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The green corn development and yield on different summer soil covering plants in the organic no-tillage system

Aline Marchiori Crespo[1*], Maurício Novaes Souza[2], Luiz Fernando Favarato[3], Rogério Carvalho Guarçoni[4], João Batista Silva Araújo[5], Otacílio José Passos Rangel[6], Jacimar Luis de Souza[7], Dalila da Costa Gonçalves[8]

[1,2,6,8] Prédio da Pós-Graduação, Instituto Federal do Espírito Santo (IFES), Alegre, ES, Brazil
Email: alinemcrespo@gmail.com
[3,4,5,7] CPDI, Instituto Capixaba de Pesquisa, Assistência Técnica e Extensão Rural (Incaper), Domingos Martins, ES, Brazil
*Corresponding author

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***Abstract*— *The objective of this study was to evaluate the growth and yield of green corn cultivated under organic no-tillage system on different ground cover plants. The work was developed in the municipality of Domingos Martins, ES, Brazil (20° 22' 16.91"S and 41° 03' 41.83" W), being arranged in a randomized block design, with six replications and five production systems, consisting of: three soil covers in the organic no-tillage system - with sunn hemp, millet and sunn hemp/millet intercropping; and two systems without straw and with soil tillage - one organic and the other conventional. The double hybrid of corn AG 1051was used, at a spacing of 1.00 x 0.20 m. Evaluations were carried out of stem diameter and plant height, at stagesV5 (five developed leaves), V10 (10 developed leaves) and R3 (milky grains); ear yield with straw and without straw; average weight of 15 ears with straw and without straw; average length and diameter of ears without straw and the percentage of straw. For all agronomic characteristics evaluated, except for length and average diameter of ears without straw and the straw percentage, all the treatments studied were statistically superior to the conventional system treatment. The agronomic characteristic "yield" which is the most important among all evaluated, did not show statistical difference among all treatments under organic system. Therefore, both the organic system without straw and with soil tillage, and the organic systems with straw and without soil tillage using single sunn hemp, single millet and sunn hemp/millet intercropping are possible to be used with good corn yield.*

I. INTRODUCTION

Due to its economic and social value corn is considered one of the most important crops worldwide. [1] In Brazil it is cultivated in all regions in monoculture, rotation, succession and intercropping, reaching a total production of 105,167.2 million tons in the 2019/20 harvest according to data from; [2] and with expected production between 121.4 to 182.7 million tons for the next decade. [3]

Although its production in grains is quite common green corn is an activity of high economic interest for the producers as it presents continuous demand throughout the year and a high rate of income aggregation. Green corn is important for the national trade because it is typical of certain regions, being used in meals, mainly, in festive and cultural seasons in the preparation of derivatives, complements and human consumption. [4, 5, 6] Its cultivation takes place preferably on small and medium-sized properties [7] generating employment and income for the region where it is cultivated.

Corn has numerous uses among which in natura consumption stands out popularly known as “green corn point”, in which is also possible to prepare dishes such as the Brazilians “pamonha” and “curau”, cakes, ice cream, among others. [8, 9] According to the phenology of the corn plant the stage of development for green consumption is called "R3" or "milky grain". [10]

Among the technologies used in maize cultivation, the no-tillage system (NTS) stands out. It is characterized by reducing production costs and improving soil quality, promoting higher yields without compromising the agroecosystem. [11]

This system has three basic assumptions: no soil disturbance, crop rotation and permanent soil covering with straw. [12] Among the advantages of the NTS stands out the protection of the soil against the direct impact of raindrops, the reduction of surface runoff and, consequently, increased water infiltration and availability for plants, and the reduction of soil loss and of nutrients by water erosion. [13] Associated with the input of organic residues and less soil disturbance there is an increase in content of organic matter in the soil which results in improvements in its physical, chemical and biological properties. [14]

However, the implementation of the NTS without the use of herbicides presents itself as a major challenge for research in organic agriculture. [15] An alternative would be the adoption of crop rotation with the use of green manure with Poaceae species and Fabaceae species which would produce a large amount of plant material to cover the soil. [16][17] and [18], mention that one of the factors that contributes to the effective success of the NTS are the crop rotations that provide a high addition of different types of crop residues to the soil, compensating for the rapid decomposition of straw in tropical climates, in order to maintain the protected soil surface for as long as possible and also increase the soil organic matter (SOM).

