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Vol. 10(32), pp. 3093-3100, 6 August, 2015
DOI: 10.5897/AJAR2015.9957
Article Number: 00F1D4B54682
ISSN 1991-637X

http://www.academicjournals.org/AJAR

African Journal of Agricultural Research

*Full Length Research Paper*

# Agricultural characteristics and evaluation locations of sorghum plots with different eucalyptus arrangements

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Received 1 June, 2015; Accepted 21 July, 2015

**The aim of the experiment was evaluate agronomic characteristics of grain sorghum plots, collected at different sites within four spatial arrangements of eucalyptus for the forest crop livestock integration system (iLPF). The work was implemented in the second crop in the agricultural year 2011-2012, after the soybean harvest in Uberlândia, Minas Gerais. For this, they were planted in areas adjacent seedlings of eucalyptus clone I 144 simple rows: 10 × 2 m; double rows: (2 × 3) + 15 m, (2 × 3) + 20 m in triple rows (3 × 2 × 3) + 20 m. At six months after planting clone, seeded through conventional tillage to cultivate sorghum 1G220 in the eucalyptus rows. It used the experimental randomized block design in split plot with five replications. The plots consisted of four spatial arrangements of eucalyptus and the subplots 3 sorghum assessment of sites within the plots (center, right side and left side of eucalyptus). The** site assessment of the plots affect**assessment of the plots site affects the main agronomic characteristics of sorghum. In future experiments it is necessary that sorghum portions are formed by central and lateral lines within the wider spacing eucalyptus. The spatial arrangement ( 2 ×× 3 ) + 20 m and 10 ×× 2 m are more promising for the consortium . The definition of best arrangement will depend on the market for the sale of wood.**

**Key words:** Agroforestry system, sustainability, consortium.

## INTRODUCTION

The integration of Crop-Livestock-Forest (iLPF) is an alternative to recover degraded areas, which are found in all regions of Brazil, including the cerrado. Thus, it is necessary to know how to implant this system to improve production of involved agricultural species. Intercropping has emerged as an important system of land recovery since it increases the efficiency of land use, diversifies production and optimizes use of natural resources such as soil, water, temperature and radiation (Oliveira et al., 2013). Therefore, the choice of species that make up the integration system is directly related to the viability of this system (Bravin and Oliveira, 2014).

Cereals most frequently used for the implementation of this system are corn, sorghum, millet, beans, soybeans,

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rice and sunflower. In Brazil, there are successful experiences with various shaded crops. However, further studies of some crops and areas of interest are necessary. Additionally, the generated technologies should be tested in production areas and not only in experimental areas (Oliveira et al., 2011).

According to Alvarenga et al. (2010), crops of corn and sorghum, both for the production of grain and silage, stand out within the iLPF due to the potential they offer regardless the size of the property. Cereal crops, forage and eucalyptus are consortium in Brazil, but this system is rarely used in other countries (Borghi et al., 2013).

Currently, there is a high demand for more sustainable production models, such as the agroforestry systems (Cubbage et al., 2012). These systems are important to enhance soil fertility (Jackson and Ash, 1998; Pinho et al., 2012), increase the farm economical return (Dube` et al., 2002; Souza et al., 2007; Prasad et al., 2010; Pacheco et al., 2013), and sequester the carbon that can be stored in the tree biomass and in the soil (Montagnini and Nair, 2004; Haile et al., 2010; Howlett et al., 2011; Tonucci et al., 2011), among others. Therefore, the agroforestry systems and techniques such as no-tillage were included in the Brazilian government financing program called low carbon agriculture to enable the recovery of degradedBrazil has large stretches of degraded land, mainly occupied by pasture (Paula et al., 2013).

Sorghum is the fifth most produced cereal in the world. The nutritional value is similar to corn, and has the advantage of the absence of gluten. It is recommended for iLPF systems because of its competitiveness when associated with other crops, as forage and tree species.

The sorghum (*Sorghum bicolor* (L.) Moench) has long been used because it is easily intercropped, offers good productivity and adapts to drought conditions (Oliveira, 2011). However, it is necessary to know the best spatial arrangements of trees to obtain the best production output.

In integrated systems, the adaptation of forage species and agronomic crops in consortium with trees must be well known, especially because of the microclimate conditions and competition among plant components for the available natural resources. Some studies show increased canopy growth under shade (Soares et al., 2009).

