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Production of Broccoli on No-Tillage and Surrounding Range

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Abstract

The broccoli (bráassic oleracea var. ittheLica) is a kind of great consumer demand and attractive price to producers in Mato Grosso. The present Work had as objective to develop a cultivation system using no-tillage and surrounding range, aiming to improve the production of broccoli. The experiment was conducted open Field and between the period of17/07/2016 to 31/12/2016.In the plots were evaluated the presence and absence of the surrounding range with Sorghum broom (sorghum vulgare) and in the subplots were evaluated four soil covers on no-tillage of Millet (pennisetum Glaujizz), sorghum (sorghum bicolor), Crow's foot grass (elusive indica), fallow (spontaneous species) and conventional cultivation with soil revolting. The parameters evaluated were fresh mass of leaves, stem and inflorescence (production - kg Plant^{-1}), inflorescence and stem diameter at inflorescence insertion (cm), number of leaves and visual aspect index of Inflorescences. The type of soil cover did not influence any of the evaluated parameters. The use of the surrounding range provided better results for fresh stem mass, inflorescence diameter and fresh inflorescence mass.

Keywords: Brassica oleracea var; ItalicsL; Tropical horticulture; Ground cover; Cultural practices

Introduction

Broccoli (Brassica oleracea L. var. italics) is a species that awakens cultivation interest to the olericultures of the state of Mato Grosso, mainly due to its high market price in the state Seabra, et al. This species despite being originated from the Mediterranean, being, therefore, adapted to mild climate conditions, in Brazil is being cultivated in tropical climate regions, presenting good performance Production (Seabra et al. Antunes et al. [1]. This confirmation was ACCABY Lalla et al. [2], Seabra et al. [3] and Seabra et al. Antunes et al. [1] you emphasize that in Regions tropical crops, genotypes should be cultivated that present thermotolerance, aiming at obtaining quality inflorescence for the market. A problem faced in the cultivation of vegetables is soil management, which due to intensive conventional tillage, revolting with plow, grid and enchantment, cause environmental damage and Mainly soil loss due to erosion, as well as degradation of organic matter and reduction of fertility.

Conservation practices such as minimum cultivation and no-tillage have been studied in order to improve the chemical and physical properties of soil, cycle Nutrients, break cycle of pests and Diseases, Consequently decreases the breakdown of soil particles, contributing to the increase and maintenance of porosity, conservation of moisture and reduce the temperature of Soil, factors that can provide better conditions for the plant to express the productive performance. The use of roofing plants has influenced the productivity of vegetables due to contributions in soil quality, mainly by chemical and biological processes Pereira [3-4] Rossi [4], and due TO weed suppression Gomes [5]. In Mato Grosso, research on no-tillage has significantly influenced the productivity and quality of B-rocolis and Face, presenting promising results, compared to the system Conventional, mainly when cultivated on the cover of species such as grasses Nespoli & Silva [6,7].

Another factor influencing the production of vegetables in the and Stood is the incidence of pest's rotundas of monoculture soybean and maize Vargas [8,9]. In this way, employment of FAI surrounding Basin the cultivation environment has the ability to Reduction Zir Pest Infestation and Increase the presence of natural enemies, and this brings advantages such as increased productivity, quality of Crops and reduction of the use of pesticides, producing more food Health and decreased cost of Production PICI [10,11]. The adoption of agronomic practices, which aim at a more sustainable cultivation environment, such as crop rotation, consortia, no-tillage or minimum cultivation, green fertilizers and the use of a surrounding range (plant barrier), Has the ability to promote the balance between insect pests and natural enemies, by providing the development of a more complex agroecosystems with a FUNCTIONAL biodiversity Michereff Filho [12]. The present Work had as objective to develop a cultivation system using no-

tillage and surrounding range, aiming to improve the production of broccoli.

Material and Methods

The experiment was carried out in Nova Mutuum-MT, in the experimental area of the Campus of the State University of Mato Grosso -Unmeet, which is located in the south latitude 13, 05 ' 04 "and longitude West 56 º 05 ' 16". The soil is classified as Oxazole dystrophic yellow red EMBRAPA, (2013). The climate is of the type Aw (Koppel), tropical, with rainfall concentrated in the summer (October to April). The average annual rainfall is 1900 mm and the average temperature is 26 °C Nogueira [13]. During the experiment, the average daily thermal amplitude was 12.64 ºC, and the temperature averages were 32.9, 20.2, 26.5 °c, for maximum, minimum and mean, respectively (Figure 1).

