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Quality of seedless watermelon cultivated under different doses and phosphorus application forms

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Effects of doses and phosphorus application forms were studied on the postharvest quality in seedless watermelon hybrid 'Style'. For this, an experiment was conducted in Upanema/RN, Brazil, during the period of September to December 2013, in a randomized block at factorial scheme 5×2 constituting of five phosphorus doses applied in foundation (0, 76, 168, 275 and 397 kg ha^{-1} of P_2O_5) and foundation + fertigation (0+50, 26+50, 118+50, 225+50, 347+50 kg ha^{-1} of P_2O_5) with four replications. Fruit harvested at commercial maturity (78 days after sowing) were evaluated by average fruit weight (AFW), pulp firmness (PF), chroma index, hue angle, soluble solids content (SS), titratable acidity (TA), maturation index (MI), total phenols content (TP), vitamin C (VC), total sugars content (TS), reducing sugars content (RS) and pH. Among the quality parameters evaluated phosphorus application forms did not affect physical characteristics of fruit, but combination of application via foundation + fertigation increased VC, TS and MI. There was interactive effect of dose and phosphorus application form for the SS, TA, pH and TP. The dose of 50 kg P_2O_5 ha^{-1} applied only in fertigation significantly increased values of SS, TA and TP. It is concluded that low doses of P in cultivation and its application via foundation and fertigation improved the main quality characteristics of 'Style' watermelon.

Key words: *Citrullus lanatus*, fertigation, foundation fertilization, soluble solids.

INTRODUCTION

Watermelon belongs to Cucurbit's family, which has assumed an important position in the world market. Out of the 109.28 millions of tons of watermelon produced worldwide in 2013, China was responsible for 66.97% of this total, followed by Iran (3.61%), Turkey (3.56%), and Brazil (1.98%) (Faostat, 2015). In the last years, Brazilian

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production of watermelon showed significant increases, from 226,778 tons in 2000 to 2,171,288 tons in 2014 (Ibge, 2015). Commercial watermelons differ in cell ploidies, being classified as diploid (with seed) and triploid (seedless). In these days, seedless watermelon cultivation has aroused interest of producers, especially from those who look forward to attend the external market demand, where the product is widely accepted. Generally, seedless watermelon, comparing to watermelon with seed, presents a crispier texture and sweeter taste, given its firmer pulp (12.0 N vs. 9.9 N, respectively) and larger level of soluble solids (12.7 vs 10.5%, respectively), (Maynard et al., 2002; Leskovar et al., 2003).

Besides the 90% of water in the pulp, what makes it a very natural source of water for human hydration, watermelon is a natural source of antioxidants compounds, such as lycopene (42.7-102.4 mg kg^{-1}), vitamin C (105.2-239.8 mg kg^{-1}), phenolic (89-147.3 mg GAE kg^{-1}) and flavonoids (111.3-176.1 mg RE kg^{-1}), most important bioactive compounds present in the pulp (Tlili et al., 2011), that prevent oxidant damages in cells (Melo et al., 2006; Costa et al., 2012). However, fruits chemical composition may be affected by a series of factors, including its genetics, environment conditions and cultural practices (Cao et al., 2015). Within the cultural practices, the mineral nutrition has a major rule in watermelon's crop performance and quality (Barros et al., 2012; Silva et al., 2014). In these terms, the study of nutritional management, emphasizing quality and nutrients application method, is essential to check the results in production's quality. Phosphorus (P) is one of the nutrients which requires more careful management due to its low concentration in soil solution and for having scarce sources worldwide (Ashley et al., 2011). When applied in soil, P supply is limited by its strong bonding capacity when in insoluble forms (Pandey et al., 2015), however, it may be easily available for plants depending on how it is applied (Mueller et al., 2015).

In watermelon crop, P application can be applied in foundation (100% pre-planting), or in foundation and fertigation (Silva et al., 2014; Souza 2012). Pre-planting fertilization, besides the fact that may increase the initial in-solution level of P for root development, compromises the availability of nutrient throughout crop cycle. On the other side, combining pre-planting fertilization with fertigation may balance the in-solution P availability to adequate levels during plant cycle (Marouelli et al., 2015). Even though P has a large influence over growth and yield, there is not much information if it brings a great effect on fruit quality. In watermelon plants, the effects of P deficiency in reducing photosynthetic rate, stomatal conductance, and intercellular carbon concentration (Meng et al., 2014) may influence in fruit's final quality. In strawberry, P level positively correlates with in-fruit concentration of soluble solids (Cao et al., 2015). Under adequate P level, in-plant ATP levels are satisfying for sugar exportation in phloem (Rao, 1990) to fruit or leaf, and, thus, contribute to increase soluble solids in fruits. Adebooye et al. (2006) reported that P may also indirectly influence the antioxidant compounds level of fruits (total phenolic and flavonoids) through the pentose phosphate pathway. To this end, the present study tested the hypothesis of whether P levels, applied only in foundation, and in foundation + fertigation, affect physicochemical characteristics of seedless watermelon fruits hybrid 'Style'.

