Scientia Agraria Paranaensis

Scientia Agraria Paranaensis – Sci. Agrar. Parana.
ISSN: 1983-1471 – Online
DOI: https://doi.org/10.18188/sap.v20i1.26016

INFLUENCE OF SOIL PREPARATION AND PLANTING METHODS ON WATERMELON PRODUCTIVITY AND QUALITY

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SAP 26016 Received: 01/10/2020 Accepted: 05/02/2021
Sci. Agrar. Parana., Marechal Cândido Rondon, v. 20, n. 1, jan./mar., p. 45-51, 2021

ABSTRACT - The productivity and quality of watermelon fruits can be influenced by several factors, edaphic or associated with cultural management, such as, the type and form of soil preparation and planting methods, which can be by direct sowing or through transplanted seedlings. The objective of this work was to evaluate productive characteristics and quality of watermelon fruits grown under different forms of soil preparation and planting methods. The experimental design used was randomized blocks, organized in a 2x3 factorial scheme, containing three replications, with 24 plants per plot. The evaluated factors were two forms of soil preparation and three forms of cultivation. The fruits were harvested when their tendrils showed visible signs of dryness, when their productive and qualitative characteristics were analyzed. The variables analyzed were the number of fruits per plant, fruit mass, transverse and longitudinal circumference of the fruits, total soluble solids (° Brix), total titratable acidity, maturation index (*ratio*) and total productivity. The planting methods do not alter the productive characteristics and the quality of the watermelon fruits, which proved to be adequate to the standard demanded by the national market. Conventional tillage, with plowing followed by harrowing, increases the number of fruits per plant and total productivity, reaching 30.7 Mg ha-1, a value 35.08% higher than the average for the state of Rondônia and 28.33 % above the national average.
Keywords: *Citrullus lanatus* (Thunb.) Matsum & Nakai, soil management, no-till, conventional preparation.

INFLUÊNCIA DO PREPARO DE SOLO E MÉTODOS DE PLANTIO SOBRE A PRODUTIVIDADE E QUALIDADE DE MELANCIA

RESUMO - A produtividade e qualidade de frutos de melancia podem ser influenciadas por diversos fatores, edáficos ou associados ao manejo cultural, tais como, o tipo e forma de preparo do solo e os métodos de plantio, que podem ser por semeadura direta ou através de mudas transplantadas. O objetivo deste trabalho foi avaliar características produtivas e qualidade de frutos de melancia cultivadas sob diferentes formas de preparo do solo e métodos de plantio. O delineamento experimental utilizado foi blocos casualizados, organizado em esquema fatorial 2x3, contendo três repetições e 24 plantas por parcela. Os fatores avaliados foram duas formas de preparo do solo e três formas de cultivos. Os frutos foram colhidos quando suas gavinhas apresentavam visíveis sinais de ressecamento, ocasião em que foram analisadas suas caracteristicas produtivas e qualitativas. As variáveis analisadas foram o número de frutos por plantas, massa dos frutos, circunferência transversal e longitudinal dos frutos, sólidos solúveis totais (°Brix), acidez total titulável, índice de maturação (*ratio*) e produtividade total. Os métodos de plantio não alteram as caracteristicas produtivas e a qualidade dos frutos de melancia, que se mostraram adequados ao padrão exigido pelo mercado nacional. Já o preparo convencional do solo, com aração seguido de gradagem, aumenta o número de frutos por planta e a produtividade total, alcançando 30,7 Mg ha^{-1}, valor 35,08% superior à média do estado de Rondônia e 28,33% acima da média nacional.
Palavras-chave: *Citrullus lanatus* (Thunb.) Matsum & Nakai, manejo do solo, plantio direto, preparo convencional.

INTRODUCTION

Watermelon (*Citrullus lanatus* (Thunb.) Matsum and Nakai), family Cucurbitaceae, is a cosmopolitan vegetable species, widely cultivated in tropical and subtropical regions of the world (KOMANE et al., 2017). Brazil is the fourth largest world producer (FAOSTAT, 2019), with approximately 2.24 million tons produced annually, in an area of approximately 102.4 thousand hectares (IBGE, 2018).

The cultivation of watermelon occurs in all Brazilian regions, and since it is an activity carried out predominantly by family farmers, it is considered of great economic and social importance (PEREIRA et al., 2019), as it generates employment and income in its entire production chain. The main producing states are Rio Grande do Sul with 346,310 tons, São Paulo, 291,846 tons and Goiás with 267,896 tons (IBGE, 2018). The northern region of the country has favorable climatic conditions for the cultivation of this species (REZENDE et al., 2010), however, with the exception of the state of Tocantins, which produces about 28.13 Mg ha^{-1}, the average productivity in the other states

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(15.5 Mg ha^{-1}) (IBGE, 2018) is relatively low when compared to large producing centers.