Among the species used in straw production Fabaceae stand out for fixing atmospheric N_2 and presenting a low C/N ratio (< 17.5) in their mass, which combined with the presence of soluble compounds and the reduced amount of lignin and polyphenols in their tissue, [19, 20] favors the rapid decomposition and mineralization of residues, with an expressive contribution of N to the soil-plant system, but with a reduction of the essential ground cover for the NTS. [21, 22]

Grasses, in turn, characterized by a high C/N ratio (> 30) are more persistent in soils contributing for relatively highs amounts of dry matter as they produce more aerial biomass and have an expressive root system, characteristics that improves the soil physical properties, on the order hand occurring frequent immobilization of N by decomposing microorganisms that use this nutrient contained in the soil in order to decompose the phytomass of grasses. [19, 23, 24]

[25] and [26] referring to the dynamics of N in the soil argue that the ideal would be a straw with an intermediate C/N ratio of the vegetable residue (17.5 to 30) in order to achieve a balance between the ground cover maintenance given by the persistence of plant remains, and the availability of N for subsequent crops. According to these same authors the intercropping of grasses with legumes in cropping systems promotes the above-mentioned ideal condition in addition to the greater distribution of roots at different depths in the soil.

In this context it is necessary to consider the importance of NTS in the success of organic green maize culture, reducing production costs, improving soil quality, promoting higher yields and less impact on the agroecosystem. However, there is a need for more in-depth studies in order to identify which are the best Poaceae species and Fabaceae species to be used for this purpose, for each specific agroecosystem. Thus, the objective of this work was to evaluate the development and productivity of green corn cultivated under NTS on different cover crops in the organic production system in the mountainous region of the state of Espírito Santo – Brazil.

II. MATERIAL AND METHODS

The work was conducted at the Agroecology Reference Unit (ARU) of INCAPER in Domingos Martins-ES, Brazil (20 ° 22 '16.91 "S and 41 ° 03' 41.83” W), at an altitude of 950 m. In this region average maximum temperatures in the warmer range between 26.7 and 27.8 ºC and the average minimum temperatures in the cooler months range between 8.5 and 9.4ºC. Annual average rainfall is 1,800 mm.

The entire ARU has been cultivated under organic management since 1990 with an area of 2.5 ha subdivided into 15 permanent fields where horticulture experiments are conducted. In the first ten years of research the focus was mainly on the generation of technologies for management of organic compound, of soils and of crops. From the 10th to the 20th year of the project the priority was researches about the planning of organic systems and the generation of soil management technologies that were long-lasting considering the cumulative effects of several years of cultivation. [27]

The general organic management of soils of fields has been carried out through the recycling of biomass using crops rotation also grasses and legumes plants appropriate to supply cultural remaining to the soil; through the application of organic compound inoculated with poultry manure; and practices such as green manure, use of mulch, crop rotation, applications of biofertilizers via soil and leave and other which lead to recycling, mobilization and availability of nutrients. It is worth mentioning that fertilizations with organic compound have been carried out on the basis of 15 t ha^{-1} (dry weight) for most crops resulting in an average annual contribution of 22.5 t ha^{-1}, considering the average of 1.5 cultivation of vegetables per year, per field. [27] These were the characteristics of the organic compound used in fertilizations from 2009 to 2011: N, P, K, Ca and Mg; 2.0, 1.2, 1.5, 6.0 and 0.6 dag. kg^{-1}, respectively; Zn, Fe, Mn, Cu and B: 223, 16.1, 804, 50 and 36 mg.dm^{-3}; MO: 48 dag.kg^{-1}; and C/N: 13/1.

