

GROWTH, PHYSIOLOGY AND YIELD OF FORMOSA 'PAPAYA' CULTIVATED UNDER DIFFERENT DOSES OF COATED AND CONVENTIONAL UREA¹

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ABSTRACT – Mineral fertilizer management is one of the most important agronomic techniques applied in papaya cultivation, which generally extracts large amounts of nutrients from soil, especially nitrogen. This study aimed to assess the phytotechnical and physiological attributes and yield of 'Formosa' papaya hybrid Caliman 01 as a function of different doses of coated and conventional urea in the region of Bom Jesus - PI, Brazil. The treatments were arranged in a factorial scheme (2 × 4) and distributed in a randomized block design with four replications, corresponding to 2 nitrogen sources (coated urea, 43% of N; and conventional urea, 45% of N) and 4 doses nitrogen (350, 440, 530 and 620 g per plant). The N doses used corresponded to 80, 100, 120 and 140% of the nitrogen fertilization. It was used six plants per plot with two row borders, totaling 192 plants cultivated in the field. It was assessed the intercepted photosynthetically active radiation (*int.PAR*), radiation interception efficiency (*PAR_{eff}*), leaf area index (LAI), plant height, stem diameter and yield. The coated urea promotes a higher growth and yield of 'Formosa' papaya compared to the conventional urea. The application of 1.0 g of coated N promotes the production of 2.87 g of fruit per hectare while the application of 1.0 g of conventional N produces only 1.89 g of fruit per hectare, showing that the source of polymerized N increases the use efficiency of N applied to soil.

Keywords: *Carica papaya*. Coated N. Fruticulture. Fruit production.

CRESCIMENTO, FISILOGIA E PRODUTIVIDADE DO MAMOEIRO FORMOSA CULTIVADO SOB DIFERENTES DOSES DE UREIA PROTEGIDA E CONVENCIONAL

RESUMO - O manejo da adubação mineral é uma das mais importantes técnicas agrônômicas aplicadas no cultivo do mamoeiro, que de modo geral, extrai grandes quantidades de nutrientes no solo, com destaque para o nitrogênio. Objetivou-se avaliar os atributos fitotécnicos, fisiológicos e a produtividade do mamoeiro Formosa híbrido Caliman 01 em função de diferentes doses de ureia protegida e convencional na região de Bom Jesus-PI. Os tratamentos foram dispostos em esquema fatorial (2 x 4), distribuídos em blocos ao acaso, com 4 repetições, correspondentes a 2 fontes de nitrogênio (ureia protegida, 43% de N; e ureia convencional, 45% de N) e 4 doses de nitrogênio (350, 440, 530 e 620 g planta⁻¹ de N). As doses de N utilizadas são correspondentes às percentagens de 80, 100, 120 e 140% da adubação nitrogenada. Utilizou-se 6 plantas por parcela, sendo duas bordaduras, totalizando 192 plantas cultivadas no campo. Avaliou-se a radiação fotossinteticamente ativa interceptada (*RFA_{int.}*), eficiência de interceptação da radiação (*Ef_{RFA}*), índice de área foliar (IAF), altura de planta, diâmetro do caule e produtividade. A ureia protegida promove maior crescimento e produtividade do mamoeiro formosa em relação à ureia convencional. A aplicação de 1,0 g de N protegido promove a produção de 2,87 g de frutos por hectare enquanto que a aplicação de 1,0 g de N na fonte ureia convencional produz apenas 1,89 g de frutos por hectare, mostrando que a fonte de N polimerizada incrementa a eficiência de uso do N aplicado no solo.

Palavras-chave: *Carica papaya*. N-protegido. Fruticultura. Produção de frutos.

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INTRODUCTION

Papaya (*Carica papaya* L.) is an herbaceous plant, typically found in tropical areas, with fast and frequent production throughout the year. Brazil is the world's largest producer of papaya, with an average yield of 52.19 t ha⁻¹, especially in Bahia and Espírito Santo, the main Brazilian producing states (IBGE, 2012).

Mineral fertilizer management is one of the most important agronomic techniques applied in papaya cultivation, which generally extracts large amounts of nutrients from soil, especially nitrogen, which is the nutrient required in larger quantities throughout the crop cycle (MARINHO et al., 2010). Traditionally, it is used different N sources for papaya nitrogen fertilization, such as ammonium nitrate, ammonium sulfate, and most commonly, the urea, as observed in studies developed by Santos et al. (2014) and Santos et al. (2016). However, these soluble N forms are more susceptible to losses to the environment through ammonia volatilization and nitrate leaching (NOELLSCH et al., 2009).

In order to reduce losses occurred during the conventional nitrogen fertilizer practice, it has sought technological alternatives that can increase the nitrogen fertilization efficiency. Among the feasible means, it has studied the use of nitrogen fertilizers of controlled release, which constitute inputs whose granules are protected with a layer composed of mineral additives and polymers, favoring gradually the nitrogen supply in the soil solution and, consequently, improving its use efficiency by plants throughout the cultivation (GRANT et al., 2012).