In Rondônia, about 960 hectares are cultivated annually, with an average productivity of 18.60 Mg ha^{-1} (IBGE, 2018), and this is mainly due to low investments in technologies, such as seeds, fertilizers and pesticides, in addition to inadequate soil and crop management. The vegetative development and production of watermelon fruits can be affected by several factors, such as edaphoclimatic conditions (CARMO et al., 2015), quality of genetic material, fertilization management (NASCIMENTO et al., 2015), in addition to type and form of soil preparation (DALASTRA et al., 2015; DIA et al., 2016).

Due to the ease of incorporating cultural remains and keeping the cultivation area free of weed plants, conventional soil preparation, with plowing followed by harrows, is the most used method in the production of watermelon in Rondônia. However, this practice can negatively affect the hydraulic and biological properties of the soil, cause disruption of aggregates in the surface layer, accelerated exposure and decomposition of organic matter, increase the density and resistance of the soil to penetration into the subsurface (ARATANI et al., 2009) in addition to favoring water and wind erosion, since the watermelon canopy is not able to fully cover the soil (ELTZ et al., 2005).

The adoption of conservationist practices, such as no-till, can be an alternative to minimize soil degradation, increase and stabilize crop productivity (ZHOU et al., 2016). In this system, the plant material present on the surface forms a physical barrier that reduces the impact of drops and the drag of particles (SUZUKI; ALVES, 2006). In addition, it maintains the humidity in the system due to the reduction of evaporative rates (BAETS et al., 2011), promotes the control of weeds (ARAÚJO et al., 2019), and consequently the competition for water, light and nutrients (ALBUQUERQUE et al., 2017).

In addition to the aspects mentioned above, the watermelon planting method, which traditionally is carried out by direct sowing (REZENDE et al., 2010), can also affect the crop's yield. Despite the ease of direct sowing, which requires less labor at the time of implantation, the method can generate crops with uneven stands, due to inadequate temperature and humidity conditions that hinder seed germination (SILVA-MATOS et al., 2017). On the other hand, the implantation of the culture through seedlings, provides seed savings, which is desirable, mainly in the case of seeds of improved genetic materials, of high cost (DALASTRA et al., 2016), in addition to the possibility of regulating the temperature and humidity in the nurseries, giving favorable conditions to the initial development of the plant (HARTMANN; KESTER, 2011).

The size of the container for the formation of seedlings is a relevant factor that must be studied, as it directly affects the volume of substrate available for root development. The vegetable seedlings are traditionally grown in styrofoam trays, with small cells, which have the advantage of saving substrate and space inside the greenhouse (FILGUEIRA, 2008). However, very small volumes can impair the formation of the root system, the absorption of water and nutrients, photosynthetic activity, the content of chlorophyll in the leaves, the respiratory rate and consequently the quality of the seedling (NESMITH; DUVAL, 1998).

In this context, the objective of this work was to study the effects of soil preparation and planting methods on the yield and quality of watermelon fruits, under edaphoclimatic conditions in the brazilian Amazon.

MATERIAL AND METHODS

The experiment was carried out between March and June 2016 in the experimental area of the Federal University of Rondônia (UNIR), municipality of Rolim de Moura, Rondônia. The local climate, according to the Köppen classification, is type Am, characterized as tropical monsoon (ALVARES et al., 2013), with a well-defined dry season, average annual temperature of 26ºC, average precipitation of 2,250 mm, and relative humidity in around 85%. The temperature and precipitation data that occurred during the experiment are described in Figure 1.

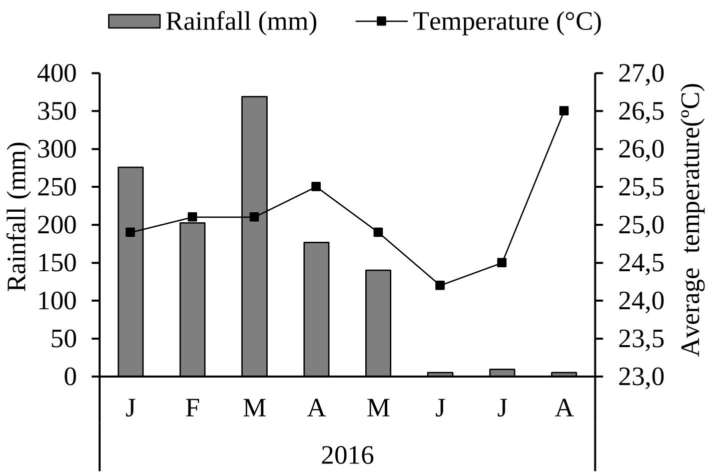

FIGURE 1 - Rainfall and average monthly temperature during the period of conduction of the experiment.

