

Original Research Article

Interactive effect of soil mulching and ISAREG model based irrigation on watermelon production Production characteristics of watermelon under different coverings and irrigation depth using the ISAREG model

ABSTRACT

Even with the growing scenario of water scarcity, in the Northeastern semi-arid region, the irrigation management is still not properly managed, resulting in the waste of scarce water resources in the region. The ISAREG model has been used in several countries, being able to assist in the simulation of irrigation. In addition, the ISAREG model quantifies irrigation depths at different percentages of storage, increasing irrigation efficiency. Another way to reduce the use of water loss resources in agriculture is through the use of soil cover, which is a simple technology and whose benefits over crop production and productivity are irrefutable. Added to this is the fact that visual interactions among these applications can amplify these effects. The objective of this study was to compare the irrigation propositions generated from ISAREG model with the actual irrigation management adopted by the irrigators farmers of the Jaguaribe - Apodi Irrigation District, Brazil. In addition, evaluating and analyzing field experiments were performed to assess the influence of the fruit development variables and crop productivity under the different irrigation and soil cover conditions on fruit development and yield of watermelon; and the effects of this interaction on water resource economics and watermelon development. To do this, These field experiments were performed after field surveys with irrigators.farmers in. These field experiments were conducted under a randomized complete block design with subdivided plots and four replicates. The treatments consisted of the combination of four irrigation propositions (three ISAREG propositions: M1 = 100%, M2 = 80% and M3 = 60% of Available Water Capacity in Soil, and M4, irrigation depth used by irrigators), and four subplots, the uncovered soil (, denominated C0), covers with rice husks (C1), with white mulching (C2) and with black mulching (C3), denominated C1, C2 and C3, respectively. The results data were submitted subjected to analysis of variance, and when significant, they were submitted to regression analysis, averages test and trend graphs were performed. From the results it was concluded that the irrigators farmers do not practice the correct management of the irrigation, because the irrigator farmers irrigated applies more water than the to a greater irrigation depth as indicated by the ISAREG model (100% of the Available Water Capacity in Soil) throughout the watermelon cultivation cycle. In general, plants irrigated with 100% of available Water Capacity and on soils covered by rice husk and white mulching showed better productivity. e characteristics.

Comment [R1]: The abstract should be modified. A last sentence of conclusion based on the results should be provided.

Keywords: deficit irrigation; software; *Citrullus lanatus*; living together with semiarid.

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1. INTRODUCTION

Growing water scarcity due to population growth and economic development is a raising the challenges for agriculture. Therefore, and new solutions strategies for the management of water resources in irrigated cultivated areas are needed, especially in the semi-arid region are essential, where water is limited and wasted resource. As a consequence, a technical problem of water supply is already perceived that will be increasingly disputed aggravated by different human activities, making it necessary to use it water in a controlled manner in agriculture [1]. In addition, in the semi-arid region of the Northeastern of Brazil where, the irrigation is not properly managed ment is not properly realized. As a result, in addition to crop yields being below their potential are low and,

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more water **is usually applied than the** than those required by crops **need, is used** resulting in the waste of the scarce water resources **in of** the region.

As a solution, the rational management of irrigation aims, among others, to maximize the efficiency of water use, maintaining favorable conditions for soil moisture and plant health, taking into **account** consideration the climatic conditions of the **place of cultivation agroclimatic region**, as well as the crop characteristics **of crops**. Rational water management aims to supply **the water needs of to the** crops, **providing water** at the right time and **in the correct** amount, **no waste** [2]. In addition, high crop yields can be obtained by maintaining without necessarily soil soil moisture at suboptimal being in the field capacity levels [3].

One of the alternatives to avoid **wasting** water **resources wastage** is the use of computational software used in irrigation management that calculates water requirements based on climate, soil and crop data [2]. As an example, the ISAREG model, which is a simulation software for soil water balance, developed at the Higher Institute of Agronomy, in Portugal, which is able to deal with capillary ascension and percolation through the root zone.

The ISAREG model has been used as a new technology in irrigation management in several countries, being able to assist in the simulation of irrigation depth in order to maintain soil moisture in different percentages of the maximum storage.

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Another way to reduce the use of water resources in agriculture is through the use of ground cover, **which This** is a simple technology, **but the benefits and whose benefits over for** crop **production development** and production **onvity** are irrefutable, especially in situations of **low** water **availability scarcity**, reducing the frequency of cultural practices and the production costs.

