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RESEARCH ARTICLE

EFFECT OF SIX (6) PREVIOUSCROPPING ON SOYBEANGROWTH AND YIELD (GLYCINE MAX) IN THE MUNICIPALITY OF KOUANDÉ IN NORTH-WEST BENIN

Michel Batamoussi Hermann, *Sabi Bira Joseph Tokore Orou Mere, Michée Iboukoun Essegnon Raoul Gaba Yarou and Issoham Dieudonné Yocola

Département de Production Végétale, Faculté d'Agronomie, Université de Parakou, BP: 123, Parakou, Bénin

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ABSTRACT

To improve commercial broiler production, Soybean (Glycine max) is a legume that was intended for centuries before J. C to enter the rotation of cultures to fix atmospheric nitrogen. But nowadays, because of its great wealth and many interests, soy cultivation has grown in all parts of the world. The current study conducted in the municipality of Kouandé aims to assess the effect of previous cropping (maize, sorghum, cowpea, soybean, peanut and yam) on the agronomic performance of the Jupiter variety of soybean. For this objective, five (05) squares of 1m² area have been installed in the direction of the diagonals of an envelope. It come out from the results that the previous soybean yielded more flowers (38.83 ± 7.33 flowers/seedlings) followed by the previous maize (25.75 ± 10.32 flowers/seedlings) in contrast to the previousyam, which gave the lowest number of flowers (17.3 ± 71.02 flowers/seedlings). This study showed that the different treatments significantly ($P \leq 0.05$) influenced the fruiting time of soybean plants. The early onset of 50% of soybean seed pods was more pronounced with the previous maize (72.33 ± 13.31 Jas), while the number of soybean pod has significantly increased ($P \leq 0.05$) with the previous cowpea with the corollary the increase in soybean yields (2400 kg/ha ± 400 kg/ha). To improve the yields of soybeans that benefit from few inputs in its production in the municipality of Kouandé, it is desirable to precede it with cowpea, groundnut or to produce at least twice the soybean on the same area.

INTRODUCTION

A legume native of the Far East, more precisely from northern and central China (Hymowitz, 1970), soybeans (Glycine max) were intended for centuries before J.C to enter the rotation of crops to fix atmospheric nitrogen. But nowadays because of its great wealth and its many interests as for men, animals than the nature, soybean cultivation has grown in all regions over the world. Indeed, soy products have a high nutritional quality since they provide both proteins with all the essential amino acids, unsaturated fatty acids including omega 3, carbohydrates in the form of starch (with low glycemic index), fibers and certain oligosaccharides having a pre-biotic effect. In addition, many minerals including phosphorus, magnesium, iron, zinc, copper and manganese, as well as vitamins E, B1, B2, B6 and B9 are available in soybeans (Boislève, 2010). As a result, soy formulas are complete foods and constitute one of the best sources of vegetable protein (Boislève, 2010). Soy contains 42 to 48% nitrogenous material, making it the only plant providing the eight essential amino acids essential for animal growth.

Corresponding author: **Sabi Bira Joseph Tokore Orou Mere,**
Département de Production Végétale, Faculté d'Agronomie, Université de Parakou, BP : 123, Parakou, Bénin.

It has good digestibility for all types of animals (Aurélie *et al*., 2009). The mineralization of soybean crop residues enriches the soil with nitrogen, which helps to improve soil fertility, retain soil water and reduce the incidence of pests and diseases (Karaboneye 2013). For the soil, it has been shown that 90 to 100% of the leaves fall to the ground during their senescence, and that these leaves contain about 110 kg 0N. ha-1, the mineralization of residues from leaves, stems, petioles, roots and nodules is beneficial to subsequent crops (Osunde *et al*., 2003). According to FAO (2013), world, African and Beninese soybean production in 2012 amounted to 253.1 million, 2.03 million and 11,000 tons, respectively. Despite the great effort of producers, world soybean production is affected by many abiotic and biotic factors. As a result, more and more farmers are asking for information about the causes of capping their crop yields and the farming practices they could adopt to improve the potential of their land without to harm the environment. The diversification of cropping systems, more precisely the variation of previous crops, has several agronomic and environmental advantages, such as increasing yields, reducing the use of chemical fertilizers, reducing diffuse pollution and breaking the cycle of insects pests and diseases. It is therefore necessary to evaluate the effects of the different plant species (maize, yams, groundnuts, sorghum,

cowpeas, soybeans) most often cultivated and used as previous soybean crops on its growth and yield in Benin in general and especially in the municipality of Kouandé, one of the most producers of soybean.

