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The Effect of Different Composts Made from Jatropha Cake on the Yield of Headed Cabbage (*Brassica oleracea* L.) in Ngandajika, Case of the Locality of KASEBA (Lomami, DR Congo)

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Abstract

In Ngandajika (Democratic Republic of Congo), given the state of our soils, farmers and researchers resort to chemical fertilizers, such as NPK, to achieve the expected yield. *Jatropha curcas* by-products used in composting would be a strategic solution to this dilemma. Jerky (*Jatropha curcas* L.) is a plant of the Euphorbiaceae family. Pressing its oil-rich seeds produces a by-product, the cake, the accumulation of which causes an environmental problem. To address this problem, the use of this by-product in compost was considered and is the subject of this study. Five types of compost were developed using cake alone or combined with animal waste (small ruminant droppings or poultry droppings). The composts were then tested on the yield of cabbage apple. The experimental design used is completely randomized, comprising 6 treatments repeated three times each. The study showed that mixing cake with 10% of small ruminant droppings resulted in good quality compost with a high nitrogen and potassium content (Ntot 1.83%; Ktot. 1.76%). Compost made with Jatropha cake and 20% of small ruminant droppings resulted in the best yield in both total biomass and apple biomass. The different composts made from *Jatropha curcas* cake significantly improved the chemical characteristics of the soil. These different results therefore show that cake is a good material for the production of compost. This recovery therefore makes it possible to avoid the unnecessary and harmful accumulation of this product and helps to solve the environmental problem it constitutes.

Keywords: *Jatropha curcas* Cake, Compost, Cabbage Yield.

1. INTRODUCTION

Jatropha curcas L., its scientific name, is a plant of Latin American origin that is now widespread in all arid and semi-arid tropical regions of the world. A member of the Euphorbiaceae family, it is a drought-resistant perennial plant that can live up to 50 years and grows on poor soils (Henning, 2007). The seed contains 30 to 40% oil whose properties are similar to those of fossil diesel (Sanou, 2010). Pressing the seeds produces pure vegetable oil, of course, but also residues rich in nitrogen (4.14%) and phosphorus (0.50%) (Samake, 2007), which prove to be a good organic fertilizer. In Ngandajika, its use as a fertilizer at a rate of 5 t/ha of cake in maize trials increased yields by 45% (Ouédraogo, 2000). Cuhna Da Silveira (1934) mentions that in Cape Verde, it was used on wheat (mixed with superphosphate) and on maize (mixed with potassium sulfate). In Zimbabwe, it is marketed as a fertilizer for its high NPK content.

Furthermore, the problem of high decline in soil fertility in Ngandajika is a concern both for farmers who are faced with the high cost of mineral fertilizers and the scarcity of manure, and for researchers who are looking for rational technologies capable of maintaining or restoring the fertility of degraded soils. The extensive land use system based on shifting cultivation and longterm fallow had the advantage of being balanced and allowed the maintenance of relatively stable agricultural production (Zoumana and Cesar, 1994). But today this balance has been broken following a high level of land occupation linked to the population explosion, to the detriment of fallow land and forests. According to Ferrao (1962), there is a link between the aridity of the climate and the oil content of seeds, which would explain the higher oil content in Cape Verde. Several authors have thus described aridity as a factor favoring plants to store lipid reserves.

The natural distribution of jatropha is mainly in arid and semi-arid areas (Jones and Miller, 1992; Makkar *et al*., 1997) but it is also found in humid tropical regions such as Guatemala (greater than 4000 mm/year), or northern Vietnam and Thailand. Thus, Rijssenbeek *et al*., (2007) place its cultivation area between latitudes 30°N and 35°S. According to Mûnch (1986), germination is induced by the change in soil humidity in the air, following a period of drought. Heller (1996) was unable to demonstrate a dormant period. It takes 1 to 4 weeks for germination. This work is a contribution to the valorization of Jatropha cake in composting for the improvement of soil fertility. It focuses on the effect of different composts made from Jatropha cake on the yield of headed cabbage (*Brassica oleracea* L.). The objective of the work is the valorization of an industrial by-product that constitutes *Jatropha curcas* cake for the improvement of soil fertility.