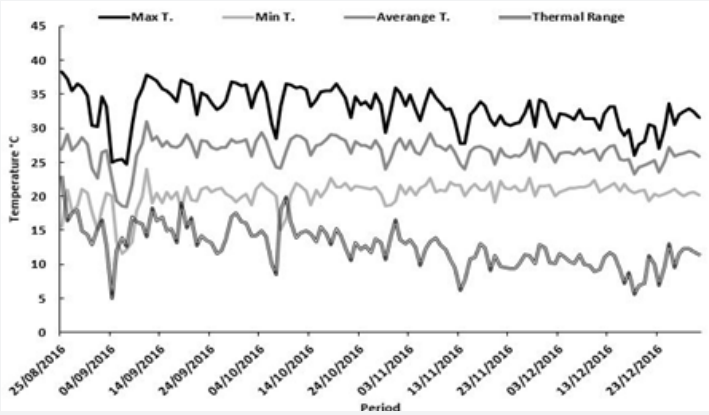

Figure 1: Maximum, average, minimum temperatures and thermal amplitude of the air during the conduction of the experiment.

The experiment was carried out with Salinas Hybrid Broccoli® from Sakata and the treatments were arranged in split-plots in randomized blocks with four replications. In the plots were evaluated the presence and absence of the surrounding range with Sorghum broom (sorghum scoparium cavadas) and in the subplots were evaluated four soil covers on no-tillage of millet (Pennisetum glaujizz L. B. R.), sorghum (sorghum bicolor L. Moenc), Crow's-foot grass (eleusine indica L. Gaertn.), fallow (spontaneous species), and conventional tillage with soil tillage. During the experiment, the average relative humidity was 73.34% and the accumulated precipitation in the period was 1189mm (Figure 2).

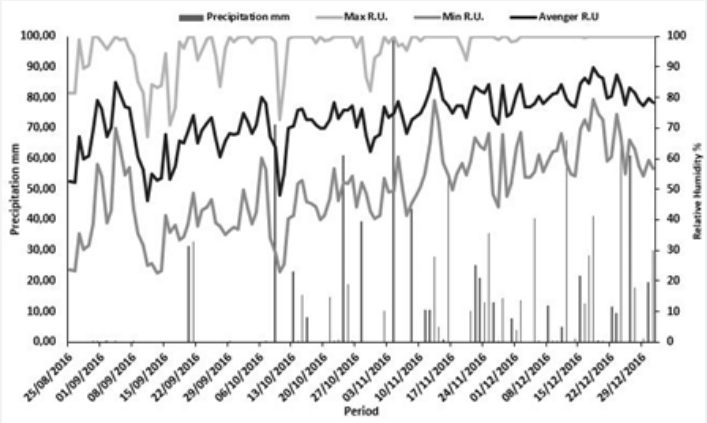

Figure 2: Maximum, average and minimum air precipitation and relative humidity during the conduction of the experiment.

Each parcel unit consisted of 2.7 x 3.0m, being conducted in two beds in the dimensions of 1.2 x 3.0m. The seeding of the cover species was performed at 88 days before the broccoli transplantation, and sowing in spaced lines of 0.30m, using 40kg ha-1seed for Millet CV. Adr 300, 30kg ha-1for sorghum CV. ADV 200 and 20kg ha-1for the chicken foot grass cv. ANPG 207. The cutting of the species used for soil cover was performed on Day 05/10/2016, totaling a CYCLE of 82 Days After Sowing (DAS). The surrounding range was sown on the same day of implantation of the species of soil coverings, which was implanted in 15/07/2016 and had three cultivation lines in the spacing of 0.50 m between line, with a population of 5 plants m^{-1} and surrounded , the parcel, with distance of 5 m of the parcel without surrounding range. The soil presented the following physical characteristics S (0-20cm): Sand 82.5%, silt 3.7%, clay 13.8%, and chemical: PH (CACL2) = 6.9; H + Al = 1.2 Comic DM-3; Al = 0.0 cmolc DM-3; Mg = 1.0

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cmolc DM-3; Ca = 3.8 Cmolc DM-3; K = 0.04 cmolc DM-3; P = 99.7 mg DM-3; CTC = 6.0 Cmolc DM-3; V = 80%; MO = 15.0 g DM-3. The planting mineral fertilization was performed by applying the doses of Thirty of them Kg ha-1of N, four of them 00Kg $ha^{-1}$of P_2 in the The Five of them and48Kg $ha^{-1}$from K_2 in the O, using as a source the urea(44% N), potassium chloride(58% K_2O)and Simple superphosphate(18% P_2O_5),the fertilization was performed aiming at a productivity of 30 T ha^{-1}, Second Ribeiro [14].

