation water suitable for irrigation can maximize the profits of papaya fruit [4].

This work aimed to evaluate the effect of different levels of soil water in the production of papaya seedlings of Solo and Formosa groups.

MATERIALS AND METHODS

The survey was carried out under greenhouse conditions on the State University of Paraiba, Catole do Rocha, State of Paraíba, Brazil (6°2'38"S; 37°44'48"W; 275 a.s.l.) from March 19 to May 12, 2010. The experiment was conducted in a completely randomized design in factorial arrangement 5x2, corresponding to five water levels (60, 70, 80, 90 and 100% of substrate field capacity) and two genotypes of papaya Solo and Formosa group, with three replicates. Irrigation was made ??based on the weighing process, providing the daily amount of water corresponding to each treatment.

The substratum was constituted of a mixture of 2 kg of soil material + earthworm humus in the proportion of 1:1 v/v, conditioned in black polyethylene bags with 15 cm of diameter and 30 cm of height. The soil and humus chemical attributes are, respectively: pH = 7.15 - 7.38; P = 5.5 - 55 (mg dm^3); K = 109 - 551 (mg dm^3); Ca = 3.85 - 35.40 ($cmol_c$ dm^3); Mg = 2.01 - 19.31 ($cmol_c$ dm^3); Na = 0.30 - 57.95 ($cmol_c$ dm^3); OM = 8.1 (g/kg). In each black polyethylene bag were sown four seeds from each of the genotypes of papaya. At 25 days after sowing, when seedling were 6 cm in height, thinning was done by keeping only one seedling per bag. Immediately after thinning, every fifteen days until the end of the experiment, the plants were sprayed with a suspension of urea at 0.2% N.

At 55 days after sowing were evaluated the number of leaves, height of seedlings from the cervix to the apical bud and stem diameter. Then the shoot (stem + leaves) of each seedling was separated from the roots and put into an oven with circulating air at a temperature of 65ºC until constant weight to obtain dry biomass of shoots and roots. The results were subjected to analysis of variance and polynomial regression using the software System for Analysis of Variance – SISVAR [5].

RESULTS AND DISCUSSION

Water levels and the interaction of soil water levels and genotypes (Table 1) had significant effects on all variables. This situation shows different behaviors among the genotypes as water requirements during the initial growth.

The increased level of water in the soil stimulated the growth in height of the genotypes; 55 DAS seedlings of Solo and Formosa reached the greatest heights of 32.48 and 31.82 cm in soil with 93% and 100% moisture of field capacity, respectively (Figure 1). However, at 55 DAS, the seedlings irrigated with 60% of field capacity, had already reached the recommended ideal height to transplant in situ, i.e, 15 cm as Soares [6].

Even accepting the small difference between the heights of seedlings (32.48 cm and 31.82 cm), corresponding to only 2.1% at the heights, the economy of water was 7% compared seedling Formosa with Solo. However, the heights of seedlings with 100% of field capacity, in this study were lower than the height of 43.83 cm, corresponding to changes of Baixinho de Santa Amália, grown under optimal soil moisture up to 34 DAS [7].

The increase in soil moisture stimulated the development of stem diameter of seedlings of both genotypes (Figure 2).

Table 1: Summary of variance analysis of height (H), stem diameter (SD), leaf number (LN), shoot dry matter (SDM), root dry matter (RDM), total dry matter (TDM) and root/shoot ratio (R/S) in papaya seedlings from the Solo and Formosa group, 55 days after emergence.