There are numerous studies that show the influence of solar radiation on grasses grown in agroforestry systems (Macedo et al., 2006; Oliveira et al., 2009; Almeida et al., 2014), however few studies have been made regarding the sorghum grain crop (Albuquerque et al., 2013). Sorghum could be an alternative in consortium systems, especially with tree species (Dan et al., 2010).

The objective of this study was to observe the effect of different spatial arrangements of eucalyptus on the main agronomic characteristics of grain sorghum in iLPF system in Uberlândia, MG.

## MATERIALS AND METHODS

### Location and description of the experimental area

The experiments were established in November 2011 with the planting of eucalyptus and soybean, and in March 2012, after harvest of soybean, with the planting of sorghum in the experimental area in the city of Uberlândia, MG, located at the coordinates of 18º50'S and 48º14'W at an altitude of 785 m.

The climate according to Köppen classification is an Aw type, characterized as rainy tropical, megathermal, typical for savannah, with dry winter, with average rainfall of 1550 mm and annual average temperatures of 23.1°C.

Variations for ten-day periods, during the conduct of experiments involving the sorghum crop, are shown in Figure 1. The soil was classified as Dystrophic Red Latosol of medium texture. The chemical attributes, before planting of sorghum are shown in Table 1, EMBRAPA (2009).

### Plant component

The clone of Eucalyptus used in this experiment was I 144 hybrid, a cross between *Eucalyptus grandis* x *Eucalyptus urophilla*. It is widely commercialized in the region; its wood is widely used for energy production, for pulp and paper industry, and for the production of poles and stakes (Terra Forte Florestal, 2014).

Regarding sorghum, the 1G220 hybrid was used, from Dow AgroSciences, which has early cycle, low height and half-open panicle.

### Evaluated spatial arrangements

The effect of spatial arrangements of the eucalyptus agrosilvopastoral system was studied with single line: 10 × 2 m; double lines: (2 × 3) + 15 m, (2 × 3) + 20 m and with triple lines (3 × 2 × 3) + 20 m. The evaluations of sorghum characteristics took place between the lines of trees, where spacing is as greater as described in the followingin Figure 2.

Table 2 shows the arithmetic mean of eucalyptus clone height and number of trees per hectare in different arrangements after harvest sorghum.

### Deployment and conducting of the experiment

Liming took place in August 2011 with subsequent plowing in order to incorporate and increase the base saturation to 70%. For this, 4.6 t ha$^{-1}$ of dolomitic limestone was used. In November harrowing was carried out in order to prepare the soil for planting eucalyptus in different spatial arrangements. The planting of eucalyptus was made according to the terraces in the area. Thus, the lines were placed in north-south direction. Magnesium thermophosphate (120 kg ha$^{-1}$ $P_2O_5$) was applied into the furrows during planting of eucalyptus seedlings. Top-dressing fertilization of Eucalyptus took place 45 days after planting via lateral furrows with 240 g of a 08-28-16 fertilizer, along with 3 g of Borax per plant. The eucalyptus fertilization followed the recommendations of the 5th approach (Ribeiro et al., 1999). Mechanized sowing of the 1G220 sorghum took place in March 2012. For this a vacuum planter was used, set with 0.50 m spaces. The density of 140 thousand plants ha$^{-1}$ was used for sorghum. To evaluate sorghum, there were randomized blocks in split plots with five replications. The experimental plot consisted of four spatial arrangements of eucalyptus and the subplots of three locals of assessment (center, right and left side of eucalyptus) of the agronomic characteristics of sorghum. To delimit the useful area of each spatial arrangement, two central