MATERIAL AND METHODS

Plant Material: The plant material consists of the Jupiter soya variety produced in a peasant environment under the same conditions. In addition, maize, yam, soybean, cowpea and sorghum crops have been cultivated previously (previous season) on the various plots of experimentation.

Field of study: The municipality of Kouandé is located in northern Benin in the department of Atacora. It extends between parallels 9 ° 57 'and 10 ° 55' of North latitude and between the meridian 1 ° 22 'and 2 ° 01' of East longitude with an area of 4,500 Km² of which 20% of forest and 64% of cultivable land. The relief of the town is slightly hilly. The municipality of Kouandé has a Sudano-Guinean climate, characterized by a rainy season, from mid-April to mid-October. A dry season from mid-October to mid-April. The town belongs to an agro-ecological zone characterized by a high rainfall which oscillates between 900 and 1100 mm per year with a peak in August. The average temperature is 27 ° C. Moreover, in the municipality of Kouandé, the soils encountered are mainly poorly developed soils with ferruginous tendency, slightly leached soils and leached soils. Ferralitic and ferruginous-tropical soils are found, but lateritic soils and undergrowth soils are available in small areas in the northern part of the municipality. The town therefore has a very important soil potential favorable to agriculture. As for vegetation, it is dominated by saxicolous tree and shrub savanna and by the forest gallery along streams (PDC, 2011).

Method

For this study, the device used is a block made of three (3) repetitions. Each repetition is represented by a village chosen in each district of the municipality, making a total of three (03) villages. In each village, six (06) previous crops were tested: maize, sorghum, yams, cowpeas, peanuts and soybeans. The choice of villages is made according to the availability of previous crops. Each village is characterized by the simultaneous presence of the six (06) previous crops above mentioned. Thus, in each village we have six (06) separate areas previously occupied by each of the aforementioned crops. Soybeans arriving after each of these crops in the rotation, for a total of 18 elementary plots. For data collection, on each elementary parcel, five (05) squares of 1m ² areas were installed in the direction of the diagonals of an envelope that is to say a square at each corner of the parcel and a fifth square in the middle of the diagonals. Thus, per village we have thirty (30) squares making ninety (90) squares for all the three villages.

Collected data: The collection of the different data is done on these squares. Several data have been collected. These include:

- **Date of appearance of the flowers:** The counting of the flowers is done manually from the appearance of the first flower in each square and ended at the appearance of the first pod.
- **Date of appearance of the pods:** As soon as the first pod appears, each day they are counted until the number becomes unchanged in each square.
- **Height of the soya plants:** The height of the plants is measured at the end of the vegetative cycle (mature plants) using a measuring tape.
- **The yield:** At maturity, the harvest is made in the middle squares and weighed using a digital balance in each square.
- **Nodule counts:** After harvesting, the plants are pulled off with a hoe to count the nodules.

Statistical data analyzes: The collected data was processed using the EXCEL 2007 spreadsheet (the spreadsheet is used to draw the graphs or figures). The SPSS software is then used for statistical analysis and the test of the smallest significant difference (ppds) is used to compare allowed the averages. The signification threshold is 5%.

RESULTS

Effect of previous crops on the number of flowers; the date of appearance of the flowers and pods

Date of appearance of flowers: There is no significant difference ($P \leq 0.05$) between the different treatments with regard to the early appearance of flowers. The number of days after sowing corresponding to the appearance of 50% of the flowers according to the various treatments varied from 57.67 to 65.67 days after sowing (Table 1).