2. MATERIALS AND METHODS

The Experimental Site

This study was conducted during the 2023-2024 growing season in Kaseba/Tshioji in a locality of the same name (KASEBA), one of the fish farming center sites located 7 km from the city center of Ngandajika territory. The site is located at 6°48'31.956'' South latitude and 23°57'31.15188'' East longitude, at an average altitude of 756m.

Material

Plant Material

The different types of compost were tested with the Oxylus variety of headed cabbage (*Brassica oleracea* L.). This Oxylus variety is more or less dark green in color and slightly flattened in shape. Its head can reach 2.5 or 3 kg, and its cycle from transplanting to harvest is 65 to 70 days. Harvesting can take 5 to 10 days. The seeds were purchased from a certified seed retailer. We chose headed cabbage because this vegetable is of economic importance in Ngandajika and worldwide. It is also demanding in terms of fertilizing elements (N, P, K).

Compost Constituent Materials

The composition of the starting materials determines the quality of the final compost, i.e., its fertilizing value. The following materials were used to develop the different types of compost submitted for agronomic testing:

Jatropha curcas Cake and Animal Waste

Jatropha cake is the base material for the decomposing organic pile, and animal waste is an excellent composting material. Thus, small ruminant droppings and poultry droppings were incorporated into the compost piles at rates of 10% and 20%.

Methods

Composting Method

Composting is carried out in cement-bottomed bins to prevent effluent from the compost pile from seeping into the soil. The cemented bottom of the bins has a slight slope to allow the liquid from the compost to drain into a pipe with a tap through which the effluent is drained if the compost is too wet. The piles are covered with plastic sheeting, which protects the compost from the ambient air and reduces the release of heat produced inside the pile. The bins are covered with metal sheets to protect the compost from the elements. This composting method is an aerobic method similar to the Indore and Bangalore methods. It differs from the Indore method in that there is no brushwood at the base of the pile (cement-bottomed bins). However, it is close to the Bangalore method in that the pile is completely covered by plastic sheeting (instead of mud or clods of earth) which protects from the ambient air and prevents the release of heat produced inside the pile.

Three turnings were performed during the composting process. The first turning took place two weeks after the piles were established, the second at the fifth week, and the third at the eighth week. Mature compost was obtained after 12 weeks (3 months).

For compost production, two factors were considered: the type of animal manure incorporated into the piles (small ruminant droppings or poultry droppings) and the manure incorporation rate (0%, 10%, or 20% of the pile), resulting in the following combinations: C0, C10, C20, F0, F10, and F20.

To achieve their combination, five composting trials with two replicates, for a total of 10 experimental units, were set up instead of six trials, as we deemed it unnecessary to have too many replicates of compost without the addition of animal manure. C0 and F0 are nothing other than Tm.

Composting Trials:

- Tm (C0 or F0): Cake (90%) + Soil (10%)
- C10: Cake (80%) + Droppings (10%) + Soil (10%)
- C20: Cake (70%) + Droppings (20%) + Soil (10%)
- F10: Cake (80%) + Droppings (10%) + Soil (10%)
- F20: Cake (70%) + Droppings (20%) + Soil (10%)

Amendment Test Method

Experimental Design

The experimental design used was a completely randomized design, comprising six treatments, each replicated three times. Each elementary plot covered an area of 6 m², or 5 m x 1.2 m. Two neighboring elementary plots were separated by a 40 cm path. A 1 m wide border was placed around the entire experiment.

Treatments

The treatments used were as follows:
T0: No compost (absolute control)
Tm: Jatropha seed cake compost
C10: Jatropha seed cake compost + droppings (10%)
C20: Jatropha seed cake compost + droppings (20%)
F10: Jatropha seed cake compost + droppings (10%)
F20: Jatropha seed cake compost + droppings (20%)

Statistical Analysis of Results: The results were statistically analyzed using STATISTICA software and then analyzed using the Duncan test at the 5% threshold. The results are presented and discussed in the following section.