In this sense, nitrogen fertilization effect of slow release, in economically important crops, has been reported in the scientific literature with emphasis on studies conducted with major crops, such as wheat (GRANT et al., 2012) and corn (NOELLSCH et al., 2009), besides vegetable crops such as tomato (FAN et al., 2009) and cabbage (RODRIGUES et al., 2010), and fruit species such as peach (KANDIL et al., 2010), guava (OSMAN et al., 2009) and mango (EMAN et al., 2009), summarizing its positive effects on their phytotechnical and productive attributes. However, specifically for papaya cultivation, studies on the feasibility of using controlled release fertilizers in Brazil and in the world are still incipient.

Given the above, this study aimed to assess the phytotechnical and physiological attributes and yield of 'Formosa' papaya hybrid Caliman 01 as a function of different doses of coated and

conventional urea in the region of Bom Jesus - PI, Brazil.

MATERIAL AND METHODS

The experiment was conducted during the period from November 30, 2011 to February 15, 2013 at the fruticulture experimental farm of the Campus Professor Cinobelina Elvas (CPCE), at the *Universidade Federal do Piauí* (UFPI), located in Bom Jesus - PI, Brazil. The area is located at geographical coordinates 09° 04' 28" S and 44° 21' 31" W, with an average altitude of 277 m during the period of November 30, 2011 to February 15, 2013. Bom Jesus is located in the semiarid region of Piauí state with warm and humid climate, classified by Koppen as *Cwa* type.

For the seedlings production, it was used certified seeds of 'Formosa' papaya hybrid Caliman 01 provided by the *Instituto Capixaba de Pesquisa, Assistência Técnica e Extensão Rural* (INCAPER) of the Espírito Santo State. It was used a substrate composed of sandy soil and cattle manure in the proportion 3:1, respectively, adding 1.4 kg of single superphosphate (18% of P₂O₅) and 1.0 kg potassium chloride (60% of K₂O) per m³ of substrate. Seedlings were cultivated under protected conditions (screen with 50% shading) in polyethylene bags (23 × 12 cm) filled with substrate. It was sown three seeds per bag, with the thinning carried out 15 days after plant emergence and being left only the most vigorous per container; the seedlings were transferred to the field as they had approximately 20 cm high, 60 days after sowing (MARIN, 2004).

The treatments were arranged in a factorial scheme 2 × 4, corresponding to 2 nitrogen sources (the coated urea Kimcoat N[®], coated with polymer layers, and conventional urea) and 4 nitrogen levels (350, 440, 530 and 620 g per plant). The treatments were distributed in a randomized block design with 4 replications and 6 hermaphrodite plants of 'Formosa' papaya per plot, being 4 useful plants and 2 row borders, cultivated at double spacing (3.8 m between double rows × 1.8 m between rows × 2.0 m between plants), totaling 192 plants with a density of 1,785 plants ha⁻¹.

The N doses used corresponded to 80, 100, 120 and 140% of nitrogen fertilization, as recommended by Costa and Costa (2003). The nutrient amounts (g plant⁻¹) were applied monthly in top dressing following recommendations of Costa and Costa (2003), which are presented in Table 1.

Table 1. Nutrient amounts applied monthly, in top dressing, for papaya cultivation.

Time of application	N					K ₂ O	P ₂ O ₅
	Recommended dose*	80%	100%	120%	140%		
----- g plant ⁻¹ -----							
Mar./12	25	20	25	30	35	5	-
Apr./12	25	20	25	30	35	10	-
May/12	35	28	35	42	49	60	40
June/12	35	28	35	42	49	20	-
July/12	35	28	35	42	49	30	-
Aug./12	40	32	40	48	56	40	25
Sept./12	40	32	40	48	56	40	-
Oct./12	50	40	50	60	70	40	-
Nov./12	50	40	50	60	70	40	25
Dec./12	35	28	35	42	49	40	-
Jan./13	35	28	35	42	49	35	-
Feb./13	35	28	35	42	49	35	-
Total	440	350	440	530	620	395	90

*Splitting of N doses according to Costa and Costa (2003), according to rates of each treatment.

The conventional urea contained 45% of N, whereas the coated urea presented 43% of N. Thus, the doses 350, 440, 530 and 620 g per plant corresponds, approximately, to the amounts of 780, 980, 1180, 1380 g plant⁻¹ of conventional urea and 815, 1,025, 1,230 and 1,440 g plant⁻¹ of coated urea, throughout the cultivation period.

Potassium chloride (60% of K₂O) was used as potassium source and phosphorus fertilization was performed with single superphosphate (18% of P₂O₅). All fertilizers (urea, single superphosphate and potassium chloride) were applied in a circular

circle under the canopy projection, 20 cm from the stem and slightly incorporated into the soil with the assistance of field hoes. All fertilizations were finished in February 2013, corresponding to the last harvest month.