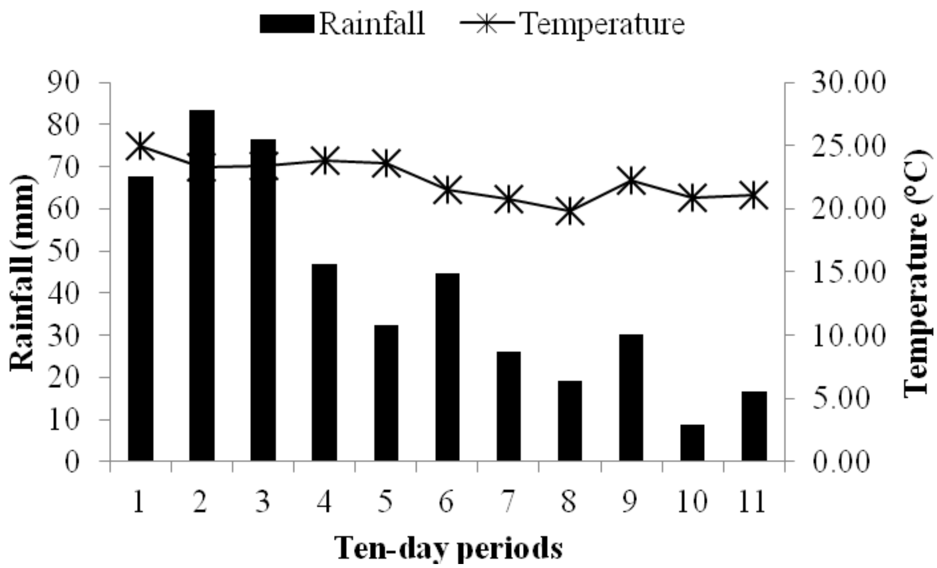


**Figure 1.** Temperature and rainfall per ten-day periods, in Uberlândia, MG, from 01/03/2012 to 01/06/2012. Data provided by UFU weather station in Uberlândia, MG.

**Table 1.** Soil chemical properties, in the layer of 0.00-0.20, Uberlândia, 2012.

| Layer | pH $H_2O$ | P | K | Al | Ca | Mg | H+Al | SB | t | T | V | m | MO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M | | | | | | | cmol$_c$ dm$^{-3}$ | | | | % | | dag kg$^{-1}$ |
| 0.00-0.20 | 6.25 | 11.73 | 0.14 | 0.06 | 0.73 | 0.78 | 1.75 | 1.65 | 1.71 | 3.40 | 47.82 | 5.64 | 2.11 |

P, K = (HCl 0.05 mol L$^{-1}$ + $H_2SO_4$ 0.0125 mol L$^{-1}$) available P (Mehlich-1 extractor); Ca, Mg, Al, (KCl 1 mol L$^{-1}$); H+Al = (Buffer Solution – SMP a pH 7.5); SB = Bases Sum; t = effective CTC; T = CTC at pH 7.0; V = Base saturation; m = Aluminum saturation (EMBRAPA, 2009).

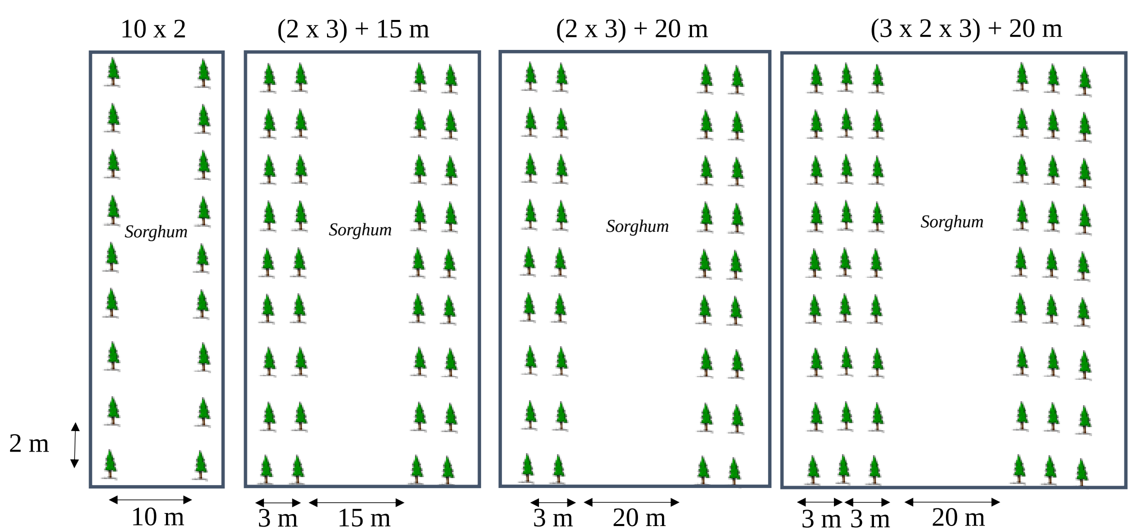


**Figure 2.** Spatial arrangements of the eucalyptus agrosilvopastoral system.

lines of sorghum were considered, planted between the greatest distance from the eucalyptus rows and two lateral lines on the right

**Table 2.** Number of trees per hectare in the various arrangements and arithmetic mean of eucalyptus height after sorghum harvest (EH).

| Arrangement | Number of trees | EH (m) |
|---|---|---|
| 2 × 3 + (15 m) | 556 | 3.10 |
| 2 × 3 + (20 m) | 435 | 2.97 |
| 2 × 10 m | 500 | 3.29 |
| 3 × 2 × 3 + (20 m) | 577 | 3.06 |

and two lateral lines on the left of the tree component. There was a border line with sorghum in the direction of eucalyptus on both sides.