3. RESULTS

Physical Characteristics of the Different Jatropha Cake-Based Composts

The physical characteristics show a brown-colored compost with a crumbly texture at maturity. It should be noted that all composts have the same color and texture.

Chemical Characteristics of the Different Composts Prepared

Table I presents the chemical characteristics of the different composts prepared.

It shows that mixing the cake with 10% droppings resulted in good-quality compost with the highest nitrogen (1.83%) and potassium (1.76%) contents.

Table I: Chemical characteristics of the different composts produced.

Differents Composts	**P^H eau ½**	**C org.** (%)	**N tot.** (%)	**C/N**	**P tot.** (%)	**K tot.** (%)
T_m	7,89c	14,87c	1,71ab	8,72	2,28b	1,16bc
C_{10}	8,27a	19,38a	1,83a	10,60	1,96c	1,76a
C_{20}	7,36d	16,67bc	1,75ab	9,53	1,67d	0,88c
F_{10}	8,24a	19,24ab	1,56b	12,43	1,96c	1,54ab
F_{20}	8,10b	17,84ab	1,53b	11,56	2,63a	1,82a

Tm=compost of Jatropha cake alone; C10=compost of Jatropha cake + droppings (10%); C20=compost of Jatropha cake + droppings (20%); F10=compost of Jatropha cake + droppings (10%); F20=compost of Jatropha cake + droppings (20%). Values in the same column assigned the same letter index are statistically identical at the 5% threshold.

Chemical Characteristics of the Soil before the Experiment

The chemical characteristics of the soil before the experiment are listed in Table II.

It shows that the experimental soil has varying levels of nitrogen, phosphorus, and potassium.

Table II: Chemical characteristics of the soil before testing

Chemical characteristics						
pH		Corg	N	C/N	Ptot.	Ktot.
Water	KCl	(%)	(%)			
7,20	6,18	0,76	0,09	8,44	0,0024	0,0115

The Effect of Different Composts on Headed Cabbage Production

The Effect of Different Composts on Headed Cabbage Biomass

Figure 1 shows the effect of the different composts used on headed cabbage biomass. All tested composts significantly increased head yields by a factor of 5% compared to the absolute control (without compost). The highest yield was obtained with compost C20; composts C10 and F20 had a similar effect on yield. The lowest yields were obtained with composts Tm (compost with Jatropha cake alone) and F10 (compost with 10% poultry droppings), which were statistically identical.

