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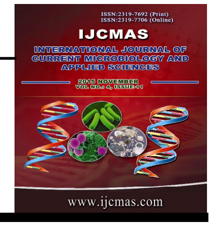

Original Research Article

Effect of the Combination of the Layout and the Cutting Level of *Moringa oleifera* Lam Plants on the Yield in Apple of *Brassica oleracea* L (Cabbage, Variety Oxylus)

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A B S T R A C T

Keywords

Effect, *Moringa oleifera*, *Brassica oleracea*, Layout, Cutting level, Yield

The effect of the combination of factors layout and cutting levels of plant of *M. oleifera* on *Brassica oleracea* (cabbage) yields was studied. These factors contain respectively three and two levels. Each level of the first factor was combined with each of the two levels of the second giving six (6) treatments A1B1, A1B2, A2B1, A2B2, A3B1 and A3B2. Also, to compare the results with a baseline, a control treatment (T) where the cabbage is sown in pure culture was used. The measured parameters are the weight and diameter of cabbage heads. The yield in terms of weight of cabbage per hectare was evaluated under different treatments. Statistical tests on the comparison of means showed that the yield by weight, the average weight and the average diameter are significantly different between treatments at the 5% threshold. The study also showed that there is a positive correlation between the weight, the size of the cabbage for treatment A1B1, A1B2, A3B1 and control treatment.

Introduction

For centuries, African farmers deliberately leave trees in their fields because of some of their properties, thus constituting real agroforestry systems with outstanding stability. Many scientific studies have shown the value given to this land use pattern (Anafe-Sahel Raft, 2006). According to Ong et al. (1991), the ecological interactions between trees and crops are beneficial because ligneous has an effect on soil fertility through the fixation of atmospheric nitrogen (N2) for legumes, organic matter production, recycling of nutrients from the soil by the leaves of trees; they also protect the soil against erosions (Wiersum, 1991) and therefore improve crop yields. In order to harmonize the tree-crop association and to benefit all segments, cultures are often practiced in tree alleys forming systems called intercropping systems. Studies conducted by Thevathasan and Gordon (1997) have shown that these systems can help to increase the returns of organic matter to the soil, compared to agricultural systems, through residues in aerial biomass of trees and decomposition in situ of their roots.

Similarly, humus from deciduous trees litters are often excellent quality and therefore can be managed as true fertilizers, which may induce reduction in inorganic fertilizers use. However, their incorporation in the soil requires implementation of specific technical routes (Baldy et al., 1993). Several studies have been conducted with the objective of evaluating the effect of the tree on the productivity of intercropping. However, as the tree-crop interface may have complementary effects, so it can present competitive effects (Jose et al., 2007). Jose et al. (2004) have shown that, under temperate climate, trees competition for water can become critical as to significantly reduce the productivity of intercropping.

Reynolds et al. (2007) and Rivest et al. (2009) showed that in Quebec and Ontario, the decrease in the yield of crops *Glycine max* (soybean) and *Zea mays* (maize) is assigned to the shade of nearby trees. Gbemavo et al. (2010) studied the influence of shading *Vitellaria paradoxa* (Shea) on the culture of *Gossypium herbaceum* (cotton). These authors found a significant difference between the mean number of plants / m² and the average number of branches per plant loaded capsules cotton which are lower in shea 24.07% and 27.26% respectively. Moreover, the number of capsules per cotton plant decreases 28.46% on average in crown shea. Addressing the same direction, Rivest et al. (2009) analyzed the effect of three hybrid poplar clones on different productivity parameters of *Glycine max* (soy) during two growing seasons. In drawing up a summary document of experiments companies for the acquisition of technical and economic references on the operation of agroforestry systems, Balandier (1999) did case of different forms of association studied in order to have a better understanding of the mechanisms used during the interaction between a tree and a culture, to model these interactions to determine the long-term evolution of the system and thus choose the most complementary species in these types of association.

Today the combination also concern fruit trees and vegetable crops. Thus, in Niger there is a introduction of increasingly growing trees like *Manguifera indica, Carica papaya, Cocos nucifera, Phoenix dactylifera, Psidium guajava, Citus limon, Citrus sinensis, Moringa oleifera in the* spaces devoted to crops vegetable.