The number of flowers: Table 1 presents the number of flowers of the soybean plants according to the different previous crops. The analysis of the variances shows that there is a significant difference ($P \leq 0.05$) between the number of flowers of the soybean plants according to the treatments. The highest number of flowers is obtained with areas that received soybeans as a precedent crop (38.83 ± 7.336 flowers / plants) followed by maize (25.75 ± 10.32 flowers / plants) when the lowest number of flowers is obtained with the areas with yam as previous crop (17.37 ± 1.02 flowers / plants).

Date of appearance of pods: The different treatments significantly increased ($P \leq 0.05$) the early appearance of the pods. 50% of pods were obtained 72 days after sowing (jas) with the corn as previous crop against 89 days for sorghum as a precursor of soya. It comes out from the analysis of these results that corn as previous crop shortened of 16-day the soybean cycle compared to sorghum (Table 1).

Effect of previous crops on height and nodosity

Height of the plants: The different previous crops tested have significantly increased ($P < 0.05$) the growth in height of the soybean plants (Table 2). The heights of the soybean plants varied from 48.69 cm to 82.39 cm depending on the treatments. The highest soybean height is observed with the peanut as previous (82.39 ± 10.02 cm) followed by maize (80.61 ± 3.9 cm). On the other hand, the lowest heights are obtained in plots that have as previous crop the yam (48.69 cm ± 4.83 cm).

Number of nodules: The number of nodules of the soybean plants according to the different revious crops is shown in the Table 2.

Table 1. Effect of previous crops on the number of flowers; the date of appearance of the flowers and pods

previous crops	Date 50% flowers	number of flowers	Date 50% pods
maize,	62.67±10.26a	25.75±1.03a	72.33±13.31a
sorghum	65.67±3.05a	23.57±1.65a	89.00±1.00b
cowpea	60.33±2.08a	22.56±2.89a	79.33±0.057ab
soybean	57.67±1.15a	38.83±7.33b	80.33±0.57ab
peanut	60.00±3.60a	19.06±1.04a	79.00±3.60ab
yam	61.72±2.00a	17.37±1.50a	85.33±0.57b

The averages followed by the same alphabetical letter in columns are not significantly different at the 5% level.

Table 2. Effect of previous crops on height and nodosity

previous crops	height of plants (cm)	number of nodosity
maize,	80.61±3.96c	51.00±7.81a
sorghum	69.73±12.52bc	86.67±67.88a
cowpea	65.29±11.76abc	42.33±8.62a
soybean	53.72±8.46ab	54.33±10.78a
peanut	82.39±10.02c	35.67±18.58a
yam	48.69±4.83a	33.00±12.49a

The averages followed by the same alphabetical letter in columns are not significantly different at the 5% level.

Table 3. Effect of previous crops on pod numbers and yield

previous crops	pod numbers	yield (kg/ha)
maize,	40.75±10.26a	2100±100d
sorghum	37.33±3.05a	1100±100ab
cowpea	50.21±8.62a	2400±400d
soybean	39.34±10.78a	2000±500cd
peanut	35.65±18.58a	1400±400bc
yam	35.65±18.58a	600±100a

The averages followed by the same alphabetical letter in columns are not significantly different at the 5% level.

The analysis of the results reveals that a highly significant difference ($P < 0.01$) exists between the different treatments. The average number of nodules of soybean plants ranged from 33.00 nodules / plant to 86.67 nodules / plant. The induction of nodules is greater with sorghum as previous crop while the lowest number of nodules is recorded with yam as previous.

Effect of previous crops on pod numbers and yield

Number of pods: The different cultural precursors tested, significantly ($p \leq 0.05$) increased the number of pods of soybean plants (Table 3). The number of pods of soybean plants ranged from 19.67 cloves / plant to 50.21 cloves / plant according to the different treatments. The highest number of pods is obtained with cowpea as previous crop (50.21 ± 0.79 cloves / plant) followed by maize as previous (40.75 ± 16.87 cloves / plant) and soybean as previous (39.34 ± 17.96 cloves / plant). The lowest number of pods of soybean plants is obtained with the previous" yam " (19.67 ± 6.51 pods / plant).

