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SOURCES OF NITROGEN IN THE PRODUCTION OF PASSION FRUIT SEEDLING

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Abstract: The production of quality seedlings involves the composition of the substrate used in this stage. The work aimed to evaluate the addition of different sources of N to a commercial substrate in the production of yellow passion fruit seedlings. The experiment was conducted in DBC with 6 treatments and 4 replications, with each plot consisting of 8 seedlings. The treatments evaluated were C (control - commercial substrate Carolina Soil ®), UC (C + conventional urea), UP (C + polymerized urea), NBPT (C + urea with urease inhibitor), SA (C + ammonium sulfate), EB (C + cattle manure in a 2:1 ratio). The N dose was divided into two applications at 36 days after emergence (DAE) and 51 DAE using the sources of each treatment. The tanned cattle manure was mixed with the substrate on the day of sowing. At 51 DAE, four plants from each treatment had the SPAD index, seedling height, root and shoot dry biomass evaluated. Assessments were repeated at 66 DAE on the remaining four seedlings of each treatment. The addition of N in the form of polymerized urea (UP), ammonium sulfate (SA) and urea with urease inhibitor (NBPT) to the commercial substrate provided the best responses in the production of yellow passion fruit seedlings.

Keywords: *Passiflora edulis* Sims *f.flavicarpa* DEG. Commercial substrate. Fertilizing.

INTRODUCTION

The yellow or sour passion fruit (*Passiflora edulis* Sims *f.flavicarpa* DEG) is widely cultivated in Brazil, providing good economic returns to producers. This crop is of great importance due to the quality of its fruits, which are rich in nutrients and vitamins (LIMA, 2002).

The use of quality seedlings is one of the first steps to achieving high productivity and in the production process it is important to take into account the quality of the seed and the substrate to be used. The substrate must have some characteristics that make it viable, such as providing a good environment for the root development of the seedlings, without limiting it from a physical and nutritional point of view. According to Silva et al. (2011), the substrate directly interferes with the quality of the seedlings due to the variation in its physical, chemical and biological properties.

For the production of vegetable and fruit seedlings, it is common to find commercial substrates that are recommended for isolated use, that is, without the addition of other compounds or nutrient sources. However, some supplementation may be necessary due to a low concentration of certain nutrients in the original commercial substrate formula, which could compromise the quality of the seedlings.

Nitrogen (N) is a nutrient that is highly required by crops and is extremely important during the seedling production phase. However, this nutrient is quite limiting in soils, with a huge dependence on the use of external sources to meet its demand. Nitrogen sources can be organic and mineral such as urea, ammonium sulfate and nitrogenous phosphates, among others.

The main source of N used in Brazil is urea, which has the advantages of high concentration of N and the lowest price of N per unit supplied. However, this source presents the possibility of N losses due to NH_3 volatilization (CANTARELLA, 2007) when applied to the soil surface and this loss leads to low efficiency of this fertilizer. There are *enhanced*- efficiency fertilizers on the market that can be classified into slow or controlled release fertilizers and stabilized fertilizers (CANTARELLA; MARCELINO, 2008), enabling the use of N sources that present less volatilization during the time between fertilization and mechanical incorporation or by irrigation/

rain. In this context, we can mention the use of fertilizers with urease inhibitors (NBPT: N-(n-butyl) triamidethiophosphoric acid) and nitrification inhibitors, and the use of urea coated with polymers (CANTARELLA, 2007). NBPT inhibits urea hydrolysis for a period of three to fourteen days, depending on soil humidity and temperature conditions (CANTARELLA et al., 2008), reducing the rate of conversion of urea to ammonia. Nitrogen fertilizers coated with polymers fall into the group of slow-release fertilizers and the subgroup of encapsulated products, reducing N losses by promoting a physical barrier of soluble forms against exposure of the nutrient to the environment (CIVARDI et al, 2011). In fertilizer encapsulation technology, the aim is to ensure that the protective layer against agents that cause nutrient loss does not completely interfere with their availability to the plant (SILVA et al., 2012). This slower release may favor synchronization between nutrient availability and absorption by plants (OLIVEIRA; SCIVITTARO, 2002). There are studies on the use of these slow-release sources of N for some crops such as corn.