The soil of the experimental area is classified as a Quartzarenic Neosol (Entisol) (EMBRAPA, 2013) with sandy texture. The physical and chemical characteristics at depths from 0.0 to 0.20 and from 0.20 to 0.40 m, before experiment installation, are summarized in Table 2, following method described by Raij et al. (1987).

Table 2. Soil physical and chemical characteristics in the experimental area (0.0–0.20 and 0.20–0.40 m).

Soil characteristic	Unit	Depth (cm)	
		0–20	20–40
pH–H ₂ O (1:2.5)	-	5.0	4.8
Potassium	cmol _c dm ⁻³	0.23	0.11
Calcium	cmol _c dm ⁻³	1.6	0.9
Magnesium	cmol _c dm ⁻³	0.4	0.2
Sodium	cmol _c dm ⁻³	0.02	0.02
Aluminum	cmol _c dm ⁻³	0.0	0.0
Hydrogen	cmol _c dm ⁻³	1.7	1.3
CEC*	cmol _c dm ⁻³	3.9	2.5

*CEC: Cation Exchange Capacity.

Table 2. Continuation.

Soil characteristic	Unit	Depth (cm)	
		0–20	20–40
P (Mehlich-1)	mg dm ⁻³	18.0	14.0
Organic matter	%	1.0	0.4
Base saturation	%	57.0	48.0
Clay	g kg ⁻¹	60	60
Silt	g kg ⁻¹	20	20
Sand	g kg ⁻¹	920	920

*CEC: Cation Exchange Capacity.

The data related to climatic variables (air temperature, relative air humidity and rain precipitation), collected at the meteorological station

of the UFPI/CPCE during the experiment conducting, are shown in Figure 1.

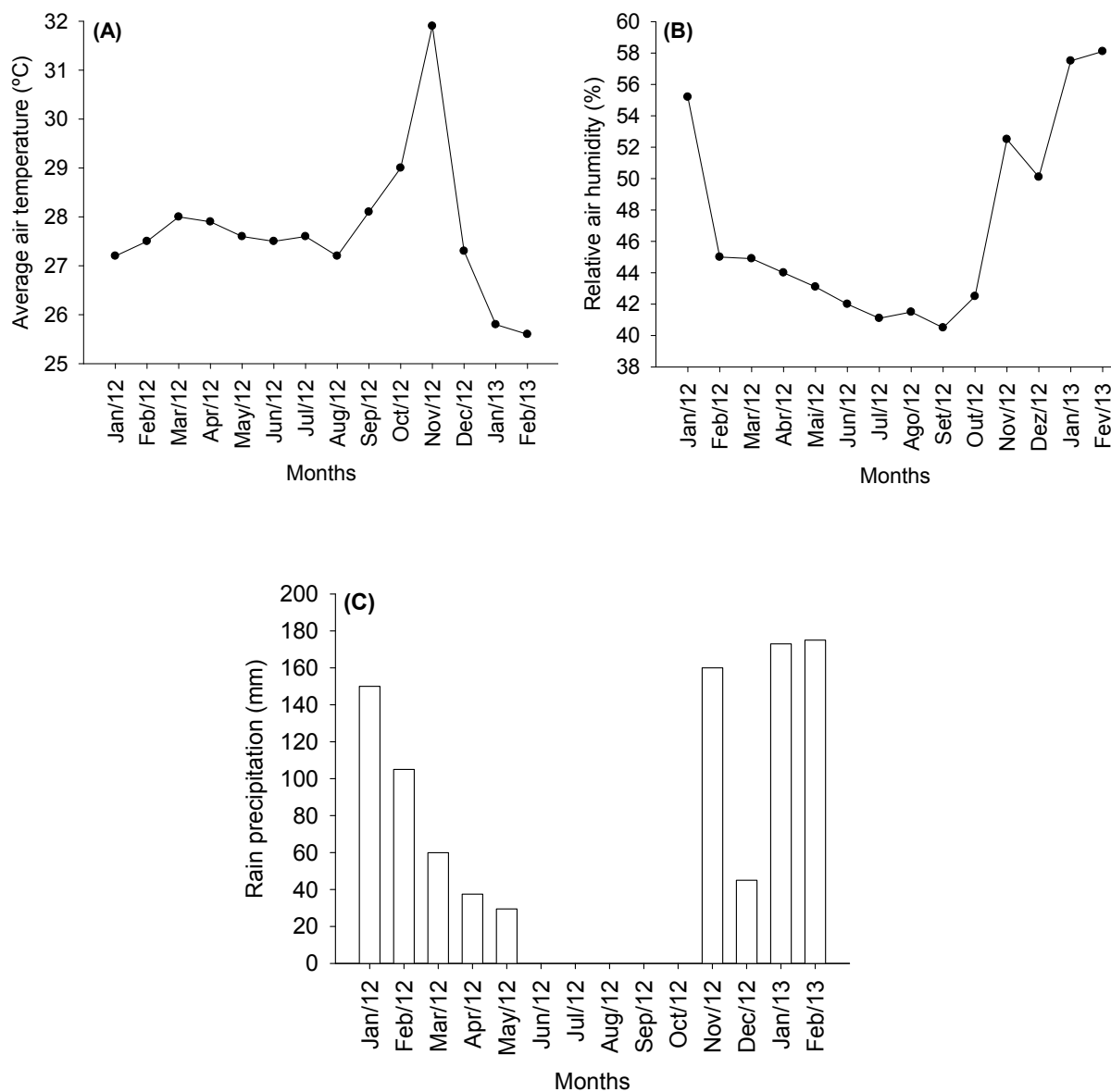


Figure 1. Air temperature (A), relative air humidity (B) and rain precipitation (C) while performing the experiment.