Yield: The analysis of Table 5 shows that there is a significant difference ($P \leq 0.05$) between the different cultural precursors tested. Yields ranged from 600 kg / ha to 2400 kg / ha depending on the different treatments. The highest yields are obtained respectively with cowpea as previous (2400kg / ha ± 400kg / ha), maize (2100kg / ha ± 100kg / ha) and soybean (2000kg / ha ± 500kg / ha). By cons the lowest yield is obtained with yam as previous (600 kg ± 100 kg / ha).

DISCUSSION

The analysis of results shows that soybeans, cowpeas and peanuts as previous allowed the soybean plants to produce respectively the largest number of flowers, pods and the highest height of the plants. Wopereis *et al*. (2008) have shown that legumes often have a nitrogen fixation capacity of 10 to 50 kg / ha. (TCHABI *et al*., 2002) states that nitrogen is an essential factor in plant growth, especially in leaves and stems. These results confirm those of (WILLIAM, 2003) which reveals that an excess of nitrogen stimulates an exuberant growth of the aerial part, thus favoring an increase in the ratio of leafy stems / roots and heights of the plants. In addition, Ae *et al*. (2001) demonstrated that groundnuts root exudates were responsible for its ability to solubilize phosphorus. However, phosphorus is also an essential element in plant growth (FAO, 2005). However, since soy is not particularly prone to lodging, plant height is a minor characteristic, except that the small size corresponds often at a low insertion of the first stages of pods that can be exposed to the ground projections by the rains and therefore be more susceptible to decay (WEY and Ibrahim, 2008). Preced therefore soybean cultivation to that of peanut would avoid rotting of the most immediate pods of soil. Our results show that cowpea, maize and soybean used as previous crops yielded the best soybean yields. Cowpea and soybeans are leguminous, but for the soil, it has been shown that 90 to 100% of the leaves fall to the ground during their senescence, and knowing that these leaves contain about 110 kg N. ha-1, the mineralization of the residues from leaves, stems, petioles, roots and nodules, is beneficial to subsequent crops (Osunde *et al*., 2003), (Amadji & Aholoukpe, 2008) have shown that in some cases the increase in crop yields after cowpea is attributed to the improvement of the physicochemical properties of the soil. This role is justified by the ability of its plants to cover 40 to 80% of their nitrogen needs thanks to the symbiotic fixation according to the plant species and the sols. In addition, interesting results were also obtained with corn as previous crop. These results are due to the diet linked to the root system of these two types of crops.