The ammonium sulfate source is an alternative to the use of urea, being a low N concentration fertilizer that does not present the problem of volatilization. However, this fertilizer's efficiency is reduced by nitrate leaching (THEAGO et al., 2014), in addition to acidifying the soil.

As an organic source of some nutrients, there is the option of cattle manure, which is often used as a complement to mineral fertilizer or as a substitute for it, also contributing to the physical quality of the substrate. For Lima et al. (2007), the incorporation of organic material into the substrate improves the structure, reduces plasticity and cohesion, increasing water retention and aeration, allowing greater penetration and distribution of roots.

The objective of this work was to evaluate the complementation of a commercial substrate with different nitrogen sources in the production of yellow passion fruit seedlings.

MATERIAL AND METHODS

The experiment was conducted in the municipality of Guarda-Mor/MG, located at 616.28 meters of altitude and geographical location 17º 46' 15" S 47º 05' 52" W, in the northwestern mesoregion of Minas Gerais.

The experimental design used was in randomized blocks (DBC), with six treatments and 4 replications, totaling 24 plots consisting of 8 plants each, using polyethylene bags measuring 15 x 20 cm. The six treatments were C (control - commercial substrate), UC (commercial substrate + conventional urea), UP (commercial substrate + polymerized urea), NBPT (commercial substrate + urea with urease inhibitor), SA (commercial substrate + ammonium sulfate), EB (commercial substrate + cattle manure).

The commercial substrate Carolina Soil ® recommended for the production of fruit seedlings that contain peat, expanded vermiculite, dolomitic limestone, agricultural gypsum, calcium carbonate and traces of NPK (SUBSTRATO, 2018). In the EB treatment, commercial substrate was used with tanned cattle manure in a 2:1 ratio and the mixture was made on the day of sowing. In the other treatments, N sources were divided into two applications on the surface of the substrate with subsequent irrigation, the first being carried out at 36 days after emergence (DAE) and the second at 51 DAE. It is noteworthy that in the SC treatment there was no addition of nitrogen source. The doses of each nitrogen source were established for a total supply of 20g plant $^{-1}$ of N (MALAVOLTA, 1981).

Passiflora edulis were used Sims obtained from ripe commercial fruits. Sowing, with two seeds, was carried out on April 27th at a depth of 0.03m. At 15 DAE, thinning was

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carried out, leaving one plant per bag.

During the experiment, daily irrigations and manual control of weeds were carried out when necessary.

At 15 days after the first application of the nitrogen source, that is, at 51 DAE, four seedlings from each plot had their heights evaluated with the aid of a graduated ruler. The SPAD index was evaluated in the fully expanded leaves of the upper stratum of these seedlings using a portable Minolta chlorophyll meter, model SPAD-502, which allows instantaneous readings of the relative chlorophyll content in the leaf without destroying it.

Subsequently, these four seedlings had their aerial part and roots separated with the aid of a stylet to determine the dry biomass of the roots and aerial part. The parts of the plant, after being washed and removing excess water with paper towels, were dried in a forced air circulation oven at 60ºC until they reached a constant weight. They were then weighed using a precision scale.

That same day (51 DAE) the second nitrogen fertilization was carried out with different sources on the four remaining seedlings of each treatment, except for SC and EB. All assessments were repeated 15 days after the second application, which occurred at 66 DAE.

The data were subjected to analysis of variance and the means compared by the Tukey test at 5% probability, using the SISVAR program.