Several authors cited by [4] prove the benefits of this technique: a) it improves the quality of the products, like the production of strawberry, pumpkin and watermelon; b) it increases the productivity of crops; c) it extends the time of water availability in the soil; d) it reduces soil temperature variations; e) it reduces the development of weeds; e, f) it reduces or eliminates the possibility of erosion by blocking the direct impact of rainfall and provides savings in the costs of agricultural production.

In addition, the interaction between these technologies can increase agricultural productivity and reduce the use of water resources. It is possible that the irrigation depth dimensioned by the ISAREG model to maintain the bare soil at 80% of the available soil water capacity may be enough to keep the soil under rice husk at 100% of the available soil water capacity, due to less evaporation under this condition.

This study was e **research** aimed to compare the irrigation **proposals patterns** generated **from theusing** ISAREG model with the actual irrigation **management practices** adopted by **irrigators the farmers** of the Jaguaribe - Apodi Irrigation District, Brazil. Further, we **evaluateding** and **analyzeding** the fruit development **variables** and crop productivity of watermelon under the different irrigation and soil cover conditions. The interactive ; and the effects of **this these practices interaction** on the water resource economics **and watermelon development were also determined**.

2. MATERIAL AND METHODS

The research was carried out in the UEPE (Teaching, Research and Extension Unit) of the Federal Institute of Education, Science and Technology - IFCE, in Limoeiro do Norte-Ceará (05o06'38 "S; 37o52'21" W; 145.95 m), in the Irrigation District Jaguaribe-Apodi, Brazil.

Comment [R6]: You have to explain the jargon at the first usage.

The local climate is BSw'h, semi-arid, according to Köppen's climatic classification, with the following average conditions: relative humidity (66.1%), rainfall (717.1 mm) and air temperature of 26.9 °C.

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Two consecutive experiments were carried out with the watermelon **culture**. All the methodologies and analyzes performed were identical for the 2 cycles, except for the irrigation depth simulated by the ISAREG model. **The duration of the experiment was 6 months.**

The input data used in the ISAREG model were: field capacity humidity; permanent wilting point; Phenological stages of the crop (1st stage - from planting to first irrigation, 2nd stage - beginning of

vegetative growth, 3rd stage - total cover and flowering, 4th stage - fruit formation, 5th stage - leaf senescence and 6th phase - harvest and end of the cycle); water availability factor (f) and effective depth of the root system (Z), both for each phenological phase. Also, the model required data on irrigation management, in which three (3) were calculated by ISAREG (Irrigation with deficit - 60%, 80% and 100% of CAD) and the other one consisted of the mean leaf of 6.3 mm.dia⁻¹, during the watermelon cycle, practiced by the irrigator of DIJA. This irrigation management was the fourth irrigation condition added to ISAREG.

The research was conducted by cultivating the watermelon culture Top seed[®] brand watermelon (*Citrullus lanatus* var. Crimson sweet) seeds obtained from an agriculture store was used for the study under proposals of the ISAREG model and the management used by the producers with and without the use of soil cover. The watermelon seeds were obtained in agricultural store. Seeds of the variety "Crimson sweet" brand "top seed" were used.

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For this, the experiment was carried out in a randomized complete block design with subdivided plots and 4 replicates (4 x 4 x 4, totaling 64 subplots). The treatments consisted of the combination of 4 irrigation propositions (three propositions of the ISAREG model and one irrigation management used by the producers named M1, M2, M3 and M4), which constituted the plots, and 4 subplots, with 3 conditions of soil coverage with rice husk (C1), with white mulching (C2) and with black mulching (C3, denominated C1, C2 and C3, and subplot 4, the soil without cover (control C0), denominated C0.

Comment [R9]: Mention what materials were used for the white and black mulching.

The irrigation propositions by the ISAREG model were: M1, the optimal irrigation management (irrigation depth proposed for daily soil maintenance in its maximum storage capacity, 100% of available water capacity, without percolation, for an uncovered soil); M2, proposal of daily irrigation for maintenance of storage of uncovered soil water, around 80% of available water capacity; M3, proposal of daily irrigation for maintenance of storage of uncovered soil water, around 60% of available water capacity; and the M4 treatment represented the daily irrigation depth used by local irrigators.

The crop spacing was 2.0 m x 0.5 m, each sub-plot with 6 plants, with 6.0 m² (2.0 m x 3.0 m). The analyzed variables were obtained in the area occupied by 4 plants in the center of the planting row.