MATERIALS AND METHODS

The experiment was conducted from September 2013 to December 2013 in an area located in the city of Upanema (5°35'04" S, 37°12'08"W, and 123 m of altitude), state of Rio Grande do Norte, Brazil. According to Koppen climate classification, the region is BSw'h type, that is, dry and hot; presenting irregular rainfall, with average of 469.8 mm per year; temperature of 28.1°C and humidity average of 70% (CPRM, 2015). The soil in the experimental area is classified as a Cambissolo (Embrapa 2013), The characteristics of the soil as well as the water supply are shown in Table 1.

The study was carried under a completely randomized block experimental design, with four replications, arranged in a 5×2 factorial scheme. Combination of five phosphorus (P) doses and two application methods were the factorial treatments. P doses were applied only in foundation (76, 168, 275, and 397 kg ha^{-1} of P_2O_5), and in foundation + fertigation (0+50, 26+50, 118+50, 225+50, and 347+50 kg ha^{-1} of P_2O_5). Pre-planting fertilization was manually managed, in every 30 cm, with a wooden stick. Triple-super phosphate (41% of P_2O_5) applied with 100 kg ha^{-1} of Barimicro® (FTE BR12), containing 1.8% of B, 0.8% of Cu, 2.0% of Mn, 9.0% of Zn, and 4.0% of S.

Watermelon (*Citrullus lanatus,* Schrad.) used in the experiment was a seedless cultivar, hybrid 'Style'. Also, a non-commercial cultivar (diploid) was used as pollinizer. Transplanting of seedling to field was proceeded 14 days after seeding in trays with 200 cells. Spacing of 1.9×0.6 m used in field with one seedling per hole, at the proportion of two 'Style' for each pollinizer, resulting in a population of 8,872 'Style' plants per hectare. Experimental plot area formed by 16 'Style' plants, with a useful area of eight plants. Drip irrigation system was used with one dripper per plant. Depth of water applied was calculated based on daily crop water need (ET crop) using crop factor method (Allen et al. 2006). Climatic data of the period which the experiment was carried was obtained at the weather station of IFRN (Federal Institute of Rio Grande do Norte), located 40 km away from the experimental area in the city of Ipanguaçu (RN). Monthly average of climatic variables gathered: temperature of 28.7°C (±0.3); air humidity of 48.1% (±1.6); solar radiation of 24.4 kJ m^2 (±1.5); 00 mm of rainfall; wind at a height of 10 m of 4.5 m s^{-1} (±0.2); and reference crop evapotranspiration of 7.2 mm dia^{-1} (±0.2). In addition, an efficiency of 91% for water application was adopted based on the irrigation system. Soil moisture was monitored with tensiometers, maintaining matric potential over -30 KPa. The total depth of water applied in irrigation at the end of crop cycle was 398 mm.

Fertigation ran daily from the first day after transplanting (DAT) until the DAT 57. Fertigation system comprised by two tanks connected to water pipes independently, where one of those tanks applied fertilizer in treatments of pre-planting (foundation) fertilization, and the second one applied fertilizer in pre-planting and after-planting fertigation. Fertigation was administered based on a model developed by Paula et al. (2011), with the following fertilizers: urea, ammonium sulfate, calcium nitrate, monoammonium phosphate (MAP), potassium chloride, and magnesium sulfate. In total, 120 kg ha^{-1} of N, 90 kg ha^{-1} of K_2O, 15 kg ha^{-1} of Ca, and 15

Table 1. Characteristics of the soil[1] and water supply.

				Soil						
Clay	**Silt**	**Sand**	**$pH_{(H2O)}$**	**O.M.**	**P**	**Ca^{2+}**	**Mg^{2+}**	**K^{+}**	**Al^{3+}**	**H+Al**
-----g kg^{-1}-----				**---mg kg^{-1}---**		**----------------mmolc dm^{-3}----------------**				
228	87	685	7.4	23.86	4	48.4	21.1	5.6	0.0	14.9
B		Cu		Fe		Mn		Zn		Pr
				---------------mg kg^{-1}---------------						
0.21		0.8		0.7		17.9		7.0		24
				Water						
E.C. dSm^{-1}	**pH**	**Ca^{2+}**	**Mg^{2+}**	**K^{+}**	**Na^{+}**	**Cl^{-}**	**HCO_3^{-}**	**CO_3^{2-}**	**RAS $(mmol_c\ L^{-1})^{0.5}$**	
				-------------------------mmolc L^{-1}-------------------------						
0.47	7.8	2.25	0.89	0.44	2.16	1.31	4.0	0.16	1.72	

