Original Research Article

Evaluation of lettuce in consortium with carrot in agroecological production of Brazil

ABSTRACT – Agroecology is the science that establishes the basis for construction of sustainable farming styles. The consortium usually to stand out as alternative interesting for small for producers with structural and financial limitations, because it is an effective cropping system practiced long ago and found in all parts of the world, with greater diversity in the tropics. The experiment was conducted in between the months of August to November of 2012 in the municipality of Garanhuns-PE/Brazil. Had as objective to observe how the lettuce would behave in consortium with the carrot in an agroecological system of production. The parameters evaluated in the experiment were plant height, total weight of the plant, weight of leaves and number of leaves. The data obtained were submitted to a statistical comparison test between averages of the consortium and non-consortium beds, using Student's t-test at a significance level of 5%. It was observed that the consortium between lettuce and carrot presented a significant difference for most of the studied variables, negatively influencing its growth.

Keywords: Biodiversity, agroecology, agricultural systems.

1. INTRODUCTION

The lettuce (*Lactuca sativa* L.), is an herbaceous plant originating in Asia, preferred for the salads due to its pleasant and refreshing taste and ease of preparation, belongs to the Asteraceae family (FILGUEIRA, 2003).

The carrot (*Daucus carota* L.) is an oleracea introduced in Brazil, coming from Europe (France and the Netherlands) and Asia (Japan). It is cultivated, currently, besides the cultivars originating in the Nantes and Kuroda groups,

cultivars of the Brasilia group, obtained of older carrot populations, collected in the south of the country. These besides present good color and shape of root, are productive and adapted to the summer crop (VIEIRA et al., 1999).

Agroecology is the science that establishes the bases for the construction of sustainable agriculture (CAPORAL and COSTABEBER 2004; CAPORAL and AZEVEDO, 2011). It is presented as a disciplinary matrix integrative, so that one can understand and apply the knowledge of several disciplines. Generally, Agroecology is not only concerned with the ecologically responsible management of natural resources, but also with the social and ecological integration and its multiple interrelationships and mutual influences (CAPORAL and COSTABEBER, 2006). The consortium often stands out as an interesting alternative for small producers with structural and financial constraints, because it is a system of effective cultivation practiced long ago and found in all parts of the world, with greater diversity in the tropics (FRANCIS, 1978). This system is not associated with the use of high technology, nor with the achievement of high productivity (VIEIRA, 1989; TUBALDINI et al., 2009).

However for many researchers, is a primitive practice that should be replaced by monoculture as a natural consequence of the development of modern agriculture, known as conventional agriculture. The cultivation system consortium has been pointed out as a fundamental factor in the maintenance of small properties agricultural, being considered as a component of agricultural systems more sustainable (BALASUBRAMANIAN and SEKAYANGE, 1990).

The objective of the work was to observe how the lettuce would behave in consortium with the carrot in an agroecological system of production.

2. MATERIAL AND METHODS

The experiment was conducted between August and November 2012 in the municipality of Garanhuns-PE/Brazil, understood in coordinates 08º53'25 "S and 36º29'34"W, the 900 meters of average altitude and that presents average annual temperature of 20,4ºC.

The area was, previously, with a plant cover, which was incorporated into the soil during its preparation. The preparation of five beds, with the use of hoes

and tread for its dimensioning, leaving them with 4m of length by 1m wide and 20cm high. The preparation also included fertilization of foundation with manure and soil revolving with the aid of spades. It was not no chemical input was used in the experiment.

The experimental units (consortium and control) were distributed in the five beds, according to the following scheme: beds I, II and III - Growing Lettuce consorted with carrots; Beds IV and V growing single lettuce, control of experiment. The sowing of lettuce (*Lactuca sativa* L.) cultivate curly Cinderella occurred in indirect way, held in a greenhouse, seeded in trays with 200 cells, filling them with the Hortomix® substrate, being careful not to compress them. Three seeds were placed in each cell, to a depth of 1 cm. They were conditioned for a period of 21 days (from 02 September to 23 of the same month). The thinning was carried out still in the greenhouse, on the 16th of September, in order to select the most vigorous plants.

