TECHNICAL PAPER

CROP COEFFICIENT AND WATER CONSUMPTION OF EGGPLANT IN NO-TILLAGE SYSTEM AND CONVENTIONAL SOIL PREPARATION

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ABSTRACT: Under organic management in Seropédica-RJ, Brazil, using a weighing lysimeter, the crop coefficients (kc), the maximum evapotranspiration and the productivity of eggplant cultivation under two cropping systems (no tillage with straw plus soil with conventional preparation) were determined. A whole randomized layout with two treatments (no tillage and conventional) and five replicates during 134 days of cultivation were adopted. There were no significant differences in the eggplant cultivation in the two cropping systems, with a maximum commercial productivity obtained from 47.42 Mg ha^{-1} for the no-tillage system, and 47.91 Mg ha^{-1} for the conventional tillage. The accumulated ETc was 285.15 and 323.44 mm for the no-tillage and conventional, respectively. The crop coefficients value for the phases: 1 - transplanting, flowering, 2 - flowering-fruiting, 3 - fruit- first harvesting, 4- first harvesting of the final crop cycle was 0.83, 0.77, 0.90 and 0.97 in no-tillage system for the respective phases and for the conventional one 0.81, 1.14, 1.17 and 1.05 for the same steps described above.

KEYWORDS: *Solanum melongena* L., weighing lysimeter, irrigation.

COEFICIENTE DE CULTURA E CONSUMO HÍDRICO DA BERINJELA EM SISTEMA DE PLANTIO DIRETO E DE PREPARO CONVENCIONAL DO SOLO[1]

RESUMO: Sob manejo orgânico, foram determinados em Seropédica-RJ, utilizando lisímetro de pesagem, os coeficientes de cultura (kc), a evapotranspiração máxima e a produtividade da cultura da berinjela, em dois sistemas de cultivo (plantio direto com adição de palha e em solo com o preparo convencional). Foi adotado o delineamento inteiramente casualizado, com dois tratamentos (plantio direto e convencional) e com cinco repetições, durante 134 dias de cultivo. Não houve diferenças significativas na produtividade da cultura da berinjela nos dois sistemas de cultivo, sendo a produtividade comercial máxima obtida de 47,42 Mg ha^{-1}, para o sistema de plantio direto, e de 47,91 Mg ha^{-1}, para o sistema de plantio convencional. A ETc acumulada foi de 285,15 e 323,44 mm, para o sistema de plantio direto e plantio convencional, respectivamente. Os valores de coeficiente de cultura para as fases: 1 - transplantio-florescimento; 2 - florescimento-frutificação; 3 - frutificação - primeira colheita; 4 - primeira colheita - final do ciclo foi de 0,83; 0,77; 0.90 e 0,97 no sistema de plantio direto para as respectivas fases e para o plantio convencional de 0,81; 1,14; 1,17 e 1,05 para as mesmas fases descritas anteriormente.

PALAVRAS-CHAVE: *Solanum melongena* L., lisímetro de pesagem, irrigação.

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INTRODUCTION

Eggplants (*Solanum melongena* L.) are grown on approximately 1,500 hectares in Brazil and have an increased demand due to their medicinal properties and represent a good source of minerals and vitamins (GONÇALVES et al., 2006). According to RIBEIRO (2007), the eggplant crop in 1996 showed a production of 30,700 t, of which the Southeast participated with 88.79% of the production, especially Sao Paulo (60.74%), Rio de Janeiro (12.43%) and Minas Gerais (14.32%).

CASTRO et al. (2005) state that eggplants show good adaptability to ecological conditions of the metropolitan region of Rio de Janeiro (Fluminense), in which they are grown in the winter season when they suffer less competition in the market with the Mountainous Regions and with Middle Paraíba, because in these regions the winter temperatures are unsuitable for eggplant cultivation. However, the winter period shows a significant deficit in the water in the region, so for this, the use of irrigation technique to enable better use of agriculture is necessary. In the state of Rio de Janeiro there is an official recommendation regarding the water consumption of eggplant grown in the Fluminense area.

To enable the efficient use of water, FOLEGATTI et al. (2004) claim that the irrigation systems must have the ability to restore water to the soil in adequate amounts and in a timely manner. They still report that the excess water in the soil usually reduces the amount and the quality of its production, which can cause an excessive growth of the plant, the leaching of soluble nutrients (mainly nitrogen and potassium), higher incidence of diseases caused by soil pathogens and physiological disorders, higher energy costs and the wear of the irrigation system.