There was a borderline between the lines with treatment, making nine lines (9.0 m x 2.0 m = 18.0 m width). Each block had four subplots per treatment, with area of 216.0 m² (18.0 m x 12.0 m). The total area of the experiment was 864.0 m² (18.0 m x 48.0 m). There were approximately 864 plants throughout the experimental area (864 m²).

The sowing of the 1st cycle was carried out on August 15 and 2nd cycle on November 12. They were carried out in styrofoam trays with 128 cells with commercial substrate. Transplanting occurred on August 22 (1st cycle) and November 19 (2nd cycle).

The amounts of the chemical fertilizers used to supply the crop requirements were recommended according to the soil analysis results. However, for the determination of the frequency of fertirrigation application, the research carried out by [5] was used as the basis, which in his search verified better results with daily applications, throughout the watermelon cycle. Fertilizers were applied via fertirrigation, starting on the day of transplanting and ending at 50 DAT (days after transplanting). The commercial chemicals used were urea (N), white potassium chloride (K₂O), phosphoric acid (P₂O₅), sulfur sulfate (S) and boric acid (B).

The control of weeds was carried out during the crop cycle, with weeds, using hoes, in the inter - rows and manual thinning near the plants.

White fly, cochineal and fungus attack were observed, and they were controlled with the rational use of insecticides and fungicides.

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The first and second cycles were started when the fruits reached the point of physiological maturation, with a minimum °Brix around 8°, determined with a portable refractometer.

The periodic harvests were carried out at intervals of five days, beginning at 67 days after transplanting. Two harvests were made, with commercial fruits weighing more than 0.80 kg, normal and non-spoiled.

The daily irrigations were performed with self-compensating drippers, average flow of 2.3 L h⁻¹, service pressure of 300 kPa.

The crop evapotranspiration (ET_c) data were obtained through local experiments, by soil water balance methodology; and reference evapotranspiration (ET_o) was estimated by Penman - Monteith / FAO, described by [6], with data from local climatic variables. The crop coefficient (K_c) was obtained by the ratio between ET_c and ET_o.

The irrigation time was calculated from the irrigation depth proposed for each treatment, according to equation 1.

$$Ti = \frac{L_I * E_L * E_g * F_C}{E_i * q_g} \quad \text{(Equation 1)}$$

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Where: Ti is the irrigation time, in hours; LI is the irrigation depth proposed by each treatment on the ISAREG model; EL is the spacing between irrigation lines, 2.0 m; Eg is the drip spacing, 0.5 m; FC is the soil cover factor, dimensionless; Ei, is the irrigation efficiency, dimensionless (0.95); qg, is the flow of the dripper (2.3 L h⁻¹).

The application of the coverage factor (Fc) of the watermelon cycle, which represents the relationship between the wet area and the area occupied by the crop, was followed by the recommendation of [7], when he stated that Fc should be of at least 33% (0.33) for arid and semi-arid regions. They were also used the results of [8]. The Fc used varied from 0.33 to 1.00 (phase of maximum water demand of the crop).

Tensiometers were installed at 20 cm depth to verify soil moisture at the effective depth of the watermelon root system.

The soil cover used was rice husk (C1), mulching white (C2), mulching black (C3) and without cover (C0)

The variables analyzed were average fruit weight, average productivity and number of fruits per plant.

The qualitative results were submitted to analysis of variance. The results were submitted to the Tukey averages test at 1% and to 5% of probability when significant by the F test. The quantitative variables were submitted to regression analysis.

3. RESULTS AND DISCUSSION

Number of fruits per plant, average fruit weight and average productivity in First (1st) cycle

From the analysis of variance (Table 1), a significant effect was observed for the interaction between irrigation depth versus soil cover, for the following analyzed variables: number of fruits per plant (P <0.05), average fruit weight (P <0.01) and average productivity (P <0.01).