Sources of variation	DF	Mean Square						
		H	SD	LN	SDM	RDM	TDM	R/S
Water level (WL)	4	161,99**	10,31**	4,96**	0,29**	14,48**	16,92**	2,45**
Genotype (G)	1	3,24ns	1,31ns	2,70*	$0,11^{ns}$	12,63**	15,15**	2,12**
WL x G	4	23,90*	5,12**	1,03**	0,44**	3,55**	3,98**	0,86**
Residue	18	6,58	0,35	0,43	0,03	0,71	0,85	0,13
CV		21,45	6,06	9,54	8,11	18,93	13,93	17,92

*, **, ns, Significant at 5 and 1% (F test) and no significant, respectively

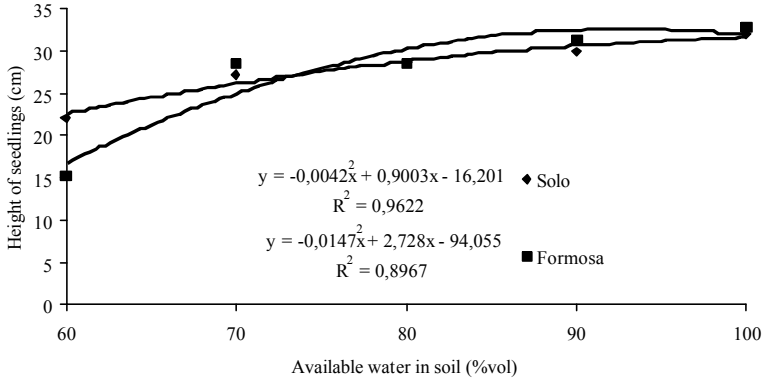

Fig. 1: Height of seedling of papaya Solo and Formosa group as a function of available water in soil

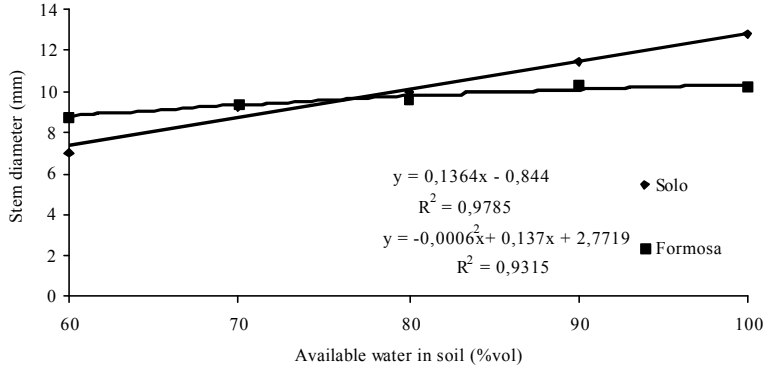

Fig. 2: Stem diameter of seedling of papaya Solo and Formosa group as a function of available water in soil

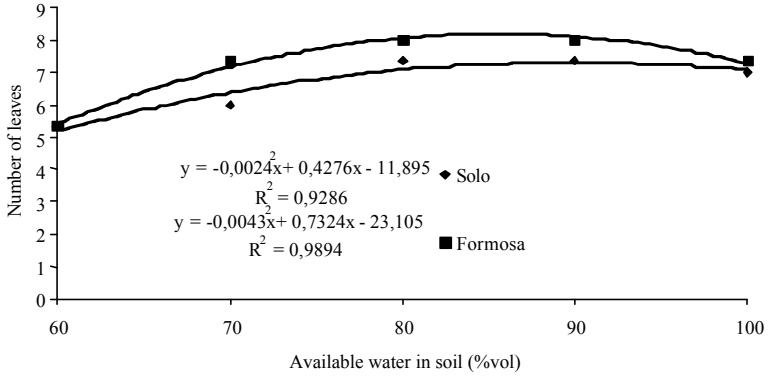

Fig. 3: Number of leaves of papaya Solo and Formosa group as a function of available water in soil