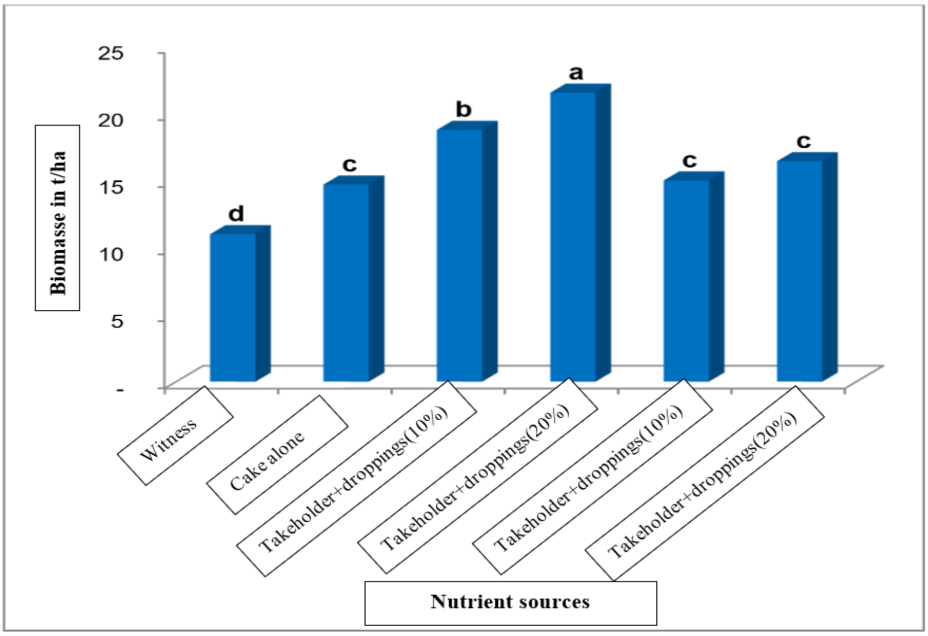

Figure 1: Evolution of biomass yields of cabbage heads according to the different composts used

The Effect of Different Composts Used on Total Cabbage Biomass

Figure 2 shows the effect of different composts used on total cabbage biomass. All tested composts significantly increased total biomass yield at the 5% level compared to the absolute control (without compost). Compost C20 provided the best total biomass yield. Composts Tm, F10, and F20 provided low total biomass yields.

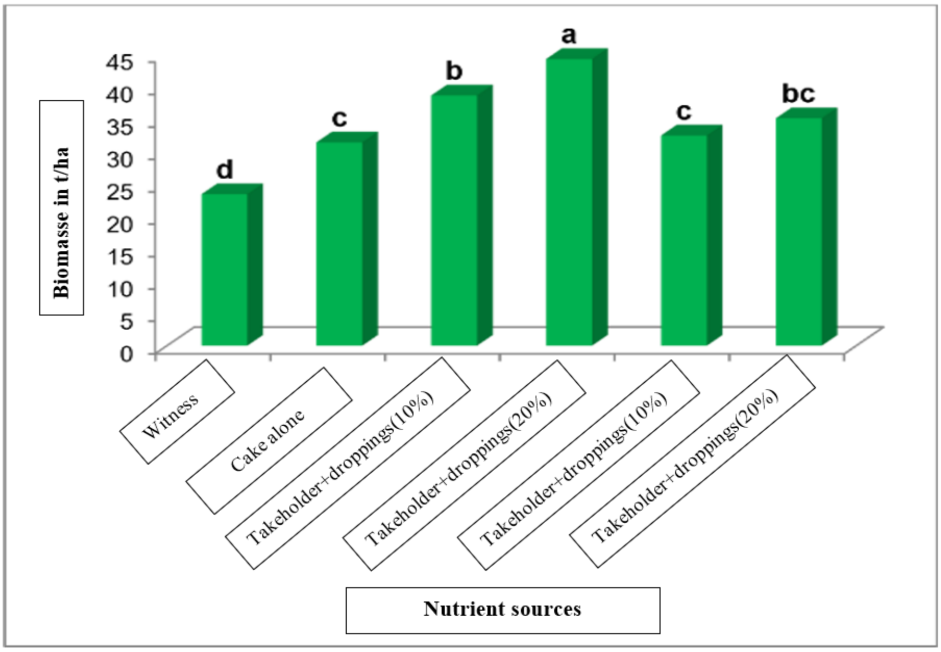

Figure 2: Changes in total cabbage biomass yields based on the different composts used

Impact of the different composts on the trial soil

This section presents the results of the impact of the different composts on the trial soil.

Table III presents the chemical characteristics of the soil at cabbage harvest. It shows that the C10 and C20 composts slightly increased soil basicity; better still, the C10 compost increased soil pH more (+0.59). Carbon and nitrogen levels decreased compared to the pre-test soil on the soil without compost (T0). The different composts increased phosphorus levels compared to the pre-test soil.