Table 1. Summary of analysis of variance and significance levels for the variables: number of fruits per plant (NFP), average fruit weight (AFW) and average productivity (AP) - 1st cycle

VS	DF	Medium Square		
		NFP	AFW	AP
Irrigation depth (I)	3	0.09563*	5.08333**	511.02042**
Residue (a)	12	0.02187	0.10083	0.94094
Covers (C)	3	0.57229**	10.27000**	2171.01042**
Interaction I x C	9	0.05451*	1.79667**	118.92333**
Residue (b)	36	0.02299	0.04417	0.61455

Total	63	-	-	-
CV % (I)	-	10.31	6.43	1.58
CV % (C)	-	10.57	4.26	1.28

VS= Variation source; DF = Degree of freedom; CV= coefficient of variation; * and ** = Significant at 5% and 1% respectively

Through the regression analysis (Figures 1A and 1B), it was verified clearly shows that the different irrigation depths, in the absence and presence of soil cover, showed exhibited a polynomial effect, under for the number of fruits per plant and average fruit weight.

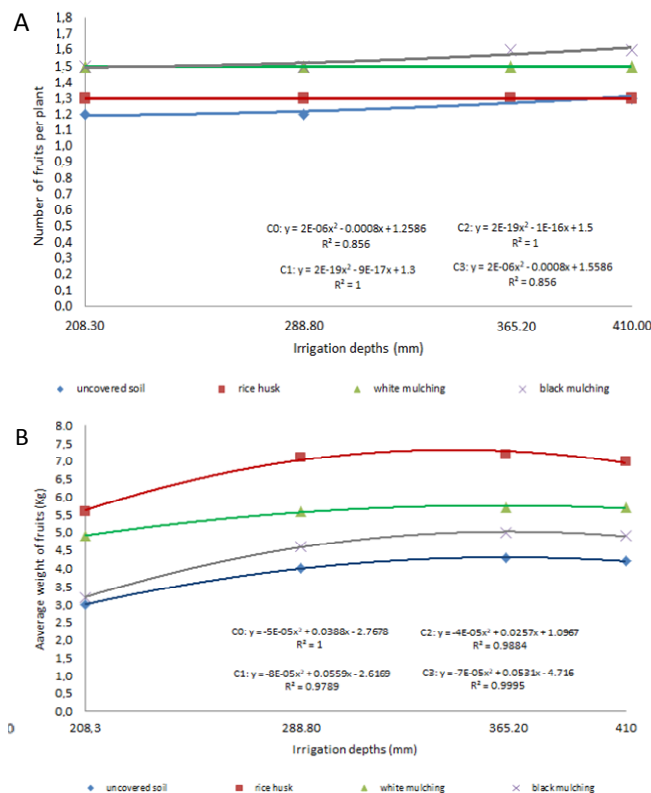


Figure 1. Influence of irrigation depths and soil cover conditions on the number of fruits per plant (A) and average fruit weight (B) of watermelon, during the first cycle.

In Figure 1A, when analyzing the interactions of the irrigation slides with the soil coverings in the soil, it is verified indicates that there is a pattern trend of increase of in the number of fruits per plant, in relation to the amount of water applied, until the blade M1 (365.2 mm), which is evidenced in uncovered soil conditions and black mulching. Likewise, [9], evaluating irrigation methods in watermelon production, verified that the applied blade influences, to a certain extent, the number of fruits per plant.

The irrigation depth M1 (365.2 mm) and M4 (410 mm), with a black mulching cover resulted in the highest numbers of fruits per plant (1.6). However, the uncovered soil, mainly with the lowest irrigation depth (208.3 mm), resulted in the lowest number of fruits per watermelon plant (minimum of 1.2 and maximum of 1.3). This was probably due to the lower humidity in the soil. This is in accordance with Azevedo et al. was verified by [10], they reported that where the water deficiency causes a marked decrease in the physiological activities, mainly in the division and growth of cells and, consequently, in the growth and production of crops watermelon. According to Marouelli et al. [11]

and Sousa et al. [12], the water deficit during flowering and the birth of fruitsfruit development decrease the number of fruits per watermelon.

Through tThe regression analysis of Figure 1B, reveals it was verified that the differents irrigation depths, in the absence and presence of soil cover, provided induced a polynomial effect on the average weight of the fruits per watermelon. This is in line with Sousa et al. [13] The same observation was verified by [13], when researching the production of the who also observed watermelon subjected to water stress, concluded that the increase of the irrigation depths provided a similar response in regarding the average weight of the watermelon fruits in response to increasing irrigation depths.

When analyzing An analysis of the interactions of the between the irrigation depths with the and soil coverings in the soil, it was verifiedrevealed that there was a positive interactioninfluence on, regarding the average weight of the fruits. So, that is, with the an increase of the applied in irrigation depths, up to the limit of M1, the records of the fruit weight were was higher, regardless of the type of coverage. This can be explained by the ISAREG model simulations, which predicted the presence of excess water excess in the soil, when applying athe irrigation depth was beyond larger than 365.2 mm (M1).