Genotype in Solo, the stem diameter increased linearly to the level of 0.1364 mm by increasing unitary of soil moisture in relation to field capacity reaching the highest value of 12.8 mm in the soil with moisture kept equal to 100% field capacity. This treatment exceeded by 74.8, 47.1, 20.8 and 11.9% regarding irrigation to maintain soil moisture levels of 60, 70, 80 and 90% field capacity, respectively. The stem diameter of genotype Formosa increased as a function of moisture reaching the maximum value of 10.47 mm with treatment maintained the moisture de100% of field capacity; however, the deficit and excess water affected the number of seedlings of both genotypes. These higher results observed in the genotypes Formosa were above 9.0 mm and lower than 12 mm obtained by Araújo *et al*. [8] and Souza *et al*. [9], respectively. The stem diameter of seedlings Solo and Formosa was greater than 9.79 cm observed by Mahouachi *et al*. [7] with seedlings of the cultivar Baixinha Santa Amália, subjected to water stress. The issue of seedling leaves of both genotypes increased as a function of soil moisture (Figure 3). However, according to the results, the genotype Formosa, during

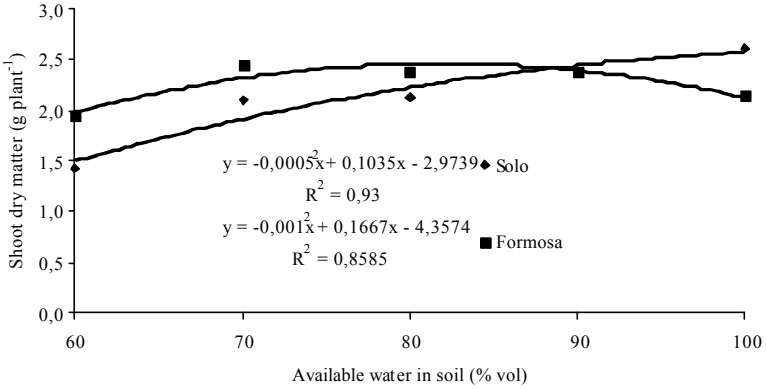

Fig. 4: Shoot dry matter of seedling of papaya Solo and Formosa group as a function of available water in soil

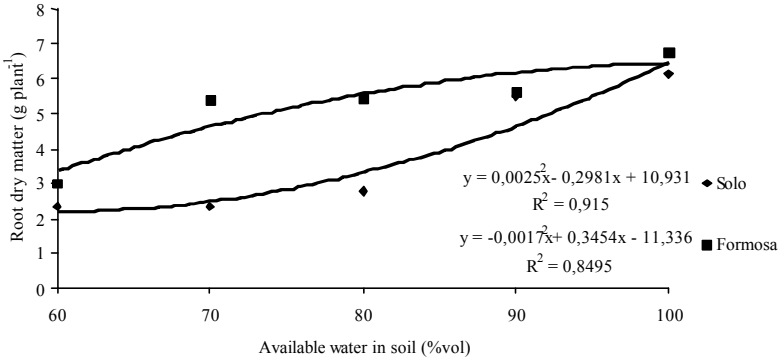

Fig. 5: Root dry matter of seedling of papaya Solo and Formosa group as a function of available water in soil

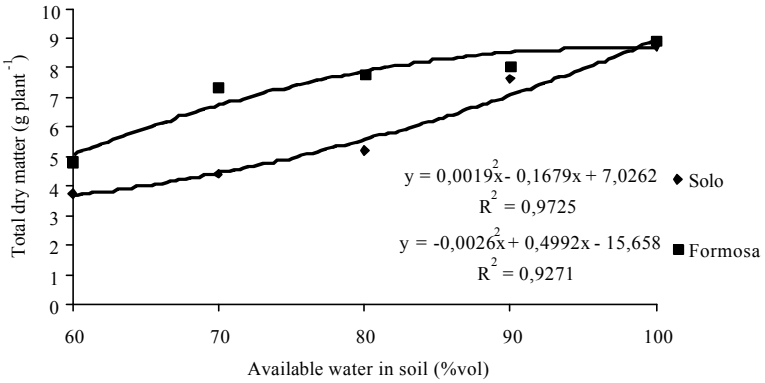

Fig. 6: Total dry matter of seedling of papaya Solo and Formosa group as a function of available water in soil

the formation of seedlings, was less water demanding than the Solo issuing eight leaves on the ground with moisture content of 85.2% compared to 7 sheets of Solo, with 89.1% in the soil moisture level of the field capacity. Moisture levels in the substrate above the values listed inhibit leaf emergence in plants of both genotypes. This situation indicates that the water excessive causes loss of breath with negative consequences on the absorption and nutrients and indeed, in the production of treated organic resulting in inhibition of growth and the quality loss of the seedlings. The number of leaves of the seedlings in this study was similar to 7-8 leaves and 8-9 leaves found on seedlings belonging to the Formosa group, which reached at the time, 25 DAS [10] and time of 60 DAS [11], respectively.