The quantification of the water flow vapor into the atmosphere from the moist surfaces, such as cultivated or fallow areas, is of great interest to determine the water needs of crops and the soil water availability. To this end, the weighing lysimeters are structures that have been used, enabling the direct determination of the ETo or the evapotranspiration of a particular cultivation (ETc) (FARIA et al., 2006). Indirectly, the ETc can be estimated using crop coefficient (kc) associated with the estimates of reference evapotranspiration (ETo) (MENDONÇA et al., 2007).

Currently, the practice of irrigation should not be seen merely as a technique used to eliminate the risk of losses caused by drought and prolonged droughts, but mainly as a high-level technology for accelerating the modernization of agriculture, increasing the food production, with gains in quality and productivity. In this context, it is essential to adopt rational management techniques of soil and water conservation for the sustainability of agriculture.

Among the techniques used in conservation programs of soil and water conservation, the no-tillage system is one of the most widely used and now it needs to be further studied in vegetable production. According to CASTRO et al. (2004), the technique needs to undergo changes so that it should better define the most efficient plants in the crop grinding residues production, but that does not hinder the sowing or transplanting of vegetables.

In the case of organic agriculture, the great challenge of the use of no-tillage management is still in training for the crop grinding residues without using herbicides. Promising experiments about the no-tillage cultivation of vegetables under organic management were reported by CASTRO et al. (2005) cultivating eggplant and by PURQUERIO et al. (2009) cultivating beet.

Based on the previous information, this study aimed at determining the water necessity, the crop coefficients (kc) and the maximum evapotranspiration for the no-tillage cropping systems with the addition of straw and in conventional soil preparation with plowing and harrowing to the environmental conditions of Seropédica-RJ.

ISSUE DESCRIPTION

Methodology

The study was conducted at SIPA (Integrated System of Agro ecological Production) - "agro ecological farm (Fazendinha) at km 47, located in the municipality of Seropédica-RJ, Brazil, (latitude 22°48'00" S, longitude 43°41'00" W, altitude of 33.0 m). The soil is classified as Acrisol (ALMEIDA et al., 2003) and, according to CARVALHO et al. (2006), the climate is type Aw in the Köeppen classification.

The experiment was conducted from May 23 to October 3, 2008, in two experimental plots of 144 m² (12 x 12 m) of available land, containing in the center of each, a weighing lysimeter, whose characteristics are presented by CARVALHO et al. (2007). The plots were designated ET1 and ET2 corresponding respectively to the no-tillage system and the conventional one.

After chemical characterization, the soil presented in the layer 0-0.2 m: pH in H_2O: 6.3; Al: 0.0 cmolc dm^{-3}; Ca+Mg: 4.2 cmolc dm^{-3}; P: 82.7 mg dm^{-3} and K: 215.0 mg dm^{-3}, for the area denominated ET1. For the ET2 area, the chemical characteristics were: pH in H_2O: 6.2; Al: 0.0 cmolc dm^{-3}; Ca+Mg: 4.6 cmolc dm^{-3}; P: 117.0 mg dm^{-3} and K: 325.0 mg dm^{-3}.

The soil water content corresponding to the field capacity (FC) was determined in the laboratory by using the Richards' extractor as REICHARDT & TIM (2004), and had values of 0.243, 0.213, 0.217 cm^3 cm^{-3} at depths of 0.1, 0.2, 0.4 m, respectively, for the no-tillage system. For the conventional soil preparation, the values were 0.227, 0.223 and 0.205 cm^3 cm^{-3}, respectively, for the same depths mentioned above. The soil density for the areas of the no-tillage system was 1.61, 1.59, 1.58 g cm^{-3} for depths of 0.10, 0.20 and 0.40 m, respectively. As for the conventional one, the values were 1.54, 1.60, 1.70 to 0.10, 0.20 and 0.40, respectively.

The preparation of the area called ET1 consisted of a cutting, leaving the soil under all the crop grinding residues from spontaneous vegetation. Then the holes were prepared with a depth of 0.20 m. Organic cattle manure was used at a dosage of 0.54 kg of dry matter per hole. For the area called ET2, the conventional tillage was used with a plow (disc plow) at a depth of 0.2 m and two leveling harrowing. Afterwards, graves were prepared and fertilization was performed, following the same criterion of the area with no-tillage (ET1).

