International Journal of Applied Research 2020; 6(4): 175-181

ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2020; 6(4): 175-181
www.allresearchjournal.com
Received: 17-02-2020
Accepted: 19-03-2020

AYOLIE Koutoua
University Jean Lorougnon Guédé, UFR (Faculty) of Agroforestry, Laboratory for improving Agricultural Production, BP 150 Daloa, Côte d'Ivoire

SORO Dogniméton
University Jean Lorougnon Guédé, UFR (Faculty) of Agroforestry, Laboratory for Improving Agricultural production, BP 150 Daloa, Côte d'Ivoire

BLEHOU Edja Clotaire
University Jean Lorougnon Guédé, UFR (Faculty) of Agroforestry, Laboratory for Improving Agricultural production, BP 150 Daloa, Côte d'Ivoire

BALLO Espérence Kouadio
University Jean Lorougnon Guédé, UFR (Faculty) of Agroforestry, Laboratory for improving Agricultural production, BP 150 Daloa, Côte d'Ivoire

KANGA Ahou Nadia
University Jean Lorougnon Guédé, UFR (Faculty) of Agroforestry, Laboratory for Improving Agricultural Production, BP 150 Daloa, Côte d'Ivoire

KOUADIO Yatty Justin
University Jean Lorougnon Guédé, UFR (Faculty) of Agroforestry, Laboratory for Improving Agricultural Production, BP 150 Daloa, Côte d'Ivoire

Correspondence Author:
AYOLIE Koutoua
University Jean Lorougnon Guédé, UFR (Faculty) of Agroforestry, Laboratory for Improving Agricultural Production, BP 150 Daloa, Côte d'Ivoire

Effects of alternatives substrates to soil on the growth and production of the Eggplant (*Solanum macrocarpon*)

Ayolie Koutoua, Soro Dogniméton, Blehou Edja Clotaire, Ballo Espérence Kouadio, Kanga Ahou Nadia and Kouadio Yatty Justin

Abstract
These last few years, eggplant production in sub-Saharan African countries has declined due to scarcity and depletion of arable land, while domestic demand and exports are high.In order to provide substrates that will improve the production of eggplants by using residues from the forestry and agricultural industries like the coconut fiber (CF), cocoa pod hull (Cph) and the Samba tree sawdust (SS), available and cheaper as growing medium. Seeds of Gboma-eggplant (*Solanum macrocarpon*) were sown in a nursery on the soil of the Université Jean Lorougnon Guédé field of experimentation. 39 plants of 40 days after sowing from this nursery were transplanted into 4 dm^3randomized pots containing the substrates, soil, CF, Cph and SS; for thirteen treatments in monosubstrate (100 % substrate) or with combination organic substrate/soil (25; 50; 75 % substrate/soil 75; 50; 25 %), with three replicates. The results of this study revealed a significant difference (P <0.05) between the substrates. All coconut fiber (CF) treatments showed better vegetative parameters (plant height from 77.33 to 81 cm and fruit length from 9.53 to 10.66 cm) and important yields average (YA) from 32.25 to 58.24 t/ha, followed by the Samba sawdust (SS) all combinations (plant height from 66.66 to 69.33 cm and YA 24.84 to 45.53 t/ha).Cocoa pod hull (Cph) 100 % exhibited medium vegetative growth and a yield of 33.98 t/ha, but Cph 25 % was not good and has facilitated the withering and death of the plants and should be tested in combinations with other organic substrates.

Keywords: Gboma-eggplant, substrates, cultivation, yields

Introduction
In Côte d'Ivoire, as in most sub-Saharan African countries, food crops and market gardening occupy an important place in population's lives. As far as eggplant is concerned, it is an annual vegetable plant of the Solanaceae family and is involved in food and trade (Daunay *et al.*, 2001; Alla *et al*., 2018) [11, 1]. It would occupy the third place in volume of consumption after the tomato and the couple onion-okra (Lester and Seck, 2004; Mulaji, 2011) [21, 22]. According to these authors, the annual production of eggplant fruits estimated at 4500 t in Burkina Faso; 8000 t in Senegal and 60000 t in Côte d'Ivoire (Fondio *et al*., 2008) [17] are lower to cover national and international demand this last years (Fondio *et al.*, 2007) [16]. Besides, croplands for the cultivation of these crops aremore and more occupied by perennial crops such as cocoa, hevea and oil palm in Daloa department.
So, the excessive exploitation of the rest of arable land, inevitably leads to soil poverty.
To respond to this ever-increasing demand for food crops, farmers are rushing on the use of fertilizers and pesticides (Johnson *et al*., 2019) [20]. However, the abuse and wrong use of agrochemicals products is harmful to the environment (Fondio *et al.*, 2012; Obodji *et al* 2016) [18, 26], causing pollution and soil depletion, and bring about diminishing of harvests yields.
To solve this problem, several studies have been carried out by researchers to determine productive accessions of eggplant (N'Tamon, 2007; Djidji and Fondio, 2013) [25, 14] and other speculation, including tomatoes (Garane *et al*., 2019); yam (Bakayoko *et al*., 2019) [2, 4]. However, the poor quality of the arable land makes impossible to satisfy the needs of the farmers.