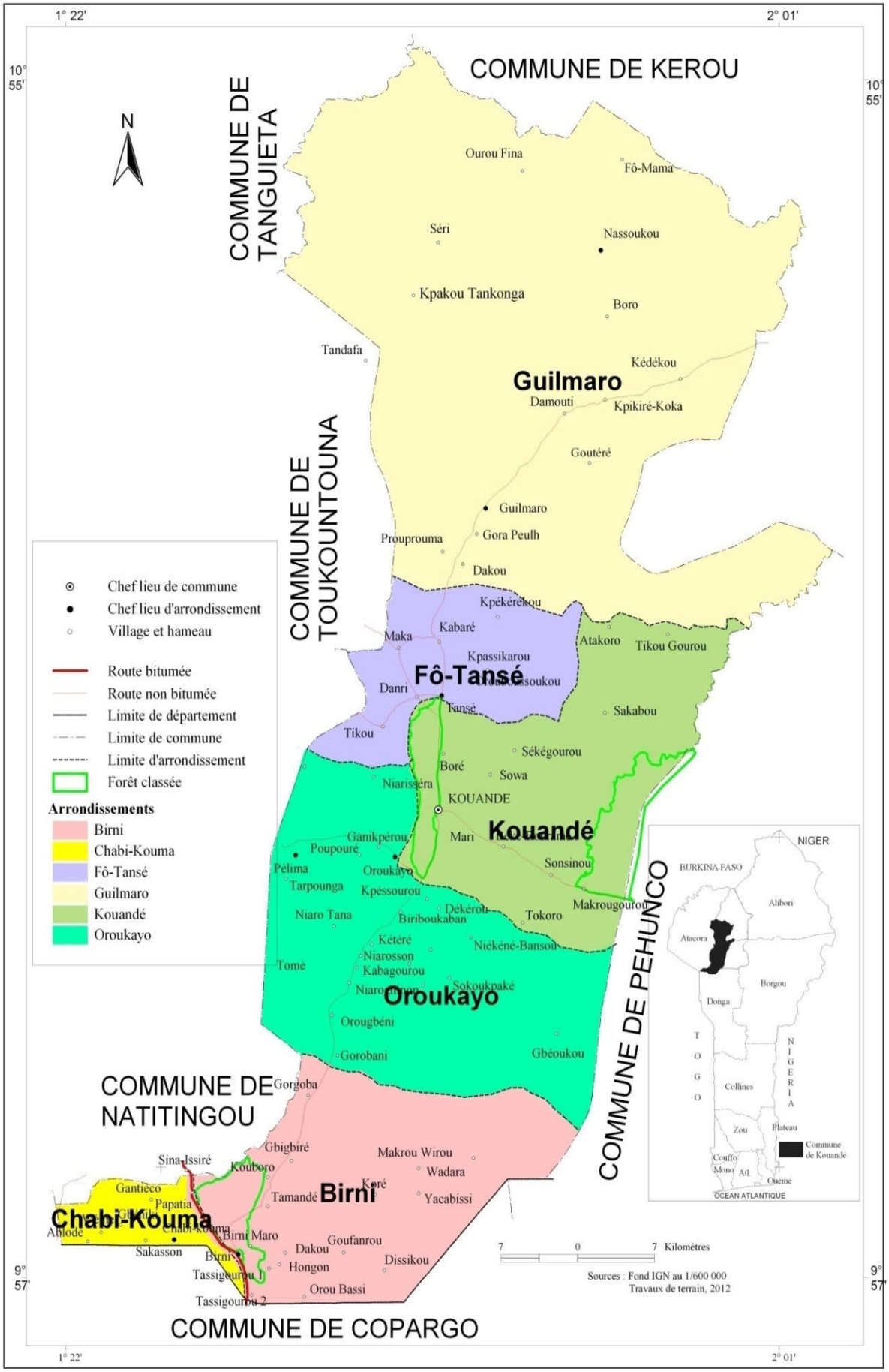

Figure 1. Map of the study area (PDC, 2011)

In fact, legumes and cereals do not have the same needs and priority in mineral elements. The results of (MAWUSSI *et al*., 2015) made it possible to classify the three nutrients studied by need for priority input to the maize crop in descending order of N> P> K. Indeed, recovery rates indicate that nitrogen was the most used mineral element for maize with a value greater than 31% compared with 11 and 9% for P and K respectively. In addition, soy is a plant that has the capacity to accumulate nitrogen in nodules. This nitrogen is used for the next crop and sometimes facilitates if soybeans return to the same plot the ease of nodule production due to symbiotic bacteria already adapted to environmental conditions. Despite the fact that soy has such a high nitrogen requirement, it should be pointed out that its good growth and development requires the equally significant quantities of potassium and phosphorus, which are minerals contained in cereal tops and which are also left by cereals at the end of the cycle thanks to the system of upwelling. This explains the satisfactory results also obtained with corn as previous crop. In addition, the studies of Vanasse carried out in 2014 on the impacts of rotations and soil quality on crops show that, to preced soybean by corn, alows also to reduce the harmful effects of sclerotia. The sorghum previous crop increased the number of nodules (86.67 ± 67.88). (Agnoro, 2008) has shown that nodulation varies according to the soil type and the previous crop of the plot. However, a large number of nodules are not synonymous with a good yield according to Losco *et al*., (2016) when they state that there is no consistent correlation between nodosities and yield. The number of nodules is not a guarantee of yield, but their good development is necessary to a correct yield. This explains the highest number of nodules recorded in soybean plants preceded by sorghum while yields are low in these treatments.

