FRUIT QUALITY OF BANANA 'PACOVAN KEN' FERTIRRIGATED UNDER NITROGEN AND POTASSIUM LEVELS

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ABSTRACT: The objective of this work to evaluate levels of N and K, applied via fertigation, in the 2nd cycle of banana 'Pacovan Ken', on the quality of the fruits, in soil of the coastal trays of the State of Espírito Santo. The experiment was developed at the Experimental Farm of the Federal University of Espírito Santo - CEUNES / UFES, located in the municipality of São Mateus, in the northern region of Espírito Santo. The experimental design was in randomized blocks (DBC), with four blocks, in a 4x4 factorial scheme, whose treatments were four doses of nitrogen (200; 400; 600 and 800 kg ha^{-1} of N) and four doses of potassium (300; 600; 900 and 1200 kg ha^{-1} of K_2O). It was observed that, the increase of nitrogen doses interferes negatively in the quality of the fruits. Potassium fertilization via fertigation provides greater increases in the quality of the fruits of the banana “Pakovan Ken”, in the second growing cycle.

KEYWORDS: *Musa* spp., nutrition, physical characteristics

QUALIDADE DE FRUTO DA BANANEIRA “PACOVAN KEN” FERTIRRIGADA SOB NÍVEIS DE NITROGÊNIO E POTÁSSIO

RESUMO: Objetivou-se com o trabalho, avaliar níveis de N e K, aplicados via fertirrigação, no 2° ciclo da bananeira “Pacovan Ken”, sobre a qualidade dos frutos, em solo dos tabuleiros costeiros do Estado do Espírito Santo. O experimento foi desenvolvido na Fazenda Experimental da Universidade Federal do Espírito Santo – CEUNES/UFES, localizada no município de São Mateus, região norte do Espírito Santo. O delineamento experimental foi em blocos casualizados (DBC), com quatro repetições, em esquema fatorial 4x4, cujos

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tratamentos foram quatro doses de nitrogênio (200; 400; 600 e 800 kg ha^{-1} de N) e quatro doses de potássio (300; 600; 900 e 1200 kg ha^{-1} de K_2O). Observou-se que, o acréscimo de doses de nitrogênio interfere negativamente na qualidade dos frutos. A adubação potássica via fertirrigação propicia maiores incrementos na qualidade dos frutos da bananeira “Pakovan Ken”, no segundo ciclo de cultivo.

PALAVRAS-CHAVE: *Musa* spp., nutrição, características físicas

INTRODUCTION

The banana (*Musa* spp. L) Is one of the most consumed fruits in the world, being grown in most tropical countries (ROBINSON & GALAN, 2010). Currently, India is the world's largest producer of fruit, and Brazil occupies the 4th position, with production around 6.8 million tons (FAO, 2020).

Banana farming has traditional exploitation in the State of Espírito Santo, mainly in the Central-Serrana and Litorânea Sul regions, to the detriment of the favorable climate and soil conditions in this region for the development of this culture (VENTURA et al., 2005). Present in more than 90% of the municipalities, it stands out for exercising great socioeconomic importance for the State (INCAPER, 2018).

The banana tree is a plant with high nutritional requirements and, at the same time, a balanced supply of nutrients is important (HOFFMAN et al., 2007a). In Brazil, the high demand for fertilizers is due not only to the high accumulation and export of nutrients by the plant, but also to the cultivation of banana trees in soils with low fertility (BORGES & OLIVEIRA, 2000). According to Hoffmann et al. (2010b), potassium and nitrogen are the nutrients most absorbed by the banana.

Potassium (K) is the most relevant element in banana, and has an important role in the energy state, in the translocation and storage of photoassimilates and in the water maintenance of plant tissues. It has a direct role in the synthesis, transport and accumulation of sugars, which allows for better development and quality of the fruits, in addition to being essential in the production of bunches and cloves (SILVA et al., 2013).

Nitrogen (N) is essential for exercising important physiological functions and for being involved in enzymatic reactions and in photosynthetic processes (EPSTEIN & BLOOM, 2006), with greater expressiveness from the beginning of vegetative growth until the emission of inflorescence (7° to 10th month), with reduced absorption until harvest (MARTIN-

PREVEL, 1977) being responsible for reducing the cycle and increasing the size of bunches and bunches (BORGES et al., 2002).