The planting of the carrot (*Daucus carota* L.) occurred on September 04, 2012, two days after sowing the lettuce, directly in the beds, to a maximum of 1 cm of depth. So he alternately planted the lettuce and the carrot. The arrangement of the plants in the bedside occurred with inferior and superior border of 5 cm and 10 cm of the lateral borders, with a spacing of 30 cm between rows and 25 cm between columns.

The transplanting of the lettuce was performed after presenting 3 to 4 leaves (day September 23, 2012), having the same spacing conditions in the consortium and non-consortium beds.

The beds were submitted to periodic maintenance, involving weeding manual repairs, edge repair due to erosion caused by irrigation, fertilization of cover with manure, manual harvesting of pests that attacked both crops (*Diabrotica speciosa* (kitty) and *Elasmopalpus lignosellus* (caterpillar-elasmo) and the carrots that were exposed to the surface with the soil were covered, avoiding exposure of the them in the sun.

Irrigation management was done manually, twice a day using watering cans during the course of the experiment; each plot received the volume of water corresponding to two watering cans (approximately 10 liters each) twice a day. In the vegetation house, each tray received enough water to reach the drainage point of the substrate.

At the end of the experiment, one of three consortium beds (bed III) was discarded to match the number of samples between the consorted beds and not consortium members. The lettuce samples were taken from each bed, discarding those of the edges, because they were the most exposed to the inclemency of the environment. Not evaluated the performance of the carrot, because there was no control (bed with single carrot) for comparisons.

Harvesting of lettuce and carrot was performed 58 days after sowing of lettuce, having its outlet directed to the local community (Academic Unit of Garanhuns).

The parameters evaluated in the experiment were plant height, total weight of plant, fresh weight of leaves and number of leaves. The data obtained were submitted to a statistical test of comparison between averages of the consortium and non-consortium beds, using Student's t-test at a significance level of 5%.

3. RESULTS AND DISCUSSION

~~Based on the parameters evaluated, can be observed in (table 1) the comparison of the means of the variables in question.~~ This is verified by the ~~t test of Student~~ who for plant height variable (AP) there was no significant difference between the C1 and C4 beds and between C1 and C5. However, there was a significant difference between the C2 and C4 beds and between C2 and C5. In relation to the total weight of the plants (PTP) it is noticed that there was no significant difference between the beds C1 and C4, but for the other comparisons, this difference is observed. For the leaf weight variable (PF) a significant difference was observed for the comparisons between C1 and C5, C2 and C4, and C2 and C5. Although C1 and C4 did not present significant difference. The number of leaves (NF) presented significant differences only for the comparison C1 and C5, being insignificant in the other comparisons. The number of leaves (NF) presented significant differences only for the comparison C1 and C5, being insignificant in the other comparisons.

~~**Tabela 1.** Analysis of the variables plant height (AP), total plant weight (PTP), leaf weight (PF) and number of leaves (NF).~~

Comparation	Test value T de student			
	AP	PTP	PF	NF
C1 e C4	1.00 NS	1.75 NS	1.46 NS	1.59 NS
C1 e C5	0.40 NS	3.20*	4.27*	3.66*
C2 e C4	3.15*	5.30*	3.12*	0.12 NS
C2 e C5	2.17*	7.60*	8.09*	1.16 NS

Table 1. Comparison between Consortium and Non-consortium plant Parameters

Parameters	C1	C4	T-value	C1	C5	T-value	C2	C4	T-value	C2	C5	T-value
	Mean±SE			Mean±SE			Mean±SE			Mean±SE		
AP plant height	±	±	1.00 NS	±	±	1.75 NS	±	±	1.46 NS	±	±	1.59 NS
Total plant weight	±	±	0.40 NS	±	±	3.20*	±	±	4.27*	±	±	3.66*
Leaf weight	±	±	3.15*	±	±	5.30*	±	±	3.12*	±	±	0.12 NS
Number of leaves	±	±	2.17*	±	±	7.60*	±	±	8.09*	±	±	1.16 NS

C1 * C2 - consorted flowerbeds; C4 * C5 - Non-consortium beds;
*=Significant; NS not significant (at the 5% level of probability)

In Figure 1A, it is observed that single crop (monoculture), in beds 4 and 5, show higher growth in relation to plant height, with averages of 27.69 and 27.38 cm, respectively, while the second showed the lowest height, with a mean of 25.63 cm.