Soil tillage was conducted 60 days before transplanting the seedlings and liming was carried out according to soil chemical analysis results for the experimental area. It was applied 1.22 t ha⁻¹ of dolomitic limestone (RNV = 75%) in total area, increasing base saturation to 80% (MARIN, 2004). Half dose was applied before plowing and the other half after plowing and before harrowing by using a harrow and thereby ensuring greater application uniformity. The pits were opened with dimensions of 40 × 40 × 40 cm, in which were added 170 g of single superphosphate (18% of P₂O₅), following the recommendations of Costa and Costa (2003).

Seedlings transplantation was conducted on February 9, 2012 using two plants per pit spaced 20 cm from each other, being trained with wooden stakes 1.0 m long. Thinning was carried out at the 120 days after flowering, based on the plants sexing, leaving only one hermaphrodite plant per pit (MARIN, 2004).

The irrigation was performed by drip system, providing a daily average water depth of 6.9 mm, equivalent to the daily evaporation obtained based on the class A evaporation pan method installed at the meteorological station of the UFPI/CPCE and corrected according with the crop coefficient (Kc) of papaya, as in Coelho Filho et al. (2006).

Weed control was carried out monthly in the inter-row by hoeing and mowing, and pests and diseases control was conducted according to the recommendations for papaya commercial production systems (OLIVEIRA et al., 1995).

At 120 days after transplanting, when the plants were in full bloom, the following physiological variables were estimated: a) intercepted photosynthetically active radiation (*int.PAR*, expressed in $\mu\text{mol m}^{-2} \text{s}^{-1}$), calculated following the recommendations of Varlet-Grancher et al. (1989), as follows: $\text{PAR} = \text{inc.PAR} - \text{ts.PAR}$, where *inc.PAR* is the incident radiation and *ts.PAR* is the transmitted radiation to soil, highlighting that both radiation (*inc.PAR* and *ts.PAR*) was determined in triplicate, in a sunny day between 9:00 and 11:00 h and at the same time using a ceptometer (Decagon Devices Inc., USA) with sensors installed below and above the canopy, respectively; b) PAR interception efficiency (*PAREff.*) by the crop, estimated by the ratio between *int.PAR* and *inc.PAR*.

At 275 days after transplanting, it was carried out the following assessments: a) plant height (cm), using millimeter measuring tape (0.01 cm) and by measuring the distance from the base to the last leaf insertion; and b) stem diameter (mm), determined with a digital caliper (0.01–300 mm, Digimess®) measured at 20 cm from soil.

At harvest time, conducted from October 15, 2012 to February 15, 2013, totaling 120 days, it was

determined the yield (t ha⁻¹) considering the fruits harvested in all plants of the experimental plots (usable area of 4 plants per plot). Fruits were harvested weekly in the maturation stages 3, when presented only 25 to 50% of the peel surface with yellowish color, according to the recommendations of Marin (2004). Thereafter, the fruits were selected, counted and weighed on a precision balance (0.01 g) in order to determine the fruit mass per plant and estimate the total yield given by the sum of fruit mass per plant throughout the harvest period for each treatment multiplied by the number of plants per hectare (1785 plants).

The results were submitted to analysis of variance for the diagnosis of significant effects between the sources and doses of nitrogen, using the F and Tukey's tests in order to compare the means of nitrogen sources. For N doses, it was applied the simple regression analysis using the statistical programs Assistat and SigmaPlot.

RESULTS AND DISCUSSION

By means of the analysis of variance of the phytotechnical and physiological attributes and yield of 'Formosa' papaya was found individual effect of sources and doses of nitrogen for plant height ($p < 0.01$), intercepted photosynthetically active radiation ($p < 0.05$), use efficiency of PAR ($p < 0.05$) and yield ($p < 0.01$). For the interaction between sources and the nitrogen fertilization doses studied, there was a significant effect on plant height (PH), stem diameter (SD), intercepted photosynthetically active radiation (*int.PAR*), use efficiency of PAR (*PAREff.*) and yield (Pt) at 5% probability (Table 3).