This research was conducted at the 05 field in 720 m² of area that is in NTS since 2009.

The field was divided into plots physically isolated by concrete slabs buried at 0.40 m depth where were conducted successive cultivations under summer and winter covering plants as well as intercropping between both. The evaluated species were cabbage on sunn hemp and maize; eggplant on white lupine and black oats; green corn on black oats and white lupine; cabbage on corn and sunn hemp; green corn over corn and sunn hemp; green maize again on white lupine and black oats because the previous field was lost by attack of capybaras; cabbage on white lupine and black oats; and lettuce on black oats, and white lupine.

The trial was conducted from September 2019 to March 2020. The chemical characterization of its soil was performed before its implementation at a depth of 0-20 cm and it is shown in TABLE 1.

Table. 1: Means of the chemical characteristics of the soil before the implementation of the trial

Attributes	G	L	G + L	OS	CS
pH H_2O	6.9	6.8	6.9	6.8	5.4
P (mg dm^{-3})	870.9	975.8	1076.0	971.4	145.3
K (mg dm^{-3})	623.0	445.4	463.0	387.0	197.0
Ca (cmol$_C$ dm^{-3})	13.2	13.4	14.2	14.6	5.5
Mg (cmol$_C$ dm^{-3})	3.4	3.5	3.7	3.4	0.8
Al (cmol$_C$ dm^{-3})	0.0	0.0	0.0	0.0	0.1
H+Al (cmol$_C$ dm^{-3})	1.7	1.7	1.7	1.6	4.5
SB (cmol$_C$ dm^{-3})	17.8	18.4	19.3	18.6	6.8
t (cmol$_C$ dm^{-3})	17.8	18.4	19.3	18.6	6.9
T (cmol$_C$ dm^{-3})	19.5	20.1	21.0	20.8	11.3
MO (dag kg^{-1})	5.1	5.4	5.5	5.1	3.6
Zn (mg dm^{-3})	33.1	43.0	45.4	45.7	12.9
V(%)	91.2	91.3	92.0	92.3	60.3
Fe (mg dm^{-3})	60.6	57.0	56.4	58.0	134.4
Mn (mg dm^{-3})	96.6	102.5	104.7	102.0	82.7
Cu (mg dm^{-3})	2.1	1.83	1.74	2.0	5.3
B (mg dm^{-3})	0.6	0.4	0.5	0.6	0.3

CS– conventional system without straw; OS–organic system without straw; G– organic NTS with grass straw; L– organic NTS wit legume straw; G+L–organic NTS with grass + legume straws.

It was installed in a randomized block design, with six replications and five treatments, totaling 30 experimental plots with dimensions of 6.0 x 4.0 m, with a total area of 24.0 m² and a useful area of 16.0 m². The treatments consisted of three soil coverings in the organic NTS (G - organic NTS with grass straw; L - organic NTS with legume straw; G + L - organic NTS intercropping and two systems without covering and with tillage system, one organic and the other conventional (OS - organic system without straw; CS - conventional system without straw). For treatments under soil cover were used millet (*Pennisetum americanum*) as the grass specie, sunn hemp (*Crotalaria juncea*) as legume specie and the intercropping between both species.

The cover plants were sown on September 25, 2019 both in single and intercropped crops spaced 0.33 m between rows. The density of seeds in single crops was 29 grams per parcel for millet (12 kg ha^{-1}) and 91 grams per parcel for sunn hemp (38 kg ha^{-1}). Sowing densities and seed costs were reduced by half in intercropped crops due to planting in alternate rows.

Weeding was carried out between the lines of the cover plants at 18 days after the emergence of corn (DAE)and the irrigation according to observation of visual aspects of the cultures and previous practical experiences of ARU field employees.

The cover crops were mowed with a motorized backpack mower at 82 days after sowing. Samples of these plants were collected using a square measuring 1x1m on aside randomly placed in each experimental plot. Sub-samples were taken from these samples to quantify fresh weight and dry weight. For drying the sub-samples was used an oven with forced air circulation at 65ºC for a period of 10 days.

