Full Length Research Paper

Influence of *Jatropha curcas* L. plants on the development of *Lactuca sativa* L. in market gardening

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Received 04 May 2020; Accepted 12 June 2020

Abstract. Climate change would have an impact on vegetable crops, especially lettuce (*Lactuca sativa* L.) which is consumed generally raw with salad. The present study aimed to investigate the effects of *Jatropha curcas* L. on the survival and growth of *Lactuca sativa* L. plants. Only one factor, *Jatropha curcas* L. cuttings, was studied. The results showed a significant effect of the factor on the survival rate ($p < 0.5$). The test named Student revealed that the plots associated with *Jatropha* was recorded a better survival rate (66.670%) than that of the control plots (46.800%). However, JCL did not improve leaf growth (length and width). The measured characteristics of JCL, particularly the height and the number of leaves, recorded low values attesting to a less efficient agronomic dynamic. These results suggest that the *Jatropha*-*Lactuca* combination has raised survival rates and would have increased lettuce growth if JCL were well developed.

Keywords: *Lactuca sativa* L., *Jatropha curcas* L., cutting.

1. INTRODUCTION

Climate changes affect measurable meteorological quantities (temperature, humidity, pressure, precipitation, etc.). The Exposure to climatic variations is first of all a governmental issue, means, geographic locality, for example, communities living along the coasts will be more exposed to sea level rise and cyclones while those living in semi-arid areas will be more exposed to drought (THIAW, 2018). Climate change is currently affecting agriculture, in particular market gardening (cultivation of *Lactuca sativa* L.) by lower yields, the appearance of new diseases and a strong proliferation of pests.

Cultivated lettuce (*Lactuca sativa* L.) is a herbaceous plant that belongs to the genus *Lactuca*, of the Asteraceae family, widely cultivated for its tender leaves and eaten as a vegetable, generally raw with salad. The origin of cultivated lettuce is uncertain. The following questions arise: is it a descendant of the wild form *Lactuca serriola* or a half-sister of *L. serriola*? (Kesseli et al., 1991) have shown that *L. sativa* is closely related to *L. serriola*. Its ancestor is probably thorny wild lettuce (*Lactuca serriola* L.), which crosses easily with cultivated forms.

This species has a certain requirement which, according to Grubben (2015), lives better at moderate daytime temperatures of 15-25 °C and cool of 10-15 °C. It is grown on any type of soil with good structure and good fertility. Water holding capacity is important because lettuce has a relatively small root system. This makes the plant vulnerable to drought.

Thus, in order to increase their yield, farmers generally use fertilizers to fertilize the soil. Senegalese agriculture (all forms combined) consumed on average, for the 2014/2015 agricultural campaign, 48,000 tonnes of NKP15 and 34,000 tonnes of urea (ANSD, 2017). In addition to fertilizer, pesticides are also applied to cultivars revealed by PAN (2006) which states that the quantities used in the market gardening sector are in the range of 225,000 to 250,000 liters and 200 to 250 tonnes of powders and granules. In all conditions, nitrogen fertilizer remains the most used, probably because of its instantaneous and remarkable effect on crops (FAO, 2005). Green fertilizer influences

the content and activity of soil microorganisms and can also be a boundary against certain diseases (Thorup-Kristensen et al., 2003). But the works of Navarrete et al. (2010) have shown that the introduction of green manure in the rotation can also have harmful effects: tendency to increase epidemics of *Sclerotinia* and increasing risks of leaching of nitrates during the rapid mineralization of some buried residues

In the same way, Assigbetse and Ndour (2019) have shown that the culture of *Jatropha curcas* L. (JCL), in the three pedoclimatic zones (Bambey, Nioro, Missirah of Senegal) studied did not have any harmful effects on soil quality indicators. They go on to say that by squeezing the JCL cakes used as an organic amendment improved certain soil properties plus the agromorphological parameters of the corn.

In addition to its use as organic fertilizer, Barro (2016) adds that *Jatropha* has a repelling effect on several species such as stray animals and also used for the delimitation of land in Senegal (Barro, 2016). The integration of *Jatropha curcas* L. (JCL) in vegetable crops (salad) could have an influence on biodiversity on the one hand by analogy to the results of Tschardt et al. (2008) and, on the other hand, increase soil fertility.