[1]Chemical extrators: Mehlich-1 for P, K and Na; KCl 1N for Ca, Mg and Al; Calcium Acetate for H+Al; DTPA solution (pH=7.3) for Cu, Fe, Mn e Zn and and B available was extracted with HCl (0.05M), and soil/extractor ratio of 1:2. Pr is remaining P obtained after stir sample for one hour, in solution of $CaCl_2$ 0.01 M, with 60 mg L^{-1} of P, in ratio soil/solution of 1:10, and left to rest for 16 h and O.M is organic matter.

kg ha^{-1} of Mg were applied. Fruits were harvested in the commercial maturity (63 DAT) and transported to Laboratório de Tecnologia de Alimentos da UFERSA, where eight fruits of each treatment were evaluated the following characteristics: average fruit weight (AFW), longitudinal diameter (LD), traversal diameter (TD), pulp color [in pulp central area, measured with Minolta Chroma Meter CR-300, and results expressed in hue angle and chroma index], pulp firmness (PF) [obtained cutting fruit lengthwise, reading twice in middle area and once in basal area (opposite side of stem) on each piece, using a McCormick Penetrometer model FT 327 (12mm-diameter tip), and results expressed in Newton (N)], titratable acidity (TA) [checked via titration with NaOH 0.1 mol L^{-1} until pH equals 8.2 (IAL, 2008), and results expressed in malic acid percentage (%)], soluble solids (SS) [calculated from the juice made by homogenizing a portion of middle area of lengthwise cut of each fruit and read with a digital refractometer, with automatic temperature control, and results expressed in percentage (%)], potential of hydrogen (pH) [measured from a extracted sample using a pH meter, in buffer solution at pH 4 and 7 (AOAC 1997)], maturation index (MI) [calculated by ratio of soluble solids level (SS) and titratable acidity (TA) of pulp], total sugars content (TS) [quantified in 1.0 g of pulp using the Anthrone method and read in a spectrophotometer with absorbance at 620 nm (Yemn and Willis 1954), and results expressed in percentage (%)], reducing sugars content (RS) [measured through Somogyi-Nelson method, and results expressed in percentage (%)], total phenols content (TP) [Folin-Ciocalteau method used (Singleton et al., 1999) with a Gehaka model UV-340G spectrophotometer, and results expressed in mg GAE100 mL^{-1} of pulp], Vitamin C content (VC) [determined using the standard titration method of the Association of Official Analitical Chemists (AOAC 1984), and results expressed in mg of ascorbic acid 100 mL^{-1} of pulp]. The data was submitted through variance analysis, Tukey's HSD test with 5% of significance level and unfolding analysis using the SISVAR 5.6 software (Ferreira, 2011). The regression analysis was made using the Table Curve software (Jandel Scientific, 1991).

RESULTS AND DISCUSSION

There was isolated effect of different P doses for following traits: average fruit weight, longitudinal and transversal diameters, pulp firmness, chroma index, and hue angle (Table 1). However, the form of application did not influence physical traits of watermelons (Table 1). An increase in average fruit weight (AFW), longitudinal diameter (DL), and transversal diameter (TD) was seen in increasing doses of P up to 208, 192, and 226 kg ha^{-1} of P_2O_5, which fruits reached the maximum of 4.83 kg (AFW), 21.87 cm (LD), and 21.22 cm (TD), respectively (Figure. 1A, 1B, and 1C). P doses higher than these cited before resulted in negative effect in AFW, LD, and TD. The literature reports increment in AFW of Canary melon with phosphate fertilization, which maximum value was 42.67% higher than the AFW with no P applied (Abrêu et al., 2011). However, the ideal approach is using low doses with positive effect on quality's traits of fruits for reducing production costs, and nutrient optimization (Ashley et al. 2011). Phosphorus is the major nutrient with influence on fruit size (Mendes et al. 2010), and its significant effect over fruit's diameter and yield may be explained for its function in plants' energy system (Adebooye et al., 2006). But restricted P supply cause metabolic and physiology changes, alters plant morphology (root and leaf), and affects photoassimilates production required for plant growth (Pandey et al. 2015). Cropping with P doses up to 76 kg ha^{-1} decrease pulp firmness (PF) of fruits, but higher doses do not cause any significant variation on FP (Figure. 1D). According to adjusted equation, the highest PF (8.332 N) among cultivated fruits was achieved in absence of P, being 38.44% above the PF (6.01 N) of fruits with P dose of 76 kg ha^{-1} P_2O_5. P influences in fruiting of plants, and its lack or deficiency delays formation and maturation of fruits, what explains the higher PF of fruits from control group with no treatment. Martins et al. (2013) found a PF average of 10.63 N in 'Style' watermelon. This value was 60.96% higher than the average PF of this study. Such difference may be related to fruits' maturation stage, since this study's fruits were harvested after a longer period (78th Day After Sowing) compared to the referred authors (DAS 65). Verified an increase of chroma index