However, few studies have been conducted as part of the assessment of the influence of fruit trees on the productivity of vegetable crops. That's why this study was to investigate the effect of some treatments on *M. oleifera* on *Brassica oleracea* (cabbage) apple yields. Indeed, before the installation of vegetable crops farmers practice cuts on the plants of *M. oleifera* at different levels. It is in this study to evaluate the effect of the combination of two factors namely the arrangement and plant cutting level of *M. oleifera* on apple cabbage yield. The results that will come from this study will help to make a proposal for a combination of the layout and the cutting level on the plants of *M. oleifera* in order to improve the yield of apple cabbage and subsequently yields of cultures associated with *M. oleifera*.

Material(s) and Methods

Study area

The trial was conducted on-farm in the municipality 5 of Niamey (Niger), located at the right bank of the Niger River. The climate is Sahelian with average rainfall 550mm / year and average temperatures fluctuating between 23°C and 37°C (INS, 2014). In the study area vegetable crops such as *Lycopersicon lycopersicum Solanum melongena*, *Brassica oleracea*, *Cucurbita moschata*, *Allium Cepa*, *Capsicum annuum, Cucumis sativus and Hibiscus sabdariffa* are associated with *M. oleifera*.

Experimental device

The study is to assess the effect of the layout and the plant cutting level of *M. oleifera* in *Brassica oleracea* L. yields (cabbage). The experimental design was a randomized complete block with two (2) factors (A and B).

The factor (A) includes three (3) levels and it's relative to the layout of *Moringa oleifera* plants with compared to cabbage: level 1 where the *M. oleifera* plants have a spacing of one meter between lines and between plants *M. oleifera* on line. For level 2, the plants of *M. oleifera* were associated with cabbage with a distance of one meter on the lines and two meters between rows of plants of *M. oleifera*. As for Level 3, the plants of *M. oleifera* hedges were arranged in two rows with a distance of one meter between the rows and rows of hedges and a spacing of two (2) meters between the hedges.

The factor (B) concerns the cutting level on the *M. oleifera* plants. This factor has two levels. For level 1, the plants of *M. oleifera* were cut to 0.5 m above the ground while for level 2, the plants of *M. oleifera* were cut at 1m from the floor. These cutting levels represent levels normally practiced by operators.

Each level of the factor (A) was combined with each of the two levels of the factor (B) giving six (6) treatments. Also, to compare the results with a reference situation a control treatment (T) in which the cabbage was transplanted in pure culture was established. In sum, seven (7) treatments each corresponding to an experimental unit of 200 m were used with five (5) replicates. Thus, the study included 35 experimental units.

Plant material and farm work

The plant material used consists of Oxylus variety of cabbage (*Brassica oleracea* L.) and *Moringa oleifera* Lam. Transplanting cabbage plants was performed when the *M. oleifera* plants had 14 months. These plants were cut the day before the cabbage installation. Six (6) feet of cabbage were planted per square meter. Irrigation was done at the request afternoons with a motor pump. Two inputs of mineral fertilizers were carried out: the first took place 20 days after transplanting in Di Ammonium Phosphate (DAP) and urea in the second when cabbage starts apple. Between the two mineral fertilizer applications, it was made a manure application at rate of a one bag containing 50 kg dry manure by experimental unit. The amount of fertilizer given by cabbage is 2g to the first application and 5g to the second. Before each application of fertilizer or manure, a hoeing all experimental units were conducted to ensure good soil aeration and better infiltration of water. The crop cycle of *B. oleracea* lasted four months from October 2014 to January 2015.

Data collection

All yield parameters measurements were performed on the plants of *Brassica oleracea* L. In each experimental unit, it was placed a small square of $1m^2$ containing six (6) feet headed cabbage in order to assess yield. To avoid the effect border and the interference between the experimental units, the plots were placed at the point of intersection of the diagonals of each experimental unit. At maturity, the cabbage plants were harvested and measures weight and two perpendicular diameters of the apple of each six feet contained in the plot were performed. Thus, the average weight and average diameter were evaluated by plot. The total harvest weight gives yield in kg / m² and by extrapolation, the yield per hectare.

Statistical analysis

Statistical analyzes have focused on yields parameters such as weight and diameters of the apple cabbage. In order to normalize the population and stabilize variances the numerical values collected of the yield variable were transformed into logarithmic values (natural logarithm) while the weight and diameter have not undergone any transformation. Comparing averages was made by ANOVA for yield values for the non-parametric Krukal-Wallis test for those of weight and diameter.