The dry matter accumulation by shoots of seedlings increased as a function of soil moisture, up to an estimated level of 83.2% with 2.3 g per seedling in genotype Solo and 2.6 g per seedling in the soil with 100% field capacity by a Formosa of papaya seedlings (Figure 4). In general, the accumulated water deficit caused the temporary wilting at times of higher temperature of some plants, affecting their physiology and consequent decrease in biomass production.

Comparatively, the values of the present study were higher than 1.64; 0.46 and 0.39 g dry mass of shoots obtained by Costa [12], Melo *et al.* [13] and Negreiros *et al*. [14] when studying different organic substrates, nitrogen and phosphate fertilizer, respectively, in the production of seedlings of papaya Solo group. However, the values lower than 5.43 and 4.65 g per seedling papaya Hawaii fertilized with 1660 and 2634 mg of N dm^{-3}, respectively [15].

Except for treatment with humidity at 100% of field capacity, where the values are similar between the two genotypes, the Solo papaya plants produced more dry mass of roots with increasing soil moisture in relation to Formosa (Figure 5). Comparing the values shown in Figures 4 and 5 showed that both genotypes produce more dry roots (2.6 and 2.3 g $seedlings^{-1}$) than in shoot (6.1 and 6.2 g $seedlings^{-1}$).

The data of total dry matter of papaya Solo group until the level of soil moisture of 96% of field capacity were significantly higher than the data of Formosa group (Figure 6). The behavior of these data was similar to those observed by roots of plants. In both genotypes, the highest values 9.2 and 8.3 g $plant^{-1}$ obtained in the treatment of 100% and 96% soil moisture were higher than 2.28, 2.16, 1.63 and 2.18 g $plant^{-1}$ obtained by Costa *et al*. [16], Negreiros *et al*. [14], Melo *et al*. [13] and Hafle *et al.* [1] in papaya Solo and Famosa group in different substrates and volumes.

The relationship between the values of dry matter of roots with the shoots of seedlings increased with the humidity of the substrate, with the highest ratio in seedlings of treatments with humidity of 100% of field capacity, with the highest values of 3.35 and 3.41 g g^{-1} for the genotypes Formosa and Solo, respectively. These values express the inadequate proportion between the development of roots and shoots of seedlings. According to Daniel *et al*. [17] appropriate values of the relative mass of roots / shoots mass must be situated around 0.50 or 50%. Values ??in this range are indicative of chemical and physical conditions of substrates appropriate to plant growth.

CONCLUSION

The highest values of height, diameter of stem and leaves emitted were obtained from the substrate with humidity between 85 and 100% of field capacity in both genotypes.The values of dry biomass of shoots, roots and dry biomass ratio of root / shoot increased with moisture in the substrate, with supremacy of the Solo on the Formosa papaya. Papaya Formosa develops more shoot and yields root dry matter less than the genotypes Solo.