Table III: Chemical characteristics of the soil at the time of harvesting headed cabbage

Sources of nutrients	PH		C org.	N tot.	C/N	P tot.	K tot.
	Water	KCl	(%)			(%)	
Soil before testing	7,2	6,18	0,76	0,09	8,44	0,0024	0,0115
T_0	7,34c	6,47c	0,52d	0,04c	13,73a	0,0033c	0,0096c
T_m	7,27d	6,34d	0,91ab	0,09a	10,05bc	0,0057ab	0,0126b
C_{10}	7,79a	7,05a	0,94ab	0,08b	11,45b	0,0059a	0,0127b
C_{20}	7,50b	6,63b	0,84bc	0,08b	11,19bc	0,0053b	0,0139a
F_{10}	7,11e	6,25e	0,96a	0,09a	10,82bc	0,0054ab	0,0140a
F_{20}	7,24d	6,61b	0,75c	0,08b	9,62c	0,0053b	0,0126b

Tm=compost of Jatropha cake alone; C10=compost of Jatropha cake + droppings (10%); C20=compost of Jatropha cake + droppings (20%); F10=compost of Jatropha cake + droppings (10%); F20=compost of Jatropha cake + droppings (20%). Values in the same column assigned the same letter index are statistically identical at the 5% threshold.

3. DISCUSSION

Physical characteristics and chemical composition of the different composts produced.

The incorporation of animal waste into *Jatropha curcas* cake before composting appears to make the compost slightly basic. However, composts containing 20% animal waste are less basic than those with 10% animal waste. The mixture of Jatropha cake with 10% small ruminant droppings (C10) had the highest basicity (pH = 8.27). This slight basicity of the composts may be related to the predominance of ammonia coupled with the basic cations (Ca2+, Mg2+, K+) found in these substrates, namely the cake and animal waste. These results are consistent with those of Weber *et al*., (2007) according to which mature composts have a pH between 7.3 and 8. Furthermore, according to Koledzi in 2011, the pH of a mature compost is between 7 and 8.5.

The carbon content of the different composts produced varied from 14.87% for the compost made solely from oil cake (Tm) to 19.38% for the compost containing 10% small ruminant droppings (C10). This carbon content decreased with increasing animal manure content in the composts. The nature of the animal manure does not appear to have any influence on the carbon content of the composts. These results show that the incorporation of animal manure significantly improves the organic carbon content of the composts. These contents are close to those obtained by Matejka *et al*., in 2001 and Koledzi in 2011. The total nitrogen content varied from 1.53% for the compost containing 20% poultry droppings (F20) to 1.83% for the compost containing 10% small ruminant droppings (C10). The incorporation of poultry droppings reduced this total nitrogen content while the addition of droppings did not also improve the total nitrogen content because the nitrogen contents of the C10, C20 and Tm composts were statistically identical.

The results obtained after the analysis of variance of the C/N ratios show that there are no significant differences between the different composts. But if we only consider the nature of the manure or the incorporation rate, the differences are significant. The incorporation of animal manure slightly increased the C/N ratio. The incorporation rate seems to have no effect on the C/N ratio. The C/N ratios are between 8.72 for the compost made only from Jatropha cake (Tm) and 12.43 for the F10 and F20 composts. A wide range of C/N is mentioned in the literature for composts; for example, for fermenting composts, we find C/N ratios ranging from 10 to 80 (Bernal *et al*., 1998; Koledzi, 2011). This ratio decreases during composting to reach values between 8 and 25, which is explained by the fact that microorganisms consume more carbon than nitrogen (Bernal *et al*., 1998; Koledzi, 2011).

The results obtained after analysis of variance and Duncan's test discrimination at the 5% threshold of the average phosphorus contents show that there are significant differences between the different composts. Thus, F20 compost has the highest phosphorus content (2.63%) and Tm compost has the lowest phosphorus content (1.67%). These values slightly exceed those obtained by Gounsougle in 2010, using composts made with shea cake (1.65%) and cottonseed hulls (1.11%).

As for potassium content, C10 and F20 composts have the highest potassium contents. The lowest potassium content is obtained in C20 compost (0.88%). These results are consistent with those presented by Domergue and Pirot in 2008, according to which potassium contents range between 0.8 and 1.75%.

Chemical Composition of the Soil before the Experiment

The experimental soil showed varying levels of mineral elements. This may be explained by its previous use. However, the low mineral content of this soil was a crucial factor in assessing the true fertility of the resulting composts.