In order to determine the relationship between yield parameters, a linear regression was made between the weight and the diameter of the apple. Validation of different models obtained was conducted through a verification of the overall significance of the model and the coefficients.

Furthermore, normality tests, the nullity of average, homogeneity of variances and autocorrelation of studentized residues generated by the two parameters were performed. The software used for statistical analysis are R (R development Core T., 2010) and Minitab Version 14.

To evaluate the shading effect that could put the plants of *M. oleifera* on the formation of the apple cabbage; a linear correlation study was made between the weight and diameter of the apple cabbage and will be sanctioned by linear adjustment according to treatment.

Results and Discussion

Effect of treatments applied on cabbage yield headed

Table 1 shows average yield of cabbage per hectare depending on the treatment. Analysis of this table shows that these averages are not statistically different. Otherwise, cabbage behaved indifferently to treatment. The average yield in cabbage apple is 942.59 ± 210,05kg apple / ha.

Effect of treatments applied to the weight and the average diameter of cabbage

Table 1 shows the weight and the average diameters of cabbage headed based treatments. The analysis of this table shows that the difference between the average weights as well as between the average diameters of cabbage feet is not statistically significant. The average weight and the average apple are respectively 1.88 ± 0.42 kg and 12.3 ± 1,3cm.

Effect of treatments on the linear correlation between the weight and the diameter of the head of the cabbage

The analysis of determination coefficients given by the Figure 1 shows that the models A1B1, A1B2, A3B1 and the witness are those that best explain the variability of the weight depending on the diameter with more than 50% of information and analysis of table 2 shows that these models are globally significant. The joint analysis of this table and this figure shows that these models are those, whose equations best fit their treatments clouds respective. These treatments promote the formation of the apple.

The results showed that the difference between the weights and diameters of cabbage based treatments is not significant.

Table.1 Average yields, weight and diameter averages of cabbage harvesting based treatments

Treatments	Average yields (kg/ha)	Average weights (g)	Average diameters (mm)
A1B1	112650 ± 9166(11,63) *a*	1877,5 ± 372,8*a*	122,13 ± 15,10*a*
A1B2	106000 ± 6821(11,57) *a*	1765,8 ± 290,8*a*	123,67 ± 15,31*a*
A2B1	124990 ± 25609(11,72) *a*	2055,7 ± 545,2*a*	126,63 ± 12,66*a*
A2B2	107890 ± 18983(11,57) *a*	1798,2 ± 370,3*a*	123,13 ± 12,48*a*
A3B1	121600 ± 12138(11,70) *a*	1968,3 ± 498,4*a*	121,80 ± 14,50*a*
A3B2	109200 ± 7831(11,59) *a*	1820,0 ± 258,5*a*	123,87 ± 9,76*a*
T	114652 ± 22452(11,63) *a*	1910,9 ± 483,6*a*	122,63 ± 16,94*a*
P	***0,52***	***0,51***	***0,86***

Legend: A1B1: *M. oleifera* plants have been associated with cabbage with a spacing of one meter between the rows and the rows of *M. oleifera* and are cut to 0.5 m above the ground; A1B2: *M. oleifera* plants have been associated with cabbage with a spacing of one meter between the rows and the rows of *M. oleifera* and are cut to 1 m above the ground; A2B1: *M. oleifera* plants have been associated with cabbage with a spacing of one meter on lines and two meters between the rows of *Moringa oleifera* plants and are cut to 0.5 m above the ground; A2B2: *M. oleifera* plants have been associated with cabbage with a spacing of one meter on lines and two meters between the rows of plants *Moringa oleifera* and are cut to 1m above the ground; A3B1: *M. oleifera* plants were arranged in two rows of hedges with a spacing of one meter between the rows and on rows of hedges and a spacing of two (2) meters between the hedges and *Moringa oleifera* plants are cut to 0.5m above the ground ; A3B2: *M. oleifera* plants were arranged in two rows of hedges with a spacing of one meter between the rows and on rows of hedges and a spacing of two (2) meters between the hedges and *Moringa oleifera* plants are cut to 1m above the ground; T: witness.

Means followed by the same letter in the same column are not statistically different; numbers in parentheses are the means from the numeric values converted into neperians logarithmic values.