RESULTS AND DISCUSSION

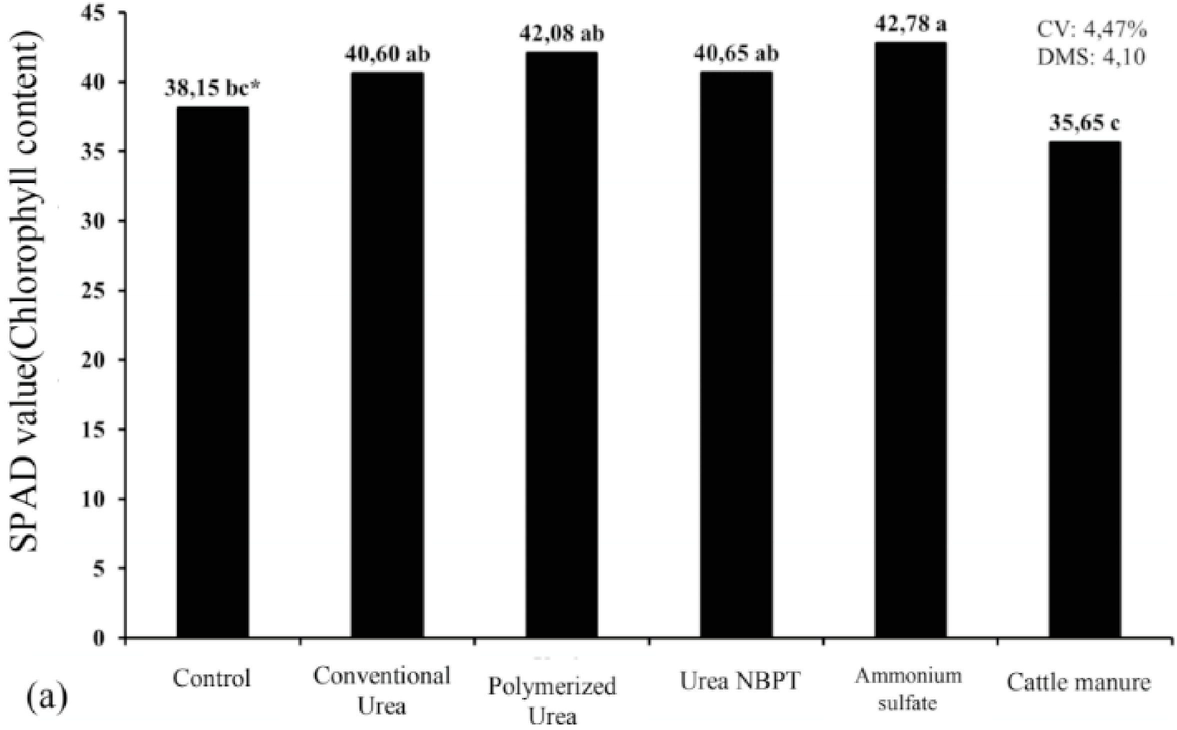
Statistical analyzes were significant for the SPAD index, which correlates the chlorophyll content with the N concentration in the plant, in the different treatments and in the two evaluation periods.

Figures 1a and 1b present the average values for this variable at 51 DAE (15 days after the first N application) and at 66 DAE (15 days after the second application), respectively.

At 51 DAE, the application of SA provided a higher average SPAD index in relation to other nitrogen sources. Cattle manure was the one with the lowest average SPAD index.

The higher SPAD index in the treatment using SA can be explained by the high water solubility of this fertilizer, releasing N, providing a higher chlorophyll reading in the leaves in the first evaluation period. The need for mineralization of the organic source in the EB treatment resulted in a lower SPAD index, and it may be that the 51DAE were not sufficient to make this nutrient available. Santos et al. (2011), when studying the combination of soil, sand and cattle manure with nitrogenous mineral sources in passion fruit plants grown in pots, they observed that those grown only in the presence of cattle manure presented lower SPAD index values than those that, in addition to manure, received mineral fertilizer of ammonium sulfate, ammonium nitrate or conventional urea. The fact that the Control treatment presented a higher average than the EB can be explained by the fact that the commercial substrate has traces of N as evidenced by its label, making it available faster than the organic source applied in a 2:1 ratio.

The evaluation of the SPAD index at 66DAE showed the superiority of polymerized urea (UP) followed by NBPT urea with a urease inhibitor. The slower release of N and the inhibition of urease may have contributed to a lower loss of N through volatilization, with a consequent higher content in the leaves indirectly assessed by the SPAD index. Santos et al. (2018), determined an increase in the chlorophyll content in leaves of tamarind seedlings 35 days after transplanting the seedlings with the use of slow-release fertilizer. Frazão et al. (2014), found that the coating of urea with polymers favored the N