For the seedlings production of the hybrid seeds, Ciça (hybrid developed by Embrapa with oblong fruit, glossy dark purple staining) was used. The seedlings were grown in a greenhouse, sown in polystyrene trays with 128 cells on April 15th, provided with a substrate composed of clay subsoil, washed sand, cattle manure, poultry "bed" vermicompost in the proportion 4:2:2:1:1 (based on volume). The transplant was performed 38 days after sowing (DAS) using the 1.4 m spacing between rows and 0.7 m plants. At this point, the seedlings had an average of five leaves and a leaf area of 72.83 cm^2.

The eggplant plant contained in each lysimeter received the same cultivation practices of neighboring plants (outside the lysimeter), not changing the spacing proposed in the study (1.4 m x 0.70 m).

The lysimeters were composed of a metal box with dimensions 1.0 x 1.0 m and 0.7 m base height, mounted on a single load cell capable of measuring up to 2.0 Mg, with a sensitivity of approximately 6,000 divisions, or 0.3 kg.

The ETo was estimated by Pennam-Monteith (ALLEN et al., 1998), using weather data collected in an automatic station, located inside the SIPA. In this season, the weather elements and the load cell readings were recorded continuously on a data logger device that stores information every 3 seconds, issuing an average of every 30 minutes (CARVALHO et al., 2006).

In each experimental area a system was set up composed by four sprinkler irrigation sector (model Pingo, nozzle 3 mm) positioned at the four corners of the plot and distanced 12 m. Before the establishment of the eggplant crop, the uniformity was assessed by precipitation and coefficients of uniformity of water application (CUC), and obtained an average rainfall of 9.8 mm h^{-1} and a CUC of 86% for sprinklers installed at a height of 1.0 m and a working pressure adjusted with the aid of a pressure control valve corresponding to 210 kPa.

The experimental design was completely randomized with two treatments and cropping systems (no-tillage and the conventional) with five replications and ten crops during cultivation. Each sample was composed by eight plants that have characterized the production of the cultivation.

On the 29th day after the transplanting (DAT), the area ET1 received Cameron grass straw at a dosage of 1.50 kg m^{-2} of dry matter. Upon addition of the mulch grass, it showed 78% of moisture and the leaves being only used in order to prevent germination of the buds presented in the stems. The grass was only cut and distributed throughout the entire growing area, in order to simulate a no-tillage with a higher dose of soil cover.

Throughout the cycle, it was performed the following cultural practices: weeding in the row of plants, mowing in between line and top dressing with castor bean at a dosage of 0.2 kg $plant^{-1}$ performed monthly and weekly by spraying a mixture of 1% of Neem oil and 1% of lime sulfur.

On the 30th, 62nd and 99th days after placing the Cameron coverage in the field, spontaneous vegetation samples were collected to quantify and compare the emergence of weeds in both tillage systems. The samples, with five replicates per treatment were collected in a known area, demarcated by metal template and drawn randomly.

Besides the treatment being carried out with the lysimeter, this study also used the methodology of TDR to monitor the soil moisture, and to this, probes were installed at depths of 0.10, 0.20 and 0.40 m in four of the replications of the five treatments.

The irrigation management as well as the determination of the eggplant crop evapotranspiration (ETc), was based on the daily variation of the mass of the set (box-soil-plant), following the methodology proposed by CARVALHO et al. (2007). Irrigation was performed every two days, always on time with a lower incidence of winds.

The eggplant productivity was evaluated in 10 samples, carried out from August 1st (69 DAT) to October 3rd (135 DAT), and the topics analyzed were the total production, commercial production and diameter, following the agroquality control of CEAGESP, considering the following classes: Class 11 (less than 14 cm), Class 14 (more than 14 cm to less than 17 cm), Class 17 (greater than 17 cm to less than 20 cm), Class 20 (greater than 20 and less than 23), Class 0 (defective fruit that is not accepted by the consumer market). We have discarded the fruit which was smaller than 0.10 m and bigger than 0.25 m and also the ripe fruit, with poor training and mechanical injuries. In each plot fruit from eight different plants was harvested.

The data for the experiments were subjected to Cochran and Bartlett tests, to check if the errors of the productivity data had homogeneous variances and followed the normal distribution by Lilliefors test. It is possible, therefore, to proceed to the variance analysis (ANOVA) of the data without transforming them. For the data of the soil moisture, it was applied the Scott Knott test, at a probability level of 5%. All statistical analyzes were performed with the aid of the statistical software SISVAR version 4.6.

Climatic conditions and water demand of the eggplant (*Solanum melongena* L.) during the cultivation period

In Table 1 the values of meteorological variables are shown during the cultivation of the eggplant. The reference evapotranspiration (ETo) average was 2.35 mm day^{-1}, totaling 315.4 mm throughout the growing season. The total rainfall was 221.4 mm, being the month of August the one with higher rainfall.