Therefore, it is necessary for a healthy, profitable and environmental friendly agriculture to popularize techniques of soils biological improvement, rather than the use of large quantities of synthetic fertilizers.

This study will enable us to get some techniques that will allow the biological improvement of the production of eggplant by valorizing the by-products of the forestry and agricultural industry such as the coconut fiber (CF), cocoa pod hull (Cph) and sawdust of the Samba (SS), throw back as waste into the environment. More specifically, it was:

- to determine the fractions of substrate allowing a good vegetative development and a good plants growth and;
- to evaluate the effect of different fractions of these substrates on the production of eggplant.

2. Materials and Method

2.1. Site of experimentation

The experiment was conducted on the experimentation field of Université Jean Lorougnon Guédé (UJLoG), at latitude 6°53 Nand longitude 6°27 W, in the town of Daloa in the west-centre of Côte d'Ivoire, at 383 km from Abidjan the economic capital of the country, where was made the nursery and stored the potted plants.

2.2. Plant material.

Seeds of *Solanum macrocarpon* (Gboma-eggplant), cultivated by farmers in the Daloa region, were selected because of it low productivity and importance in the diet (Djidji and Fondio, 2013) [14].

2.3. Preparation of the nursery and substrates.

To make the nursery, a board of 2 m^2 (2 mx 1 m), 20 cm deep was made in the soil of UJLoG experimentation's field, in which were incorporated 15 kg of compost of chicken droppings and 400 g of Carbofuran 5%to control nematodes.

Two days later, three seeds were sown per pole at 5 cm to another at 1.5 cm deep on lines 10 cm apart. Then the board was covered with palm.

At the emergence, nine days after sowing, a 1 m high shade was installed above the nursery, with a protective net, while continuing the watering. Fertilizer was spread on the board, and then the shade was gradually removed.

For the cultivation, four different substrates were used, there are:

- Soil of the Université Jean Lorougnon Guédé (UJLoG) in Daloa experimental site;
- Samba tree (*Triplochiton scleroxylon*) sawdust (SS); of the STBO (Société de Transformation du Bois de l'Ouest)sawmillinDaloa consisting of 75% slim particles (≤ 1 mm in diameter) and 25% coarse particles (>1 mm);
- Coconut fiber (CF); of COPALTECH/Bonoua, finely wiped fine medium, composed of fine particles and short fibers, which characteristics are as follows:
- very good aeration assured by the presence of short fibers and chips (cubic fraction);
- excellent water and air holding properties; pH (H_2O) <6.8; Electrical conductivity:
- EC <0.15 ms/cm; available in bulk.
- cocoa pod hull (Cph), recovered from a plantation; dried, crushed and machine-ground to obtain particles of varying sizes: slim (<1 mm, 75%) and coarse (> 1 mm, 25%).

2.4. Experimental design.

The experimental design used in this study was a randomized complete block design (RCBD), with thirteen (13) treatments and three replications in 4 dm^3 pots. The treatments were prepared into two groups (Group 1 and 2), depending on the nature and proportion of substrates used: single (100 %) substrates (monosubstrates) or combinations with the soil as indicate on the Table I, for a total of 39 pots. In all the pots containing the substrates, 250 g chicken droppings and 0.2 g of Carbofuran 5% to control nematodes were incorporated, followed by gentle and regular watering during 14 days to allow decomposition of the organic matter, and then covered with a black plastic film before transplantation.

Table 1: Composition of the substrates of culture

	Treatments
Group 1: Mono substrates: 100% Substrates	100 % soil
	100 % coco fiber (CF 100 %)
	100 % Samba sawdust (SS 100%)
	100 % cocoapodhull (Cph 100%)
Group 2: Soil/Substrates combinations	25 % soil + 75 % coco fiber (CF 75 %)
	25 % soil+ 75 % Samba sawdust (SS 75 %)
	25 % soil + 75 %cocoa pod hull (Cph75 %)
	50 % soil+ 50 % coco fiber (CF 50 %)
	50 % soil+ 50 % Samba sawdust (SS 50 %)
	50 % soil + 50 % cocoa pod hull (Cph50 %)
	75 % soil+ 25 % coco fiber (CF 25 %)
	75 % soil+ 25 % Samba sawdust (SS 25 %)
	75 % soil + 25 % cocoa pod hull (Cph 25 %)

2.5. Transplantation and maintenance

After thoroughly wetting the soil of the nursery 40 days after sowing, vigorous plants were removed and then transplanted into the various potted substrates with a spacing of 0.5 m between the pots. The crops was regularly watered with a single supply of chemical fertilizer NPK 15-15-15 and urea respectively 10 and 0.5 g per pot by dissolution in water 30 days after transplantation, with applications of foliar fungicide (IVORY 80WP) of very wide spectrum contact and insecticide (CYPERCAL 50).