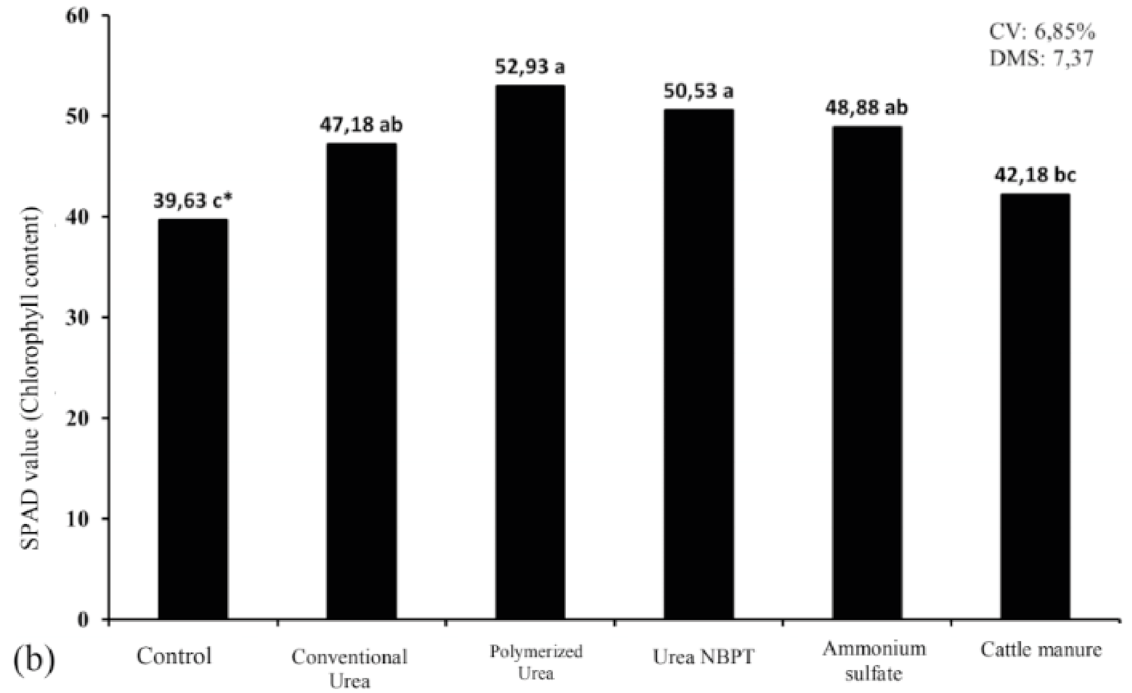


Figure 1: SPAD index of yellow passion fruit seedlings at 51 DAE (a) and 66 DAE (b) of application of different sources of N (* Mean followed by the same letter do not differ statistically by Tukey's test at 5% significance)

content in the corn leaf when compared to the application of conventional urea with a consequent increase in productivity. However, for the same culture, Martins et al. (2014) and Silva et al. (2012) found no influence on leaf N content when comparing the same sources. When studying the productivity of wheat crops, Theago et al. (2014), found no differences regarding the use of ammonium sulfate, conventional urea and urea with a urease inhibitor.

Figures 2a and 2b show the average heights of passion fruit seedlings in the two evaluation periods.

Statistically, there were no significant differences at 51 DAE for the height of the seedlings between the UP, NBPT, SA, UC and control treatments, with the treatment with the presence of cattle manure (EB) having the lowest average (Figure 2a). However, Santos et al. (2018) reported that doses of slow-release fertilizer did not provide a significant increase in the height of tamarind seedlings 35 days after transplanting the seedlings, explaining that the evaluation time was possibly not sufficient for the release of N.

When the seedling height was evaluated at 66 DAE, the SA and UP sources were statistically superior to the other treatments (Figure 2b). When studying three sources of N, including conventional urea and ammonium sulfate, Feitosa Filho et al. (2004) found no significant difference in the height of yellow passion fruit seedlings. Evaluating the use of common urea and urea with polymers at the height of corn plants before harvesting at the end of the cycle, Civardi et al. (2011) found no statistical differences for this variable.

The average values for root and shoot dry masses are represented in Figures 3 (3a and 3b) and 4 (4a and 4b), respectively, in the two evaluation periods.

The UP and NBPT treatments were statistically superior to the others in the production of dry root biomass at 51 DAE, with the control (SC) and the combination with cattle manure (EB) presenting the lowest average values. In the assessment at 66 DAE, the highest average value for the SA treatment was observed, although statistically it is not different from the others.

NBPT urea presented the highest average value of aerial part dry biomass at 51 DAE, while at 66 DAE the highest average value was determined in the application of UP urea. In this second evaluation period, the SPAD index also presented the highest average value when applying urea UP followed by NBPT. Viana and Kiehl (2010) found that the SPAD index proved to be a good parameter for predicting the production of dry biomass in the aerial part of wheat.