The soil of the experimental area is characterized as a Latossolo Vermelho Amarelo distrófico, with medium clay texture and chemical characteristics in the layer of 0 - 20 cm: pH (water) = 5.4; phosphorus (P) = 2.3 mg dm^{-3}; potassium (K^{+}) = 0.17 $cmol_c$ dm^{-3}; calcium (Ca^{2+}) = 1.3 $cmol_c$ dm^{-3}; magnesium (Mg^{2+}) = 0.5 $cmol_c$ dm^{-3}; hydrogen + aluminum (H + Al^{3+}) = 3.5 $cmol_c$ dm^{-3}; base saturation (V%) = 36% and organic matter (M.O.) = 20.6 g kg^{-1}.

The historic of the area shows that in 2015 the soil of the place was prepared in a conventional way and cultivated with melon (*Cucumis melo*), and immediately after the harvest it was placed under fallow, and, naturally, covered by *Brachiaria brizanta*. The increase in base saturation to 70% (FILGUEIRA, 2008) was carried out by liming with dolomitic limestone three months before the installation of the experiment.

The experimental design used was randomized blocks, organized in a 2 x 3 factorial scheme (2 forms of soil preparation x 3 forms of planting), containing three replications. The factors studied were: two forms of soil preparation, the first being the conventional method, consisting of plowing followed by two harrows and the second by direct planting on the straw of *Brachiaria brizantha*, dried with glyphosate 480 g L^{-1} and three forms of planting, respectively: through seedlings produced in plastic cups of 100 cm^3, in polystyrene trays of 128 cells and direct sowing in the field.

In order to verify the degree of soil compaction in the no-till area, soil samples with preserved structure were collected and their density and porosity were determined, according to Embrapa's methodology (2011), pointing out the results in layer 0 to 20 cm: 1.63 g cm^{-3} of medium density; 0.38 m^3 m^{-3} of microporosity; 0.10 m^3 m^{-3} of macroporosity and 0.48 m^3 m^{-3} of total porosity. To determine the amount of straw, six samples were collected, with the aid of a metallic square of 0.5 x 0.5 m, which were dried in a forced circulation oven at 65°C, until a constant mass was obtained, and the result medium demonstrated the equivalent of 13.3 Mg ha^{-1} of straw.

Sowing in trays and cups was carried out simultaneously with direct sowing, using the commercial substrate Plantmax® and seeds of the cultivar Crimson Sweet (Horticeres®), of open pollination. The transplant took place at 12 days after sowing, when the seedlings showed the beginning of the emergence of the first definitive leaf and about 10 cm in height. In planting fertilization, 160 kg ha^{-1} of P_2O_5 and 90 kg ha^{-1} of K_2O were applied (FILGUEIRA, 2008), using simple superphosphate (18% P_2O_5) and potassium chloride (60% K_2O) as sources. Two cover fertilizations were carried out, nitrogen and potassium, the first at 20 and the second at 40 days after sowing, at doses of 30 and 40 kg ha^{-1} of N and K_2O, respectively.

The planting spacing was 2.0 m between rows and 1.3 m between plants and each plot was composed of 4 rows with 6 plants, totaling 39 m^2 and 24 plants per plot, from which the fruits of the four central plants were selected for evaluation. The weed control was carried out through manual weeding whenever it was necessary until the complete closing of the lines. For the control of pests and diseases, spraying with agricultural pesticides recommended for the crop was carried out, as recommended in Agrofit (2017) and the water supply was carried out mechanically through the drip irrigation system, following the guidelines of Santos et al. (2004).

The fruits were harvested manually and gradually, when the tendrils showed visible signs of dryness, according to Carvalho's guidelines (2005). It started at 85 days after sowing, extending to 100 days. The variables analyzed were: number of fruits per plant, fruit biomass (kg), longitudinal (m) and transversal circumference (m), average fruit weight (kg) and total productivity (Mg ha^{-1}).

Regarding the quality of the fruits, the content of soluble solids (ºBrix) was evaluated, determined with the aid of a digital refractometer. The fruits were cut longitudinally, extracted a slice and placed in a manual juicer to obtain the juice, used in the refractometer to read the soluble solids (SS) content. Total titratable acidity (TA) was determined according to the standards of the Adolf Lutz Institute (IAL, 2008), the results of which were expressed in g of citric acid 100 g^{-1} of pulp and the maturation index, or ratio, was obtained by the quotient between SS and AT.

The obtained data were submitted to the verification of the presence of outliers by the Grubbs test, the normality of the residues by the Shapiro-Wilk test and homogeneity of the variances by the Cochran test. After verifying the assumptions, the analysis of variance was performed by the F test to verify the effects of the treatments, and, when significant, they were compared by the Tukey test, at 5% probability of error. Static analyzes were performed using the R statistical software (R CORE TEAM, 2015).