Plant nutrition in the traditional way has been replaced by application via irrigation water, which allows low operating and maintenance costs. Fertigation has provided good vegetative and reproductive results to plants, as it provides better distribution and parceling of applications of nitrogen and potassium fertilizers according to the demand of the crop (GUERRA et al., 2004), and promotes efficiency of nutrient absorption by the plant, for making them readily available in the soil solution (MARCUSSI et al., 2004).

Although there are several publications in the literature related to mineral nutrition of banana (GOMES et al., 2004; ROFFMAN et al., 2010b; DAMATTO JÚNIOR et al., 2006; MELO et al., 2010; SILVA et al., 2013) the information available on the supply of nutrients via fertigation is insignificant and its effect on the quality of banana fruits, notably in the coastal trays of the State of Espírito Santo. In this sense, the objective was to evaluate different levels of N and K, applied via fertigation, in the 2nd cycle of banana "Pacovan Ken", on the quality of fruits, in soil of the coastal trays of the State of Espírito Santo.

MATERIAL AND METHODS

The experiment was developed at the Experimental Farm of the North University Center of Espírito Santo, Federal University of Espírito Santo, located in the municipality of São Mateus, ES, located under the coordinates 18º 43 ’S, 39º 51´ W and average altitude of 39 meters. The climate is Aw, according to the Köppen classification, characterized by a dry season in autumn-winter and a rainy season in spring-summer. The local soil is classified as Yellow Argisol, sandy loam texture, typical of coastal boards (EMBRAPA, 2013).

The banana variety (*Musa* spp. L.) selected was “Pacovan Ken”, with a spacing of 3 between rows of plants and 2 meters between plants, with evaluations in the second growing cycle.

The irrigation system used was the automated micro sprinkler, flow rate of 70 L h^{-1}. The applied irrigation depth was dimensioned based on the replacement of the crop evapotranspiration (ETc) estimated through the water balance in the soil (BERNARDO et al., 2006) in a control volume corresponding to a depth of 0.40 meters and the evapotranspiration of reference estimated through the Pennann-Monteith equation, according to Allen et al. (1998).

The experimental design used was randomized blocks (DBC), in a 4 x 4 factorial arrangement, with four replications, totaling 64 factor combinations. The treatments consisted of four doses of nitrogen (200; 400; 600 and 800 kg ha^{-1} of N) and four doses of potassium (300; 600; 900 and 1200 kg ha^{-1} of K_2O). Urea (45% N) and Potassium Chloride (58% K_2O) were used as sources of nitrogen and potassium, respectively. Fertigation was performed weekly by means of injectors of the type of bypass flow.

The culture cycle was divided into three phases, according to Borges & Costa (2002): establishment, from December/2016 to February/2017 (applied 10% N and 5% K_2O of the total dose); rapid growth (pre-inflorescence), from March/2017 to August/2017 (applied 75% N and 65% K_2O of the total dose) and fruiting, from September/2017 to December/2017 (applied 15% N and 30% K_2O of total dose).

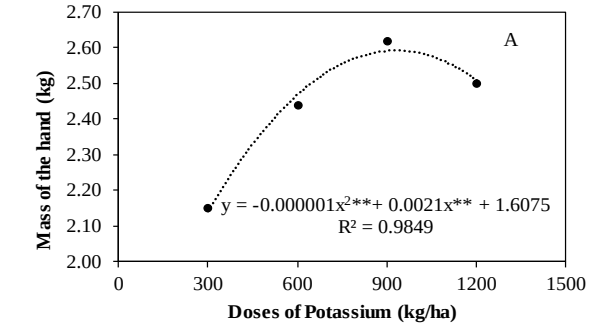
The bunches were harvested when the fruits reached their full physiological development, based on the reduction and / or disappearance of the corners or angularities of the fruit surface, as suggested by Alves et al. (2004). After the harvest, the bunches were plummeted, the bunches of each bunch and the fruits of each bunch were cut, evaluating the mass of the bunch (kg), mass of the fruits (g), number of fruits per bunch, commercial length and total fruit (cm) and fruit diameter (mm).

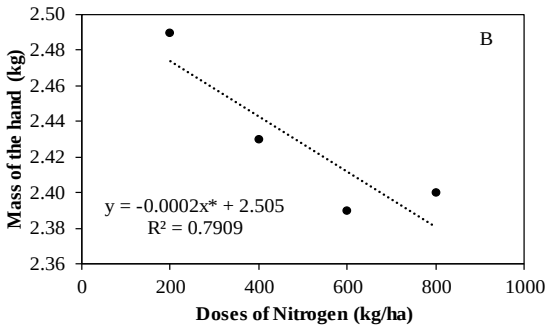
The results obtained were subjected to analysis of variance, with the effects unfolding, according to their significance. The choice of the regression model was based on the model with the highest significant degree by the F test, in which the deviation of the regression was not significant.