In the two evaluation periods, the control and the combination of commercial substrate with cattle manure (EB) provided the lowest average values for this variable. Santos et al. (2011), found that the treatment containing only cattle manure mixed with commercial substrate presented the lowest average for the dry biomass of the aerial part of wheat plants when compared to pots that received the addition of nitrogenous mineral sources.

CONCLUSION

The nitrogen fertilizers polymerized urea, ammonium sulfate and NBPT urea proved to be the best sources to be added to the commercial substrate in the production of yellow passion fruit seedlings.

The isolated use of commercial substrate or with addition of cattle manure proved to be the least efficient options in the production of yellow passion fruit seedlings.

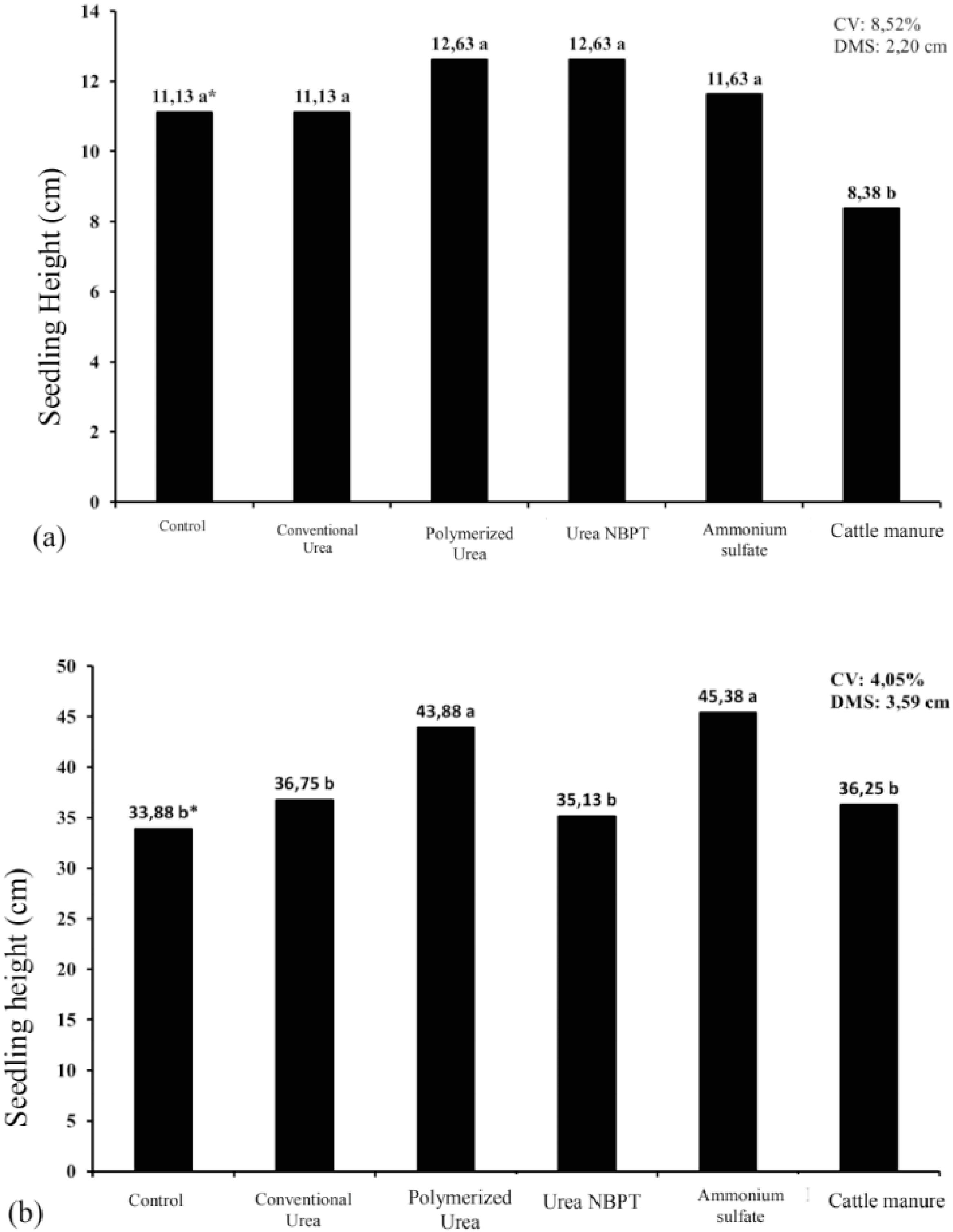


Figure 2: Height of yellow passion fruit seedlings at 51 DAE (a) and 66 DAE (b) of application of different sources of N. (*Average followed by the same letter does not differ statistically according to the Tukey test at 5% significance.)