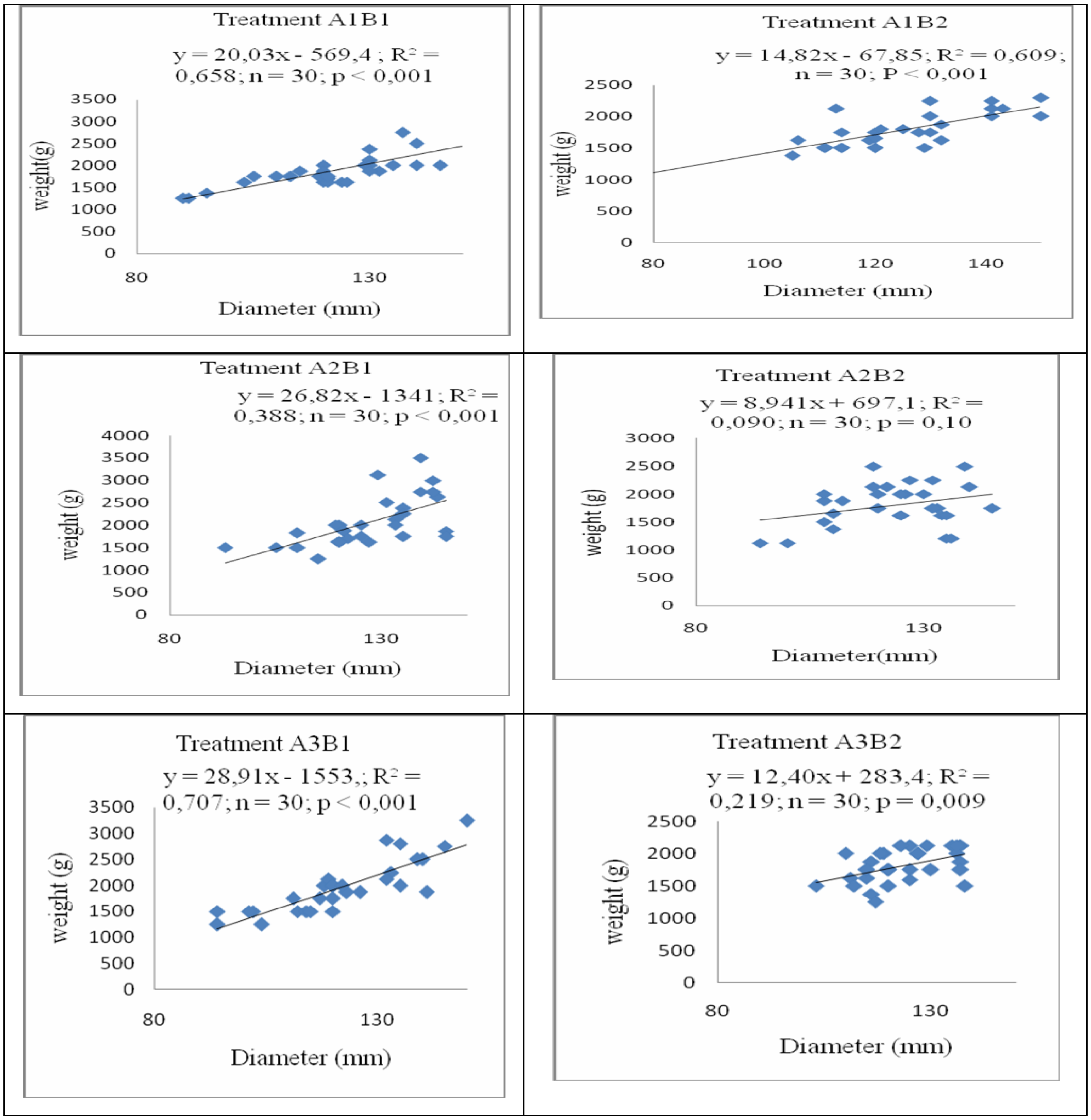
Table.2 Values of the probability (p) for the various validation tests of models according to treatment realized