The interaction between different doses of nitrogen fertilization showed quadratic behavior for plant height, with estimated maximum values of 192.76 and 167.21 cm for doses of 466.08 and 510.21 g per plant, for the nitrogen sources coated (Figure 2A) and conventional (Figure 2B) urea, respectively. The maximum values found for the plants cultivated with coated urea (192.76 cm) are low compared to those found by Souza et al. (2005) (240.0 cm), who studied the growth and yield of 'Formosa' papaya fertirrigated with phosphorus by surface and subsurface drip in Cruz das Almas, BA, Brazil. This fact may be associated with the regional climatic conditions where the experiment was conducted, characterized by high temperature and low relative air humidity throughout the crop cycle (Figure 1), affecting papaya growth. On the other hand, the plant height values are higher than 180.0 cm as reported by Souza et al. (2007), who assessed papaya growth and yield under different nitrogen sources combinations.

Table 3. Summary of analysis of variance related to measuring in plant height (PH), stem diameter (SD), intercepted photosynthetically active radiation (*int.PAR*), use efficiency of PAR (*PAREff.*), leaf area index (LAI) and yield (Pt) of 'Formosa' papaya cultivated under different doses of coated and conventional urea.

Source of variation	PH cm	SD mm	<i>int.PAR</i> $\mu\text{mol m}^{-2} \text{s}^{-1}$	<i>PAREff.</i> index	LAI index	Pt t ha^{-1}
N source (F)	76.14**	1.62 ^{ns}	4.59*	4.62*	0.63 ^{ns}	25.49**
Coated urea	177.95a	65.76a	962.44b	0.51b	0.24a	10.89a
Conventional urea	158.86b	62.80a	1228.87a	0.65a	0.24a	6.91b
LSD	4.55	4.71	258.63	0.13	0.06	1.62
N doses (N)	26.49**	0.69 ^{ns}	2.99*	3.03*	0.74 ^{ns}	9.44**
Interaction (F × D)	8.77*	0.07*	4.46*	4.54*	0.31 ^{ns}	4.49*
CV (%)	3.67	9.96	32.10	31.96	3.72	24.80

CV = coefficient of variation; LSD = least significant difference; ** = significant at 1% probability ($p < 0.01$); * = significant at 5% probability ($p < 0.05$); means followed by different letters in columns are statistically different by the Tukey's test at 5% probability.