The Effect of Different Composts on Headed Cabbage Production

The Effect of Different Composts on Head Cabbage Biomass

The positive effect of different composts on cabbage production was discussed by Amadji in 2002 and Amadji *et al*., in 2009. Contrary to their results, the difference between the control and the other treatments was highly significant. These results show that the different composts made from Jatropha cake significantly increased cabbage yield.

The Effect of Different Composts Used on Total Cabbage Biomass

All composts tested significantly increased total biomass yield. These results confirm those obtained by Gounsougle in 2010, which also showed a significant effect of different composts on head cabbage yield.

The Impact of the Different Composts on the Test Soil

The increase in pH values following the different composts confirms the results obtained by Fassinou (1996) on a hydromorphic soil under cabbage, those of Cédric (1997) on a ferralitic soil under radish and amaranth, and those obtained by Amadji (2002) on a sandy soil under headed cabbage. It should be noted, however, that despite the significant effect of the composts on soil pH, the pH remained neutral.

Carbon and nitrogen levels decreased compared to the pre-test soil on soil without compost (T0). This clearly shows that the different composts increased these carbon and nitrogen levels. The compost made from oilcake alone and the one containing 20% manure improved these carbon and nitrogen levels the most. Total soil phosphorus was improved by the different composts. Compost containing 10% manure improved this phosphorus content the most. The various composts also improved the potassium content.

Generally speaking, the various composts made from *Jatropha curcas* meal improved the chemical characteristics of the soil.

4. CONCLUSION

- At the end of this work, it emerged that the various composts made from Jatropha cake significantly improved cabbage yield and soil characteristics.
- From these results, the following conclusions can be drawn:
- Mixing the cake with 10% small ruminant droppings resulted in good-quality compost with a high nitrogen and potassium content (Ntot 1.83%; Ktot 1.76%); the compost made with Jatropha cake and 20% of small ruminant droppings provided the best yield in both total biomass and apple biomass;
- The various composts made from *Jatropha curcas* cake significantly improved the chemical characteristics of the soil.
- The incorporation of droppings improved the quality of the cake-based compost.
- In contrast, the addition of droppings did not appear to have any effect on the Jatropha cake compost.
- The results obtained are from a single season only; they should preferably be repeated
- During the dry season to confirm them or obtain more reliable data. Furthermore, these tests can be repeated to determine the equivalent of mineral fertilization from the prepared composts.

BIBLIOGRAPHIC REFERENCES

- Albrecht R., 2007. Co-composting of wastewater treatment plant sludge and green waste: a new methodology for monitoring organic matter transformations. Doctoral thesis, Faculty of Science and Technology, Paul Cézanne University Aix-Marseille III, 189 p.
- Amadji G. L., Saidou A. and Chitou L., 2009. Recycling of organic residues in compost to improve coastal sandysoil properties and cabbage shoot yield in Benin in International Journal of Biological and Chemical Sciences. 3(2): 192-202, ISSN 1991-8631
- Amadji G.L., 2002 Recycling of household waste through the production of cabbage on sandy coastal soil. FSA/UAC. 10 p.
- Bernal, M.P., Navarro, M.A., Sanchez-Monedero, M.A., Roig, A., Cegarra, J., 1998. "Influence of sewage sludge compost stability and maturity on carbon and nitrogen mineralization in soil." Biochem. Soil Biol. 30(3): 305-313.
- Cédric D., 1997. Study of the response of amaranth and radish crops grown on ferrallitic soil following the application of three organic fertilizers. EPLF Engineering Diploma in Rural Engineering; specialization in Environment. Cotonou, Benin, FSA/UNB, 44p.Cuhna da Silveira, J., 1934. Contribution à l'étude du pourghère aux îles du Cap Vert. *Anais do Instituto Superior de Agronomia*, vol.6:n°1: pp.116-126.
- Chachage B. 2003. Jatropha oil as a renewable fuel for road transport. Policy implications for technology transfer in Tanzania. Master's Thesis, International
- Devisscher S., 1997. Properties and Valorization of Compost. DESS Thesis, University of Picardie, 60 p.
- Domergue M. and Pirot R., 2008. *Jatropha curcas* L. Bibliographic Summary Report, CIRAD, AGRO generation, Montpellier-Paris, 118 p.
- Fassinou D.S., 1996. Comparative Study of the Fertilizing Values of Two Types of Organic Fertilizers on Ginger (Zingiber officinal) and Headed Cabbage (*Brassica oleracea* L.) on a Hydromorphic Pseudogley Soil. Agricultural Engineering Thesis. Cotonou, Benin, FSA/UNB. 60p.
- Francou C., 2003. Stabilization of organic matter during composting of urban waste: Influence of the nature of the waste and the composting process – Search for relevant indicators. Doctoral thesis, National Institute of Agronomy Paris-Grigon, 289p.
- Goel G., 2007. Phorbol esters: structure, biological activity, and toxicity in animals. International Journal of Toxicology. Vol. 26, pp. 279–288.