Planting fertilization was performed on the same date that the cover plants were mowed using organic compound at a dose of 17.89 tha^{-1} (dry matter) uniformly distributed by haul over all experimental plots in organic management. These were the characteristics of the compound: N, P, K, Ca and Mg; 2.8, 0.7, 5.0, 3.3 and 0.5 dag kg^{-1}, respectively; Zn, Fe, Mn, Cu and B: 151.4, 13014, 455.3, 45.3 and 9 $mg.dm^{-3}$; C.O: 18.4 $dag.kg^{-1}$; and C/N: 6.5. In the plots in conventional cultivation the planting fertilization for corn was carried out with 280 kg ha^{-1} of urea according to soil analysis and fertilization recommendation according to the Lime and Fertilization Recommendation System program. [28] There was no application of supplementary fertilization in coverage in the plots in organic cultivation in order to understand the effect of N from straw; nor in the plots in conventional cultivation so that there would be no competitive advantage from this treatment over others.

The suitable for consumption in the form of green maize the hybrid AG 1051was sown on December 19, 2019 using a special for NTS manual seeder adopting a spacing of 1.00 m between lines and 0.20 m between plants with a density of four seeds per hole. Subsequently it was thinned to one plant per hole recommending a population of 50,000 plants ha^{-1}. A greater number of seeds were sown per hole to avoid failures in planting as the presence of birds that feed on seeds and newly emerged plants was found in the area.

Weeding was carried out between the lines of the plots in organic and conventional systems at 23 and 38 DAE corresponding to the V5 and V10 stages of corn according to observation of visual aspects of the culture and previous practical experiences of the URA field employees.

At 23, 38 and 79 DAE, respectively, at stages V5, V10 and R3the following evaluations were carried out on ten plants randomly identified in the useful area of the plot: stem diameter and plant height from the ground until the insertion of the last leaf completely expanded. Treatment means were compared by Tukey test at 5% probability.

At stage R3, ninety ears per treatment were harvested and evaluated for ear weight with straw - EWS (kg ha^{-1}), ear weight without straw - EWNS (kg ha^{-1}), average ear weight of 15 ears with straw - AEWS (g), average ear weight of 15 ears without straw - AEWNS (g), average ear diameter - AED (mm), average ear length - AEL (cm) and percentage of straw - SP. The straw percentage data were transformed by the function y=arcsen [√ (x/100)] being submitted together with the other characteristics evaluated to the analysis of variance and the means compared by the Tukey test at 5% probability.

In evaluating of the similarity between treatments a matrix with the means of the variables was created and subsequently, a dendrogram was constructed using the mean Euclidean distance to measure the distances between treatments and the method of hierarchical grouping of complete linkage. For statistical analysis, the R program [29] was used.

III. RESULTS AND DISCUSSION

3.1. Cover crop dry matter production

In the evaluation of green and dry matter yield of cover crop sit was observed that for green weight there was a statistical difference between the means of treatments, with treatment G + L being superior to treatment L, but not different from G. For dry weight, however, no differences were observed between the treatments studied (TABLE2).

Table.2: Means of the characteristics green weight and dry weight of cover crops.

Treatments	Green weight (kg. ha^{-1})	Dry weight (kg. ha^{-1})
L	31566.7 b	9417.3 a
G + L	50466.7 a	12372.6 a
G	42666.7 ab	11282.7 a
Mean	41566.7	11024.2
CV (%)	28.47	24.44

[1]Means followed by the same letter vertically do not differ by Tukey test at 5% probability. G – Organic NTS with grass straw; L – Organic NTS with legume straw; G + L – Organic NTS with grass + legume straw.

[30] working with several species of cover crops, including single millet and sunn hemp, concluded that these species produce sufficient biomass for the formation and maintenance of a straw layer in the NTS and can be recommended for the NTS in that region.