The panicles were covered with paper bags at flowering to protect against birds. Pesticide applications to control pests, diseases and weeds took place during the experiment, according to recommendations and practices commonly adopted in the region.

### Evaluated characteristics

#### *Plant height (m)*

The plant height was measured from the insertion of the upper panicle to the ground, expressed in meters, with four plants from the useful area per plot after physiological maturity of grain.

#### *Grain weight (kg)*

It was obtained by weighing the grain of the plants from two rows of 4 m in different installments.

#### *Grain yield (t ha$^{-1}$)*

Data regarding grain weight from the plots after threshing were corrected for moisture of 13% and converted to t ha$^{-1}$ using Equation 1.

$$P13\%=PC(1-U)/0.87 \quad (1)$$

In: P13%: grain yield (t ha$^{-1}$) corrected to standard moisture of 13%; PC: grain yield without correction; U: grain moisture observed at harvest.

#### *Effective grain yield (kg ha$^{-1}$) for spatial arrangement*

Using grain yield (kg ha$^{-1}$), the effective yield was calculated, which is based on sorghum productivity in integration with the forest system, discounting the area occupied by trees (m²). It was determined by Equation 2.

$$\text{Effective Produtivity}=\text{Produtivity}\times(10000-\text{area occupied by forest}/10000) \quad (2)$$

### Statistical analysis

Individual analysis for spatial arrangements was held and subsequently the data were submitted to the normality and homogeneity tests for further realization of joint analysis of variance and Scott-Knott test at 0.05 significance.

## RESULTS AND DISCUSSION

The temperature and the rainfall were considered normal during the experiment (Figure 1). The interaction of spatial arrangements of eucalyptus and sites of sorghum evaluation was significant (P<0.05) for plant height, grain weight, average productivity and effective productivity of sorghum grains, as well as the local of plots and spatial arrangements of eucalyptus (Table 3).

For the height of sorghum plants in consortium in spatial arrangement of simple line of eucalyptus (10 x 2 m) there was no difference between the locals of evaluation (Table 4). Regarding the other three spatial arrangements, there was difference in sorghum height depending on the place of evaluation. Thus, for the system of double lines (2 × 3) + 15 m and triple lines (3 × 2 × 3) + 20 m the height of sorghum plants was greater in the center, with values of 0.85 m 0.88 m (Table 4). Lower height in the (2 × 3) + 15 m spatial arrangement was observed on the left side, with 0.71 m; however, for the triple-line system, a lower height was on the right side, of 0.59 m.

Regarding the (2 × 3) + 20 m spatial arrangement, the center had the highest plants, with 0.87 m. The left side, with 0.81 m, and the right side, with 0.76 m, obtained lower values (Table 4). Moreover, when sorghum was grown in simple spatial arrangement (10 × 2 m) no difference was observed in plant height, regardless of the assessment site. However, for the other three spatial arrangements, the height of sorghum was affected by the location, where the center obtained higher values under these conditions.

These results were similar to those reported by Oliveira (2011), in a study of intercropping sorghum with eucalyptus in iLPF system, where the height of the plants in the lines close to the trees was lower comparing with the center lines of the plot. The reduction in sorghum height occurred as approaching the tree, resulting in smaller sorghum plants in the vicinity of eucalyptus.

The same was observed by Macedo et al. (2006), who found higher values of the average height of the consortium of corn with eucalyptus situated 4.5 to 5.4 m away from the eucalyptus lines than those located 1.8-2.7 m from eucalyptus possibly because of the greater light

**Table 3.** Analysis of variance for plant height (PH), grain weight (MG), average productivity (PR) and effective productivity (PREF) of sorghum grown with different Eucalyptus spacings. Ajustar as siglas para ingles.