RESULTS AND DISCUSSION

The planting methods did not influence ($p > 0.05$) in any of the variables analyzed, thus, any of the planting options, direct sowing or transplanted seedlings, can be adopted, and should always prioritize the economic factor. In more technical systems, using improved hybrid seeds, of high commercial value, it is recommended to produce seedlings in nurseries, using 128-cell Styrofoam trays, which requires less substrate than disposable cups. In low-tech systems, where the use of low-cost, open-pollinated seeds predominates, direct sowing may be the best option, as it avoids nursery costs and reduces the need for labor.

The number of fruits per plant was statistically higher ($p < 0.05$) in the conventional planting system, where an average of 0.84 $plant^{-1}$ fruits were harvested (Figure 2A). In no-till, the average was 0.66 fruits $plant^{-1}$, that is, a 25% reduction compared to conventional preparation. Regarding the weight of the fruits (Figure 2B), there were no differences between treatments ($p > 0.05$), with values found in the range of 9.1 to 10.7 kg, which are classified as commercial fruits (ANDRADE JÚNIOR et al., 2006) and extra or special commercials (CARVALHO et al., 2005). Eltz et al. (2005) evaluating watermelon production under different soil managements obtained similar results, with an average fruit mass of 10.08 kg for crops under conventional tillage and no-tillage systems, confirming that soil management does not influence fruit mass.

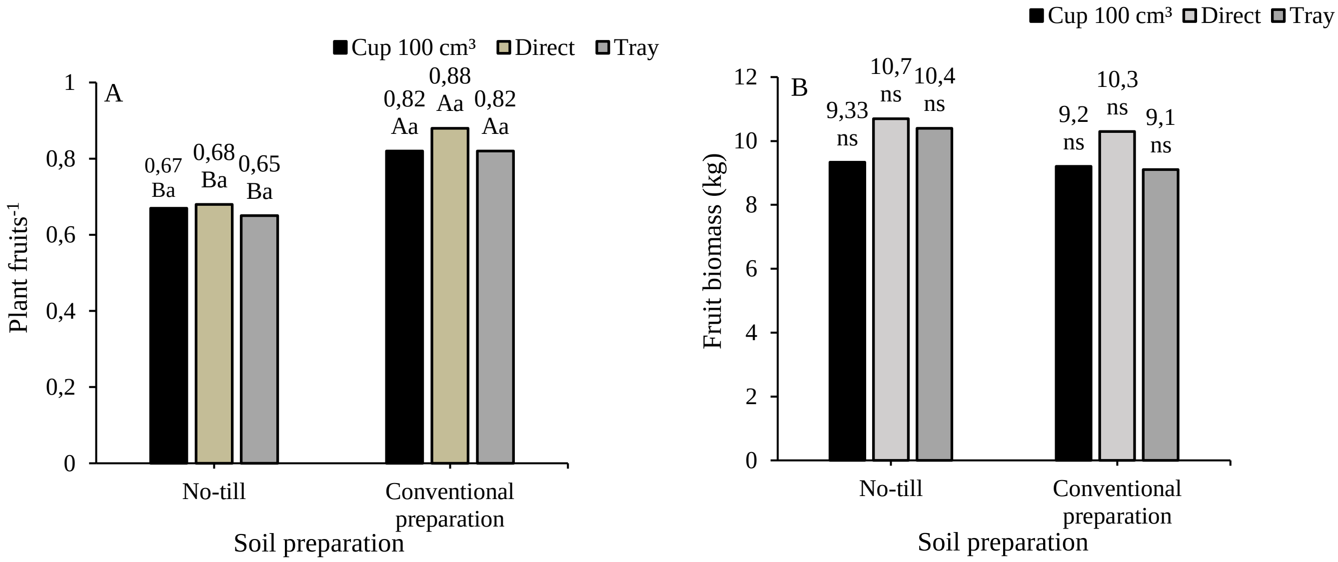

FIGURE 2 - Number of fruits per plant (A) and average fruit biomass (B) of watermelon grown under two tillage systems, combined with three planting methods. Means with different capital letters indicate differences ($p < 0.05$) with each other for the treatment of soil preparation and lower case for the planting method. Comparison of means performed by the Tukey test, at 5% probability of error, ns = not statistically significant ($p > 0.05$) by the F test.

The size of the fruits, measured through the transverse circumference, varied between 0.78 m and 0.81 m, not being affected by the treatments (Figure 3A), however, the longitudinal circumference was higher ($p < 0.05$) in no-tillage, reaching 0.89 m when the planting method was direct sowing, a value 13% higher than the average obtained in conventional preparation combined with seedlings produced in trays (Figure 3B). One of the possible explanations for the increase in longitudinal circumference in no-tillage is related to less intraspecific competition for water and nutrients, since there was a reduction in the number of fruits per plant in this treatment. Barros (2013) observed that the smaller amount of plant^{-1} fruits alters the size and quality of the harvested fruits, which are larger, in addition to having a higher content of soluble solids.