2.6. Observations and measurements.

The observations of the crops, in the pots after transplanting and the measurements, concerned the phenological dates, performances of yields components (fruit weight and yields

averages) and plant growth parameters (heights, stem's diameters of plants, fruit and limb of leaf).

2.6.1. Phenological dates

The phenological dates are those of the main qualitative changes that have occurred on the plants during this culture after potting. Those are:

- days to flowering (DF), determined by counting the days between sowing and flowering of the plants and;
- days to first harvest (DH): number of days between sowing and first harvest of mature fruits. All this allowed us to determine:
- numbers of flower buds initiated (NFB);
- numbers of fruits at first harvest ($Nf1^{st}H$) and their total weight (FTW);
- percentages of flower setting rate (FSR), defined as the ratio of the number of fruits formed on the number of flower buds initiated (EQ.1).

$$\text{FSR (\%)} = \frac{Nf1^{st}H}{NFB} \text{(EQ. 1)}$$

Components of first harvests yields

- Fruit total weight (**FTW**): the cumulative weight of all fruits harvested per substrates;
- fruit weight Average (FWA), (EQ.2)
- $\mathbf{FWA(Kg) = \frac{FTW}{Nf1^{st}H}}$ **(EQ. 2)**
- yieldaverage (AY) per hectare, (EQ.3)
- $\mathbf{AY\left({}^{t}/_{ha}\right) = Nf1^{st}H x\ FWA\ xn}$ **(EQ. 3)**
- n: number of plants per hectare in open field. For Gboma-eggplant; n = 40000 plants/ha.

2.6.2. Growth of plants in the substrate.

- The height and diameter at the base of the stems of the plants, the length and width of the limb of the leaf of the base leaf bearing the first fruit were measured with tape measure and Vernier caliper 80 days after transplanting (120 days after sowing);
- numbers of leaves per plant, in each substrate was counted 120 days after sowing (DAS);
- the height of the fruit: the height from the base of the stalk to the top and the diameter from the median were measured with a Vernier caliper, as well as lengths and diameters of fruit stalk after harvest.

3.7. Statistical Analysis

The data from observations and measurements of this experiment were processed with SATISTICA software version 7.1. In which ANOVA (analysis of variance) was performed and averages were classified by Fischer's least significant difference (LSD) test at 5% threshold.

3. Results

3.1. Flowering and first harvest days, flower setting rate, flower buds, fruits and leaves numbers.

Days to flowering (DF) and first harvest(DH), numbers of flower buds initiated (NFB) and flower setting rates (FSR) recorded highly significant differences with P <5 % (Table II).

In the case of flowering days (DF) and first harvest days (DH), treatments with 100% CF showed the shortest DF, with79 days after sowing (DAS) and DH of 103 DAS, followed by SS all combinations with 80 DAS for the average of DF and 105 DAS for the DH; while the Cph all combinations presented the longest DF, from90 to 97 DAS and DH from 110 to 117 DAS.

For the numbers of flower buds (NFB) initiated, averages varied between 5 and 9 flower buds per plant. Plants treated with substrates (CF, SS and Cph) 100% and 75%CF and SS obtained the highest averages, with 9 flower buds initiated per treatment, followed by 75% 25% CF and 50% SSwith the average of 8 flower buds versus 7 for 75% SS, while the 50% and 75% Cph substrates showed the lowest numbers of flower buds, with the respective averages of 6 and 5 at flowering.

Table 2: Flowering and first harvest days flowers setting rates and numbers of flower buds, fruits at first harvest and leaves (120 DAS).

Treatments		Days of Flowering DF(DAS)	Numbers of flower buds initiated (NFB)	Flowers setting rates FSR (%)	Days of Harvest DH(DAS)	Numbers of fruits at first harvest $Nf1^{st}H$	Numbers of leaves at 120 DAS
100 % Substrate	Soil	80ab	7c	45,23e	103a	3c	33c
	CF	79a	9a	56,02a	103a	5a	36a
	SS	81b	9a	50d	104a	5a	30de
	Cph	90c	9a	50d	110b	4b	29f
25 % Soil + 75 % Substrate	CF	80ab	9a	53,36b	103d	5a	34bc
	SS	81b	9a	50d	105a	4b	29e
	Cph	91c	6e	50d	112c	3c	15g
50 % Soil + 50 % Substrate	CF	80ab	9a	48,5d	103a	4b	35ab
	SS	81b	8b	50d	105a	4b	30de
	Cph	97d	5f	50d	117d	3c	13h
75 % Soil + 25 % Substrate	CF	80ab	8b	52,38c	103a	4b	35ab
	SS	81b	7c	50d	105a	3c	31d
	Cph	-	-	-	-	-	-
LSD P		2,66 0,001**	0,99 0,001**	1,66 0,001**	5,33 0,001**	0,99 0,001**	2 0,001**