| Sources of variation | Gl | PH (m) | MG (kg) | PRme (t ha$^{-1}$) | PRef (t ha$^{-1}$) |
|---|---|---|---|---|---|
| | | | QM | | |
| Bloc | 4 | 0.013 | 5.552 | 6855556.720 | 3957716.192 |
| Arrangement | 3 | 0.046* | 12.758* | 15751155.097* | 13656695.179* |
| Loc. evaluation | 2 | 0.085* | 9.806* | 12106683.606* | 6561457.458* |
| Local arrangement* | 6 | 0.022* | 4.238* | 5232345.963* | 3184279.199* |
| Error | 44 | 0.001 | 0.608 | 751143.339 | 450717.757 |
| Average | | 0.799 | 4.300 | 4.478 | 3.655 |
| CV (%) | | 5.23 | 18.14 | 18.14 | 18.37 |

*: Significant at 5% error probability by F test.

**Table 4.** Average height (m) of sorghum plants in eucalypt spacing in function of the local of assessment of the iLPF system.

| Spacing (m) | | | | |
|---|---|---|---|---|
| **Local of evaluation** | **10 × 2** | **(2 × 3) + 15** | **(2 × 3) + 20** | **(3 × 2 × 3) + 20** |
| Right side | 0.88$^{Aa}$ | 0.77$^{bB}$ | 0.76$^{bB}$ | 0.59$^{cC}$ |
| Center | 0.88$^{aA}$ | 0.85$^{aA}$ | 0.87$^{aA}$ | 0.88$^{aA}$ |
| Left side | 0.83$^{aA}$ | 0.71$^{bC}$ | 0.81$^{aB}$ | 0.72$^{bB}$ |

Average followed by different letters, lowercase and uppercase on the line in the column, different by the Scott-Knott test at 0.05 significance.

incident in the middle between rows of eucalyptus clones, oriented east-west. Such evidence can be explained by the fact that the sorghum evaluated in the center, that is, far from the eucalyptus lines, received the most of solar radiation input and had less competition for water and nutrients from the tree component of the system. Thus, there is greater photosynthetic rate and greater redistribution of assimilates to the plant, since sorghum is a C4 plant with high yields in sunlight.

When comparing the different space systems within each assessment site, one can observe that the heights of sorghum plants were affected by the used spacing. To the right, the plants in the spacing with single line (10 × 2 m) had greater height, however the triple line system led to lower plants (Table 4).

In relation to the center, there was no difference between the space systems of eucalyptus. On the left side, both arrangements 10 × 2 m, with 0.83 m and (2 × 3) + 20 m with 0.81 m, provided the highest plants, and did not differ between one another; the other two arrangements produced the lower values.

With regard to spacing within each trial site, the 2 × 10 m space system produced greater height on the right side (Table 4). On the left side, the highest values were found in the simple line spacing with 10 × 2 m and double (2 × 3) + 20 m. However, in the center the height was statistically equal in all, regardless of the spatial arrangement. Based on the obtained data, it can be inferred that, in the sample on the right side, the spacing with fewer trees (10 × 2 m) obtained the highest plants, due to weaker shading of the sorghum plants.

Similarly, for the left side, however, the (2 × 3) + 20 m spatial arrangement produced higher plants, perhaps because it has greater spacing between rows, allowing more light to the enter under the trees. The center of the samples was far from eucalyptus lines, and had higher brightness. Importantly, the planting of trees occurred in the north-south direction. This fact favored shading regularly in the morning, favoring the right side and in the afternoon the left side, depending on the position of the sun.

Another analyzed variable was the weight of grain, which affects an agronomic component of paramount importance showing the performance of a crop in a certain place and time. So, when sorghum was grown in the 10 × 2 m spatial arrangement and the weight of grain was evaluated on the right side and center, the values were statistically equal. However, on the left side, lower weight was noted (Table 5).

For the (2 × 3) + 15 m spatial arrangement no significant differences between the sites of evaluation were observed. Unlike what happened in the (3 × 2 x 3) + 20 m spatial arrangement where only the center had higher weight and right side lower (Table 5). For the (2 × 3) + 20 m spatial arrangement, the center and the left side showed the greatest weight and right side the lowest weight (Table 5). When sorghum was produced in the (2 × 3) + 15 m spatial arrangement, it presented the same

**Table 5.** Sorghum grain weight per plot (kg) in different eucalyptus spacings depending on the location of evaluation in the iLPF system.