Thus, the general objective of our study was to know the influence of JCL plants on the development of *Lactuca sativa* L. in market gardening. This brings us specifically to characterize the development of JCL plants and *Lactuca sativa* L. or salad first, and then study the interaction of this association.

2. MATERIALS AND METHODS

2.1. Study setting

The experiment was carried out in the commune of Mbar which is located to the north-east of the Fatick region (Senegal), more precisely in the arrondissement of Colobane (department of Gossas). This area is influenced by the Sahelo-Sudanian climate with daytime temperatures varying between 28 ° and 35 ° from November to February and from 35 ° to 45 ° between March and July. The hours of sunshine vary between 10 and 14 hours depending on the season. The village of Mbar is located between 500 and 600 mm isohyets, with an average rainfall around 450 mm. Rainfall occurs in late June until early October. The rainfall distribution is generally well done over time. September is the rainiest month.

The village of Mbar has a generally flat relief. In terms of soil science, the soils are predominantly dior. They support the cultivation of grounds nut, millet, Sunna.

2.2. Plant Materials

The plant equipment came from a local collection of two species including *J. curcas* and *Lactuca sativa* L. (salad). *Jatropha*'s mother plants are 26 months old. The cuttings were taken from secondary branches and are 30 cm long while the salad seeds were bought at the local market.

2.3. Implementation and experimental set-up

The test was done on 10/11/2018 in the garden of the Catholic mission in the municipality of Mbar. Elementary plots of 3.30 m in length and 1 m in width were delimited and plowed using pikes at a depth of 10 cm. On the same date, the 30 cm long cuttings were installed all around the plots with an equidistance of 30 cm. A sprinkling of 16l / plot / *Jatropha* plants, twice a week, with the rainwater collected, was carried out until the salad was transplanted. At the same time, salad nurseries were set up next to the elementary plots and watered with the same water in January 2019. On the date of 11/02/2019 (27 days), the transplanting of the salad was carried out in the elementary plots with a spacing of 18 cm between the feet followed at the same time a watering of 16l / day / plot.

The cuttings factor of *Jatropha curcas* L. with two levels "plot delimited with JCL" and "control plot" was the only one studied in this trial including two treatments with three repetitions making 6 experimental units. The variables were observed 17 days after the transplantation.

- On the scale of the basic plot, the survival rate of the salad plants was determined;
- On the scale of each individual, it was determined, for the plants of *Jatropha curcas* L., the height, the diameter at the collar of the main stem (DCT) and the number of leaves (N leaves).
- Similarly, for salad individuals, the width in the middle of the leaf (D2) and the length of the leaf (D1) from its insertion point were measured.

2.4. Statistical analyzes

The collected data were entered into Excel. Then, the Xlstat 2015 software was used to perform an analysis of variance in order to detect the existence or not of differences between the treatments, followed by the test of comparison of Student means, in case of significant differences, to identify the different treatments.

3. RESULTS

Analysis of the table below shows a significant effect of *Jatropha curcas* L. plants (JCL) on the survival rate (p-value <0.0001) of salad plants. The plots in association with Jatropha have a better survival rate than the control plot. However, Jatropha has no significant effect on the width (D2) of the leaves (p-value = 0.203) and the length (D1) of the leaves (p-value = 0.613) of salad.

Table 1. Effect of *Jatropha curcas* L. plants on the survival rate and growth of salad leaves.

Variable	Observations	Obs. avec missing data	Minimum	Maximum	Average	Standard deviation	p-value
Tx survival P	10	0	66,000	67,340	66,670 %	0,447	< 0,0001
Tx survival pt	10	0	46,000	47,600	46,800%	0,533	
D2P	10	0	6,3000	9,000	7,494	0,815	0,203
D2Pt	10	0	6,750	9,900	8,015	0,945	
D1P	10	0	9,000	11,730	10,075	0,909	0,613
D1Pt	10	0	5,200	13,500	10,475	2,280	

* Significant at the 0.05 threshold.

P = plot delimited with cuttings, Pt = control plot, width (D2), length (D1)

Figure 1. Principal component analysis (PCA) performed on nine variables (Tx survival P = survival rate in the plots delimited by Jatropha; D2 = width and D1 = length of salad leaves; N leaves = number of leaves, Height and DCT = diameter at the collar of the main stem of Jatropha plants) P = plots delimited by Jatropha and Pt = Control.