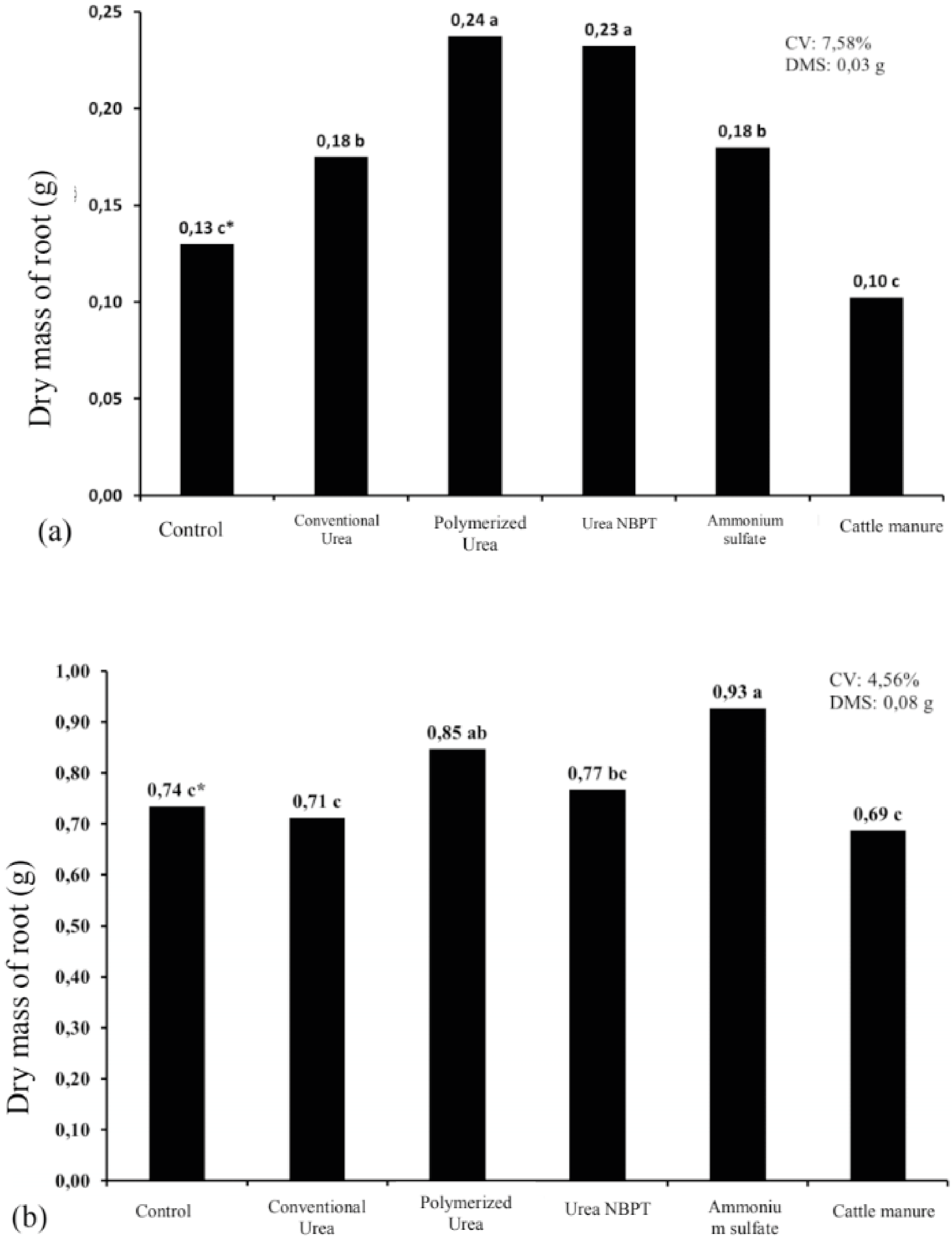


Figure 3: Root dry biomass of yellow passion fruit seedlings at 51 DAE (a) and 66 DAE (b) of application of different sources of N. (*Average followed by the same letter does not differ statistically by the Tukey test at 5% of meaningfulness.)