DAS: Daysafter sowing; **LSD:** Least Significant Difference; **P:** Probability of F; Theaverages followed by the same letter aren't significantly different from the 5% threshold; **: highly significant difference; $Nf1^{st}H$: Number of fruit at first harvest. **SS:** Samba tree sawdust; **CPH:** cocoa pod hull; **CF:** Coconut fiber; **DF:** Days of flowering; **DH:** days of harvest; FSR: flowers setting rate.

The flower setting rates (FSR) had percentages in the range from 45.23 to 56.02%. The organic substrates and their various combinations have got higher FSR than the soil (45.23%) from 50 to 56.02%. But, CF monosubstrates

howed the highest rate with 56.02%. However, losses of floral or aborted buds were observed.

According to the numbers of fruits harvested (Nf1stH) and leaves counted per plant in the treatments showed highly significant differences with P <5% (Table II). For the Numbers of fruits harvested, CF treatments 100 and 75% and SS 100% all had an average of 5 fruits per plant, followed by treatments 100% Cph; 50 and 25%CF and 75 and 50% SS with averages of 4 harvested fruits. On the other hand, the lowest fruit numbers, with an average of 3 fruits, were obtained with (75% and 50%) Cph and 25 % SS.

Concerning the leaf number, CF monosubstrate and its combinations obtained the most important numbers, from 34 to 36 leaves. But, 100% CF treatments presented the largest numbers of leaves with 36 leaves. Followed by treatments with SSall combinations, with averages ranging from 29 to 31 leaves per plant. On the other hand, the lowest numbers of leaves were obtained by treatments with Cph, 100; 75 and 50%, respectively with 26; 15 and 13 leaves (Table II).

3.2. Components of first harvests yields.

The fruit total weight (FTW), fruit weight average(FWA) and yields average (YA) at the first harvest of the plants all showed highly significant differences (P <5%) between the treatments of the different substrates (Table III). The highest fruit weights and yields averages were recorded in treatments with 100% CF and 75% respectively with FWA of 291.2 and 268.96 g and YA of 58.24 and 49.89 t/ha, followed by BS 100% and 50% FC, which obtained FWA of 242.09 and 230.87 g; YA of 45.53 and 40.41 t/ha. On the other hand, the smallest fruit weight and yield averages were recorded with Cph 75 and 50% with FWA of 163.78 and 149.57 g; for YA of 21.9 and 15.88 t/ha.

Table 3: Performance of yields components.

Treatments		Fruit total weight averages, FTW (Kg)	Fruit weight averages FWA (g)	Yields Averages 1st harvest YA (t/ha)
100% Substrate	Soil	0,49g	148,25g	19,83fg
	CF	1,45a	291,2a	58,24a
	SS	1,13b	242,09bc	45,53b
	Cph	0,84cde	196,88e	33,98cde
25 % Soil + 75 % Substrate	CF	1,24ab	268,96ab	49,89ab
	SS	0,87cd	199,36e	34,84cd
	Cph	0,54fg	163,78fg	21,9fg
50 % Soil + 50 % Substrate	CF	1,01bc	230,87cd	40,41bc
	SS	0,69def	173,7efg	27,79def
	Cph	0,39g	149,57g	15,88g
75 % Soil + 25 % Substrate	CF	0,8cde	201,63de	32,25cde
	SS	0,62efg	186,83ef	24,84efg
	Cph	-	-	-
LSDP		0,320,001**	33,10,001**	10,690,001**

The averages followed by the same letter aren't significantly different from the 5% thres hold; **P:** Probability of F; **LSD:** Least Significant Difference; **: highly significant difference; **SS:** Samba tree sawdust; **Cph:** cocoa pod hull; **FC:** Coconut fiber. **FTW:** fruit total weight averages; **FWA:** fruit weight averages; **YA:** yields averages.

3.3. Plants growth in the substrates

As far it concerned the plant growth: high, stem diameters, fruit measurements (height and length), diameter of the fruit and limb of the leaf (length and width) of the base leaves of the stem of the plant showed high significant differences with *P* <5% (Table IV), 80 days after transplanting. For plant heights, 100% CF and in combination with the soil showed the best heights, with averages ranging from 77.33 to 81 cm and diameters of 1.26 to 1.4 cm at the base of the plants stems, followed by soil with a plant height of 74.67 cm and a diameter of 1.23 cm and for the SS 75%, 72 cm in height and a diameter of 1.06 cm. On the other hand, the 100% CF and SS 25% obtained the respective low heights of 67; 69.33 and 66.66 cm; withidentical diameters measurements of 1.06 cm for the monosubstrate Cph and SS and 1.13 cm in diameter for 25 % SS. On the other hand, with 25% Cph treatments, the plants did not survive.