In the same way although there are variations according to the form of distribution of the residue on the soil and its rate of decomposition, it is important to use cover crops that produce phytomass in good quantities and that have persistence on the soil, it is observed that the amount of residues generated in this work exceeds the generally recommended for the NTS which is at least 50% of the soil surface covered. [31,19,32]

3.2. Green corn development

Plant height associated with stalk diameter are important aspects for green maize crop yield since larger plants tend to be more productive, probably because they accumulate greater amounts of reserves in the stalk. [33] The absorbed and photo assimilated nutrients produced during the vegetative phase will be used in the reproductive phase for grain filling, in addition to providing plants resistant to lodging and breakage. [34] In addition, taller maize plants will have competitive advantages over weeds, which will result in less mowing, reducing the system's production costs. [35]

In this study the agronomic trait plant height showed a significant difference in stages V10 and R3 (TABLE3 and 4). At stage V10, the NTS treatment with legume straw (L) had the highest average, followed by the organic system (OS), NTS with grass straw (G) and NTS treatments with intercropped straw (G+L), which had equal statistical averages among themselves and, lastly, the CS treatment (conventional system without straw) was observed, which presented the lowest average height among all treatments at this stage.

Table. 3: Means of plant height at stages V5, V10 and R3 of green corn.

	Plant height (cm)		
Treat.	**V5**	**V10**	**R3**
CS	16.90 a	59.15 b	219.05 b
OS	23.60 a	70.30 ab	243.50 a
G	22.82 a	64.98 ab	245.12 a
L	24.23 a	73.65 a	246.30 a
G + L	23.33 a	70.57 ab	247.00 a
Mean	110.03		
CV (%)	6.51		

[1]Means followed by the same letter vertically do not differ by Tukey test at 5% probability. G – Organic NTS with grass straw; L – Organic NTS with legume straw; G + L – Organic NTS with grass + legume straw.

Table. 4: Means of stem diameter at stages V5, V10 and R3.

	Diameter (mm)		
Treatments	**V5**	**V10**	**R3**
CS	12.41 c	24.18 a	21.75 c
OS	17.15 a	26.42 a	25.83 a
G	14.90 ab	25.85 a	24.28 ab
L	14.68 bc	24.30 a	23.47 bc
G + L	16.63 ab	24.67 a	24.47 ab
Mean	21.40		
CV (%)	6.57		

[1]Means followed by the same letter vertically do not differ by Tukey test at 5% probability. G – Organic NTS with grass straw; L – Organic NTS with legume straw; G + L – Organic NTS with grass + legume straw.

It is known that the use of leguminous species as cover crops provides a contribution of atmospheric N to the system via symbiotic fixation, [36,37] reducing the C/N ratio and increasing the rate decomposition of the straw which provides a faster release of nutrients, with emphasis on the N. [21,22] This may explain the fact that treatment L, corresponding to sunn hemp in single cultivation showed the highest average.[33] and [38], comparing predecessor crops and N doses observed greater plant height, greater ear insertion height and greater grain yield, when corn was sown after the hairy vetch and sunn hemp (Fabaceae). However, when sown after black oat and millet (Poaceae) the results obtained were inferior which proves, then, the benefit of using Fabaceous as cover crops.

At stage R3 for this same trait, all treatments were statistically superior to CS treatment.

As for the characteristic stem diameter there were significant differences in stages V5 and R3 (TABLE 4), and in both stages it is observed that the highest means were obtained, in descending order, in the OS, G and G+L treatment, followed by L and, finally, in CS treatment.