Regarding soil cover, the heavier fruits were verified obtained in the combinations with rice husk mulching and the less heavy ones in the soils without any cover. Among the soils covered by plastic, better results were verified obtained when the in soils were covered by white mulching. It can be affirmed that the use of soil coverages assists in the retention of moisture in the soil besides favoring other positive aspects to the development of the watermelon.

Lopes et al. [14] researching while studying the influence of the tomato crop in different types of soil coverings on tomato, found that the use of soil cover contributeds to the increase of fruit mass.

As in the other types of coverings, in the condition of uncovered soil the effect increased until the M1 blade, reaching a maximum weight of 4.3 kg. However, it was possible to observe the primary influence of the amount of water applied, on the average weight of the watermelon fruits. Ramos et al. [15] in a similar experiment verified showed that the average weight of watermelon fruits of was 3.6 kg., when they performed a similar experiment. Fernandes [5], in an experiment with irrigated watermelon, but under different conditions of applied irrigation depth, verifiedshowed that the average maximum and minimum fruit weight of 10.2 kg and 7.1 kg, respectively.

The combination of the M1 irrigation depth with a soil covered by rice husk resulted in the highest average fruit weight (7.2 kg). The lowest average weight fruit (3.0 kg) was obtained from in the M3 irrigation depth (208.3 mm) in the soil without any cover. As occurred observed for in the number of fruits per crop, the lowest average fruit weights were observed in the soil without cover, independent of the irrigation depth. With lower humidity in the soil moisture in the absence of without cover, fatallycritically affected, the fruits would grow less,development resulting in lighter fruits. reaching lower weights, because a According to Andrade Júnior et al. [16], when it comes to watermelon, the water deficit stress tends to reduce the average weight of the watermelon fruits, making them unacceptable in the consumer market.

According to a regression analysis of the mean values of total productivity (Figure 2), the irrigation depths and coverings in the soil promoted produced a polynomial effect.

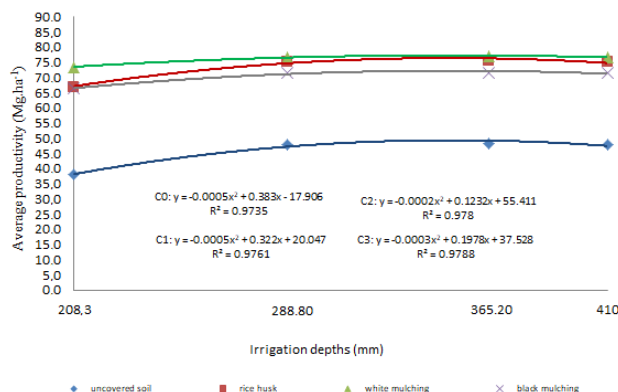


Figure 2. Influence of irrigation depths and soil cover conditions on the average productivity of the watermelon during the first cycle.

In the analysis of the interactions between the irrigation depths and the soil coverings in the soil, it was verified that there is a positive influence on the pattern of increase of the average productivity of the watermelon, in relation to the amount of water applied, independent of the type of cover in the soil. Batista et al. [17] when analyzing the effect of water deficit in watermelon, found higher productivity in the treatment without deficit under adequate water availability. Oliveira et al. [18] found a similar result for watermelon and suggested that, they affirm that such behavior is associated to the maintenance of adequate soil water contents for the crop, allowing a greater absorption of water and nutrients, which is responsible for a result in greater translocation proportion of photoassimilates translocated from the leaves to the reproductive organs, which translates into increased production.

M1 irrigation depth (365.2 mm) showed higher productivity (77.0 Mg ha^{-1}) in combination with the soil covered by white mulching, showing the importance of using this cover for irrigated watermelon cultivation. Analyzing the watermelon productivity for the soil covered with white mulching, maximum productivity (74.38 Mg ha^{-1}) was observed with a 308 mm applied irrigation depth. Ramos et al. [15] analyzing the productive characteristics of irrigated watermelon, reached obtained average total productivity values of 76.1 Mg ha^{-1} . Dantas et al. [19], in a research their study carried out in Mossoró city with irrigated watermelon cultivation in with different soil coverages, verified found maximum and minimum yields of 93.1 Mg ha^{-1} and 72.2 Mg ha^{-1} , respectively.