TABLE 1. Average monthly values of ETo and meteorological variables during the eggplant cultivation in Seropedica-RJ, Brazil.

Month/2008	Days	ETo (mm)	Prec. (mm)	AverageT (°C)	MaxT (°C)	MinT (°C)	RH (%)	U_2 ($m\ s^{-1}$)
May	9	20.9	8.8	21.8	28.5	16.8	75.6	2.1
June	30	54.1	32.4	21.0	26.0	17.0	76.5	2.0
July	31	66.0	16.4	19.8	26.9	14.4	72.5	2.2
August	31	81.5	88.2	22.1	27.7	17.8	73.8	1.6
September	30	82.2	61.4	20.8	25.7	16.7	77.0	2.2
October	3	10.7	14.2	24.5	29.1	20.8	73.0	2.5
Total	134	315.4	221.4					
Average		2.35		21.7	27.3	17.2	74.8	2.1

Prec.: precipitation (amount of rainfall); AverageT: Average temperature; MinT.: minimum temperature; MaxT.: maximum temperature; RH: relative humidity; U_2: wind speed - 2,0 m high.

The biggest event of rainfall occurred at 80 DAT with a value of 44.8 mm. Between 78 and 80 DAT (Aug from 8th to 10th) occurred precipitation of 52 mm, corresponding to 59% of the total rainfall in August and 23.5% of the total rainfall during the whole cycle. Although the crop has been characterized as the winter season when rainfall is usually low in the region of Seropédica-RJ, relatively high rainfall was observed, well distributed, in view of the expected average monthly rainfall for the region (52; 5; 28.2; 25.8; 28.7 and 59.4 mm, respectively, for the months of May, June, July, August and September). The period of greatest drought occurred from the 10th to the 25th DAT.

The range of average temperatures, as well as the observed values, was conducive to the eggplant cultivation, always remaining within the range of base temperature recommended by UZUN (2006), which is 35 °C for higher, 10 °C for lower and 22 °C for optimum. The higher temperature range was 18.6 °C, occurring on September 2nd (102 DAT) in the collection phase (5th harvest). That day, the maximum and minimum temperatures recorded were 31.12 °C and 12.5 °C respectively. According to FILGUEIRA (2003), the daily thermo periodicity for the eggplant favors fructification and results in high productivity.

During the growing season, the average soil moisture in no-tillage at a depth of 0.10 m was 0.227 $cm^3\ cm^{-3}$, the same value corresponding to field capacity. This was statistically higher than the one found for the conventional tillage system (0.175 $cm^3\ cm^{-3}$). According to NASCIMENTO et al. (2001), maintaining soil moisture levels higher in no-tillage system is due to the improvement in the structure of soil particles, which substantially changes the curve of water retention in the soil. The break in continuity of water flow, promoted by mulching the soil surface formed in no-tillage, reduces water loss by evaporation, keeping the higher moisture in the surface layers (SMITH & STONE, 2000).

The average soil moisture in no-tillage system for great part of the cycle remained close to field capacity. Although the two systems were irrigated with a blade at 100% ETc, the humidity of no-tillage system suffered minor variation to a depth of 0.2 m. At lower voltages matrix, the pore size distribution is highly correlated with the water storage in soil. Retention and water availability for plants in different soil management systems depend on the porosity and the presence of straw covering (KUNZ et al., 2007). Thus, those systems of preparation which cause greater soil revolving and therefore increases the volume, store less water in the revolving layer when comparing the same layer without revolving. In the depth of 0.40 m the values of soil moisture in no-tillage were consistently higher than the values of field capacity, with an average humidity during the 134 days of cultivation, of 0.235 $cm^3\ cm^{-3}$, significantly higher than average value found for the conventional tillage (0.195 $cm^3\ cm^{-3}$).

Variations in daily evapotranspiration of eggplant crop (ETc) in no-tillage (NT) and conventional tillage (CT) and ETo are shown in Figure 1.