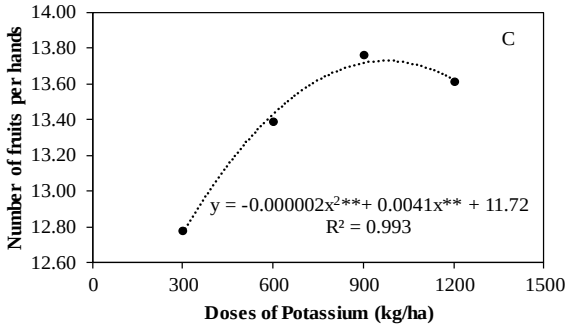
RESULTS AND DISCUSSION

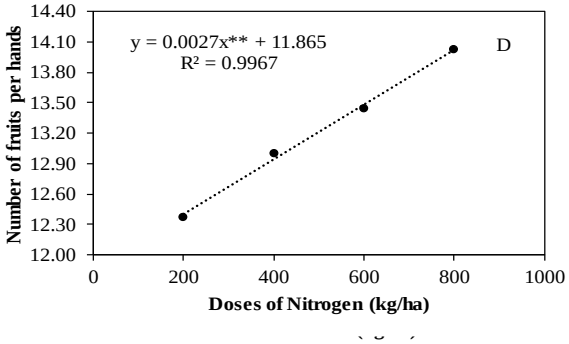
A quadratic relationship was found between the mass values of the hand and potassium levels (Figure 1A). There was an increase in the weight of the bunches with the application of increasing doses of potassium, from the dose of 300 kg ha^{-1} to the dose of 1050, whose maximum weight was equal to 2.71 kg $plant^{-1}$. Regarding the increase in nitrogen levels, a linear decreasing effect was observed for this same variable (Figure 1B). The expressive effect of potassium in relation to nitrogen can be explained by the fact that N is considered a nutrient that intervenes in vegetative development and in the production of dry mass (MELO et al., 2010), while K has an important role in transport of synthesized carbohydrates (ROMHELD & KIRKBY, 2010) which probably favored the accumulation of biomass in the

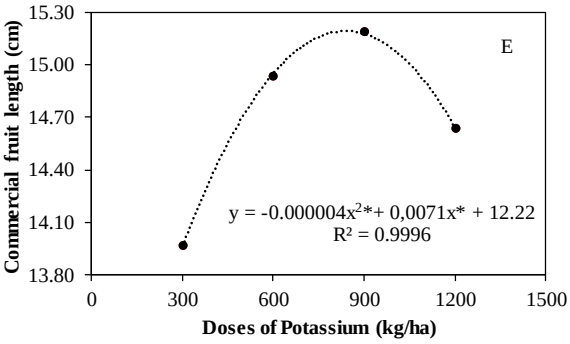
fruits. This quantitative variable is considered one of the most important, as it refers to the market indicator and the direction of fruit consumption (GUERRA et al., 2004).