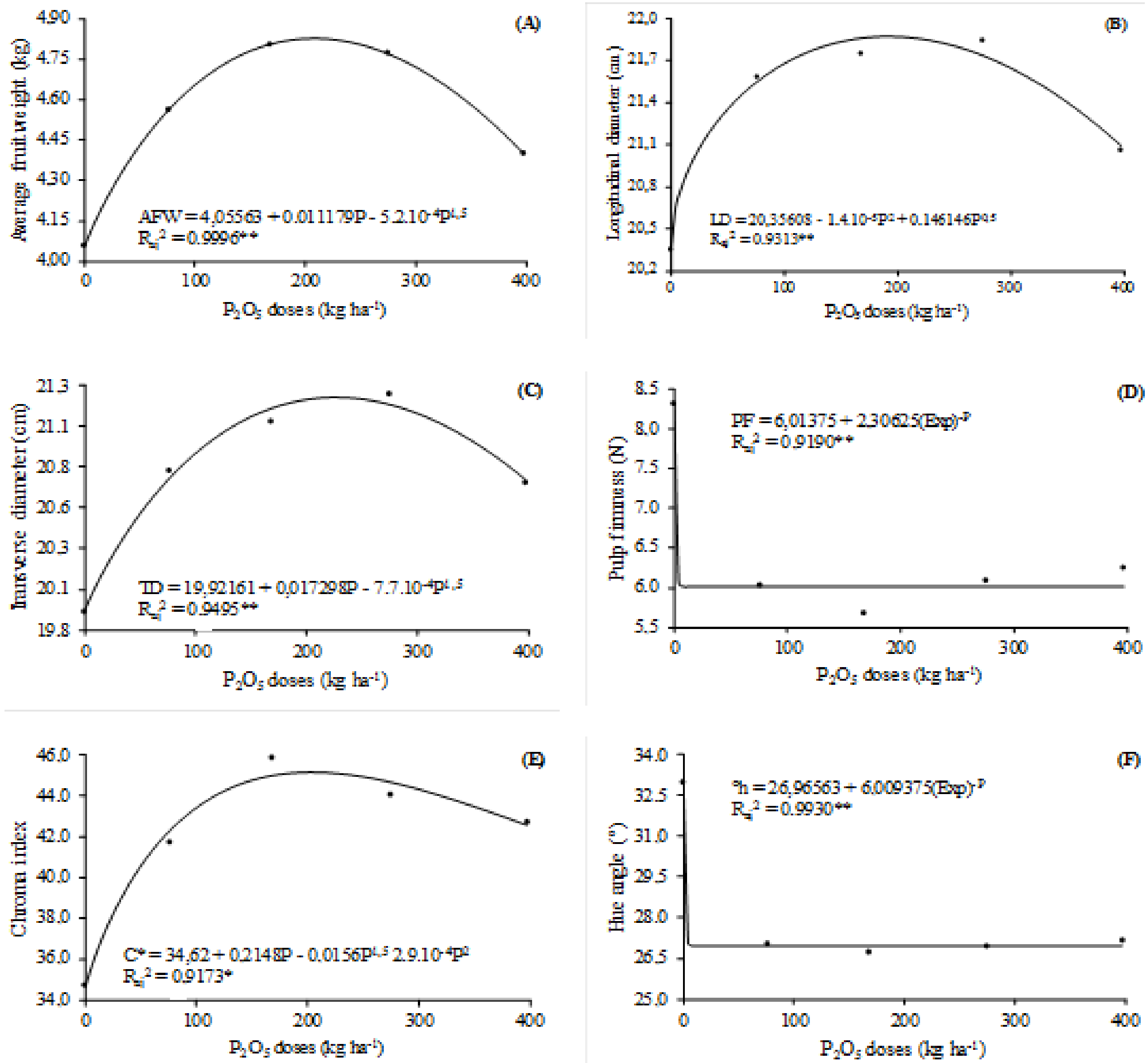

Figure 1. Average fruit weight (A), longitudinal diameter (B), transversal diameter (C), pulp firmness (D), chroma index (E) and hue angle (F) of watermelon 'Style' in different phosphorus doses.