Conclusion

The results of this study showed that cowpea, maize and peanut plants used as previous crops allowed soybean plants to produce the best yields and heights in the period that the study was conducted. At the end of this study, we suggest that producers grow soybeans after legumes, especially cowpeas, peanuts and soybeans, during two successive seasons in order to improve their yield; In addition, producers can use corn in the practice of soy rotation. The supervisors of extension services must also advise of this rotation system.

REFERENCES

Ae, N., Kato, Y., Shen, R. F., Magno, B., Horst; W. J., Schenk, M. K., Burkert, A., Claassen, N., Flessa, H., Fromme, W. B., Goldbach, H., Olfs, H.W and V. Romheld 2001. Identification of phosphorus solubilizing active components (PSAC) from root cell wall or groundnut having better growth on an infertile soil among several legume crops. In: Plant nutrition: food security and sustainability of agro ecosystem through basis and applied research. Fourteenth-Int 2001: 532-533, Kluwer Academic Publishers, Dordrecht, Netherlands

Agnoro, M. 2008. Mémoire online effet de l'inoculation avec bradyrhyzobium japonicum et de l'apport de phosphore sur la productivité du soja (Glycine max) en champs paysan au Bénin 67pp.

Aurélie, B., Enesad, Emmanuelle Neyroumande, N., Cyrille, D. and WWF-France. 2009. Vers plus d'indépendance en soja d'importation pour l'alimentation animale en Europe - cas de la France, pp49.

Boislève, J. 2010. Le Soja. – www.sante-vivante.fr , 7pp

FAO, Benin. 2012-2015. Cadre de Programmation Pays. 40 pp.

FAO. 2005. Notions de nutrition des plantes et de fertilisation des sols, Manuel de formation,Projet Intrants/FAO, 11pp.

G. L. Amadji Et H. N.S. Aholoukpe, 2008. Impact du niébé (Vigna unguiculata) et de lafumure minérale sur les propriétés chimiques de la terre de barre du Bénin. 147-157pp.

Hymowitz, T. 1970. On the domestication of the soybean. Econ. Bot. 24, 408-421.

Karaboneye, F. 2013. Caractérisation de l'efficacité symbiotique des lignées africaines de soya à hautepromiscuité. Université Laval. Québec: inédit86 pp.

Losco, A. (s.d.). 2015 Campagne SOJA en Poitou-Charentes Bilan de l'observatoire 29ars– a.losco@terresinovia.fr Domaine du Magneraud - 17700 St Pierre d'Amilly Effects of previous cropping systems on soil nitrogen and grain sorghum yield, Agron. J. J. 84:862-868.

Mawussi, G., Adden, a. K., Sogbodji, J. M., Ayisah, K. and Sanda, K. 2015. Identification et hiérachisation d'éléments nutritifs déterminants pour la production du maïs (zea mays l.) sur les sols ferrugineux tropicaux au sud du Togo,. 1p.

Osunde, A., S., B., A., S., N., Okogun, and J.A. 2003. Response to rhizobial inoculation by two promiscuous soybean cultivars in soils of the southern Guinea savanna zone of Nigeria. 274-279.

Tchabi, V., Azocli, D. and Biaou, G. 2002. Effet de différentes doses de bouse de vache sur le rendement de la laitue (Lactuca sativa L.) à Tchatchou au Bénin. 81pp.

Vanasse, A. 2014. https://www.mapaq.gouv.qc.ca/. Récupéré sur Rotations et qualité des sols: quels impacts pour les cultures Site Collection Documents/ Regions/ Centredu Quebec/ INPACQ2014/ Conferences _INPACQ Grandes_cultures_et_conservation_des_sols/rotationsetqualitedessolsquelsimpactssurlescultures.pdf 17pp.

WEY, J. and Ibrahim, S. 2008. étude de faisabilité de soja et du tournesol dans la zone cotonnière du cameroun 21pp.

WILLIAM , G. 2003. Physiologie végétale. Editions De Boeck Université, rue des Minimes 39, B-100 110-115p.

Wopereis, M., Donovan, C., Guindo, D. and N'Diaye, M. 2008. Référence 15, la gestion intégrée du sol. (C. A.-G. technique, Éd.) 61pp.

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