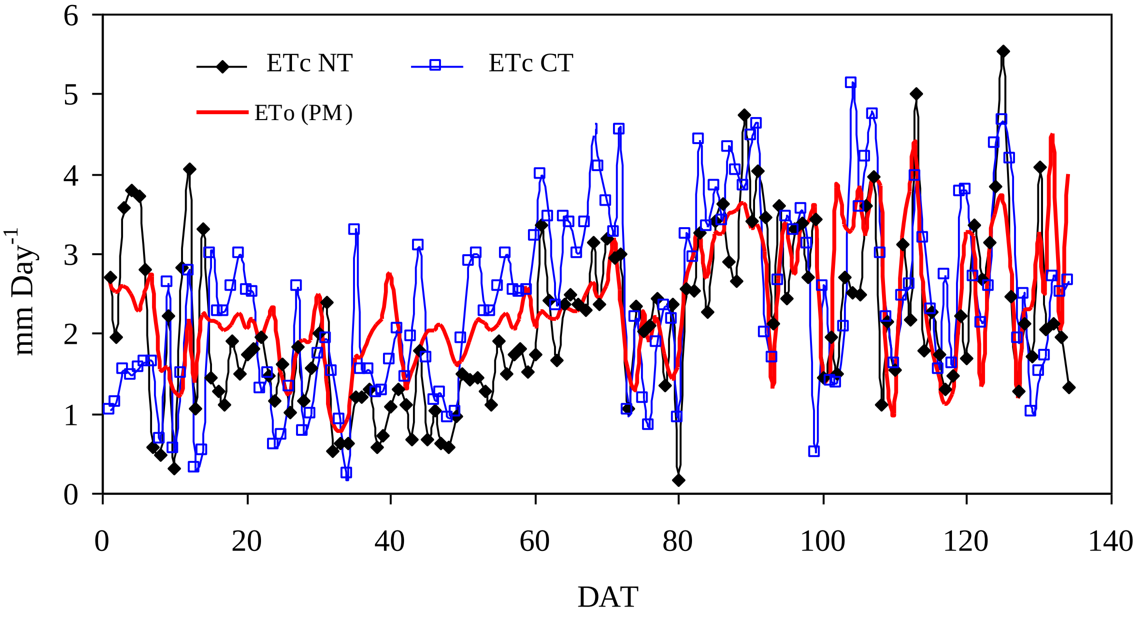

FIGURE 1. Average values of reference evapotranspiration (ETo) and crop evapotranspiration of eggplant in no-tillage ((ETcNT) and conventional (ETcCT) system, during 134 days of field cultivation.

Until the 30th DAT, which coincides with the beginning of the eggplant crop flowering, both cropping systems had 18 days, not consecutive, where ETo exceeded ETc. Remember that the mulch was added in the 29th DAT in the system NT, for which it is possible to observe that, from this date, the ETc presented lower values compared to ETo until the 61st DAT.

In the CT there is a greater fluctuation in the values of ETc, exceeding the values of ETo from the 15th DAT. The ETc continues to increase, and during the 74th to the 80th DAT, it shows a decrease due to the occurrence of precipitation. From the 127th DAT corresponding to the end of the production cycle of the cultivation, there was a decrease in the ETc.

The accumulated ETc during the eggplant cultivation was 285.15 and 323.44 mm for the NT system and CT, respectively. Considering the irrigation system used in this study, with an efficient application of 80%, the total water consumption was 342.2 and 388.1 mm for 134 days of cultivation in the CT and NT, respectively. Based on these figures, it is observed that the addition of mulching resulted in a reduction of 13.41% in the water application, representing a saving of 45.9 $m^3 h^{-1}$ of water. The average daily total ETc was 2.55 mm day^{-1} (NT) and 2.90 mm day^{-1} (CT). These average values are higher than the ones observed by MALDANER et al. (2007) that evaluated the water consumption of eggplant grown under cover in the region of Santa Maria - RS measuring ETc with microlysimeters and observed an average water consumption of 1.93 mm day^{-1} for 92 days of cultivation. DUARTE (2002), also cultivating eggplant in winter in a greenhouse, have observed values of 1.74 mm day^{-1}.

To illustrate the importance of the cultivation covering in relation to the evaporation accumulated until the 29th DAT, the average ETc in the NT system was 1.93 mm dia^{-1} and in the CT system Etc of 1.63 mm day^{-1} , or the CT had a reduced consumption by 16% when compared to NT. This increased consumption of the CT system is justified by the fact that the area had only been cut and the vegetation been kept alive on the soil surface, once there is no herbicide registered in the organic production system for the crop grinding residues. Thus, the vegetation between the lines continues evapotranspirating unlikely the CT system, where the soil was plowed and the incorporation of the vegetation in the area before planting were done, leaving a bare soil, occurring the evapotranspiration of the eggplant seedlings, which presented reduced size at this stage. On the 30th DAT, the total ETc in NT and CT systems were, respectively, 229 mm and 276.28 mm. There is therefore a reduction of 15% in the total water consumption for NT system (0.4 mm dia^{-1}), demonstrating the importance of the straw in water saving in the no-tillage system.