For the fruit measurement at the first fruit harvest, 100% CF obtained the best length of fruit with an average of 10.5 cm, for height an average of 5.96 cm, followed by combinations 75; 50 and 25% CF with soil; the fruit lengths respectively are10.16; 9.63 and 9.53 cm with heights of 6.23; 5.43 and 5.73 cm. However, the fruits of the plants grown with 100 and 75% SS obtained the same lengths and heights on average, 8.66 cm and 5.8 cm. On the other hand, with the 50 and 25% SS treatments combined with soil, the respective averages of 8.5 and 8.03 cm were recorded, while Cph treatments showed the smallest measurements (lengths and widths) of fruit. Thus, the treatments: 100; 75 and 50% CC obtained average lengths of 8.13; 7.06 and 7.33 cm for heights of 5.8; 5.26 and 4.43 cm.

Concerning the fruits stalks measurements, lengths of the fruit stalk (LfS) and diameters of the fruit stalk (fSD), there were not significant differences (*P* = 0.14> 5%), according to the LfS, it only varied around 3 cm. On the other hand, the fSDs showed a highly significant difference (*P* <5%), CF 100 and 75% obtained the best averages with 1.7 and 1.56 cm. But, the monosubstrates SS and Cph and their various combinations led to lower fSD with averages ranging from 1.26 to 1.03 cm. Treatments Cph 50 and 75% showed the lowest averages of fSD, 0.8 cm for 50%.

For the lengths (LL) and widths (WL) of the limbs of the base leaves on the stem of the plants per substrates (Table IV). The CF all combinations obtained the largest measurements, with LL from38 to41 cm, and WL from 20to23 cm, while Cph treatments showed the lowest limb of leaf measurements with LL: 22.43 cm and WL: 12.73 cm.

Table 4: Measurements of plants growth parameters.

Treatments		Plants heights (cm) 120 DAS	Stems diameters (cm) 120 JAS	Limbs of leaves (Stem base leaves)		Fruits		Fruits stalks	
				LL (cm)	WL (cm)	Lf (cm)	Hf (cm)	LfS (cm)	fSD (cm)
100 % Substrate	Soil	74,67bc	1,23cd	36,66bc	23a	10,03a	6,5a	3,75	1,7a
	CF	81a	1,4a	41,33a	23,16a	10,5a	5,96abc	3,8	1,7a
	SS	69,33cd	1,06e	34,33cde	19,46bcd	8,66bc	5,8bcd	3,33	1,2c
	Cph	67cd	1,06e	36,16bc	18,7bcde	8,13cde	5,8bcd	3,16	1,16c
25 % Soil + 75 % Substrate	CF	80,33a	1,26bc	40,33ab	20,83ab	10,16a	6,23ab	3,5	1,56ab
	SS	72cd	1,06e	33,16de	17,8cde	8,66bc	5,8bcd	3,36	1,13cd
	Cph	51,33f	1,06e	34,43cde	16,36e	7,06e	5,26bcd	3,16	1,03cd
50 % Soil + 50 % Substrate	CF	79ab	1,36ab	38,73abc	20,06bc	9,63ab	5,43cd	3,33	1,16c
	SS	58e	1,13de	31,23e	16,66de	8,5bcd	5,5cd	3,16	1,23bc
	Cph	40,33g	0,9f	22,43f	12,73f	7,33de	4,43e	3,03	0,8d
75 % Soil + 25 % Substrate	CF	77,33ab	1,36ab	41a	23,16a	9,53ab	5,73bcd	3,33	1,1cd
	SS	66,66cd	1,13de	35,23cde	19,56bc	8,03cde	5,86bcd	3,83	1,26bc
	Cph	15,86h	0,53g	-	-	-	-	-	-
LSD		4,36	0,14	4,84	3,02	1,37	0,64	ns	0,35
P		0,001**	0,001**	0,001**	0,001**	0,001**	0,001**	0,14	0,001**

DAS: Daysafter sowing; **LSD:** Least Significant Difference; **P:** probability of F; The averages followed by the same letter aren't significantly different from the 5% threshold; **: highly significant difference; ns: no significant difference;SS: Samba tree sawdust; Cph: cocoa pod hull; **CF:** Coconut fiber; **Lf:** length of fruit; **Hf:** height of fruit; **LFS:** Lengths of fruit stalk; **FSD:** Fruit stalk diameter; **LL:** limb length; **WL:** width's limb.