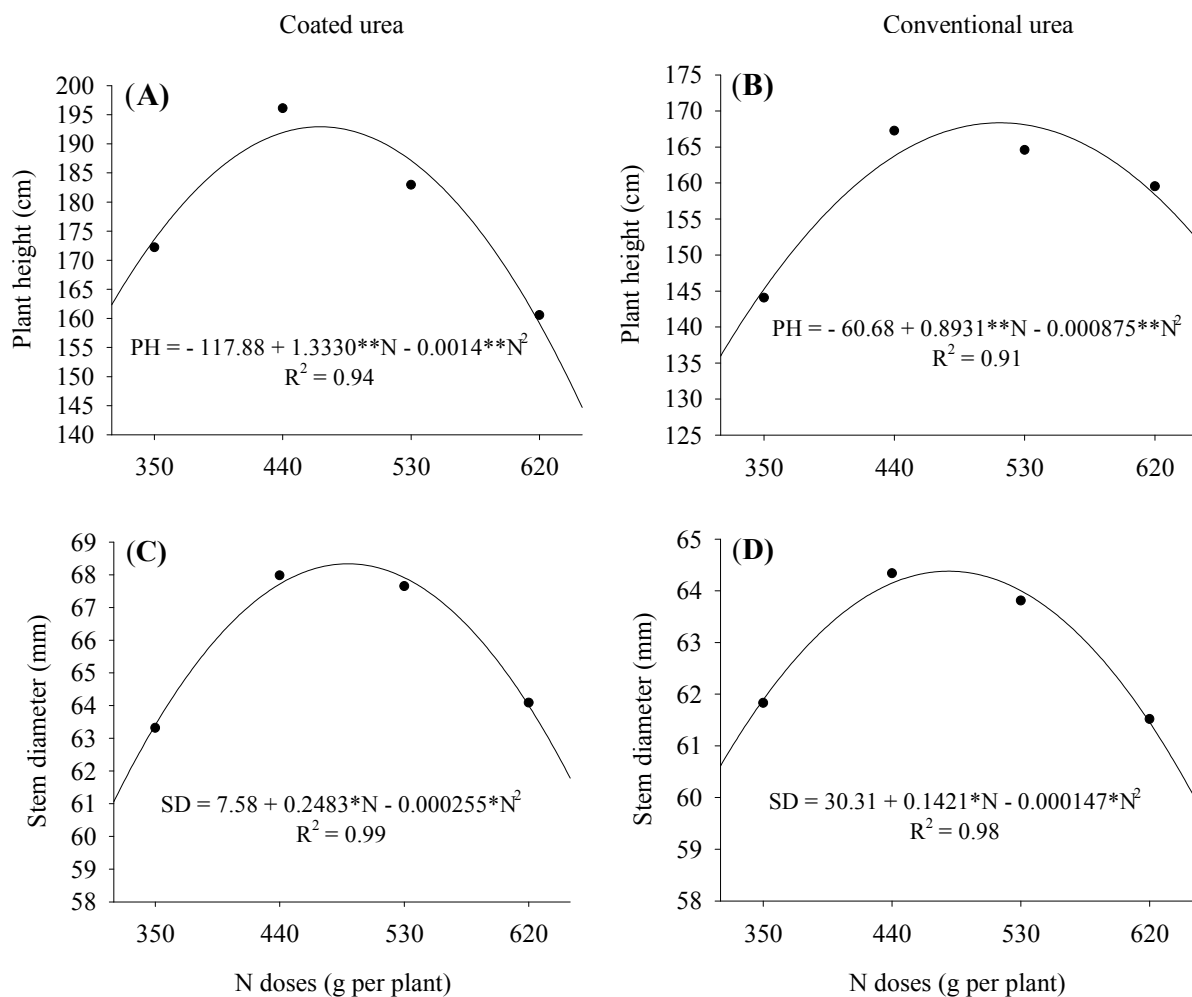


Figure 2. Height (A and B) and stem diameter (C and D) of 'Formosa' papaya plants cultivated under different doses of coated and conventional urea.

The low values reported by Souza et al. (2007) in relation to this study may be related to the planting spacing and population density, as reported

by Resende and Costa (2003), who observed that planting density is a factor to be taken into account since plant population pressures affect markedly

their growth and development. Thus, when there is an increase in the number of plants per unit area, there is also an increase in competition for essential growth factors such as light, nutrients and water. However, Souza et al. (2007) worked with single spacing and lower population density, whereas in this experiment was used double spacing with high population density.

Regarding the stem diameter, the maximum dose estimated of coated urea was 482.86 g per plant for a stem diameter of 68.02 mm (Figure 2C), whereas the conventional urea promoted a stem diameter of 64.65 mm, which corresponds to the estimated dose of 488.33 g per plant (Figure 2D).

Compared to the estimated maximum doses, the coated urea was superior to the conventional urea at 15.28% for plant height by reducing its dose from 510.21 to 466.08 g per plant, which corresponds to a reduction of 9.46% or 44.13 g per plant applied to soil. With the same tendency, but in smaller proportions, it was also observed lower N doses for a higher value of stem diameter, with an increase of 5.21% in the diameter, which corresponds to a reduction of 5.47 g per plant when coated urea was used compared to conventional urea.

The superiority of the coated fertilizer for

plant height and stem diameter is given by a better nitrogen availability applied under this source, which is involved directly in plant growth (TAIZ; ZEIGER, 2009) for a longer period in the soil, providing papaya plants larger sized.

The use of slow-release fertilizer was sufficient to increase the development of papaya plants, being possible to reduce the amount of N applied in soil and hence the environmental pollution through nitrates leaching ($N-NO_3^-$), as reports Kandil et al. (2010) when verifying similar results in studies with slow-release fertilizers on growth, nutrition and production of peach in Egypt.

In relation to the physiological variables, for the interaction between sources and doses of nitrogen fertilization, *int.PAR* presented estimated maximum values of 1,296.50 and 1,578.70 $\mu\text{mol m}^{-2} \text{s}^{-1}$ in doses of 494.85 and 461.65 g per plant for the sources coated (Figure 3A) and conventional (Figure 3B) urea, respectively.

For *PAREff.*, the maximum dose estimated to nitrogen fertilization with coated urea was 494.41 g per plant, which correspond to 0.665 (Figure 3C), whereas conventional urea promoted an index of 0.796 related to the dose estimated of 457.94 g per plant (Figure 3D).