Determination of the cultivation coefficients (kc's)

Periods of crop development according to ALLEN et al. (1998) and shown in Table 2 were used. The cultivation coefficients values (kc) are shown in Table 2 and they were obtained by taking an average of the values observed in the field for various periods of development. You can observe a significant difference in average values of kc in both cropping systems. The initial value of kc obtained for NT system was inferior to that presented by ALLEN et al. (1998), and the CT value was higher than the published by FAO. For the average kc, both values were lower than tabulated, despite showing a value close to the conventional tillage system. The values of kc for the final cultivation period (kc_{final}) observed in both systems were higher than the kc tabulated by FAO.

TABLE 2. Comparison between crop coefficients of eggplants presented by FAO and obtained in no-tillage (NT) and conventional (CT) systems.

Development periods	Cultivation Coefficient (kc)		
	FAO[1]	No-tillage System	Conventional System
Transplant - 45 DAT (kc beginning)	0.85	0.81	0.89
46 - 110 DAT (kc middle)	1.15	0.94	1.14
111 - 134 DAT (kc end)	0.80	0.95	1.05

[1] ALLEN et al. 1998

Table 3 presents the average values of kc obtained in different sub periods. Although no significant differences occurred (in production) between tillage systems, it is observed that from the flowering, the conventional system showed the highest values of kc, possibly due to the lack of soil covering. BISCARO et al. (2008) have also observed that from the flowering, the value of kc for the eggplant increased from 0.8 to a value of 1.10 during fructification and subsequently reduced to 0.90 in the final period of cultivation.

PAULA et al. (2003) have studied the ETc and the kc of eggplant for the conditions of Pelotas-RS, Brazil, in a protected environment, finding an average consumption of 1.7 mm day^{-1}, with a cumulative total of 228.97 mm for a cycle of 131 days. In the vegetative phase, the particular kc was 0.12, reaching 2.28 at harvest time.

TABLE 3. Crop coefficient of eggplant obtained in no-tillage (NT) and conventional (CT) systems for different periods of development.

Development Periods	Cultivation Coefficient (kc)	
	No-tillage System	Conventional System
Transplanting-Flowering (1st - 29th DAT)	0.85	0.81
Flowering-Fructification (30 - 58th DAT)	0.67	1.01
Fructification-First harvest (59 - 72nd DAT)	1.02	1.44
First harvest-End of cycle (73 - 134th DAT)	1.02	1.15

From Table 3, it is noticed that the biggest difference in the values of kc in both cultivation systems was evaluated from 59 to 72 DAT, corresponding to the stage of fruiting-1st harvest. At the end of the cycle, there was a reduction in the difference between kc in both tillage systems, probably by decreasing the crop grinding residues on the surface, and consequently, having a tendency of equality between the systems. In this final stage, there was an average value of 1.02 to 1.15 for NT and the CT. MAROUELLI et al. (2001) determined the values of kc for the eggplant for different sub periods and found that in the initial period, the kc was 0.95, decreasing to 0.85 in the vegetative one and reaching a maximum value of 1.15 in fructification, with a subsequent decrease (0.85) in the final sub period.

Determination of the cultivation productivity

For the production parameters evaluated, they did not reveal any significant differences after the analysis of variance. Assuming a density of 10,204 plants ha^{-1}, the commercial productivity of the eggplant, considering only the fruit within the standard commercial size and defect-free, grown on the conventional plot, was 45.84 Mg ha^{-1}, an equal amount to the conventional system. The total productivity was 47.42 and 47.91 Mg ha^{-1} respectively in the NT and CT system, being this production superior to that found by CASTRO et al. (2004). The authors have cultivated eggplant under organic management in different cropping systems (monoculture and intercropped with legumes) getting close to the national average productivity of 25Mg ha^{-1} in the conventional cultivation.

SANTOS et al. (2006) have obtained the eggplant productivity statistically different for the two cropping systems. The values found by the authors were 58.20, 22.11, and 55.84 Mg ha^{-1} for no-tillage / peanut, no tillage / grass and conventional tillage, respectively.

Regarding to the distribution within the classes, there is a tendency for the production of 34% of the fruit on average in Class 17 and 35% in Class 20, regardless of the cultivation system. Generally speaking, the fruit production equal to or greater than 17 cm was close to 70% in both systems, and the disposal of defective or bad form ones of 4.7% in NT and 4.3% in CT.