or color intensity of fruits' pulp with increment in P, where a maximum of 45.2 for a dose of 203 kg ha^{-1} of P_2O_5 was higher than the index obtained (34.7) with no P fertilization (Figure. 1E). The higher the chroma index the clearer will be the difference between shades, turning pulp color more homogeneous (Fernandes et al., 2015). Hue angle (°h) decreased as P doses increased up to 76 kg ha^{-1}, however, from this dose, increase in P dose did not cause any variation in this characteristic. Fruits grown with 0 kg ha^{-1} of P_2O_5 showed larger °h (33.0°), a value 18.2% higher than the ones obtained (27.0°) with P dose of 76 kg ha^{-1} of P_2O_5 (Figure 1F). °h decreasing to near 0° suggests a prevalence of reddish color in watermelon pulp, which benefits its quality. In chemical characteristics of 'Style' watermelon, it verified significant interactions between P doses and form of application for titratable acidity (TA), soluble solids content (SS), pH, and total phenols content (TP) (Figure 2). Isolated effect of P dose was observed for reducing sugar content (RA), and maturation index (IM) (Figure 3). Also, isolated effect of form of application was seen in total sugars content (TS), maturation index (MI), and vitamin C content. Titratable acidity (TA) increased with increasing doses of P applied in foundation, reaching a maximum of 0.102% with a dose of 337 kg ha^{-1} of P_2O_5. From this dose, the increment in P dose caused a decrease in TA (Figure 2A). Fandi et al., (2010) reported that an increment from20 to 60 ppm of P concentration in tomato reduced in