| Spacing (m) | | | | |
|---|---|---|---|---|
| **Local of evaluation** | **10 × 2** | **(2 × 3) + 15** | **(2 × 3) + 20** | **(3 × 2 × 3) + 20** |
| Right side | 5.31$^{aA}$ | 3.23$^{bA}$ | 4.38$^{aB}$ | 1.98$^{cC}$ |
| Center | 4.96$^{bA}$ | 4.24$^{bA}$ | 6.06$^{aA}$ | 5.06$^{bA}$ |
| Left side | 3.47$^{bB}$ | 3.66$^{bA}$ | 5.98$^{aA}$ | 3.27$^{bB}$ |

Average followed by different letters, lowercase and uppercase on the line in the column, different by the Scott-Knott test at 0.05 significance.

grain weight regardless of location. However, other spatial arrangements obtained variation depending on the site of evaluation.

By analyzing the evaluation site, it was observed that the sorghum on the right side had higher grain weight in 10 × 2 m, (2 × 3) + 20 m spatial arrangements and the triple-line spatial arrangement provided lower value (Table 5). In the center and on the left side the behavior was similar. However, the (2 x 3) + 20 m double-line system showed increased grain yield comparing with the other three systems.

It was evident that the sorghum in the center and left side of the subplots had the highest grain yield in the (2 × 3) + 20 m spatial arrangement. On the right side, both the 10 × 2 m system and the (2 × 3) + 20 m system had higher values (Table 5). Looking at the average yield of sorghum grain, the 10 × 2 m spatial arrangement had higher values on the right side and in the center. The double row (2 × 3) + 15 m system showed no difference in grain yield among the evaluated sites. The spatial arrangement with triple row had higher value only in the center. And the (2 × 3) + 20 m spatial arrangement obtained higher values both in the center and on the left (Table 6).

Thus it can be seen that the highest productivity proved to be dependent on the spatial arrangement and the place of evaluation. The (2 × 3) + 15 m system was an exception where productivity was the same in three locations.

However, for the 10 × 2 m and (2 × 3) + 20 m systems, the center obtained the highest values, but on the right side of the 10 x 2 m system, productivity was equal to the center. In the (2 × 3) + 20 m system, the productivity on the left side was equal to the center. For the triple system, only the center showed higher value. Importantly, in all spatial arrangements, the center presented high productivity.

These results contrast those found by Almeida et al. (2014), in an experiment to evaluate the productivity of soybeans between eucalyptus rows in different positions (west, the center and east of the trees). These authors found that the number of plants per hectare, the number of pods per plant and the number of seeds per pod did not differ between the sampling positions. The yield of grain per hectare was higher in the western position, followed by the center strip, and the east provided the lowest productivity, with the orientation of trees in north-south direction.

These results highlight the importance of planning the plots in future work involving sorghum intercropped with eucalyptus. There is the need to include the center and the sides to constitute a sorghum experimental plot in iLPF systems. According to Oliveira et al. (2013), studies related to morphological and physiological characteristics of shaded forage are relevant to better understand the response of these species and fill gaps in literature on the subject. By analyzing the places of evaluation, it was observed that the right side had a higher grain yield in 10 × 2 m, (2 × 3) + 20 m spatial arrangements, and the triple system proved to give the lowest value. Already at the center and on the left side productivity was higher in the (2 × 3) + 20 m system than in the other three arrangements of eucalyptus.

Similar results were found by Albuquerque et al. (2014), where the production of sorghum in the (2 × 3) + 20 m spatial arrangement was higher comparing to denser systems, where the (2 × 3) + 9 m system showed a decrease of 37.7% in yield in relation to production without any shade. In all evaluated sites, the (2 × 3) + 20 m system showed higher productivity, however the 10 × 2 m system had no significant difference on the right side (Table 5).

The light plays an important role in regulating numerous chloroplastid enzymes; when missing or in excess it may trigger disorders associated with photosynthetic processes (Albuquerque et al. 2014).

According to these authors, low amount of light limits photosynthesis with negative effects on tillering, growth rate and consequently the production of biomass. The average productivity of sorghum in 2012, for the state of Minas Gerais, was 3.51 t $ha^{-1}$ (CONAB, 2012). In the experimental area, the obtained average was 4.77 t $ha^{-1}$, 35% higher comparing with the national average. This may be related to precipitation in place during the experiment, mainly during the first month which is the most critical, providing good results.