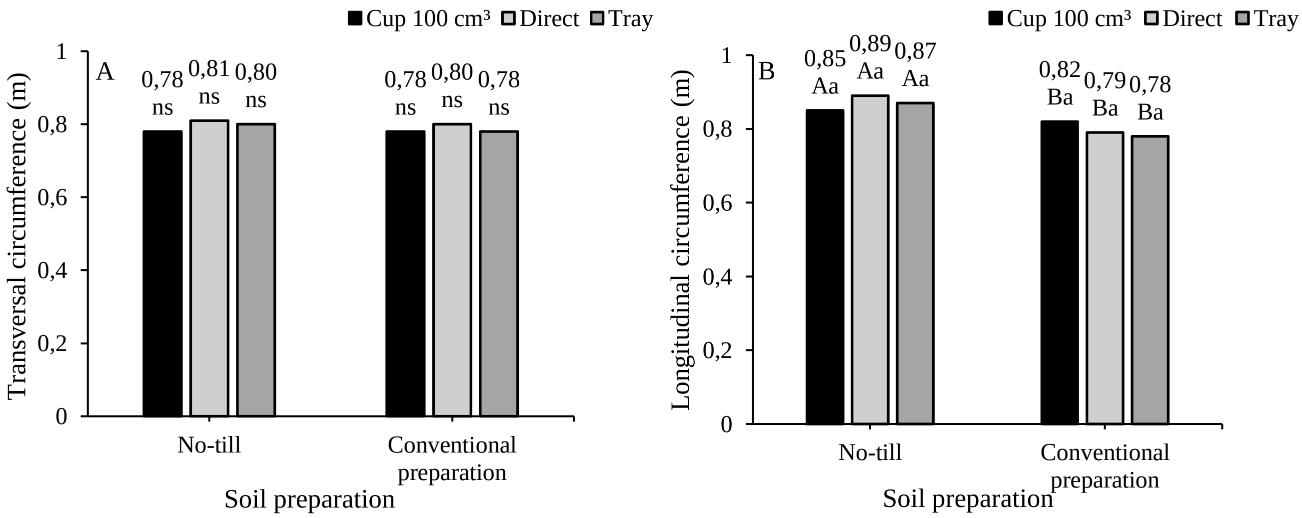

FIGURE 3 - Transverse (A) and longitudinal (B) circumference of watermelon fruits grown under two tillage systems combined with three planting methods. Means with different capital letters indicate differences ($p < 0.05$) with each other for the treatment

of soil preparation and lower case for the planting method. Comparison of means performed by the Tukey test, at 5% probability of error, ns = not statistically significant (p> 0.05) by the F test.

The content of soluble solids, total acidity and ratio, were not influenced by the treatments (p> 0.05) (Table 1). Total acidity tends to increase with the growth of the fruit, until it reaches physiological maturity, and it is a characteristic that can change due to climatic or management factors, such as fertilization and water availability. The observed results showed that the soil tillage system and the planting method do not modify the total acidity of the fruits, whose average was 0.97g citric acid 100 mL^{-1}, above what was considered adequate by Barros et al. (2012).

TABLE 1 - Chemical assessments of watermelon fruits grown under two soil tillage systems combined with three planting methods.

Chemical assessments of fruits			
Soluble solids (ºBrix)	Cup 100 cm^3 ns	Direct seeding ns	Polystyrene trays ns
No-till	10,60	10,80	10,50
Conventional planting	10,80	11,10	10,70
CV (%)	9,70	13,40	17,60
Total acidity (AT) (g citric acid 100 mL^{-1})			
No-till	0,92	0,83	0,93
Conventional planting	1,10	0,89	1,20
CV (%)	12,10	11,40	12,70
Ratio SS/AT			
No-till	11,52	13,01	11,29
Conventional planting	9,81	12,47	9,39
CV (%)	11,30	12,60	15,60

CV (%) = coefficient of variation, ns = not significant by the F test, at 5% probability of error.

The average soluble solids content was 10.7° Brix, an acceptable value and above the minimum required by the national market, which is 10° Brix (ANDRADE JÚNIOR et al., 2006). According to Chitarra and Chitarra (2005), the total acidity, the soluble solids content, and the ripeness index, or ratio, are characteristics that guarantee the true flavor of the fruit. The values found in the present work demonstrate that, regardless of the type of soil preparation and cultivation method, the fruits produced in the edaphoclimatic conditions of the Brazilian Amazon can present good organoleptic qualities.

The total productivity was significantly higher (p <0.05) in the soil prepared in the conventional way (Figure 4). With this method, the average productivity was 30.7 Mg ha^{-1}, a value, according to data from IBGE (2018), 35.08% higher than the average for the State of Rondônia and 28.33% higher than the national average. The increase in productivity in systems that use soil turning has already been observed by Rocha et al. (2011), who tested three soil tillage methods, observed that conventional tillage significantly increases productivity, reaching 126.5 Mg ha^{-1} of marketable fruits, while in no-tillage this value was 74.1 Mg ha^{-1}. On the other hand, Araújo et al. (2019) evaluating watermelon cultivation in a sugarcane regeneration area in the State of São Paulo, using the same soil tillage methods of Rocha et al. (2011), found that productivity in the no-tillage system, in two consecutive harvests, was similar to that of no-tillage.