- Gounsougle Y., 2010. Comparative study of the effects of shea butter cake and cottonseed hull composts and mineral fertilizers on headed cabbage production. ESA-University of Lomé, 79 p.
- Heller, J., Physic nut. *Jatropha curcas* L. Promoting the conservation and use of underutilized and neglected crops, in Institute of Plant Genetic Resource Institute, Rome, Italy, 1996. P. 88 pages.
- Henning K. R., 2007. Identification, selection and multiplication of high-yielding *Jatropha curcas* L. plants and economic key points for viable Jatropha oil production costs. GTZ. http://www.ifad.org/events/jatropha/agronomy/henning.pdf
- Institute for Industrial Environmental Economics, Lund University, Sweden, 58 p.
- Jones, N. and J.H. Miller, *Jatropha curcas*. A multipurpose species for problematic sites, L.r. series, Editor. 1992, World Bank.
- Koledzi K. E., 2011. Recovery of urban solid waste in the neighborhoods of Lomé (Togo): A methodological approach for sustainable compost production. Doctoral thesis, Faculty of Science and Technology, University of Lomé (Togo) jointly supervised by the University of Limoges (France), 210p.
- Matejka, G., Barbier, J., De Las Heras, F., Klein, A., Paqueteau, F., Kebe, A., 2001. Composting of urban refuse in Labé (Guinea): process optimization and agricultural value; Cagliari (Sardinia) Eighth International Waste Management and Landfill Symposiuim (CISA: Environ. Sanitary Engineering Centre) 1 - 5 Oct. 2001.
- Ouedraogo M., 2000. Biological Study and Physiology of *Jatropha curcas* L. State Thesis, University of Ouagadougou, Burkina Faso, 290 p.
- Samake F., 2007. "Communication on the Achievements of Agronomic Research on *Jatropha curcas*," National Forum on Biofuels as Part of the Project to Develop the Jatropha Industry in Mali, Bamako, September 6 and 7, 2007, pp. 5 and 9
- Sanou F., 2010. Productivity of *Jatropha curcas* L. and the Plant's Impact on Soil Chemical Properties: The Case of Bagre (Central Burkina Faso). Final Dissertation for the Diploma in Rural Development Engineering, Polytechnic Institute of Bobo Dioulasso, Burkina Faso, 55 p.
- Skiredj A., Elattir H. and Elfadl A., 2003. Technical Sheet IV: Sweet Potato, Turnip, Cabbage, Pea, and Green Bean in Agricultural Technology Transfer, No. 101
- Weber J., Karczewska A., Drozd J., Licznar M., Licznar S., Jamroz E. and Kocowicz A. 2007. Agricultural and Ecological Aspects of a Sandy Soil as Affected by the Application of Municipal Solid Waste Composts. Soil Biol. Bioch., 39: 1294-1302.
- Zoumana C. and Cesar J., 1994. Production and Use of Manure in the Dense Kohun Zone in Côte d'Ivoire. Agricultural Systems in Africa, Vol. 4, No. 2, pp. 20-27.