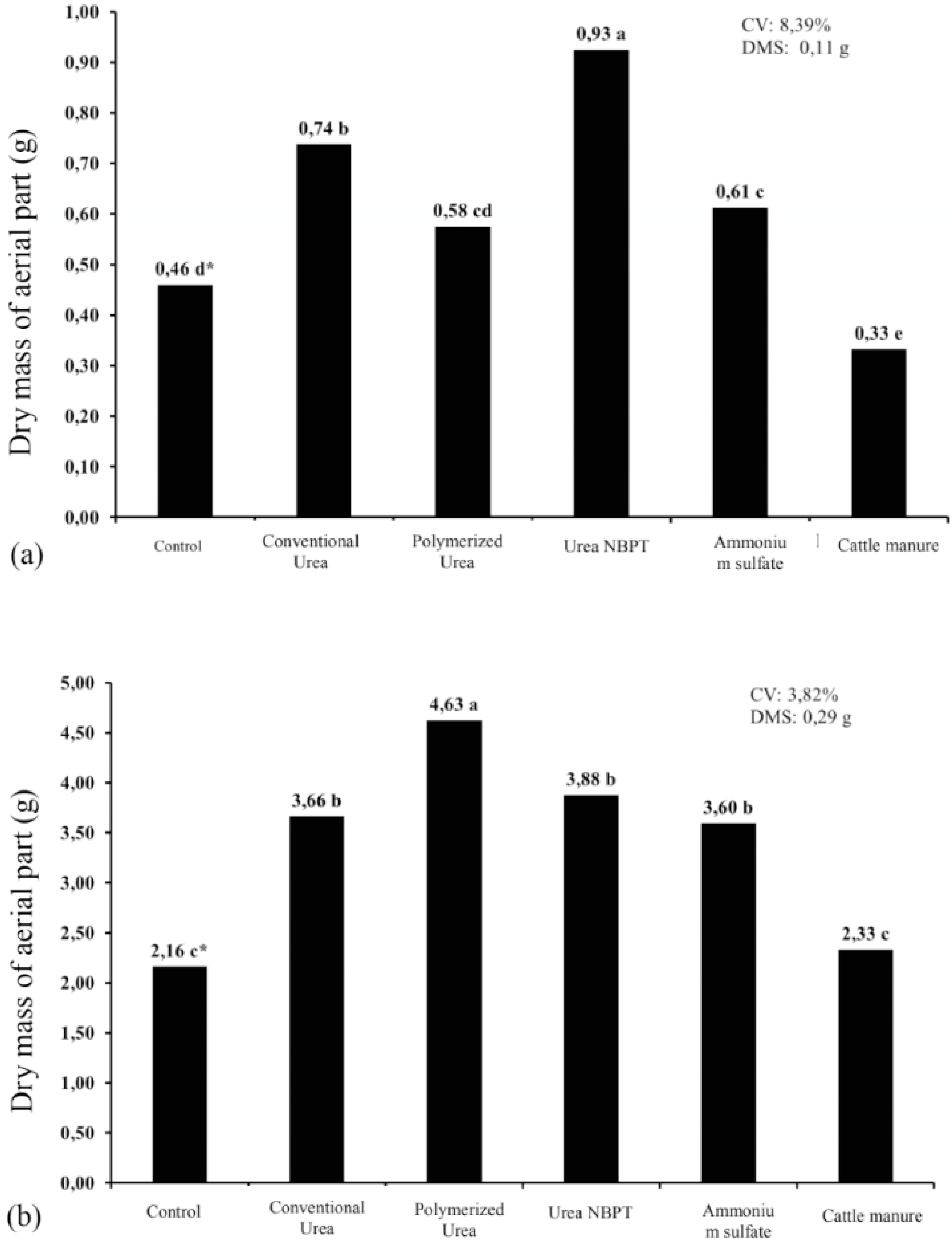


Figure 4: Dry biomass of aerial part of yellow passion fruit seedlings at 51 DAE (a) and 66 DAE (b) of application of different sources of N. (*Average followed by the same letter does not differ statistically by the Tukey test at 5% of significance.)

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