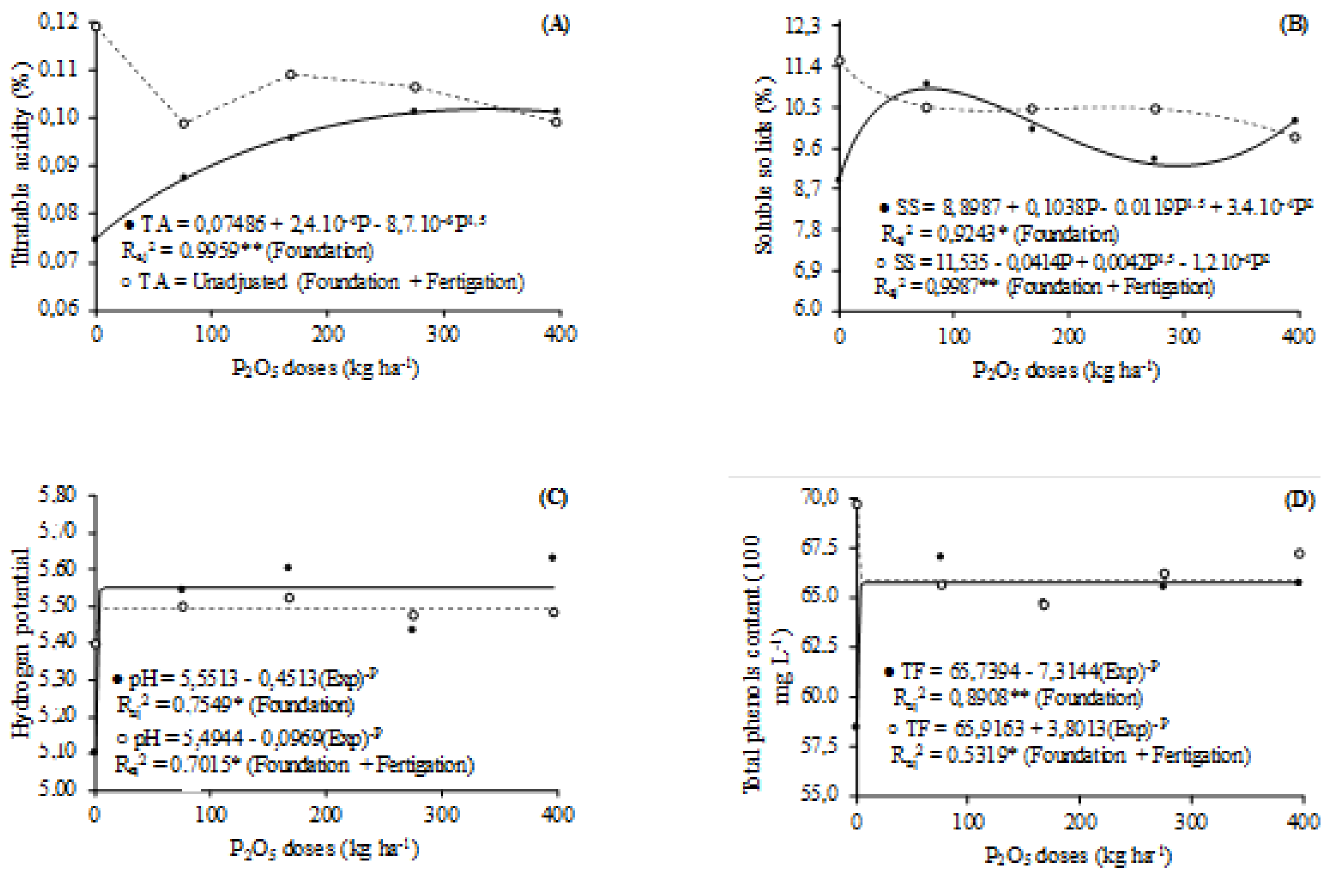

Figure 2. Titratable acidity (A), soluble solids content (B), pH (C) and total phenols content (D) of 'Style' watermelon in different phosphorus doses and application forms.

16.99% fruit acidity. On the other side, TA varied with the increase of P dose in foundation and fertigation, in which 0 kg ha^{-1} of P_2O_5 in foundation and 50 kg ha^{-1} of P_2O_5 in fertigation was the best treatment, with a value of 0.119% (Figure 2A). Watermelon is a fruit that accumulate few organic acids during its growth, and the average value at the commercial maturation stage is between 0.08 and 0.13% (Çandir et al., 2013), which is close to this study's results. An increase in P dose provided raise of the soluble solids content (SS) of 'Style' watermelon, from 8.90% without P treatment to a maximum of 10.9 and 11.5% with doses of 79 kg ha^{-1} of P_2O_5 in foundation, and without P in foundation together with 50 kg ha^{-1} of P_2O_5 in fertigation, respectively, being the fertigation P application 5.5% higher than in foundation (Figure 2B). In pineapple, there was a linear response in pulp SS for increment in P doses (Martins and Ventura 2011). The influence of P on SS is likely related to a better photosynthetic rate, and photo assimilate partitioning and transport, as Cao et al. (2015) acknowledge. The SS values obtained with combined application of P (in foundation and fertigation) were higher than the SS reported by Lima Neto et al. (2010), in different varieties of watermelon cultivated in similar soil and climate conditions, and similar results to Barros et al. (2012) in 'Crimson Sweet' watermelon (9.69 to 12.23%) cultivated with different nitrogen doses.

SS content is an important parameter of watermelon fruits quality, which ideal value must be equal or higher than 9%. Possibly, the higher average value estimated from SS obtained only with dose of 50 kg ha^{-1} of P_2O_5 in fertigation may be explained due to the balance on in soil P availability in adequate levels throughout crop cycle (Marouelli et al. 2015), making greater absorption possible for plants. It was observed that pulp pH increased in fruits cultivated with P dose up to 76 kg ha^{-1} of P_2O_5 both in foundation and foundation together with fertigation (Figure 2C). However, superior doses did not show any variation in pH in neither form. P application in foundation resulted in an increase of 8.82% in pulp pH from 5.10 (0 kg ha^{-1} of P_2O_5) to 5.55 (76 kg ha^{-1} of P_2O_5), while in fertigation increase was from 5.40 (0 + 50 kg ha^{-1} of P_2O_5) to 5.49 (26 + 50 kg ha^{-1} of P_2O_5), therefore, a slight increase of 1.67%. Similar results were reported by Adebooye et al. (2006), where they verified that increment in P doses (triple-super phosphate) up to 26.4 kg ha^{-1}, in tomato, benefited pH increase. Total phenols content (TP)