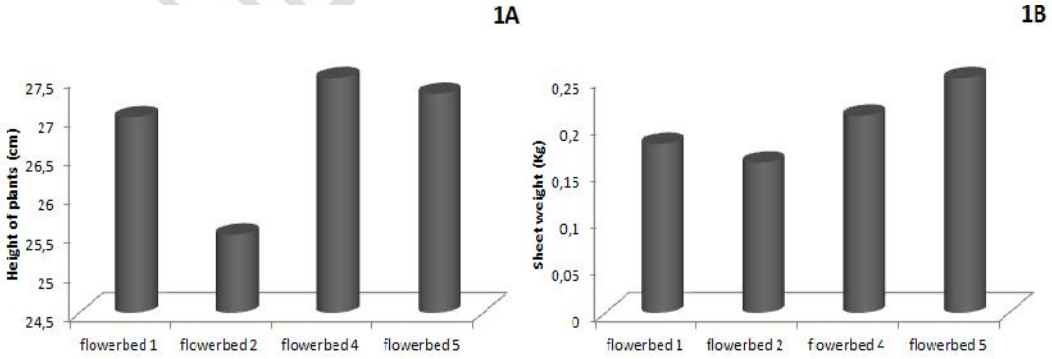

Figure 1. Mean values of lettuce plants submitted to intercropped and non-intercropped treatments
(A) Plant height (cm) (B) Leaf weight

In Figure 1B and 2A, it was observed that the single layer cultivar 5 (lettuce single crop) was the one that obtained the highest yield with respect to the weight of the leaves and the total weight of the plants, with respective averages of 0.25 and 0.41 kg. The plat 2 was the one that obtained a smaller weight of the leaves and a smaller total weight of the plants, with averages of 0.16 and 0.26 kg.

In figure 2B, it is observed that for the number of leaves, the values of the means between the beds were more uniform than those observed for the other variables. The greatest differences were between beds 1 and 5, presenting averages 18 and 22 leaves, respectively. The beds that exhibited a greater biodiversity (1 and 2) obtained the lowest yields for the evaluated parameters. The beds that exhibited a greater biodiversity (1 and 2) obtained the lowest yields for the evaluated parameters. The data found in the Figures 1 and 2 contradict Caporal (2006), which demonstrates that a greater biodiversity increases the amount of natural enemies of pests, thus taking a biological control.

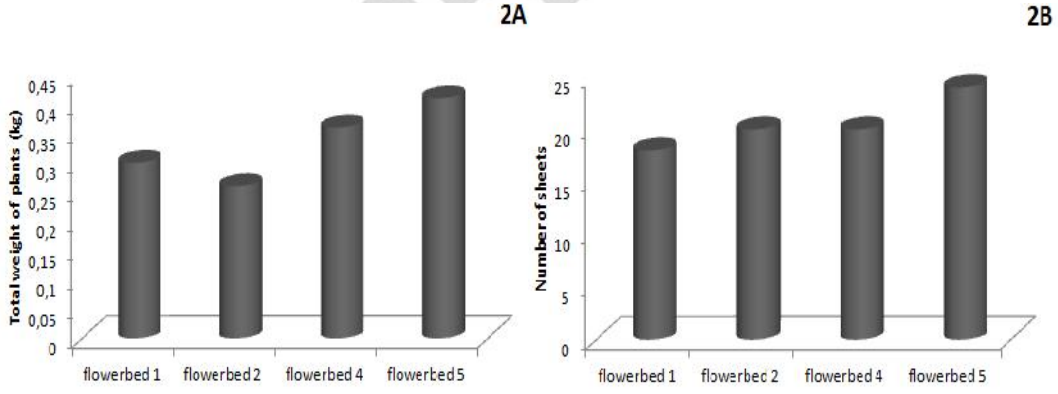

Figure 2. Mean values of lettuce plants submitted to intercropped and non-intercropped treatments
(A) Mean values of total weight (B) Mean values of Leaf number

4. CONCLUSIONS

Based on the comparative statistical test between means, Student t-Test, it was observed that the consortium between lettuce and carrot presented a

significant difference for large part of the studied variables, negatively influencing its growth.

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