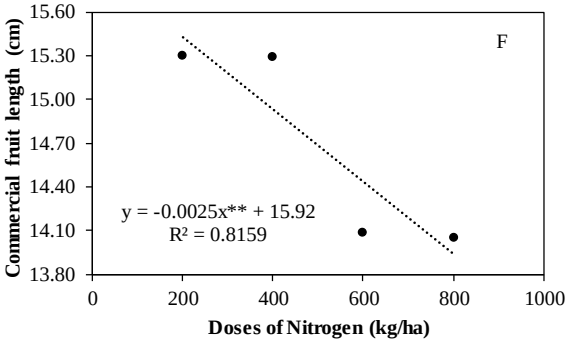


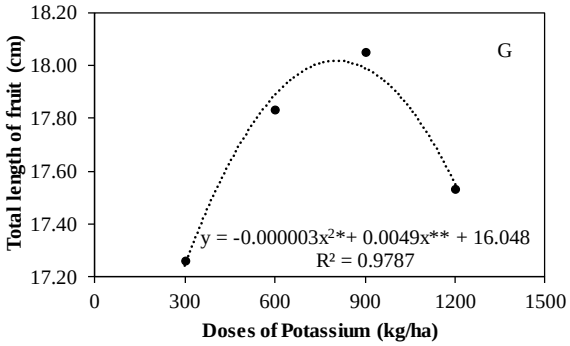


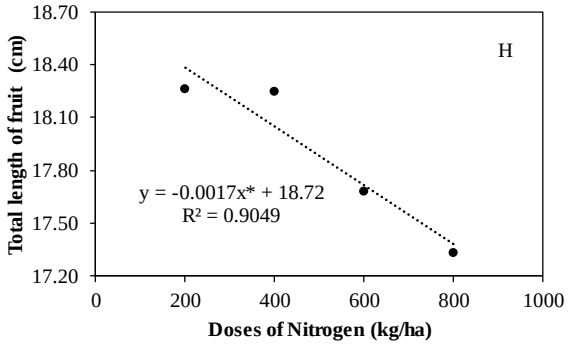












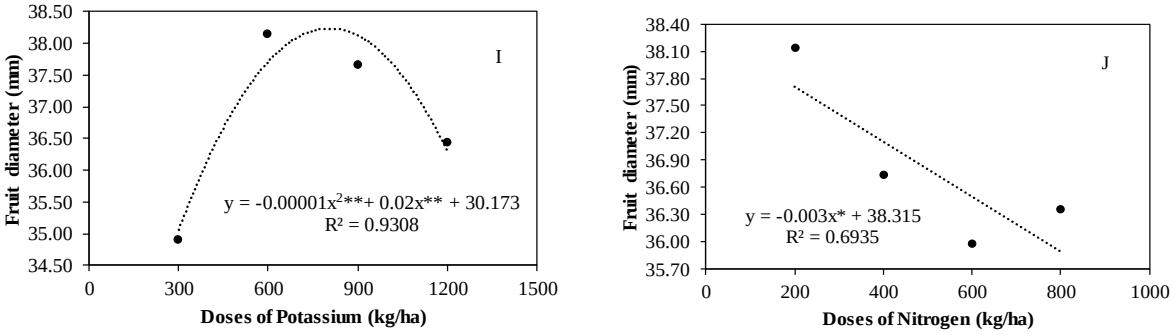


Figure 1. Quality variables of the 'Pacovan Ken' banana fruit fertigated under levels of N and K. * ** significant regression coefficient at 5% or 1% respectively by t test.

There is also a quadratic relationship between the number of fruits per bunch and the different potassium levels (Figure 1C), with an increase in the number of fruits per clump with the use of the 1025 kg ha-1 dose, which showed a total number of 13.82 fruits per bunch Gomes (2004), studying fertigation with K on the yield of banana cv. Prata-Anã, obtained 15.2 fruits penca-1 in the second growing cycle. Melo et al. (2010) also observed similar values, 16.7 fruits per bunch, using the dose of 1200 kg ha-1 of K. Analyzing Figure 1D, the number of fruits increased linearly when the fertigation with N, reaching an estimated average value of 13.61 fruits per bunch. According to Martins et al. (2011), the number of fruits per bunch is directly related to the amount of female flowers that develop after floral differentiation.

According to Holder & Cumbs (1982), water deficiency at this stage promotes a reduction in the number of female flowers, given the importance of adequate water supply to the plant through irrigation.

Regarding the commercial and total length of the fruit, increases were observed with the application of doses of 887 and 817 kg ha^{-1} of potassium (Figures 1E and 1G), which had a maximum length of 15.37 cm and 18.04 cm, respectively. Martins et al. (2011), studying irrigation and potassium fertilization via fertirrigation on banana "Willians" under fruit production and quality, observed values higher than that found in the present work, with fruit length greater than 22 cm, in the second cultivation cycle.

Analyzing the commercial and total length of the fruits as a function of different levels of N (Figure 1F and 1H), a linear response is observed, with the best results obtained when providing lower levels of N to the plants, with average values of commercial length and total fruit of 15.30 to 14.04 cm and 18.26 to 17.33, respectively, for the doses of 200 and 800 kg ha^{-1}.

For the values of fruit diameter (Figure 1I and 1J), a greater mean diameter 38.15 and 38.13 was observed, respectively, at the dose of 600 kg ha^{-1} of potassium and 200 kg ha^{-1} of nitrogen. However, regardless of the level of potassium and nitrogen supplied to the plants, the fruits had a diameter greater than 32 mm, a minimum value to classify them as "extra", according to the norms of the Brazilian Program for Modernization of Horticulture and Integrated Fruit Production (PBMH & PIF, 2006).

CONCLUSIONS

The increase of nitrogen doses interferes negatively in the quality of the fruits.

Potassium fertilization via fertigation provides greater increases in the quality of the fruits of the banana 'Pacovan Ken', in the second growing cycle.

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