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PLANT MIXTURES AND SOIL MANAGEMENT IN THE MELON CROP

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ABSTRACT
Melon (Cucumis melo L.) is a crop economically important for Brazil and for other countries, making it the eighth most produced fruit in the world and the third most fresh fruit exported from Brazil. However, soil tillage for cultivation involves the use of plowing, disking and ridging preparation to the realization of planting. That practices accelerates the process of soil degradation, decreasing soil organic matter and favoring the salinization process. Conservation practices such as the use of green manures and no tillage, are incorporated into the concept of systems to compose a low carbon emission. To adjust a technological model of tillage of melon plant for the Brazilian semiarid system and to compose the crops rotation systems of this vegetable, are being conducted long-term experiments, using plant mixtures as green manures and two tillage systems of soil. This study aimed to monitoring the impact of green manure crops in the form of plant mixtures, and soil management on productivity and fruit quality of melon. The initial stage of the experiment allows us to infer that the cultivation of plant mixtures did not change the productivity and fruit quality though, in the second year of cultivation, management factor affecting the productivity.

Key words
Green manure; no tillage; Brazilian Semi-Arid

INTRODUCTION

Melon (Cucumis melo L.) is a crop economically important in many countries, making it the eighth most produced fruit in the world. In Brazil occupying the third position among the major fresh fruit exported (Agrianual, 2013) and the Brazilian Northeast accounts for 94% of the national production this vegetable crop.

The soil tillage, through plowing and disking, and the absence of crop residues retained on the surface or incorporated may to cause reducion physical, biological and chemical soil quality, promoting the erosive, decomposition, mineralization and salinization and / or sodification processes. All these processes contribute to reduce the levels of soil organic matter (Ramos et al., 2011). In this region, soil fertility is naturally low, leading to reduce productivity of melon plant.

The tillage system, consisting of cropping systems that include green manures, can be a viable technology for melon cultivation in irrigated semiarid areas. In Brazil, occupied area with no-tillage system of vegetables is relatively small compared to annual crops of soybean, corn and beans (Wood, 2009). However, when carried properly, using green manures with great potential addition of shoot and root phytomass, biological nitrogen fixation, nutrient cycling and adapted to the conditions of the region (Factor et al., 2010), this system allows to establish commercial melon crop, that infer sustainability when grown in irrigated semiarid areas. The use of legumes and grass species can provide important contributions to the challenges to have productive and environmentally friendly cropping systems (Nyfeler et al., 2011). Presuppose thus, the use of plant mixtures associated with soil tillage can not be a viable management strategy for the melon cropping. Thus, it is important to propose a soil management system with the use of green manure that promote sustainability to the melon crop on current edapho-climatic conditions.

To set a technological model for no-till system of irrigated melon crop for the Brazilian semiarid and compose the crops rotation system of this vegetable is being carried a long-term experiment, using plant mixtures as green manures and two management soil systems. Thus, this study aimed to monitoring the impact of the cultivation of green manure in the plant mixtures form, and soil management on productivity and fruit quality of melon crop.

MATERIALS AND METHODS

The experiment was carried with the cultivation of green manure and melon crop in the Bebedouro Experimental Station, belongs to Embrapa Semi-Arid, in Petrolina city, at Pernambuco-Brazil, in the years 2012 and 2013. The soil on this area is classified as ARGISOIL YELLOW RED Dystrophic Plinthaqult, medium clay texture, relief plan (EMBRAPA, 2006), with the following physical and chemical characteristics, at a depth of 0-20 cm: 831.26 g kg-1 sand; 119.78 g kg-1 silt, 48.96 g kg-1 clay, pH (H2O) 6.3; organic matter, 6.62 g dm-3, P (Mehlich 1) 23.01 mg dm-3 and H + Al 0 64 mmol dm^{-3}; K, Ca, Mg and Na interchangeables, 0.25, 1, 8, 0.5 and 0.02 dm^{-3}.cmolc, respectively, the sum of bases (SB), 2.57 dm $cmolc^{-3}$; cation exchange capacity (CEC), 3.21 cmolc dm^{-3} and base saturation (V), 80%. The climate is classified as Bswh according to the proposed classification by Köppen, with an annual average temperature of 26.8 ° C, annual average rainfall of 360 mm and native vegetation of hyperxerophila Caatinga.