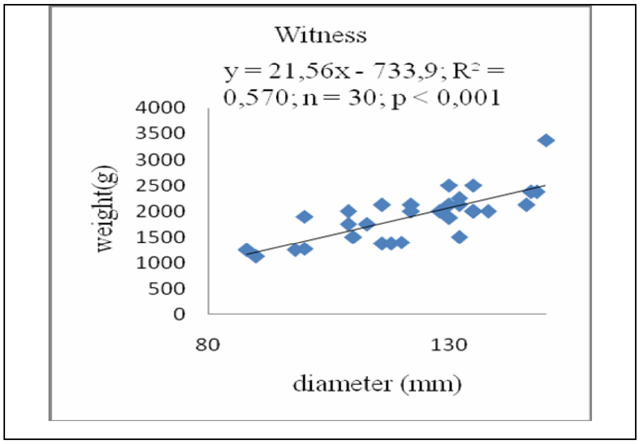
Treatments	significance	studentized residues			
		Normality	Nullity of the average	variance Homogneity	Autocorrelation
A1B1	< 0,001	0,29	0,91	0,006	0,2
A1B2	< 0,001	0,06	0,9	0,97	0,34
A2B1	< 0,001	0,11	0,93	0,05	0,04
A2B2	0,1	-	-	-	-
A3B1	< 0,001	0,53	0,96	0,04	0,77
A3B2	0,009	0,24	0,94	0,95	0,14
T	< 0,001	0,2	0,92	0,16	0,45

Legend: A1B1: *M. oleifera* plants have been associated with cabbage with a spacing of one meter between the rows and the rows of *M. oleifera* and are cut to 0.5 m above the ground; A1B2: *M. oleifera* plants have been associated with cabbage with a spacing of one meter between the rows and the rows of *M. oleifera* and are cut to 1 m above the ground; A2B1: *M. oleifera* plants have been associated with cabbage with a spacing of one meter on lines and two meters between the rows of *Moringa oleifera* plants and are cut to 0.5 m above the ground; A2B2: *M. oleifera* plants have been associated with cabbage with a spacing of one meter on lines and two meters between the rows of plants *Moringa oleifera* and are cut to 1m above the ground; A3B1: *M. oleifera* plants were arranged in two rows of hedges with a spacing of one meter between the rows and on rows of hedges and a spacing of two (2) meters between the hedges and *Moringa oleifera* plants are cut to 0.5m above the ground ; A3B2: *M. oleifera* plants were arranged in two rows of hedges with a spacing of one meter between the rows and on rows of hedges and a spacing of two (2) meters between the hedges and *Moringa oleifera* plants are cut to 1m above the ground; T: witness.
Means followed by the same letter in the same column are not statistically different; numbers in parentheses are the means from

the numeric values converted into neperians logarithmic values.

Figure.1 Effect of treatment on the linear correlation between the weight and the diameter of the cabbage head





Indeed, these results have shown that the presence of *M. oleifera* had neither a negative effect nor a positive effect on the parameters studied in the cabbage apple. This can be explained by several reasons. First, cabbage is a culture whose roots are well developed and can explore more than fifty centimeters deep.

Consequently, its root system is very powerful. It can compete well with *M. oleifera* plants for nutrients. We can conjecture that in case of competition for nutrients, *M. oleifera* can not disturb the development of the cabbage. According to Pallardy and Miller (2001), the rare trials for competition for soil nutrients have demonstrated that it is generally negligible, to the extent that the nutrient requirements of intercropping are filled by appropriate fertilization practices. However, the culture was well conducted according to the requirements of the cabbage.

Furthermore, the influence of *M. oleifera* plants on parameters studied should be exercised by shading effect. However, this was not observed because of the cutting realized on *M. oleifera* plants. Indeed, immediately after the cutting, the cabbage was transplanted and it took almost two months for the leaves of *M. oleifera* thrive. However, the effect of M. oleifera on cabbage could not be significant.

This hypothesis can be verified when looking at the effect of processing on the correlation between weight and diameter of the cabbage apple. In fact, the correlation is always positive regardless to the treatment even if for some it remains very low. Which would justify an increase in the diameter would induce an increase in weight of the apple cabbage. In other words, even in the presence of M. oleifera seedlings, apple cabbage forms well and his training is not disrupted by the shadow created by the leafy tree.

Then, the plants of *M. oleifera* were very young to cause a significant influence in the performance of cabbage. Rivest et al. (2010) found results that corroborate those of this study. According to these authors, young trees do not usually cause to crops a significant loss of productivity. Their effect may even be beneficial in some cases. However, over the years, intercropping may be adversely affected by competition of trees for light, water and soil minerals. Notwithstanding, under shade culture may not be a limiting factor for some intercropping. The results of Lin et al. (1999) and those of Clinch et al. (2009) are sufficiently illustrative. These authors have shown respectively as shading effect instead of causing a decrease in yields improve tall fescue and willow compared to monoculture.