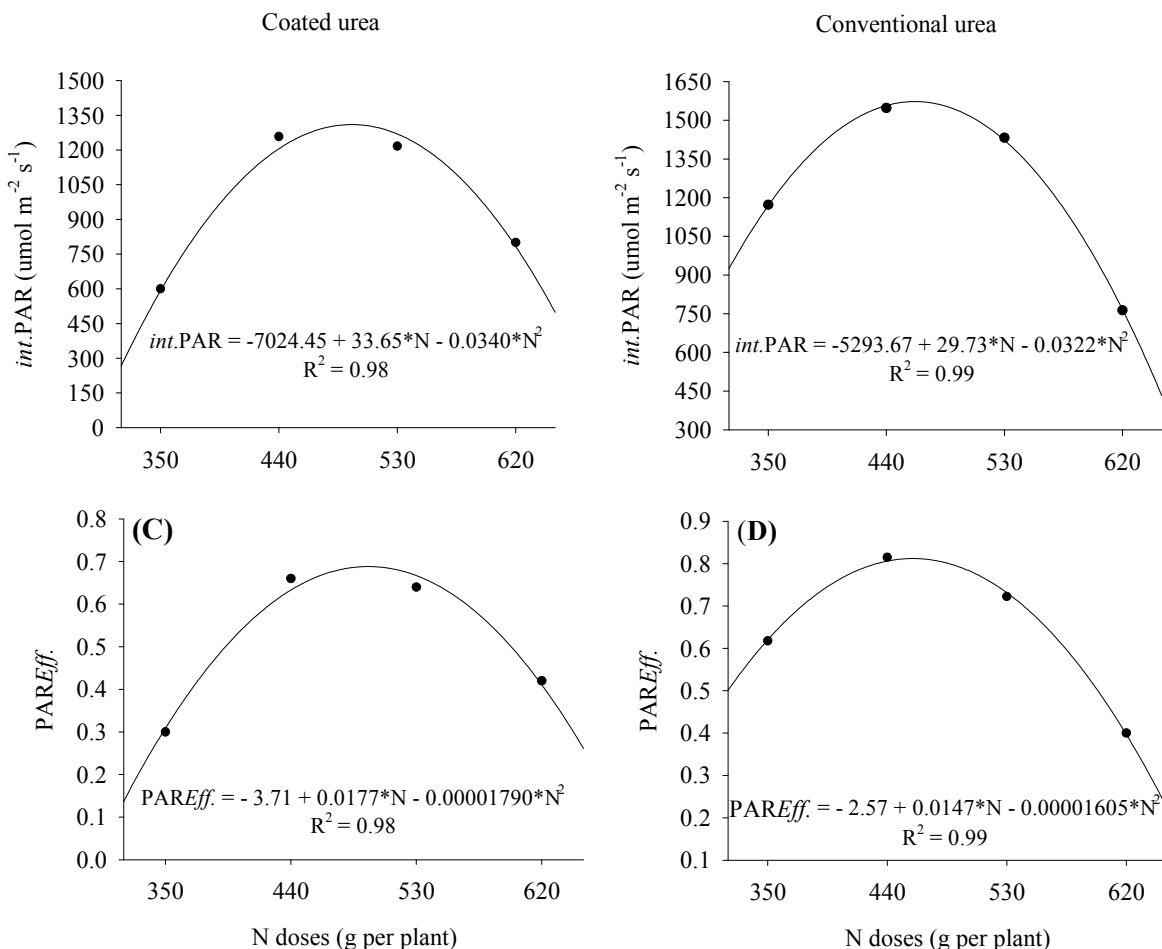


Figure 3. Intercepted photosynthetically active radiation (A and B) and use efficiency of photosynthetically active radiation (C and D) of 'Formosa' papaya cultivated under different doses of coted and conventional urea.

Nitrogen essentiality to achieve high photosynthetic rates in papaya is evidenced by the positive relationship between these characteristics. Both *int.PAR* and *PAR_{eff}* was incremented as N doses applied in the soil increased, which could be explained due to the high 'Formosa' papaya demand for this nutrient (OLIVEIRA; CALDAS, 2004), associated with the application of optimal doses since the organic matter content, the main source of N in the soil, presented low values before the experiment installation, as shown in Figure 1, favoring the effect of nitrogen fertilization. These results corroborate those observed by Taiz and Zeiger (2009), who observed that the plant photosynthetic capacity is dependent on nitrogen supply since a considerable fraction of this element is found in the leaves, allocated in proteins involved in the photosynthetic process. These authors also suggest that photosynthesis depends on several nitrogenous compounds such as enzymes and photosynthetic pigments for the production of carbon compounds that compose the aerial part. For this reason, plants photosynthetic ability and nitrogen metabolism are directly interconnected.

In addition, it is pertinent to highlight the high light saturation point of the crop fertilized with coated urea, which was above of $1,350 \mu\text{mol m}^{-2} \text{s}^{-1}$ (Figure 3A), allowing to find that there was no harmful light saturation to the crop since the maximum PAR registered above the canopy was $1,900 \mu\text{mol m}^{-2} \text{s}^{-1}$.

Martelleto et al. (2008) also observed the increase of the photosynthetically active radiation with the increasing N doses in 'Baixinho de Santa Amália' papaya when assessing the plants growth in protected environments with maximum radiation estimated in about $1,600 \mu\text{mol m}^{-2} \text{s}^{-1}$. Similarly, Cruz et al. (2007) found positive effects of nitrogen doses on photosynthetic active radiation in Golden papaya.

It is observed that the maximum dose of

conventional urea estimated provided better results for *int.PAR* and *PAR_{eff}*. However, both stem diameter and plant height were enhanced with the application of urea coated with polymers when compared to the conventional urea. It is reported that the assessment period of physiological and phytotechnical parameters occurred at different physiological stages, at 120 and 275 days after planting, respectively, which contradicts the relationship between these attributes. Therefore, at four months old, the plants were still in full vegetative growth and because the conventional urea presents a rapid N release in the soil (CIVARDI et al., 2011), it probably favored a greater crop development at this stage, contributing to greater PAR interception efficiency.

For the average yield, registered during 120 days of harvest, it is observed that for both N sources there was a quadratic increase in yield as nitrogen doses increased in the soil, with superiority for the gradual release fertilizer (Figure 4A and B). Yield presented estimated maximum values of 14.30 and 8.70 t ha^{-1} with the doses of 498 and 460 g per plant for coated (Figure 4A) and conventional (Figure 4B) urea, respectively, with a reduction in yield with the increasing N doses in the soil from the maximum doses estimated for both sources.