The increase in productivity, obtained in conventional tillage, may be associated with higher soil density (1.63 g cm^{-3}), lower total porosity (0.48 m^3 m^{-3}), in addition to the distribution of soil pores , being 0.10 m^3 m^{-3} and 0.38 m^3 m^{-3} of macropores and micropores respectively in the no-tillage system. According to Kiehl (1979), porosity is directly related to root development, and an ideal soil, capable of providing good conditions for the development of plants, must present minimum values of total porosity equivalent to 0.50 m^3 m^{-3}, and the distribution of the pores should be 1/3 of macropores and 2/3 of micropores, a fact not found in the no-tillage treatment, indicating some degree of compaction in the system, impairing the development of the watermelon.

In addition, Reichert et al. (2003) consider 1.55 g cm^{-3} as critical density for the growth of the root system in soils with medium texture, which may indicate some degree of compaction in the no-tillage treatment of this experiment. Branco et al. (2014), testing different soil tillage systems, obtained results similar to those found in this trial, concluding that the no-tillage system can restrict the development of the root system of watermelon plants and alter fruit productivity.

Conservation preparation methods, such as no-till, are extremely beneficial for the sustainability of agricultural agroecosystems, however, reports of compaction and limitation of root development due to the availability of water and nutrients are frequent (CHEN; WEIL, 2011). Sá et al. (2004) mention that in the initial phase of direct planting there is an increase in nitrogen immobilization by the microbial community and an increase in soil density, and the real benefits of direct planting are obtained after the system consolidation phase, which can vary between 11 and 20 years, when there is an increase in the levels of organic carbon, an increase in the cation exchange capacity and stabilization in the density and porosity of the soil.

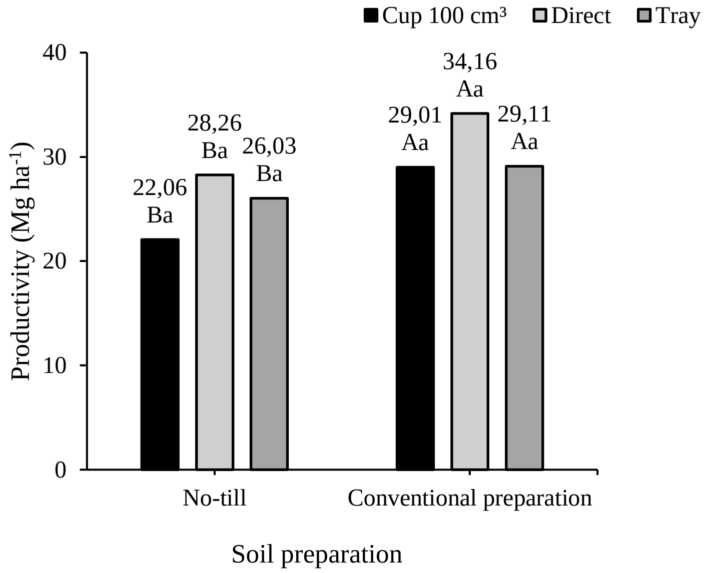

FIGURE 4 - Productivity of watermelon fruits grown in soil tillage systems combined with planting methods. Means with different capital letters indicate differences ($p < 0.05$) with each other for the treatment of soil preparation and lower case for the planting method. Comparison of averages performed by the Tukey test, at 5% probability of error.

The present work showed that the productive characteristics of watermelon fruits are affected by soil management practices, demonstrating that conventional tillage, with plowing and harrowing, is the most efficient method in the short term, where the highest yields are achieved. However, further work is needed to assess economic factors, given that interventions for the control of invasive plants in this method are greater, and also new trials that assess the effects of no-till in the long term, since it is a consensus in the scientific community long-term conservationist practices improve the physical, chemical and biological characteristics of the soil, resulting in increased productivity and reduced production costs.

CONCLUSIONS

The methods of planting, direct sowing, seedlings produced in trays or plastic cups of 100 cm^3, do not change the agronomic characteristics and quality of watermelon fruits.

In the brazilian Amazon, conventional soil tillage increases the number of fruits per plant and the total productivity of watermelon.

REFERENCES

AGROFIT. **Sistemas de agrotóxicos fitossanitários.** 2021. Disponível em: <http://extranet.agricultura.gov.br/agrofit_cons/principal_agrofit_cons>. Acesso em: 20 fev. 2021.