In assessing the effects of the straw on the emergence of spontaneous vegetation held at 30, 62 and 99 days after placing the coverage of Cameron in the field, there were 880; 868 and 357 plants m^{-2} for conventional tillage, and 0; 183 and 199 plants m^{-2} for no-tillage, respectively, for different sampling times, and these values were statistically different between treatments in different periods, being always the smallest appearance of spontaneous vegetation. Notably, we have found a significant reduction in the emergence of weeds associated with the presence of straw covering, reducing the expenses on cultivation practices in relation to weeding, despite the fact that statistical analysis was not carried out.

CONCLUSIONS

There were no significant differences in the productivity of the eggplant in both cropping systems (no-tillage plus straw from Cameron grass and conventional tillage).

The no-tillage system have provided savings in using the water for irrigation of 13.41% compared to conventional tillage, and this effect is reflected in the crop coefficients calculated.

The maximum evapotranspiration of the eggplant was 285.15 and 323.44 mm for the no-tillage and for the conventional one, respectively.

The use of straw from Cameron grass has reduced the emergence of weeds.

REFERENCES

ALLEN, R.G.; PEREIRA, L.S.; RAES, D.; SMITH, M. *Crop evapotranspiration*: guidelines for computing crop water requirements. Rome: FAO. 1998. 300 p. (Irrigation and Drainage Paper).

ALMEIDA, D.L.; GUERRA, J.G.M.; RIBEIRO, R.L.D. *Sistema integrado de produção agroecológica*: uma experiência de pesquisa em agricultura orgânica. 2003. Seropédica: Embrapa Agrobiologia, 2003. 39 p. (Documento, 169).

BISCARO, G.A.; LEAL FILHO, O.M.; ZONTA, T.T.; MENDONÇA, V.; MAIA, S.M. Adubação fosfatada na cultura do jiló irrigado nas condições de Cassilândia - MS. *Revista Caatinga*, Mossoró, v.21, supl.1, p.69-74, 2008.

CARVALHO, D.F.; SILVA, L.D.B.; FOLEGATTI, M.V.; COSTA, J.R.; CRUZ, F.A. Avaliação da evapotranspiração de referência na região de Seropédica-RJ utilizando lisímetro de pesagem. *Revista Brasileira Agrometeorologia*, Santa Maria, v.14, n.1, p.97-105, 2006.

CARVALHO, D.F.; SILVA, L.D.B.; GUERRA, J.G.M.; CRUZ, F.A.; SOUZA, A.P. Instalação, calibração e funcionamento de um lisímetro de pesagem. *Engenharia Agrícola*, Jaboticabal v.27, n.2, p.363-372, 2007.

CASTRO, M.C.; ALVES, B.J.R.; ALMEIDA, D.L.; RIBEIRO, R.L.D. Adubação verde como fonte de nitrogênio para a cultura da berinjela em sistema orgânico. *Pesquisa Agropecuária Brasileira,* Brasília, v.39, n.8, p.779-785, 2004.

CASTRO, M.C.; ALMEIDA, D.L.; RIBEIRO, R.L.D.; CARVALHO, J.F. Plantio direto, adubação verde e suplementação com esterco de aves na produção orgânica de berinjela. *Pesquisa Agropecuária Brasileira*, Brasília, v.40, n.5, p.495-502, 2005.

DUARTE, G.R.B. *Consumo hídrico da berinjela* (Solanum Melongena *L*.) *em ambiente protegido*: medida e estimativa através de métodos combinados. 2002. 73 f. Dissertação (Mestrado em Agronomia) - Universidade Federal de Pelotas, Pelotas, 2002.

FARIA, R.T.; CAMPECHE, F.S.M.; CHIBANA, E.Y. Construção e calibração de lisímetro de alta precisão. *Revista Brasileira de Engenharia Agrícola e Ambiental*, Campina Grande, v.10, n.1, p.237-242, 2006.

FILGUEIRA, F.A.R. *Novo manual de olericultura*: agrotecnologia moderna na produção e comercialização de hortaliças. 2.ed. Viçosa: UFV, 2003. 421 p.

FOLEGATTI, M.V.; SILVA, T.J.A; CASARINI, E. O manejo da irrigação como elemento essencial na utilização racional dos recursos hídricos. In: THAME, L.C.M. (Ed.). *A cobrança pelo uso da água na agricultura.* Embu: IQUAL Editora, 2004. p.213-219.