The lower watermelon productivity was observed in the soil without cover for the M1 irrigation depth. Negreiros et al. [20] while analyzing the yield and quality of the melon under irrigation depths and soil cover, verified found that there was a 51.5% increase in fruit yield produced with the use of the ground cover in the soil when compared to, in relation to the uncovered soil. Medeiros et al. [21] evaluated the productive yield aspects of melon as a function of irrigation depths and soil cover in the city of Baraúna and they verified found a 14% higher productivity of about 14% higher in when the soil is covered by a black mulching compared to the uncovered soil.

The highest watermelon yields were verified obtained in the soil covered by white mulching for the M4, M2 and M3 irrigation depths. It is possible to verify suggest that the positive relation of the use of white mulching in the soil cover in the increase of the productivity of the watermelon crop, mainly due to the retention of humidity. Carvalho et al. [22] found that the water reduction can contribute substantially to the decrease of watermelon productivity in certain phenological stages of the crop.

The A lower watermelon productivity of 38 Mg ha^{-1} of the watermelon was observed with the application of the lowest irrigation depth in the soil without any cover. It was 38 Mg ha^{-1} . This yield reduction behavior has a physiological explanation, because according to Azevedo et al. [10], the water deficit can cause a marked decrease in physiological activities, mainly in the division and growth of the cells and, consequently, in the growth of the crops. This deficiency can also cause the stomata to close, decreasing the intracellular concentration of CO_2 , generating a decrease in its assimilation, damaging the crop yield.

Comment [R12]: White substances always reflect light compared to the black ones. The development of less heat due to the reflection of light over the covered surface could also help in reducing evaporation.

316
317 In the productivity analysis, with white mulching, rice husks and black mulching, in descending order,
318 gave the best results. were obtained, whichThis demonstrates the technical advantage of using
319 these mulches as soil cover in watermelon cultivation.

320
321 Soil coverages with polyethylene films have led to an increase in growth and productivity in several
322 crops [23]. In addition to the efficiency of the coverages, deficit irrigation calculations using ISAREG
323 proved to be effective in irrigation management.

324
325 **Number of fruits per plant, average fruit weight and average productivity in Second (2nd) cycle**

326
327 From the aAnalysis of vVariance (Table 2), a significant effect ($P < 0.01$) was observed for the
328 interaction between irrigation depths versus soil cover, for the following analyzed variables: number of
329 fruits per plant, average fruit weight and average productivity.

330
331 **Table 2. Summary of aAnalysis of vVariance and significance levels for the variables: number**
332 **of fruits per plant (NFP), average fruit weight (AFW) and average productivity (AP) – 2nd cycle**

VS	DF	Medium Square		
		NFP	AFW	AP
Irrigation depths (I)	3	0.13667**	2.20917**	302.64229**
Residue (a)	12	0.00917	0.06667	0.46146
Covers (C)	3	0.63000**	14.78250**	2119.70562**
Interaction I x C	9	0.09000**	2.52694**	446.77840**
Residue (b)	36	0.01139	0.08444	0.33521
Total	63	-	-	-
CV % (I)	-	6.90	4.23	1.09
CV % (C)	-	7.69	4.76	0.93

333 VS= Variation source; DF = Degree of freedom; CV= coefficient of variation; ** = Significant at 1%

334
335 The regression analysis (Figures 3A and 3B) showed the polynomial effect on the number of fruits per
336 plant and the average weight of the fruits of the watermelon.