ALBUQUERQUE, A.J.D.A.; SANTOS, T.S.D.; CASTRO, T.S.; EVANGELISTA, M.O.; ALVES, J.M.A.; SOARES, M.B.B.; MENEZES, P.H.S.D. Estudo florístico de plantas daninhas em cultivos de melancia na Savana de Roraima, Brasil. **Scientia Agropecuaria**, v.8, n.2, p.91-98, 2017.

ALVARES, C.A.; STAPE, J.L.; SENTELHAS, P.C.; GONÇALVES, J.L. M.; SPAROVEK, G. Köppen's climate classification map for Brazil. **Meteorologische Zeitschrift**, v.22, n.6, p.711-728, 2013.

ANDRADE JÚNIOR, A.S.; DIAS, N.D.S.; JUNIOR, L.G.F.; RIBEIRO, V.Q.; SAMPAIO, D.B. Produção e qualidade de frutos de melancia à aplicação de nitrogênio via fertirrigação. **Revista Brasileira de Engenharia Agrícola e Ambiental**, v.10, n.4, p.836-841, 2006.

ARATANI. R.G.; FREDDI, O.S.; CENTURION, J.F.; ANDRIOLI, I. Qualidade física de um latossolo vermelho acriférrico sob diferentes sistemas de uso e manejo. **Revista Brasileira de Ciência do Solo**, v.33, n.3, p.677-687, 2009.

ARAÚJO, H.S.; BRANCO, R.B.F.; MORAES, C.C.; CALORI, A.H.; RÓS, A.B.; PURQUERIO, L.F.V. Watermelon cultivation in regeneration areas of a sugarcane field under different soil managements. **Pesquisa Agropecuária Brasileira**, v.54, e00039 p.1-9, 2019.

BAETS, S. DE; POESEN, J.J.; MEERSMANS, J.J.; SERLET, L.L. Cover crops and their erosion-reducing effects during concentrated flow erosion. **Catena**, v.85, n.3, p.237-244, 2011.

BARROS, J.D.S. Contribuições da matéria orgânica do solo para mitigar as emissões agrícolas de gases de efeito estufa. **Polêmica**, v.12, n.2, p.341-351, 2013.

BARROS, M.M.; ARAÚJO, W.F.; NEVES, L.T., CAMPOS; A.J.D.; TOSIN, J.M. Produção e qualidade da melancia submetida a adubação nitrogenada. **Revista Brasileira de Engenharia Agrícola e Ambiental**, v.16, n.10, p.1078-1084, 2012.

BRANCO, R.B.F.; NOWAKI, R.H.D.; SALLES, F.A.; BOLONHEZI, D.; GUALBERTO, R. Soil properties and agronomic performance of watermelon grown in different tillage and cover crops in the South Eastern of Brazil. **Experimental Agriculture**, v.51, n.2, p.299-312, 2014.

CARMO, I.L.G.S.; SILVA, E.S.; MONTEIRO NETO, J.L.L.; TRASSATO, L.B.; MEDEIROS, R.D.; PORTO, D.S. Desempenho agronômico de cultivares de melancia no cerrado de Boa Vista, Roraima. **Revista Agro@mbiente On-line**, v.9, n.3, p.268- 274, 2015.

CARVALHO, R.N. **Cultivo de melancia para agricultura familiar**. 2.ed. Brasília, Embrapa Informação Tecnológica, 2005. 112p.

CHITARRA, M.I.F.; CHITARRA, A.B. **Pós-colheita de frutos e hortaliças:** fisiologia e manuseio. Lavras: ESAL/FAEPE, 2005. 735p.

CHEN, G.; WEIL, R.R. Root growth and yield of maize as affected by soil compaction and cover crops. **Soil and Tillage Research**, v.117, n.1, p.17-27, 2011.

DALASTRA, G.M.; ECHER, M.M.; HACHMANN, T.L.; GUIMARÃES, V.F.; SCHMIDT, M.H.; CORBARI, F.L. Desenvolvimento e produtividade da melancia em função do método de cultivo. **Brazilian Journal of Agriculture**, v.91, n.1, p.54-66, 2016.

DALASTRA, G.M.; ECHER, M.M.; HACHMANN, T.L. Desempenho de cultivares de melão, em função do número de frutos por planta. **Journal of Agronomic Sciences**, v.4, n.1, 26-41, 2015.

DIA, M.; WEHNER, T.C.; HASSELL, R.; PRICE, D.S.; BOYHAN, G.E.; OLSON, S.; KINGF, S.; DAVISG, A.R.; TOLLA, G.E. Genotype x environment interaction and stability analysis for watermelon fruit yield in the United States. **Crop Science**, v.56, n.4, p.1645-1661, 2016.

ELTZ, F.L.F.; BOCK, V.D.; AMADO, T.J.C. Efeito do manejo do solo e de doenças foliares sobre a produção e qualidade da melancia. **Revista Brasileira de Agrociência**, v.11, n.2, p.201-206, 2005.