GONÇALVES, M.C.R.; MELO DINIZ, M.F.F.; BORBA, J.D.C.; NUNES, X.P.; BARBOSA-FILHO, J.M. Berinjela (*Solanum melongena* L.) – mito ou realidade no combate no combate as dislipidemias. *Revista Brasileira de Farmacognosia*, Curitiba, v.16, n.2, p.252-257, 2006.

KUNZ, J.H.; BERGONCI, J.I.; BERGAMASCHI, H.; DALMAGO, G.A.; HECKLER, B.M.; COMIRAN, F. Uso da radiação solar pelo milho sob diferentes preparos do solo, espaçamento e disponibilidade hídrica. *Pesquisa agropecuária Brasileira,* Brasília, v.42, n.11, p.1511-1520, 2007.

MALDANER, I.C.; RADONS, S.Z.; WEBLER, A.R.; COSTA, M.L.; PIVETTA, C.R.; HELDWEIN, A.B. Evapotranspiração máxima e coeficiente de cultura de berinjela cultivada em estufa plástica. In: CONGRESSO BRASILEIRO DE AGROMETEOROLOGIA, 15., 2007, Aracajú. *Anais...* 1 CD-ROM.

MAROUELLI, W.A.; SILVA, W.L.C.; SILVA, H.R. *Irrigação por aspersão em hortaliças*: qualidade da água, aspectos do sistema e método prático de manejo. Brasília: Embrapa Informação Tecnológica, Embrapa Hortaliças, 2001. 111 p.

MENDONÇA, J.C.; SOUSA, E.F.; BERNARDO, S.; SUGAWARA, M.T.; PEÇANHA, A.L.; GOTTARDO, R.D. Determinação do coeficiente cultural (kc) do feijoeiro (*Phaseolus vulgaris* L.). *Revista Brasileira de Engenharia Agrícola e Ambiental*, Campina Grande, v.11, n.5, p.471, 2007.

NASCIMENTO, J.L.; STONE, L.F.; OLIVEIRA, L.F.C. Demanda total de água do feijoeiro nos sistemas de plantio convencional e direto. *Pesquisa Agropecuária Tropical,* Goiânia, v.31, n.2, p.159-161, 2001.

PAULA, V.A. de; SCHUCK, M.R.; DUARTE, G.; DEIBLER, A.; ALDRIGHI, C.; COSTA, A.V. da; MENDEZ, M.G. Evapotranspiração máxima e coeficiente de cultura da berinjela em ambiente protegido. In: CONGRESSO DE INICIAÇÃO CIENTÍFICA, 12., 2003, Pelotas. *Anais*... 1 CD-ROM.

PURQUERIO, L.F.V.; FACTOR, T.L.; LIMA, J.R.S.; TIVELLI, S.W.; TRANI, P.E.; BRENDA JR., J.M.; ROCHA, M.A.V. Produtividade e qualidade de beterraba cultivada em plantio em função do nitrogênio e molibdênio. *Horticultura Brasileira*, Brasília, v.27, S366-S372, 2009. Suplemento.

REICHARDT, K.; TIMM L.C. *Solo, planta e atmosfera*: conceitos, processos e aplicações. Barueri: Ed. Manole, 2004. p.323-340.

RIBEIRO, C.S.C. *Berinjela* (Solanum melongena *L*.). Brasília: Embrapa Hortaliças, 2007. (Sistemas de Produção, 3). Disponível em: HTTP://sistemasdeprodução.cnptia.embrapa.br/Fontes HTML/ BeringelaSolanummelogenaL/index>. Acesso em: 1 dez. 2008.

SANTOS, C.A.B.; ESPINDOLA, J.A.A.; ROCHA, M.V.C.; ALMEIDA, D.L.; GUERRA, J.G.M.; RIBEIRO, R.L.D. *Plantio direto de berinjela* (Solanum melongena), *sob manejo orgânico, em solo com cobertura viva permanente de gramínea e leguminosa*. Seropédica: Embrapa-Cnpab, 2006. 4 p. (Embrapa Agrobilogia, Comunicado Técnico, 91).

STONE, L.F.; MOREIRA, J.A.A. Efeitos de sistemas de preparo do solo no uso da água e na produtividade do feijoeiro. *Pesquisa Agropecuária Brasileira*, Brasília, v.35, n.4, p.835-841, 2000.

UZUN, S. The quantitative effects of temperature and light on the number of leaves preceding the first fruiting inflorescence on thestem of tomato (*Lycopersicon esculentum* Mill.) and aubergine (*Solanum melongena* L.) *Scientia Horticulturae*, Amsterdam, n.109, p.14-16, 2006.