The estimated maximum N doses were 498 g per plant for coated urea and 460 g per plant for conventional urea. Thus, in higher yields, the N dose in the polymerized urea source was 7.6% higher in relation to the conventional urea dose. On the other hand, with the application of coated urea, there was an increase of 39.2% in the maximum papaya yield. Thus, the application of 1.0 g of coated N promoted the production of 2.87 g of fruit per hectare, whereas 1.0 g of conventional N produced only 1.89 g of fruit per hectare. This outcome shows that polymerized N promoted a greater use efficiency of the N applied in the soil, seen by the production gain per unit of nutrient applied, as in Fageria (1998).

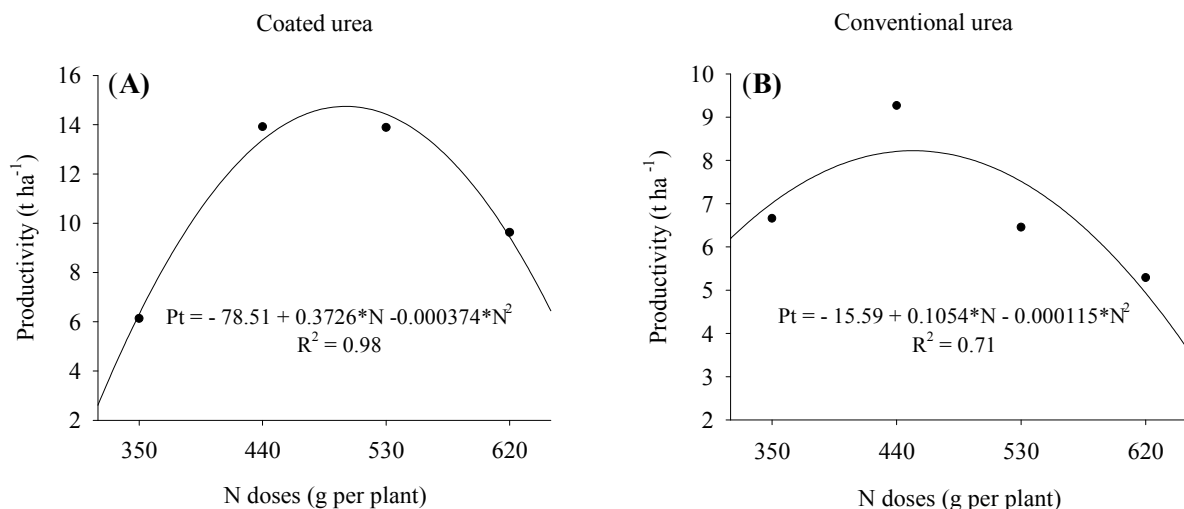


Figure 4. Yield of 'Formosa' papaya cultivated under different doses of coated and conventional urea.

The superiority of the coated urea is attributed to the fact that fertilizers coated with polymers reduce N losses by leaching and volatilization, showing greater efficiency in yield of some crops due to its granules structure (OSMAN et al., 2009). Thus, the gradual N supply with more homogeneous distribution in the soil at the production phase is very important for papaya crop, favoring the synchronization between N supply and the physiological plant demand, such as the flowers and fruits formation (BRITO NETO et al., 2011).

The average yield of 'Formosa' papaya, regardless N source, is lower compared to findings of Alves et al. (2012) in Catolé da Rocha, PB, Brazil; Tosta et al. (2012) in Mossoró, RN, Brazil; and Marinho et al. (2010) in Linhares, ES, Brazil. These authors achieved yields of 23.90, 51.42 and 48.54 t ha⁻¹ along 6 months up to 'Formosa' papaya harvest.

However, the maximum yield observed for coated fertilizer (14.30 t ha⁻¹) was higher than reports of Santos et al. (2016) (8.75 t ha⁻¹) and Brito Neto et al. (2011) (13.00 t ha⁻¹). Oliveira and Caldas et al. (2004) observed a yield range from 9.87 to 27.41 t ha⁻¹ in a study with 6-month papaya production as a function of nitrogen, phosphorus and potassium fertilization, in Cruz das Almas, BA, Brazil.

The low yields found in this study may be ascribed to short-term harvest method (120 days or four months), mainly associated with low relative air humidity (Figure 1B), which meets values obtained by Reis and Campostrini (2008) and Oliveira et al. (2004). These authors stated an average relative air humidity from 60 to 85% for papaya bloom stage; also highlighting that below this range, as observed in this study, high levels of floral abortion may occur.

CONCLUSIONS

The coated urea promotes higher growth and average yield for 'Formosa' papaya when compared to conventional urea.

The application of 1.0 g of coated N promotes a production of 2.87 g of fruit per hectare, whereas 1.0 g of N in conventional urea source produces only 1.89 g of fruit per hectare, showing that polymerized N source increases use efficiency of N applied in the soil.

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