The used treatments were arranged in four randomized block design with split plots. The plots, of 30x10m, are composed by two soil management systems (with soil tillage through the incorporation of green manures with plowing and disking and no tillage) and the split, of 10x10m, by three cropping systems (two plant mixtures and one spontaneous vegetation): T1 - 75% of leguminous+ 25% of no leguminous and no tillage; T2 25% of leguminous +75% non leguminous and no tillage; T3 - spontaneous vegetation and no tillage; T4 - 75% of leguminous + 25% non-leguminous and tillage; T5- 25% leguminous + 75% of non-leguminous and tillage; T6 - spontaneous vegetation and revolving. Twelve species of leguminous, oilseeds and grasses were used in the composition of plant mixtures, matching the following species: Leguminous - Calopogonio (*Calopogonium mucunoide*), velvet bean (*Mucuna black*), gray velvet bean (*Mucuna conchinchinensis*), sunn hemp (*Crotalaria juncea*), rattlebox (*Crotalaria spectabilis*), jack bean (*Canavalia ensiformes*), pigeon pea (*Cajanus cajan* L.), lab-lab bean (*Dolichos lablab* L.); No leguminous: sesame (*Sesamum indicum* L.), corn (*Zea mays*), millet (*Penissetum americanum* L.) and sorghum (*Sorghum vulgare* Pers.). The spontaneous vegetation was composed of the predominant species: *Commelina benghalensis* L., *Macroptilium atropurpureum*; *Desmodium tortuosum* and *Ancanthorpermun hispidun* DC.

The seeding of plant mixtures was carried in the first half of May, with a spacing of 0.50 m between rows. Seventy days after sowing, the species were cut at ground level to assess the contribution of plant mixtures and spontaneous vegetation in the total phytomass production. Subsamples of phytomass were sent to the laboratory, oven dried at 65-70°C for 72 hours to determine dry biomass. Immediately after collection of samples to determine dry biomass the plant mixtures and spontaneous vegetation, T1, T2, and T3 (no tillage) treatments were cut and residues left on the soil surface. In T4, T5 and T6 (tillage) plants were incorporated into the soil with harrow help.

Initially melon seeds, cultivar 10/00 were seeding in polystyrene trays (200 cells) and after 12 days, the seedlings of melon were transplanted to the field with spacing of 0.40x 2.0 m. Thus, melon crop was carried the second half of august, 10 days after cutting the green manure. An irrigation system, by dripping with drippers spaced at 0.50 m, with average discharge taken the field was based on Class A ETo pan evaporation and the crop coefficient (Kc), considering the efficiency of the irrigation system of 92%.

The basal fertilization, carried out according to the results of soil analysis, consisted of 20 $T.ha^{-1}$ of manure and 600 $kg.ha^{-1}$ of fertilizer 06-24-12. Fertilization was carried through fertirrigation (three times a week) using 90 kg ha^{-1} of N, using as source urea, 90 kg ha^{-1} of K_2O in the form of potassium chloride and 30 $kg.ha^{-1}$ P_2O_5 using monoammonic phosphate (MAP) purified as a source. The application of fertilizers was carried out until 40 days after transplanting. The culture was maintained without spontaneous plants by hand weeding and phytosanitary treatments commonly employed in the melon crop.

At 65 days after transplanting, there was the fruit harvest, evaluating the content of soluble solids (° Brix) and the productivity ($Mg.ha^{-1}$).