5. Discussion

The best vegetative development of this eggplant, recorded with organic substrates; Coconut fiber (CF), Samba tree sawdust (SS), Cocoa pod hull (Cph) in this test, can be explained by their physical, chemical and phytosanitary characteristics. Our results are consistent with the similar work carried out by Bégin (2008), for the soilless greenhouse tomato crop and Boudreault (2010) [6] research, for the study of the effect of physical and chemical properties on growth and development of white spruce in a container ". They confirmed by their studies that the physical properties of the different substrates are the origin of the growth. Thus, according to Morel *et al.* (2000) Johnson *et al* (2019) [20], CF has similar characteristics to peat; all the more than the cation exchange capacity and the air content of the CF are very similar to those of peat, with a significantly higher wettability and pH (5 to 7), while the retention capacity of water is lower compared to peat.CF has a high C/N ratio from 110 to 220 and microbial degradation may result in some immobilization of nitrogen (Morel *et al.*, 2000; Begin, 2008., Alla *et al.*, 2018) [1]. For this reason, CF was proposed by Noguera *et al.* (1997); and Begin (2008) as an environmental substitute for peat-growing to Quebec's farmers. For Bégin (2008), a good balance between air and water is needed to maximize plant nutrition and root nutrition; and also the porosity would influence the properties of the culture medium, as well as the size of the pores which allow air and water to circulate in the substrate (Resh, 1989; Useni, 2013). In this experiment, Cph + soil treatments were notgoodfor air and water circulation, hence the poor vegetative developments recorded with these substrates. In fact infectionwas not noticed, so it was the physical properties of the substrates which made the difference between the substrates. In addition, plant growth with marked differences in plant parameters (plant height and diameter, leaf and fruit measurements) in the various substrates was significantly higher than the plant seeds Aub25/06AK and Aub26/06Dv of Gboma-eggplant, during the agricultural field evaluation by Fondio *et al.* (2008) [17]. Thus, at the end of the present experiment at 120 DAS, the 100% CF and combinations exhibited averages of plant heights varying from 77 to 81 cm, respective leaf lengths and widths from 38.73 to 41 cm and 20 to 23.16 cm; the 100% BS and combinations showed height averages of 50 to 72 cm, lengths and widths of 31.23 to 35.23 cm and the Cph 100%, height 67 cm; length 36.33 cm and widths of 18.7 cm; against mean plant heights of 63 and 51 cm; limb lengths of 33.7 and 33.8 cm; limb widths of 18.2 and 17.7 cm; obtained with the seeds Aub25/06AK and Aub26/06Dv at 160 DAS (Fondio *et al.*, 2008; 2012) [17, 18]. On the other hand, the lack of significant difference in the lengths of the fruit stalks, regardless of the substrate, could be linked to a genetic factor, all the more than the stalk connects the fruit forming to the rest of the plant and is the passage of nutrients for fruit development. The dates to flowering from 79 to 97 DAS obtained in this evaluation complied with the 2 or 3 monthstime-limite reported by Bukenya-Ziraba and Bonsu (2004), for African eggplants, and relatively short as those of Fondio *et al.* (2008) [17], about 102 DAS. However, there was a variation in the flowering days between the different substrates used, which confirms the differences in physicochemical characteristics between these substrates. Thus, the best physicochemical characteristics presented by the CF and its combinations explain the short flowering and harvesting days. In terms of fruit set rates recorded in this test with productive organic substrates and combinations, they were average overall with rates between 48.5 and 56.02%, but significantly higher than those observed in full-field with accessions Aub 25G/06 AK and Aub26G/06Dv, which obtained respectively 39.6 and 31.9% (Fondio *et al.*, 2008; 2012) [17, 18]. On the other hand, the observed falls of flowers buds had contributed to the reduction of these rates. However, apart from diseases, according to Fondio *et al.* (2008) [17, 18] the falls of flowers depend on the temperature and the humidity of the air, whereas Grubben and El Tahir (2004) noted that in the pepper belonging to the same botanical family as the eggplant, the floral buds abort when night temperatures are above 32°C. Also, daysof the harvest which arrive at the maturity of the fruit is linked to the different previous stages of the development of the plant

that are: a good state of vegetative development, flowering, and fruit setting. Thus, for the FAO (1988); Azard and Aprel, 2019, variation between day and night temperatures are important for plant fruiting. In addition, tests carried out in Senegal with tomatoes showedthat satisfactory fructification could be obtained at temperatures between 23 and 25°C (DeLannoy, 1980; Fondio *et al.*, 2008) [17].