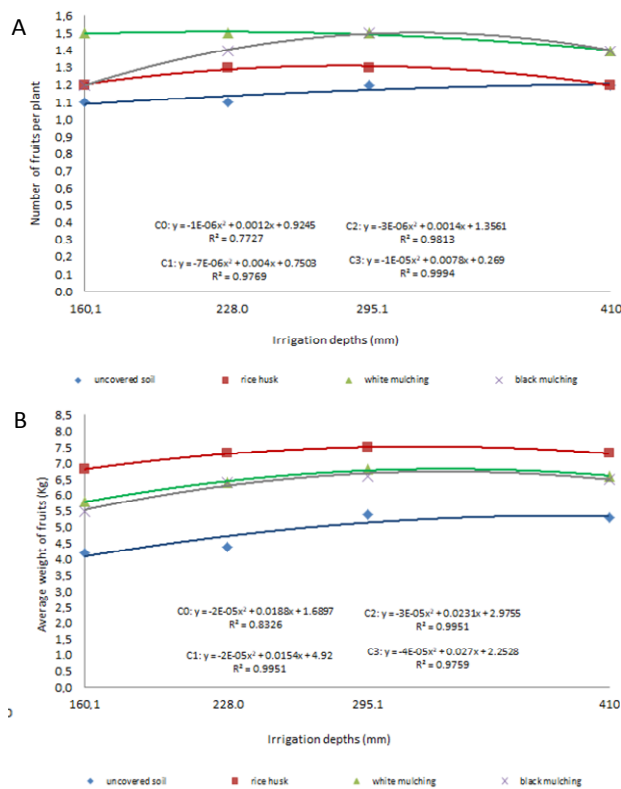


Figure 3. Influence of irrigation depths and soil cover conditions on the number of fruits per plant (A) and average fruit weight (B) of watermelon, during the second cycle.

The same tendency of the first cycle of watermelon was verified for the interactions between irrigation depths and soil cover (Figure 3A).

As in the analysis of the first cycle of watermelon, the combinations of soils covered by "mulching" (white and black) generated better results, that is, a greater number of fruits per crop. However, in the uncovered soil condition, regardless of the applied irrigation depth, the number of fruits per watermelon plant was lower (1.1), with the lowest amount of fruits per crop being observed. Similar results were observed by [Lima Junior and Lopes](#) [9].

The combination of the irrigation depth M1 in a soil covered by white mulching resulted in the highest number of fruits per crop (1.5). [Dantas et al.](#) [19], in [their study a research](#) carried out in Mossoró city, with irrigated watermelon cultivation and in different soil coverages, [verified showed that the average](#) maximum number of fruits per watermelon equal 2.0. This increase can be explained by the higher plant spacing used. The lowest numbers of fruits per watermelon plant (1.1) were obtained with the lowest irrigation depth (160.1 mm) in the soil without cover. A similar result to that obtained in this study was [also](#) observed by [Medeiros et al.](#) [21], who, when analyzing the influence of irrigation slides on the production of Cantaloupe melon, observed that the reduction of the [irrigation depth](#) determined the reduction of the number of total fruits and the number of fruits for the domestic market.

In [the](#) regression analysis of Figure 3B, [it was verified shows](#) that the different irrigation depths, in the absence and presence of soil cover, promoted a polynomial effect on the average weight of the watermelon fruits. [Lopes et al.](#) [14] analyzing the influence of black and white mulchings on the productive characteristics of vegetables, verified an interactive effect among the variables analyzed by them. Research has shown higher yields with mulching, especially with increasing soil water in arid and semi-arid conditions [24, 25] and [25].

Regarding the soil cover used in the second cycle of for watermelon cultivation, as well as in the first cycle, the heavier fruits were verified obtained in the combinations with rice husk and the **less heavy lighter** ones in the soils without cover. Among the soils covered by plastic, better results were verified with the use of white mulching. This result also demonstrates the effectiveness of plastic coverings in watermelon cultivation. Silvernail et al. [26] while investigating the effect of mulching on the watermelon production characteristics in the state of Kentucky concluded that the plastic cover provided higher average fruit weights when compared to other non-plastic coverings.

The combination of the M1 irrigation depth (295.1 mm) in a rice husk soil resulted in the highest average fruit weight (7.5 kg). Andrade Júnior et al. [27], in a similar research carried out in Piauí, **verified found that** the average weight of the watermelon fruit to be around 8.0 kg for the largest applied irrigation depth. Conclusion shared by Santos et al [28], **who analyzed on** the influence of irrigation on the watermelon production, verified suggests heavier fruits with the increase of the applied water blade. Dantas et al. [19], investigating the yield and quality of the watermelon cultivated under agrotexile plastic coverings, **verified showed that** the lowest mean fruit weight **values in watermelon happened** in the control, whose soil **had was** not **been** covered.

In general, the fruits harvested in the second cycle showed higher average weights than those of the first cycle, since even though it is known that **the amount of** water is not the only limiting factor for fruit growth, this behavior may have its cause in the climate (less evapotranspiration) of the second cycle, resulting, among other factors, in higher moisture retained in the soil. Andrade Júnior et al. [27] **verified in their nutritive composition of watermelon showed** that the fruits **of watermelon present in their nutritive composition a percentage of contained** 92.6% of water. **Therefore, so** the mass of the fruits is quite related to the water content, which makes the production of this crop quite dependent on water.