The data were submitted separately to the analysis of variance at 5% probability the factors of cropping system and soil tillage systems, as well as the interaction between them. The treatment means were compared by Tukey test at 5% probability using the software Assistat (Silva; Azevedo, 2002).

RESULTS AND DISCUSSION

There was no interaction between the factors of soil management and composition of green manure in dry biomass production for shoots. However, dry phytomass production by shoots of plants mixtures was significantly higher than the production of spontaneous vegetation, for the year 2012 and 2013. However, there was no significant difference between the plant mixtures (Table 1). Literature data highlight the differences in the phytomass production for green manure as grasses or leguminous (Heinrichs and Fancelli, 1999; Perin et al, 2004; Menezes et al 2009.). Thus, regardless of the family is important to consider the variability of different plant species that constitute green manures and edapho-climatic factors promoting significant fluctuations in phytomass production.

Table 1. Dry biomass production of green manure, contemplating plant mixtures and spontaneous vegetation, cultivated in ARGISOIL Yellow Red Plinthaqult dystrophic clayey medium texture relief plan, in Petrolina - PE, Brazil, years 2012 and 2013.

Treatments	**Dry phytomass**	
	1ºCultivation	2°Cultivation
Green Manure	.... $Mg.ha^{-1}$............	
75% L + 25% NL	5,87 a	7,12 a
25% L + 75% NL	6,21 a	7,18 a
Spontaneous Vegetetion	3,37 b	3,54 b
dms	1,60	2,02
Soil management		
No tillage	4,98 a	5,96 a
Tillage	5,32 a	5,94 a
dms	1,07	1,35
CV (%)	24,05	26,23

Averages followed by different letters in the column differ significantly ($P < 0.05$) by Tukey test.

In the first year of the melon crop, after plants mixtures cultivation, there was no interaction between the factors composition of green manure and soil management, as well as the isolated factors effects for overall productivity and soluble solid. In the second year, there was no interaction between the factors composition of green manure and soil management, however, there was significant difference soil management strategy factor for total fruit yield variable in which the treatments that include tillage had higher yields (table 2). In the first year of cropping, productivity was similar to the national average and Northeast that are 25.37 and 28.00 $Mg.ha^{-1}$, respectively (Agrianual, 2013). In the second year of cropping, observed yields much higher than the average obtained in Brazil however, lower than those found by Braga et al. (2010), which ranged from 59.28 to 74.63 Mg ha-1 in the similar climate conditions of this work.

Table 2. Total yield of melon fruits cv 10:00 and quality of fruit grown under different green manures and soil management in ARGISOIL Yellow Red Dystrophic Plinthaqult, medium texture / clayey relief plan, in Petrolina - PE, Brazil, years 2012 and in 2013.

Treatments	**Total Productivity**		**Soluble Solids**	
	1º Cultivation	2° Cultivation	1º Cultivation	2° Cultivation
Green Manure	--------Mg ha^{-1}------		-------Brix°--------	
75% L + 25% NL	25,30 a	44,89 a	12,50 a	12,41 a
25% L + 75% NL	24,41 a	47,44 a	12,47 a	12,45 a
spontaneous vegetation	25,36 a	40,89 a	12,68 a	12,80 a
dms	6,52	10,09	0,78	1,23
Soil management				
No tillage	23,56 a	40,18 b	12,72 a	12,51 a
Tillage	26,49 a	48,63 a	12,38 a	12,60 a
dms	4,36	6,75	0,52	0,82
CV (%)	20,09	17,51	4,80	7,60

Averages followed by different letters in the column differ significantly ($P <0.05$) by Tukey test

The solids soluble content of fruits in both years of melon cultivation were higher than 12ºBrix, indicating the good quality of them because, according to Junior Sales et al. (2004), to yellow melon fruit, in the range, 9-11°Brix are fully commercialized.

CONCLUSION

The phytomass production of plants mixtures was superior to spontaneous vegetation. The use of plants mixtures did not alter the yield of melon, however tillage caused greater fruit yield in the second year of cropping.

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