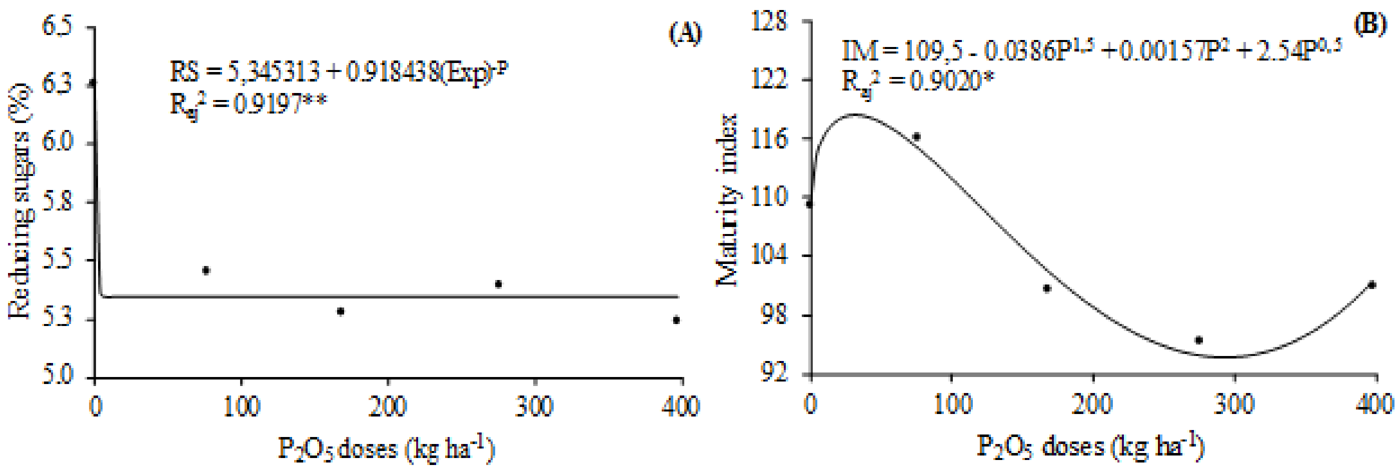

Figure 3. Reducing sugars content (A) and maturity index (B) of 'Style' watermelon in different phosphorus doses.

from fruits increased with increment in P doses in foundation up to 76 kg ha^{-1}. No significant variation was seen with increasing P supply for plant. In this form of application, levels of TP increased from 58.43 mg GAE 100 mL^{-1} (0 kg ha^{-1} of P_2O_5) to 65.74 mg GAE 100 mL^{-1} (76 kg ha^{-1} of P_2O_5) (Figure 2D). On the other side, there was adverse effect in P combined application (foundation + fertigation), which values decreased from 69.72 mg GAE 100 mL^{-1} (0 + 50 kg ha^{-1} of P_2O_5) to 65.92 mg GAE 100 mL^{-1} (26 + 50 kg ha^{-1} of P_2O_5). Levels of TP from fruits cultivated with 0 + 50 kg ha^{-1} of P_2O_5 was 5.8% higher than the highest value found in fruits cultivated with dose of 76 kg ha^{-1} of P_2O_5 in foundation. Li et al. (2002) studying P application as a mineral mixture (78.28% of P_2O_5; 14.14% of CaO; 7.58% of N) four weeks before harvest in 'Fuji' apples, verified increment in flavonoid in fruit skin. According to the authors, this behavior may be explained due to these nutrients action on increasing activity of phenylalanine-ammonia-lyase, a key enzyme in synthesis process of flavonoid compounds. In contrast, there is evidence that P deficiency in soil cause phenolic compounds accumulation in tomato and nectarine (Olivos et al., 2012; Stewart et al., 2001).

Regardless of application form, a higher concentration of reducing sugars (RS) occurred in absence of P fertilization (6.26%), and decrease when applying increasing P doses (Figure 3A). However, it is worth highlighting the low variation on levels of AR between P doses higher than 76 kg ha^{-1} of P_2O_5, which had an average of 5.35%. Levels of RS, represented as glucose and fructose, generally have larger amount in young watermelon fruits (Soteriou et al., 2014). This likely explains the higher levels of RS in fruits cultivated with no P applied, indicating delay of ripening, when compared to fruits from plants that received P fertilization. On the other side, form of application resulted in a significant difference in total sugars content (TS) of fruits (Table 2). Application of P in foundation and fertigation provided a higher increment in TS level (8.52%) than fertilization in foundation only (7.94%). This result may reflect the increase in P availability (Valentinuzzi et al., 2015) when fertigation is used (Souza, 2012), since increment in inorganic phosphate (Pi) concentration in cytosol can cause a higher transference rate of phosphate sugars in chloroplasts, via exchange of triose-P/Pi in vascular membrane. This exchange benefits the glucose formation in cytosol, which may be broken by glycolysis cycle, entering in cellular respiration, or going to saccharose synthesis (Santos et al., 2012), main sugar compound of mature fruits of watermelon (Soteriou et al., 2014). The highest averages of vitamin C (VC) and maturation index (MI) (15.45 mg 100 mL^{-1} and 109.36, respectively) were obtained with P application in foundation and fertigation, independently of P dose (Table 3). These values express superiority above 64% and 9.8%, respectively, of P applied in foundation + fertigation over the application in foundation only. The lowest averages of VC and IM, obtained with application in foundation, may be related to a lower nutrient mobility (P) caused by the presence of Calcium and clay in the experimental soil. In addition, there was effect of P doses over MI, independently of form of application, which value increased from 109.5 (0 kg ha^{-1} of P_2O_5) to a maximum value of 116.82 (17.85 kg ha^{-1} of P_2O_5), and decreasing for higher values (Figure 3B). These results were higher than the highest value of 68.78 obtained by Campagnol et al. (2016) in mini watermelon. According to the authors, higher MI indicates sweeter fruits, a desired characteristic in watermelon.