The Semirural of broccoli cultivar Salinas was carried out in 25/08/2016, in plastic cups of 300 milliliters filled with commercial substrate Vivato® and were maintained in Nursery seedlings until they reach the appropriate size to be conducted in the openfield. The transplant of the seedlings was performed on day 11/10/2016 when they reached3 to 5 definitive leaves, with about 47 Das. The plants were transplanted in double spacing of 0.8 m between double lines, 0.5 meters between lines and 0.5 m between plants, totaling 30,769 plants ha^{-1}. The pit where the seedlings form packed, possessed Dimensions of approx. 25 cm deep and 15 cm in diameter. The irrigation used after Transplant was sprinkling with Santino -type hoses installed in between lines, with an approximate distance of 2.5 m between the hoses. Soil moisture was controlled through the use of metal acoumeter tensiometers to maintain soil tension at 15 kPa at 0.2 m depth Tangune [15]. For the cover fertilization, 120kg ha^{-1} of N and 192kg ha-1 of K_2 were used, using urea (44% n) and potassium chloride (58% K_2O) respectively, divided into seven times throughout the cycle (8, 15, 24, 35, 43, 54 AND 62 days after transplantation - DAT). Foliar fertilization was also performed with b-acid (17% B) and ammonium molybdate (54% Mo) at concentrations of 1g l^{-1} and 0.5g L^{-1}, respectively, applied at 15, 30 and 45 DAT Ribeiro et al. [14]. The following parameters were evaluated: fresh mass of leaves, stem and inflorescence (production, kg plan t-1), inflorescence and stem diameter in inflorescence insertion (cm), number of leaves and visual aspect index of Inflorescences Seabra. During the experiment, the rainfall data, air temperature and relative humidity were measured daily with the assistance of the Campbell Scientific automatic Meteorological station, which is equipped with rain gauge CS 700 pluviometer, and is located 10 meters from the experimental unit. The collected data were stored in the internal memory of the equipment DATALOGGER model CR1000. In order to provide a better understanding of the data presented, as well as to sharpen the comprehension under the adaptability of the hybrid studied under tropical climate conditions, Pearson 's correlation was applied to the data of Massa Fresca calls, Diametric of inflorescence and Massa Fresca of inflorescence, for Better understanding of the aspects affecting plant development. The harvest of Broccoli began on the day 16/12/2016, extending until the day 31/12/2016, comprising a harvest period of 15 days. In Order to combat pests in culture, insecticides were used recommended for the same. For data analysis, they were subjected to analysis of variance (F test) and the averages compared by Tukey test at 5% probability, using the program (software) Assistat Silva; Azevedo.