In conclusion, the study found that the combination of factors layout and cutting level on *M. oleifera* plants had no effect on yields cabbage apple. This study also showed that the cut could prevent a shade effect of M. oleifera plants on yields of cabbage. This role could be devolved to the spacing adopted. The results also showed that for some treatments, the weight and diameter of the head of the cabbage is positively highly correlated. Hence, we may conjecture that an increase in the diameter would induce an increase in weight of the apple cabbage. Ultimately, the results of this study show that operators can now associate *Brassica oleracea* and *M. oleifera* without risk of yield loss related to the combination treatment or facts on *Moringa oleifera* plants.

References

Anafe-Raft Sahel, 2006. Manuel d'agroforesterie à l'intention des établissements supérieurs du sahel. Bamako-Mali 70p.

Balandier, P., 1999. Analyse et modélisation de l'interaction arbre-culture. *In: Bois et forêts des agriculteurs - Actes du colloque Clermont-Ferrand, 20 et 21 octobre 1999*. C. Editions. Clermont-Ferrand, INRA/Cemagref/Ministère de l'Agriculture et de la Pêche: 10-12.

Baldy, C., Dupraz, C., Schilizzi, S., 1993. Vers de nouvelles agroforesteries en climats tempérés et méditérranéens. I. Aspects agronomiques. Cahiers Agricultures. 2: 375- 386.

Clinch, R.L., Thevathasan, N.V., Gordon, A.M., Volk, T.A., Sidders, D. 2009. Biophysical

Gbemavo D.S.J.C., Glèlè R. K., Assogbadjo A.E., Katary A. et Gnanglè P.2010. Effet de l'ombrage du karité sur le rendement capsulaire du coton dans les agroécosystèmes coton-karité du Nord Bénin. Tropicultura. 28 (4) :193-199

INS-Niger, 2014. Le Niger en chiffres 2014. 84p

interactions in a short rotation willow intercropping system in southern Ontario, Canada. Agriculture, Ecosystems and Environment 131: 61-69.

Jose, S., Gillespie, A.R., Pallardy, S.G. 2004. Interspecific interactions in temperate agroforestry. Agroforestry Systems 61 : 237-255.

Lin, C.H., McGraw, R.L., George, M.F., Garrett, H.E. 1999. Shade effects on forage crops with potential in temperate agroforestry practices. Agroforestry Systems 44 : 109-119.

Miller, A.W., Pallardy, S.G. 2001. Resource competition across the tree-crop interface in a maize-silver maple temperate alley cropping stand in Missouri. Agroforestry Systems 53 : 247-259.

Ong, C.K., Corlett, J.E., Singh, R.P., Black, C.R., 1991. Above and below groundinteractions in agroforestry systems. For. Ecol. Manage. 45: 45-57.

Rivest D., Olivier A. et Gordon A. M., 2010. Les systèmes de cultures intercalaires avec arbres feuillus. Jumeler production de bois et production agricole tout en protégeant l'environnement. Université Laval. University of Guelph. 12p

Rivest, D., Cogliastro, A., Olivier, A. 2009. Tree-based intercropping systems increase growth and nutrient status of hybrid poplar : a case study from two Northeastern American experiments. *Journal of Environmental Management* 91 : 432-440.

Rivest, D., Cogliastro, A., Vanasse, A., Olivier, A. 2009. Production of soybean associated with different hybrid poplar clones in a tree-based intercropping system in southwestern Québec, Canada. Agriculture, Ecosystems and Environment 131 : 51-60.

Thevathasan, N.V., Gordon, A.M. 1997. Poplar leaf biomass distribution and nitrogen dynamics in a poplar-barley intercropped system in southern Ontario, Canada. Agrofor. Syst. 37: 79-90.

Wiersum K., F., 1991.Domestication of valuable tree species in agroforestry systems: evolutionary stages from gathering to breeding.

Williams, P.A., Gordon, A.M. 1992. The potential of intercropping as an alternative land use system in temperate North America. Agroforestry Systems 19 : 253-263.