Conclusion

P doses and form of application had effect on main characteristics of quality of 'Style' watermelon (soluble solids, titratable acidity, pH, and total phenols content). However, P dose of 50 kg ha^{-1} of P_2O_5 applied only in

Table 2. Sumary of the analysis of variance for the variables average fruit weight (AFW), longitudinal diameter (LD), transverse diameter (TD), chroma index (C*), hue angle (°h), pulp firmness (PF), soluble solids content (SS), titratable acidity (TA), maturation index (MI), vitamin C (VC), total sugars content (TS), reducing sugars content (RS), total phenols content (TP), and pH of 'Style' watermelon grown under different forms of phosphorus application.

Characteristics	SV	AF	DS	AFxDS	CV(%)	GA
	DF	1	4	5	----	---
		F				
AVF		0.85^{ns}	2.67^{*}	0.92^{ns}	11.75	4.52
LD		1.45^{ns}	2.99^{*}	1.55^{ns}	4.74	21.32
TD		1.30^{ns}	3.24^{*}	0.98^{ns}	3.88	20.74
C*		2.14^{ns}	4.26^{**}	0.39^{ns}	13.92	41.83
ºh		2.99^{ns}	4.06^{**}	$1,97^{ns}$	13.42	28.17
PF		1.88^{ns}	11.52^{**}	1.54^{ns}	13.55	6.48
SS		10.26^{**}	2.01^{ns}	7.67^{**}	6.45	10.22
TA		20.18^{**}	1.44^{ns}	6.13^{**}	10.20	0.099
MI		6.22^{*}	3.49^{*}	2.06^{ns}	11.88	104.47
VC		$191,6^{**}$	$1,103^{ns}$	$0,654^{ns}$	11,09	12,44
TS		6.48^{*}	2.41^{ns}	0.80^{ns}	8.78	8.23
RS		0.78^{ns}	2.07^{*}	1.19^{ns}	14.92	5.52
TP		4.09^{ns}	0.63^{ns}	3.67^{*}	5.73	65.48
pH		0.08^{ns}	5.69^{**}	2.51^{ns}	2,82	5.47

SV – Source of variation; AF- Phosphorus application forms; DS- Doses; CV - Coefficient of variation; GA - General average; DF - Degree of freedom.

Table 3. Average fruit weight (AFW), longitudinal diameter (LD), transversal diameter (TD), chroma index (C *), hue angle (°h), pulp firmness (PF), vitamin C content (VC), reducing sugars content (RS), total sugars content (TS) and maturation index (MI) of 'Style' watermelon grown under different phosphorus application forms.

Fertilization	AVF (kg)	LD (cm)	TD (cm)	C*	ºh
Foundation	4.44^{a}*	21.13^{a}	20.60^{a}	40.48^{a}	29.20^{a}
Foundation+Fertigation	4.60^{a}	21.51^{a}	20.89^{a}	43.18^{a}	27.14^{a}
HSD	0.34	0.65	0.52	3.76	2.44
General average	4.52	21.32	20.74	41.83	28.17
Fertilization	**PF (N)**	**VC (mg 100 mL^{-1})**	**RS (%)**	**TS (%)**	**MI**
Foundation	6.67^{a}	9.42^{b}	5.64^{a}	7.94^{b}	99.57^{b}
Foundation+Fertigation	6.29^{a}	15.45^{a}	5.41^{a}	8.52^{a}	109.36^{a}
HSD	0.57	0.89	0.53	0.47	8.01
General average	6.48	12.44	5.53	8.23	104.47

*Means followed by same letter do not differ by Tukey HSD test at 5% probability.

fertigation induced to significant higher values of soluble solids, titratable acidity and total phenols content in fruit. Fertilization in foundation with doses up to 337 kg ha^{-1} of P_2O_5 increased the titratable acidity. P application did not influence physical quality characteristics and reducing sugars content. However, P application in foundation together with fertigation resulted in higher accumulation of vitamin C, total sugars content, and maturation index of fruits. Cultivation with P doses up to 76 kg ha^{-1} of P_2O_5 decreased pulp firmness, but higher doses caused no variation in those characteristics. Average fruit weight increased with P doses up to 208 kg ha^{-1} of P_2O_5. This way, at the present study conditions, we could evidence that low doses of P for 'Style' watermelon cultivation, and combined application in foundation and fertigation, provided improvement in fruit' main quality characteristics.

Conflict of interests

The authors have not declared any conflict of interests.

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