Through the regression analysis of Figure 4 the polynomial effect was verified under the average productivity of the watermelon.

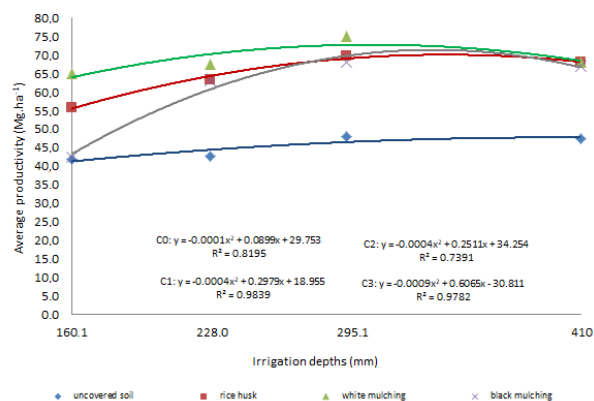


Figure 4. Influence of irrigation depths and soil cover conditions under the average yield of watermelon crop during the second cycle.

The highest watermelon yield was observed in the soil with white mulching cover (75.0 Mg ha⁻¹) with the M1 irrigation depth and the maximum productivity (73.66 Mg ha⁻¹) was obtained with an applied irrigation depth of 314 mm. Andrade Júnior et al. [27], in a similar research carried out in Piauí, observed **total average productivity of watermelon**, maximum and minimum productivity of watermelon to be, of 95.28 Mg ha⁻¹ and 74.57 Mg ha⁻¹, respectively. The lowest watermelon productivity was observed in the soil without cover (47.9 Mg ha⁻¹) for the same irrigation depth. Andrade et al. [29] conducted an experiment with Cantaloupe melon with soil cover, **and** identified that, with the exception of brown plastic, all other plastics provided superior yields to the uncovered soil.

The M3C0 combination showed the lowest productivity with a value of 41.9 Mg ha⁻¹. This may have occurred due to the water deficit provided by the lower irrigation depth and the uncovered soil. [Fernandes and Prado](#) [30] observed that watermelon is not very resistant to soil water deficit, since frequent irrigation along the crop cycle significantly increased fruit yield. Several factors may influence fruit [growthdevelopment](#), however, the cell [growth cycle](#) process is a function of cell division and cell expansion, and the presence of water is of great importance for this occurrence [31]. In comparison, [Azevedo et al.](#) [32], investigating the watermelon culture, [verified obtained a](#) maximum and minimum yields of 67.5 Mg ha⁻¹ and 46.6 Mg ha⁻¹, respectively.

By analyzing the obtained values, in comparison with the results of the first cycle, it [was could be](#) concluded that, independently of the coverings, that the larger the applied blade, to the M1 blade, the greater the productivities. Inclusively, [Santos et al.](#) [28], investigating the influence of irrigation [slides patterns](#) on watermelon production, found that there is a direct and positive relationship between the applied [blade pattern](#) and the watermelon productivity, because in the comparison between the plants irrigated under 100 mm and 500 mm [slides](#), the authors observed an increase of about 13.1 Mg ha⁻¹ in average productivity. However, the soil of this experiment has less drainability than the experiment of the aforementioned authors.

As occurred in the first cycle, watermelons cultivated in soils with coverings reached higher yields, the reverse occurring in the condition of uncovered soil. [Silvernail et al.](#) [26] researched the effect of "mulching" on the watermelon production characteristics. They concluded that plastic cover provided higher yields when compared to other non-plastic coverages or uncovered soil.

The ISAREG model proved to be efficient as a strategy in irrigation simulations with deficit. It was verified that the management of irrigation practiced by the irrigators, mainly regarding the waste of water, is not the ideal, because, throughout the cycle of the watermelon, the irrigant applied more water than the need of the crop. [Saraiva et al.](#) [33] obtained similar results when simulating the ISAREG model to analyze the irrigation management of the watermelon crop in Acaraú - CE.

4. CONCLUSION

The [irrigators farmers](#) don't practice the correct irrigation management, because they apply more water than the indication of the highest irrigation depth (100% of the available water capacity) by ISAREG model throughout the watermelon cycle. In general, plants irrigated by the M1 irrigation depth and on soils covered by rice husk and white mulching showed better productive characteristics.

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