For the CS treatment, the means lower than the others, observed both for plant height and stem diameter (TABLE 3 and 4) in the various stages mentioned, can be explained by the following factors: i) the N offered at planting, in the dose of 128.8 Kg ha-1, comes from urea, a highly volatile N source; ii) as it has been under conventional management since 2009, all the benefits of the application of organic compost and the use of NTS were not observed in this treatment, resulting in lower levels of soil organic matter (SOM) and nutrients in general, as can be seen in TABLE 1; iii) in physical destructuring and oxidation of the SOM due to continuous soil disturbance; iv) in lower soil biological conditions; v) low moisture retention and; vi) greater probability of erosion occurrence. [39, 40, 41]

Otherwise in the case of the OS treatment, which had the highest average stalk diameter at stages V5 and R3, soil tillage may have increased the rate of SOM mineralization, with consequent release of N, which probably favored the green maize growth. According to [42] the SOM decomposition rate in a conventional preparation system is practically twice as high when compared to NTS. It is important to emphasize this treatment is also included in those that use NTS since 2009, as other experiments are implemented, and therefore it presents a high rate of initial SOM, in the same way as the treatments under NTS in this work.

[43] and [44] evaluating the effect of velvet bean, pigeon pea, styling and jack bean cover crops; black oat, white lupine and black oat/white lupine intercropping, used as green manures and cover crops, concluded that stalk diameter is influenced by green manure and that the use of jack beans and lupine -white in monoculture and intercropped with black oat provided greater diameter of the corn stalk.

3.2. Green corn yield

According to [45] the average Brazilian productivity of ears without straw is between 9,000 and 15,000 Kg ha-1, which indicates that the values verified in this work (TABLE5), which ranged from 10,656.67 Kg ha-1, for the treatment CS, at 13,093.33 Kg ha-1, for treatment G, are within expectations.

It is also observed in TABLE 5 that there was no statistical difference between the treatments for all the production components evaluated (EWS, EWNS, AEWS and AEWNS), except for the CS treatment which showed the lowest mean with statistical difference for the others treatments.

However, it is important to note despite the above about the statistical analysis of the data it is noted that there was an important difference in productivity and average weight of ears without straw among the studied treatments: G had the highest average productivity of ears without straw (EWNS) totaling 13,093.33 kg ha^{-1}, which meant 2,436.66 kg ha^{-1} more ears produced compared to CS treatment. In addition, the average weight of 15 ears without straw (AEWNS) for treatment G showed ears weighing an average of 261.87 g., while for treatment CS, ears weighed an average of 213.13 g.

Table. 5: Means of ear yield characteristics - EWS (kg ha^{-1}), EWNS (kg ha^{-1}), AEWS (g) and AEWNS (g).

Treat.	EWS	EWNS	AEWS	AEWNS
CS	13946.67 b	10656.67 b	4184.00 b	3197.00 b
OS	17977.78 a	12538.33 a	5393.33 a	3761.50 a
G	19298.89 a	13093.33 a	5789.67 a	3928.00 a
L	17642.78 a	12388.33 a	5292.83 a	3716.50 a
G + L	18537.78 a	12161.67 a	5561.33 a	3648.50 a
Mean	17480.78	12167.67	5244.23	3650.30
CV (%)	8.23	5.25	8.23	5.25

[1]Means followed by the same letter vertically do not differ by Tukey test at 5% probability. G – Organic NTS with grass straw; L – Organic NTS with legume straw; G + L – Organic NTS with grass + legume straw.

Works referring to the direct planting of corn on winter and summer cover plant species show as a result that the use of a Poaceae species alone as a cover plant and depending on the size of its fragments on the soil, leads to reduced productivity because due to its high C/N ratio, there is a decrease in the availability of N in the soil caused by microbial immobilization during the process of plant decomposition. Therefore, it is recommended to use Fabaceae in intercropping with Poaceae in order to increase the availability of N in the system, which will result in increased corn grain yield. [46, 47, 26, 38, 48]

This possible immobilization of N from the soil, however, did not occur in the present work for the Poaceae straw treatment referring to the use of millet in single organic cultivation under NTS. This can be attributed to the high content of pre-existing SOM [28] due to the NTS being used in the area since 2009 and also due to the history of organic soil management in the area, where there is, according to [27], a 77% increase in SOM in 20 years. Therefore, even though the N in the residue was immobilized by microorganisms this did not result in a visual deficiency of this nutrient in the plant nor in a reduction in green corn productivity.