The two axes of the parameter APC explain 59.81% of the variability of the data (F1 = 34.04%; F2 = 25.04%). Axis F2 contrasts the survival rate of the salad in the elementary plots delimited with the length and the width of the salad leaves of the control plots. These variables are strongly correlated with the F2 axis (respectively tx survival P = 66.4%; D2Pt = 85.8%; D1Pt = 78.9%). The same trend is observed in the F1 axis grouping on the one

hand the length and width of the salad leaves in the demarcated elementary plots (D2P & D1P) and, on the other hand, the survival rate of the salad in control plots (Tx survival Pt), height and diameter at the collar of the main stem (DCT) of *Jatropha curcas* L plants. A strong correlation is also observed between the F1 axis and the five variables (D2P = 62, 2%; D1P = 73.7%; Height 81.8%; Tx survival Pt 69%; DCT 76%).

Student's test reveals significant differences in the survival rate (Fig. 3). It attests to a better survival rate (66.670%) of the salad in the elementary plots with association of *Jatropha* compared to that (46.800%) of the controls. On the other hand, Figure 2 records non-significant differences (p-value = 0.203) in the width of the salad leaves, respectively plot (P) with association of *Jatropha* and control (Pt) (D2P = 7.494 cm and D2Pt = 8.015 cm). These measurements are slightly better in the witnesses than in the plots with association. The same trend is observed in the length (p-value = 0.613) of the leaves (D1) with a non-significant difference. However, the control plots (10.475 cm) recorded values slightly higher than those with *Jatropha* (10.075 cm).

Figure 2. Effect of *Jatropha curcas* plants on salad leaf growth

Figure 3. Effect of *Jatropha curcas* L plants on salad survival

4. DISCUSSION

The survival rate of *Lactuca sativa* L. varied significantly under the influence of the plants of *Jatropha curcas* L. (Grubben 2015) and states that a harvest of 70% or more of the number of plants transplanted at the origin can be considered a satisfactory result. Thus, *Jatropha* improved the survival of the salad legs and, consequently, its yield. These results corroborate with those of the works of Bachirou et al. (2009) who showed that the combination of maize and *Jatropha* significantly resulted in a high ear yield and therefore a significant survival rate.

However, the width and length of the salad leaves did not show a significant difference under the effect of the JCL plants. These results are similar to those of the study by Bachirou et al. (2009) who showed that *J. curcas* has

no influence on the number of leaves and the height of the maize plants in combination (*Jatropha* system + maize). Similarly, the results obtained by Tchobsala et al. (2009) and Bazongo (2011) have shown that the feet of *Jatropha* less than 2 years old have little influence on leaf biomass, the height and the yield of certain associated crops (cowpea, sorghum). These statements confirm our results of which the effect of *Jatropha* is not significant on the growth of the leaves (length and width) of the salad. In the same vein, Gorgon et al. (2016) have shown that the association with *J. curcas* has no significant effect on the different corn growth parameters, but with regard to the weight of the ears a variability is observed depending on the cropping system. From their results, they manage to explain that the feet of two-year-old *J. curcas* have not yet developed a significant extension of the root system and significant shade to cause competition between the two species present. This confirms our results showing a non-significant variability in the width and length of the salad between the associated plots and the controls.

The measured characteristics of JCL, in particular the height and the number of leaves, recorded low values attesting to a less efficient agronomic dynamic. The FAO (2009) shows that a good agronomic exploit of *Jatropha* increases yields thanks to its nitrogen fixing capacity (3 times richer in nitrogen than animal manure) accumulated in its leaves and in its seeds (symbiotic bacteria at level of its root system). The poor development of JCL plants in the mission garden justifies the lack of impact on the growth of the salad.

5. CONCLUSION

In short, the test conducted in the garden of the Catholic mission in the commune of Mbar allowed us to confirm that *Jatropha curcas* L. can be introduced into market gardening. In fact, this study has shown an improvement in the survival rate of the salad under the impact of *Jatropha*. On the other hand, the association (*Jatropha*-Salad) did not improve the growth of *Lactuca sativa* L. Many authors agree that *Jatropha* could only have an impact on intercropping if it is older than two years old and well developed, while the *Jatropha* plants in this trial are 3 months old and have less leaf growth. The continuation of the study would make it possible to better respond to strong issues in terms of an alternative to the use of pesticides and biological control with *Jatropha curcas* L. in the face of reinforced environmental problems (climate change).

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