Ultimately, a combination of environmental factors, associated with crop periods and physico-chemical characteristics, would influence the development of the plant and thus the fruiting. The weights and yields of average obtained at the first harvest by most of the plants in the potted substrates during this test were considerably higher than the treatment with soil in the pots. Otherwise, FWAswere slightly more than 1 to 2 times higher, whereas YAs were more than 4 to 12 times, higher depending on the substrates than the FWA of 110 g and YAof 5 t/ha presented by the CNRA (Djidji and Fondio, 2013) [14] in full-field. These high Gboma yields can be explained by the good vegetative development (good growth) of the plants, linked to their low susceptibility to bacterial wilt (D'Acry, 1991; Obodji *et al* 2016) [26], a goodquality of sanitary treatments thanks to phytosanitary products used and especially the physico-chemical characteristics of the different substrates (Boudreault, 2010) [6].

6. Conclusion

The study of the effect of substrates on the development and production of *Solanum macrocarpon* (Gboma-eggplant), carried out in this experiment showed that residues from the forestry and agricultural industry, accessible and less expensive such as coconut fiber, the cocoa pod hull and the sawdust of samba tree that are rejected into the environment can be used as medium or input for biological improvement of the soil for the cultivation of plants. In this study, Coconut fiber monosubstrate or in combination with soil exhibited better results (good vegetative development of plants and high yields), while Samba sawdust substrates alone or in combinations on the soil and Cacao podhull monosubstrate showed medium results, but significantly higher than results in full-field cultivation on soil. But, the cocoa pod hulls with the soil showed poor vegetative development of the plants.

At the end of this work some perspectives emerge, in particular:

- experimenting with other types of organic substrates and at various stages of decomposition;
- testing combinations of other organic substrates/cocoa pod hulls;
- test other plant than eggplant.

7. Acknowledgments

Our thanks go to Professor Tidou Abiba Sanogo, President of the Université Jean Lorougnon Guédé Daloa, with the Department of Patrimony of the university, who provided the site for this study, to Mr. Yodé Toh Émile Gérard, Engeneer of Agricultural Techniques, Head of Service Régional Recherche-Développement/Direction Régionale de l'Agence Nationale d'Appui au Développement Rural (ANADER) of Daloa, for his complementary advices and the field team for his remarkable work.

8. Références

1. Alla KT, Bomisso EL, Ouattara G., Dick AE, 2018. Effects of fertilization based on byproducts of plantain peel on the agromorphological parameters of the variety of Eggplant F1 kalenda (*Solanum melongena*) in the locality from Bingerville in Ivory Coast. Journal of Animal & Plant Sciences, 2018; 38(3):6292-6306.
2. Ali Garane, Koussao Some, Jeanne Nikiema, Mamoudou Traore, Mahamadou Sawadogo. Study of the behavior of nine tomato cultivars (*Solanum lycopersicum* L.) in different agro-ecological zones of Burkina Faso during wintering. Journal of Animal & Plant Sciences (J. Anim. Plant Sci. ISSN 2071-7024). 2019; 40(3):6656-6673. https://doi.org/10.35759/JAnmPlSci.v40-3.1
3. Izard D, Aprel. Protection of the eggplant under shelter. Chamber of Agriculture, 2019, 84.
4. Bakayoko Y, Kouakou AM, Dibi KEB, Ehounou AE. Essis BS, N'zué B. Effect of the Manual Pollination Period on the Fruiting of Yam (*Dioscorea rotundata Poir; Dioscoreaceae*) in Côte d'Ivoire. European Scientific Journal September 2019 edition. 2019; 1-5, No. 27 ISSN: 1857-7881 (Print) e - ISSN 1857-7431.
5. Bégin G. Potentiel d'utilisation du bran de scie comme substrat de culture pour la tomate de serre: phytotoxicité, croissance et productivité, Mémoire présenté à la Faculté des études supérieures de l'Université Laval dans le cadre du programme de maîtrise en biologie végétale pour l'obtention du grade de Maître des sciences (M. Se.). 2008; 1-16; 20; 27-29; 43-45.
6. Boudreault S. Effets des propriétés physiques et chimiques des substrats sur la croissance et le développement de plants d'épinette blanche en récipient après une saison de culture. Mémoire présenté à la Faculté des études supérieures de l'Université Laval dans le cadre du programme de maîtrise en sols et environnement pour l'obtention du grade de Maître des sciences (M. Se.). 2010, 1-13.
7. Bukenya-Ziraba R, Bonsu KO. *Solanum macrocarpon* L. In: Grubben, G. J. H. et O.A. Denton (Eds.). Ressources végétales de l'Afrique tropicale 2. Légumes. Fondation ROTA, Wageningen, Pays Bas. 2004, 544 -548.
8. Carayol R. Agriculture africaine:les raisons du malaise. Jeune Afrique. 2016.
9. http://www.jeuneafrique.com/186076/societe/agriculture-africaine-les-raisons-du-malaise/.Consulté le, 26 juil.2016 23:21:13 GMT.
10. D'Acry WG. The Solanaceae since 1976, with a review of its biography. In Hawkes JG. Lester RN; Nee M. et RN. Estrada (Eds.). Solanaceae 3. Taxonomy, chemistry, evolution. Royal Botanic Gardens, Kew, United Kingdom: 1991, 75-137.
11. Daunay MC, Lester RN, Ano G. Cultivated Eggplants. In: Tropical breeding. Charier A., Jacquot M., Hamon S. and Nicolas D. (Eds), Oxford University press, Oxford, UK., 2001, 200-225.
12. De Lannoy G. Amélioration de la mise à fruit chez la tomate en culture d'hivernage par une sélection de lignées tolérantes à la chaleur. Centre pour le Développement de. 1980.
13. l'Horticulture (CDH), Cambérène, Dakar, Sénégal, 12 p.
14. Djidji AH, Fondio L. Bien cultivé l'aubergine en Côte d'Ivoire, CNRA (Centre Nationale de Recherche