It should be noted that the lowest mean for all productivity components was found for the CS treatment and this can be explained by the same reasons mentioned above in relation to the lowest mean plant height and stem diameter (TABLE6) also obtained for this treatment.

For the values of both diameter, average length of ears and percentage of straw, it is noted in TABLE6 that there was no significant difference between treatments.

Table. 6- Means of the characteristics mean ear diameter – AED (mm), average ear length – AEL (cm) and percentage of straw (PS).

Treatments	AED	AEL	PS
CS	41,88 a	22,75 a	23,47 a
OS	48,13 a	19,57 a	30,05 a
G	48,93 a	19,84 a	31,85 a
L	48,33 a	19,28 a	28,31 a

G + L	48,03 a	19,31 a	33,89 a
Mean	47,06	20,15	29,51
CV (%)	10,89	26,14	12,39

[1]Means followed by the same letter vertically do not differ by Tukey test at 5% probability. G – Organic NTS with grass straw; L – Organic NTS with legume straw; G + L – Organic NTS with grass + legume straw.

According to [49] and [50] ear diameter is directly linked to grain filling and number of grain rows per ear and, together with ear length, are some of the characteristics that determine the yield potential of the crop. of corn.

In opposition to the result above (TABLE 6), [51] and [52] working on the conventional NTS found that green manure significantly influenced the diameter and length of ears, which can be explained by the general condition of the soil always cultivated under the conventional system being considered inferior to that of the soil cultivated over years under agroecological practices [27] which results in a more evident response of the commercial crop in relation to green manure in the conventional management system.

A multivariate analysis was carried out using a dendrogram to observe the groups of treatments regarding production characteristics. Fig. 1 shows the graphical distribution of the five treatments studied. It is observed that the dendrogram in Fig. 1 suggests the existence of two homogeneous groups: group A formed by the CS treatment and group B, formed by the other treatments. These results confirm those seen in TABLE5, in which higher yields were observed in the OS, G, L and G+L treatments when compared to the CS treatment.

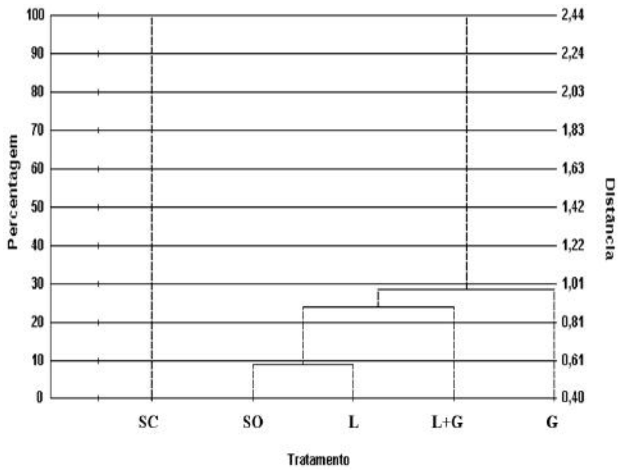

Fig. 5: Distribution of clusters with five treatments in relation to green corn production characteristics

IV. CONCLUSION

For all agronomic characteristics evaluated in this work, except for length and average ear diameter and percentage of straw, the organic treatments with or without cover crops were statistically superior to the conventional system treatment (CS);

There were statistical differences for the variable plant height at stage V10 and stem diameter at stages V5and R3 among treatments under organic system with and without straw;

The characteristic "productivity", which is the most important among all those evaluated, did not show any statistical difference among all treatments under organic system; and

Due to the fact that the area of implementation of this experiment has been under organic management for 31 years, there were positive changes in several soil properties over time resulting in an absence of response from organic systems with plants of cover in relation to the organic system without cover plant. Thus, it is concluded that these two types of systems mentioned, using single sunn hemp, single millet or intercropping sunn hemp/millet, are possible to be used in the conditions tested in this work, with high straw production and good corn yield.

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