Results and Discussion

Despite the occurrence of elevated temperatures in the cultivation environment (Figure 1), there was inflorescence emission in most plants. These temperatures (Figure 1) are much higher than those indicated as ideal for the species, according to Trevisan [16], the ideal average temperature for the development of broccoli is from 15 to 18 °c with a maximum of 24 °C, according to schiavon [17], the Plant growth is paralated with temperatures above 28 °C. However, the genetic improvement of broccoli has obtained genotypes with higher thermotolerance as evidenced by the results of Schiavon & Melo [17,18], Lalla [2], Seabra & Antunes [1]. This fact has enabled production in tropical conditions at different times of the year. The incidence of prolonged periods of temperatures higher than 25 °c may interfere with the incidence of flowering, the development of inflorescence, inflorescence size, quality parameters as the occurrence of Hollow stalk, bracts in the inflorescence, can also increase the productive cycle and the incidence of diseases Trevisan [16]. However, Seabra. Obtained good productivity indices even under high temperature conditions, with averages varying from 19.2 to 33. 4, considered high for the crop. Antunes [1] who obtained satisfactory indices of productivity in high temperature conditions, with Misdays from 21.25 to 38.67 °c for Maximum and minimum respectively, with Cultivation in a protected environment. The soil cover species did not provide significant differences for all the variables analyzed, but the surrounding ranges provided better performance for the parameter Massa F Resca do caule (Table 1). The type of soil cover did not provide significant statistical difference for the parameters; Fresh Pasta Total (MFT), Fresh Stem Mass – MFC, Fresh Leaf Mass (MFF), Plant Diameter (DP), Number of Leaves (NF)and Plant height - (AP). Plants cultivated under the effect of the surrounding range were more, but these tendencies were not observed for the other parameters (Table 2). Means followed by the same letter in the column do not differ from each other by the Tukey test ($P<0.05$). The production (G $plant^{-1}$) obtained was inferior to the results found by Cecílio [18] who developed Their study in Itatiba-SP from March to July, and obtained average productivity between 430.08 and 706.56 G $plant^{-1}$; Lalla [2] cultivated IN a large-MS field between June and September obtained mean values of 99.2 to 568.7 G $plant^{-1}$; the author Seabra who develops Ram His research in Cáceres – MT in the period from June to September, reached averages of 150 to 964 G $plant^{-1}$. In relation to the inflorescence diameter (DI), there was statistical differentiation between the treatments with the presence and absence of the surrounding range in the cultivation environment, with which the environment with the surrounding range was superior. Recent studies conducted by Lalla. [2], Seabra & Schiavon [17], obtained higher results in the inflorescence diameter. The highest results may be related to the conditions of culture development. In cauliflower, another Brassica, with similar behavior to broccoli, Zanuzo [19]. Verified a positive correlation of the inflorescence diameter with stem diameter, leaf area, biomass and fresh weight.

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Table 1: Total fresh mass – MFT (Plant-1g), fresh stem mass -MFC (Plant-1g), fresh leaf mass-Mff (Plant G-1),Plant diameter - DP(cm),Number of sheets (NF),and Plant Height-AP (cm)Dendrocoelids in function The surrounding range of sorghum and of different Coverages of soil. UNEMAT, Nova Mutuum-MT, 2017.

	Treatments	MFT	MFC	MFF	DP	NF	AP
Surrounding Range	Without	1601,98 a	346,21 b	657,74 a	67,98 a	40,27 a	62,57 a
	With	1558,98 a	420,29 a	821,83 a	76,64 a	39,87 a	66,80 a
	CV (%)	59,21	11,81	27,19	12,59	6,15	7,01
Soil cover	Millet	1411,78 a	399,67 a	762,09 a	75,73 a	39,67 a	66,01 a
	Sorghum	1378,14 a	378,52 a	709,16 a	72,15 a	40,63 a	64,38 a
	Grass	1439,21 a	401,03 a	734,91 a	72,42 a	38,57 a	64,43 a
	Fallow	2243,89 a	383,91 a	769,50 a	71,76 a	40,10 a	64,73 a
	Without	1429,38 a	353,13 a	723,27 a	69,47 a	41,37 a	63,88 a
	CV (%)	65,83	17,29	19,91	8,14	10,53	8,05

Table 2: Production of inflorescence (g Plant^{-1}), diameter of inflorescence-DI (cm), Visual aspect Index (IAV) of the cultivar of broccoli type single head Salinas in Function of the surrounding range of sorghum and different soil cover. UNEMAT, Nova Mutum – MT, 2017.

	Treatments	Production	DI	IAV
Surrounding range	No embroideries	261.12 b	13.21 b	2.82 A
	Surrounding range	350.77 A	15.16 A	2.82 A
	CV (%)	23.79	5.28	22.68
Soil cover	Millet	330.98 A	14.78 A	2.68 A
	Sorghum	299.77 A	14.33 A	2.38 A
	Grass	312.73 A	14.47 A	2.76 A
	Fallow	302, 04 to	13.34 A	3.09 A
	Without	282.22 A	14.00 A	3.22 A
	CV (%)	20.6	11.86	23.23

The Visual Aspect Index (IAV) is considered an important parameter for assessing the quality of broccoli inflorescence, as it is directly related to the acceptance of consumers to the product when commercialized Seabra et al. Not There was a significant difference between the treatments used for this parameter, where the cultivar Salinas presented acceptable indexes of visual appearance of the inflorescence, even in adverse conditions of cultivation, among them the incidence of high Temperatures and precipitation according to Figures 1 & 2. The production performance of the hybrid reached productivity values lower than the minimum achieved by Cecílio [18] who developed his STUDY in Itatiba-SP and demonstrated a promising production when compared to the Authors Lalla [2] who implanted their study in Campo Grande-MS and Seabra who carried out their experiment in Cáceres-MT, this demonstrates the production capacity of the hybrid in high Temperatures, through its Thermotolerant CIA characteristic.