When assessing the effective productivity, that is productivity without the area occupied by the tree, it was

**Table 6.** Average productivity of sorghum grain (t ha$^{-1}$) in different spacings of eucalyptus depending on the evaluation location for the iLPF system.

| Spacing (m) | | | | |
|---|---|---|---|---|
| **Local of evaluation** | **10 × 2** | **(2 × 3) + 15** | **(2 × 3) + 20** | **(3 × 2 × 3) + 20** |
| Right side | 5.90$^{aA}$ | 3.58$^{bA}$ | 4.86$^{aB}$ | 2.19$^{cC}$ |
| Center | 5.51$^{bA}$ | 4.71$^{bA}$ | 6.73$^{aA}$ | 5.62$^{bA}$ |
| Left side | 3.85$^{bB}$ | 4.06$^{bA}$ | 6.64$^{aA}$ | 3.63$^{bB}$ |

Average followed by different letters, lowercase and uppercase on the line in the column, different by the Scott-Knott test at 0.05 significance.

**Table 7.** Effective grain yield (t ha$^{-1}$), in different spacings of eucalyptus depending on the local of evaluation for the iLPF system.

| Spacing (m) | | | | |
|---|---|---|---|---|
| **Local of evaluation** | **10 × 2** | **(2 × 3) + 15** | **(2 × 3) + 20** | **(3 × 2 × 3) + 20** |
| Right side | 5.01$^{aA}$ | 2.51$^{cA}$ | 3.69$^{bB}$ | 1.60$^{dC}$ |
| Center | 4.68$^{aA}$ | 3.29$^{bA}$ | 5.11$^{aA}$ | 4.10$^{bA}$ |
| Left side | 3.27$^{bB}$ | 2.84$^{bA}$ | 5.05$^{aA}$ | 2.65$^{bB}$ |

Average followed by different letters, lowercase and uppercase on the line in the column, different by the Scott-Knott test at 0.05 significance.

noted that in the 2 × 10 m system, both the right and the center provided higher values than the left (Table 7). In the (2 × 3) + 15 m arrangement, there was no difference between the evaluated sites.

The spacing with triple rows of eucalyptus provided better effective grain yield when sorghum was produced in the center, with 4.10 t ha$^{-1}$, unlike what happened on the right side that got the lowest value, 1.60 t ha$^{-1}$. But the (2 × 3) + 20 m arrangement had higher productivity in the center and on the left side (Table 7).

By observing the spatial arrangements within each assessment site, sorghum on the right side provided the best effective productivity (5.01 t ha$^{-1}$) in 10 × 2 m spatial arrangement, and the (3 × 2 × 3) + 20 m obtained lower productivity (1.60 t ha$^{-1}$). In the center, this characteristic was superior in both systems, in the 10 x 2 m and in the (2 × 3) + 20 m system, while the other two provided less effective productivity. Finally, on the left side, the spacing with the highest value was the (2 × 3) + 20 m comparing to the other three (Table 7).

Introduction of the trees in the integration of production systems promotes profound changes that need long-term care in its planning and execution. According to Alvarenga et al. (2010), special attention should be given to the selection of species, intended use and spatial arrangement. These authors pointed out that the forestry component can achieve improved profitability was driven for timber production by sawmills, veneer lamination, with a low density of trees / hectare. Thus, due to this simple arrangement the work 10 and double row ×x 2 m (2 ×x 3) + 20 m would be most suitable because they have a lower density of trees / ha and greater productivity grain sorghum, however, experiments long-term to assess the forestry component becomes necessary to characterize the wood.

If the producer requires faster economic return of the forest component, the same can opt for the arrangement with more trees. In this case the market would be coal or energy. It is important to note that after the sorghum harvest, the area can be used for a few months paragraph tofor grazing animals, animals; it is common in the emergence of Brachiaria in the area.

Coelho et al. (2014) evaluate the dry matter production of forage in different arrangements concluded, the use of eucalyptus double lines implies reducing radiation incident in the understory, but does not imply reducing pasture productivity compared to the simple arrangement.

## Conclusions

The site assessment of the plots affectassessments of the plots affect the main agronomic characteristics of sorghum. In future experiments, it is necessary that sorghum portions are formed by central and lateral lines within the wider spacing eucalyptus.

The spatial arrangement ( 2 ×x 3 ) + 20 m and 10 ×x 2 m are more promising for the consortium . The definition of best arrangement will depend on the market for the sale of wood.

## Conflict of Interest

The authors have not declared any conflict of interest.

## ACKNOWLEDGEMENTS

The authors thank FAPEMIG, CNPQ and CAPES for financial support.

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