EMBRAPA. Empresa Brasileira de Pesquisa Agropecuária. **Manual de métodos de análise de solos.** 2ª ed. Revista Embrapa Solos, Rio de Janeiro. 2011.

FAOSTAT. **Food and agriculture organization of the United Nations statistics division**. 2019. Disponível em: <http://www.fao.org/faostat/en/#data/QC>. Acesso em: 15 fev. 2021.

FILGUEIRA, F.A.R. **Novo manual de olericultura**: agrotecnologia moderna na produção e comercialização de hortaliças. 3a. ed. Viçosa: UFV, 2008. 421p.

HARTMANN, H.T.; KESTER, D.E. **Plant propagation: principles and practices**. 8a. ed. New Jersey: Prentice Hall, 2011. 915p.

IAL. INSTITUTO ADOLFO LUTZ. **Métodos Físico-Químicos para Análise de Alimentos.** 4a. ed. 1a. ed. digital. 2008. 1020p.

IBGE. INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. **Produção Agrícola Municipal.** 2018. Disponível em: <http://www.ibge.gov.br>. Acesso em: 18 jan. 2021.

KIEHL, E.J. **Manual de edafologia, relações solo-planta.** São Paulo: Agronômico Ceres, 1979. 264p.

KOMANE, B.; VERMAAK, I.; KAMATOU, G.; SUMMERS, B.; VILJOEN, A. The topical efficacy and safety of *Citrullus lanatus* seed oil: A short-term clinical assessment. **South African Journal of Botany**, v.112, n.9, p.466-473, 2017.

NASCIMENTO, J.A.M.; SOUTO, S.J.; PEREIRA, W.E.; MEDEIROS, S.A.S.; CAVALCANTE, L.F. Macronutrients in watermelon plants fertilized with potassium and cattle manure. **Revista Brasileira de Engenharia Agrícola e Ambiental**, v.20, n.9, p.836-840, 2016.

NESMITH, D.S.; DUVAL, J.R. The effect of container size. **HortTechnology**, v.8, n.4, p.495-498, 1998.

PEREIRA, B.J.; RODRIGUES, G.A.; SANTOS; A.R.; DOS ANJOS, G.L.; COSTA, F.M. Watermelon initial growth under different hydrogel concentrations and shading conditions. **Revista Caatinga**, v.32, n.4, p.915-923, 2019.

R Core Team. **R:** a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. 2015.

REZENDE, G.M.; COSTA, N.D.; DIAS, R.S. **Plantio.** In.: Sistema de Produção de Melancia, 2010. Disponible in: <https://sistemasdeproducao.cnptia.embrapa.br/FontesHTML/Melancia/SistemaProducaoMelancia/plantio.htm>. Access: 22 Mar. 2021.

ROCHA, M.R.; ELTZ, F.L.F; SANTOS, M.S.; ROCHA, P.V.; GOULART, R.Z. Produtividade, qualidade dos frutos e distribuição do sistema radicular da melancia em diferentes sistemas de cultivo. **Revista Brasileira de Ciência do Solo**, v.35, n.4, p.1377-1386, 2011.

SÁ, J.C.D.M.; CERRI, C.; PICCOLO, M.; FEIGL, B.; BUCKNER, J.; FORNARI, A.; SÉGUY, L.; BOUZINAC, S.; VENZKEFILHO, S.; PAULLETI, V. O plantio direto como base do sistema de produção visando o sequestro de carbono. **Revista Plantio Direto**, v.14, n.84, p.45-61, 2004.

SANTOS, F.D.S.; LIMA, R.N., RODRIGUES, B.H.N.; CRISOSTOMO, L.A.; SOUZA, F.D.; OLIVEIRA, J.J.G. **Manejo da irrigação da melancia**: uso do tanque classe “A”. Embrapa Agroindústria Tropical, Circular Técnica (INFOTECA-E), 2004. 13p.

SILVA-MATOS, R.R.S.D.; ALBANO, F.G.; CAVALCANTE, Í.H.L.; PESSOA NETO, J.A.; SILVA, R.L.; OLIVEIRA, I.V.D.M.; CARVALHO, C.I.F.S. Desenvolvimento inicial de mudas de melancia cv. Crimson Sweet em função de doses de boro aplicadas na semente. **Revista de Ciências Agrárias**, v.40, n.4, p.30-39, 2017.

SUZUKI, L.E.A.S.; ALVES, M.C. Fitomassa de plantas de cobertura em diferentes sucessões de culturas e sistemas de cultivo. **Bragantia**, v.65, n.1, p.121-127, 2006.

ZHOU, C.; ZHAO, Z.; PAN, X.; HUANG, S.; TAN, X.; WU, J.; SHI, Q. Integration of growing milk vetch in winter and reducing nitrogen fertilizer aplication can improve rice yield in double-rice cropping system. **Rice Science**, v.23, n.3, p.132-143, 2016.