REFERENCES

1. Hafle, O.M., V.A. Santos, J.D. Ramos, M.C.M. Cruz and P.C. Melo, 2009. Production of seedlings of papaya tree using Bokashi and Lithothamnium. Revista Brasileira de Fruticultura, 31(1): 245-251.
2. Yamanishi, O.K., G.R. Fagundes, J.A. Machado Filho and G.V. Valone, 2004. Different growth medium and fertilizer effects on papaya seedlings growth. Revista Brasileira Fruticultura, 26: 276-279.
3. Santos, R.V., L.F. Cavalcante and A.F.M. Vital, 2010. Interações salinidade-fertilidade do solo. In H.R Gheyi, N.S. Dias and C.F. Lacerda (Eds). Manejo da salinidade na agricultura: Estudos básicos e aplicados, pp: 221-250. Fortaleza: INCTSal.
4. Lyra, G.B., N.J. Ponciano, P.M. Souza, E.F. Souza and G.B. Lyra, 2010. Economic viability and cultivation risk of papaya in function of irrigatio depth and ammonium sulfate. Acta Scientiarum. Agronomy, 32: 547-554.
5. Ferreira, D.F.V., 2003. Sisvar 4.6. System statistical analyzes. Lavras: UFLA, pp: 32.
6. Soares, N.B., 1998. Papaya Carica papaya L. In J.I. Fahl, M.B.P. Camargo, M.A. Pizzinatto, J.A. Betti, A.M.T. Melo, I.C. Demaria and A.M.C. Furlani (Eds). Instructions for major agricultural crops economic (pp: 137) Campinas. (Boletim, 200).
7. Mahouachi, J., A.R. Socorro and M. Talon, 2006. Responses of papaya seedlings (Carica papaya L.) to water stress and re-hydration: growth, photosynthesis and mineral nutrient imbalance. Plant and Soil, 281: 137-146.
8. Araújo, W.B.M., R.D. Alencar, V. Mendonça, E.V. Medeiros, R.C. Andrade and R.R. Araújo, 2010. Goat manure used in substrate composition for formation of papaya seedlings. Ciência e Agrotecnologia, 34: 68-73.
9. Souza, T.V., V.P.S. Paz, E.F. Coelho, F.A.C. Pereira and C.A.S. Ledo, 2007. Growth and yield of papaya under combinations of nitrogen sources applied by irrigation water. Irriga, 12: 563-574.
10. Garcia, F.C.H., F.M.L. Bezerra and C.A.S. Freitas, 2007. Effect of irrigation levels in the yield of papaya (group Formosa) in the Plateau of Apodi, CE. Revista Ciência Agronômica, 38: 136-141.

11. Mendonça, V., J.D. Ramos, D.J. Dantas, P.C.C. Martins, T.C.A. Gontijo and R. Pio, 2004. Effect of dosages of Osmocote and two types of substrate on the growth of papaya 'Formosa' seedlings. Revista Ceres, 51: 467-476.
12. Costa, A.P.M., 2008. Growth and mineral composition of papayain substrates fertilized with nitrogen and phosphorus. Areia. Dissertation (Master's Degree of Crop Science) - Universidade Federal da Paraíba, Areia. pp: 64.
13. Melo, A.S., C.X. Costa, M.E.B. Brito, P.R.A. Viegas and C.D. Silva Junior, 2007. Production of papaya seedlings in different substrate and phosphorus levels. Revista Brasileira de Ciências Agrárias, 2(4): 257-261.
14. Negreiros, J.R., L.R. Braga, V.S. Álvares and C.H. Bruckner, 2005. Different substrata for a production of papaya tree (Carica papaya) group Solo seedlings. Revista Brasileira de Agrociência, 11(1): 101-103.
15. Medeiros, P.V.Q., G.A. Leite, V. Mendonça, R.G. Pereira and M.S. Tosta, 2008. Papaya 'Hawai' fruit seedling growth according to nitrogen fonts and doses. Agropecuária Científica no Semiárido, 4(1): 42-47.
16. Costa, M.C., M.C.F. Albuquerque, J.M. Albreht and M.F.B. Coelho, 2005. Substrates for production of jenipapo (*Genipa americana* L.). Pesquisa Agropecuária Tropical, 35: 19-24.
17. Daniel, O., A.C.T. Vitorino, A.A. Alovisi, L. Mazzochin, A.M. Tokura, E.R. Pinheiro and E.F. Souza, 1997. Phosphorus application in *Acácia mangium* Willd seedlings. Revista Árvore, 21: 163-168.