Agronomique). 2013. *http://www.agrici.net/wp-content/uploads/2016/12/ftec_aubergine.pdf*
15. FAO, 1988. Production de légumes dans les conditions arides et semi-arides d'Afrique tropicale. Etude FAO production végétale et protection des plantes. FAO, Rome, Italie. 446.
16. Fondio L, Kouamé C, N'Zi JC, Mahyao A, Agbo E, Djidji AH. Survey of indigenous leafy vegetable in the urban and peri-urban areas of Côte d'Ivoire. In: M.L. Chadha *et al*. (Eds.). Indigenous vegetables and Legumes: prospects for fighting poverty, hunger and malnutrition. Proceedings of the 1st International Conference, ICRISAT Campus, Patancheru Hyderabad, India, December 12 - 15, 2006. Drukkerij Geers, Gent, Belgium. 2007, 287-289.
17. Fondio L, N'Tamon L, Hala FN, Djidji H. Evaluation agronomique de six cultivars d'aubergine africaine (*Solanum* spp.) de la nouvelle collection des plantes légumières du CNRA, African Journal Online (AJOL), Journal Home. 2008, 20(1).
18. Fondio L, Djidji AH, N'Gbesso MF, Tahouo O, L'agriculture hors-sol pour produire des légumes de qualité en zone urbaine de Côte d'Ivoire. 2012, 8-9.
19. Grubben GJH, El Tahir IM. *Capsicum annuum* L. In: Grubben GJH. et O. A. Denton (Eds.). Ressources végétales de l'Afrique tropicale 2. Légumes. Fondation PROTA, Backhuys Publishers, Wageningen, Pays Bas. 2004,172-183.
20. Johnson F, Gbon GA, Boga JP, Aby N. Impact of insects and nematodes on the production of eggplant Solanum aethiopicum Linné, 1756 Variety Djamba F1 in the peri-urban area of Abidjan, Côte d'Ivoire. International Journal of Multidisciplinary Research and Development. 2019; 6(1):06-11.
21. Lester RN, Seck A. *Solanum aethiopicum* L. In: Grubben GJH. et O. A. Denton (Eds.). Ressources végétales de l'Afrique tropicale 2. Légumes. Fondation PROTA, Backhuys Publishers, Wageningen, Pays Bas: 2004, 530-536.
22. Mulaji KC. Use of household bio-waste composts to improve the fertility of acid soils in the province of Kinshasa (Democratic Republic of the Congo). Doctoral thesis, Gembloux Agro bio tech, 2011, 220.
23. Morel P, Poncet L, Rivière LM. Un point sur les supports de cultures horticoles. INRA. Paris. 2000, 88.
24. Noguera P, Abad M, Martinez J. Physical and chemical properties of coir waste and their relation to plant growth. Acta Hort. 1997; 450:365-373.
25. N'Tamon L. Caractérisation agromorphologique de quelques cultivars d'aubergine (*Solanum aethiopicum et Solanum macrocarpon*) collectés dans diverses zone écologiques en Côte d'Ivoire. Mémoire de fin d'étude agronomique, IPR/IRFA de Katibougou (Mali), 2007, 69.
26. Obodji A, Aboua LRN, Tano DKC, Seri-Kouassi BP. Inventory of entomofaune associated with African eggplant (*Solanum aethiopicum* L.) according to the phonological stages assessment of damages caused by insect pests. Journal of Advanced Studies in Agricultural and Environmental Sciences. 2016; 3:2455-0221.
27. Resh HM. Hydroponics food production wood bridge press publishing company. Santa Barbara, Carlifonia 93160, USA. 1989, 462.
28. Useni SY, Chukiyabo KM, Tshomba KJ, Muyambo ME, Kapalanga KP, Ntumba NF *et al*. Use of recycled human waste to increase production eggplant (*Solanum aethiopicum* L.) on a ferrasol in south-eastern DR Congo. Journal of Applied Biosciences, 2013; 66:5070-5081.