Table 3: Pearson correlation for fresh stem mass (MFC), inflorescence diameter (DI) and fresh Mass Of Inflorescence (MFI). Unemat, Nova Mutum-MT, 2017.

TREATMENTS	MFCXDI	R	MFIXDI	R
No embroidery	0.4466*	Moderate	0.5961*	Moderate
Surrounding range	0.6145*	Moderate	0.5513*	Moderate

The mean crop cycle was 128 Days After Sowing (DAS), requiring 113 days for inflorescence emission. These data are of great importance as to the knowledge of the culture and its responses to the adverse conditions, and thus improve the applicability of its cultivation in the production systems. Andstudo de farnham and Bjorkman [20], demonstrates that the abiotic stresses suffered by culture directly affect their cycle and productivity. Although no difference was observed for most of the parameters studied, it was observed that the treatment surrounding range was better than the without surround in some aspects, being directly related to productivity, making it a good Alternative in the production of single inflorescence broccoli in unfavorable periods of cultivation. In regions with tropical climate, it is remarkably common to observe that during the process of adaptability of the studied materials there is an increase in the number of leaves and, consequently, of the leaf area Zanuzo [19]; Da Penha Ribeiro [21]. This physiological response of the plant is interpreted as compensation and/or advantage of the photosynthetic adaptation apparatus to maintain or establish the fresh weight of the inflorescence. Pearson's correlation was applied on the data of Massa Fresca of the Caules, DIâmetro of the Inflorescence and Massa fresca inflorescence, with the purpose of presenting the existence of a correlation between these three variables, and can be presented as a characteristic of adaptability of the crop to the conditions of cultivation which were submitted (Table 3).

Through the analysis of the correlation of the parameters presented above, a moderate correlation was obtained for the hybrid in all aspects analyzed. In the study developed by

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Brandeleroi [8], carried out in the CITY of Pato Branco-PR, in a dystrophic red latosol and climate considered as humid subtropical, it was At the Pearson correlation to analyze the data, and observed that the highest linear correlation was obtained between the head mass and the canopy of the part area D The plant, showing this way the Relation of the production of inflorescence with the number of leaves and leaf area of the plant. Given the above , it can be concluded that the surrounding range provided greater fresh mass of the inflorescence, possibly resulting from the action of the surrounding range As for the possible reduction of insect pest population in the cultivation environment, this fact is described by the author Medeiros et al. (2010). Zanuzo [19] verified the positive correlation of the diameter of the inflorescence with the stem diameter, leaf area, biomass of the disc and mass Fresca of cauliflower plants. In Cauliflower, another similar brassica in behavior to broccoli. During the conduction of the experiment, the incidence of elevated temperatures was observed, as shown by Figure 1. This factor was crucial for the decrease in the quality of the inflorescence. This aspect contributed positively to the authors ' assertionLalla [2] and Seabraet, who affirm that Temperature High S area limiting factor for production. The accumulated precipitation in the period was the main limiting factor of the production (Figure 2), with the decrease of productivity and quality of the inflorescence. The characteristics analyzed for harvesting in general can vary greatly according to the genetic material adopted in the study, as well as the climatic conditions found, and other factors considered uncontrollable. The data of this study present a great variation and discrepancy regarding the data found by other authors cited above, this is due to the climatic conditions observed throughout this research, where there was the occurrence of high temperatures Accompanied by the incidence of pests and diseases throughout the crop cycle, however it was possible to obtain acceptable and promising results considering the environmental conditions of cultivation [22-44].

Conclusion

The type of soil cover did not influence any of the evaluated parameters. The use of the surrounding range provided better productive performance in Broccoli. Despite the climatic conditions that did not favor the development of culture, the cultivar sendu inflorescence and end or cycle, thus showing that the material It has thermos tolerance for cultivation in the region.

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