TECHNICAL SHEET

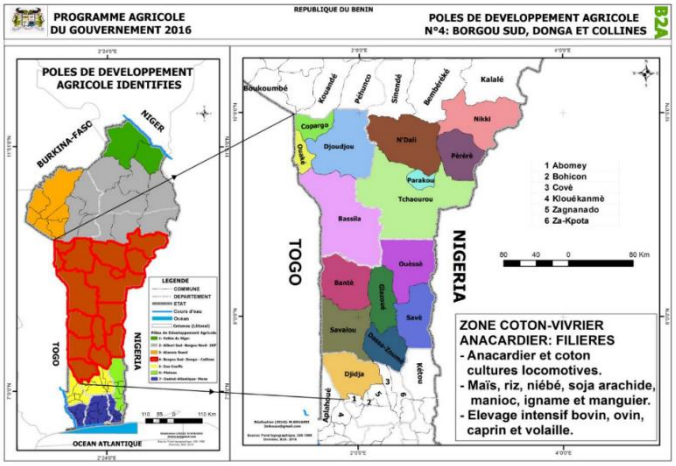
N.P.K. MINERAL FERTILIZER FORMULA FOR BETTER CASHEW NUT YIELDS ACCORDING TO PLANTATION AGE IN CENTRAL AND NORTHERN BENIN

Presentation of cashew nuts in Benin

In Benin, cashew nuts represent the second most important agricultural export product after cotton. Cashew nut exports are booming, rising from 36,487 tonnes of raw nuts exported in 2001 (PAC/DCM/SESP, 2009) to 146,332 tonnes in 2011 (ACA, 2012). Cashew nuts thus represent 8% of the total value of exports in 2008, 7% of agricultural GDP and 3% of national GDP (Tandjiékpon, 2010). The area planted is increasing from year to year. In 2015, it was estimated at 285,567.7 ha (Adégbola and Crinot, 2016).

Formulations and doses of mineral fertilizers applied to cashew trees

In 2016, Benin produced about 100,000 tons of raw cashew nuts, ranking it the fourth largest cashew producing country in Africa (BeninCajù cited by ACA, 2017). Production is therefore increasing according to the area and yields are in the range of 2-5 kg/tree (DSA, 2017). To improve these yields, and in order to overcome the very severe limitations in phosphorus and potassium recorded during preliminary studies, tests of N.P.K. mineral fertilizer formulations and doses were conducted in the Centre-Benin and North-Benin regions. These tests made it possible to determine two formulations and two optimal doses appropriate for cashew tree age classes of 3 to 5 years and 7 to 9 years for better soil fertility management and improved cashew nut yield in cashew tree plantations (INRAB/CCA-CORAF, 2017). More specifically, the study took place in the Communes of Savè and Glazoué in the Centre-Benin region and in the Communes of N'Dali and Bembéréké in the North-Benin region (Picture 1).



Picture 1: Location of the communes of Savè, Glazoué, N'Dali and Bembéréké in Benin

- Formulations and doses of mineral fertilizer applied to 7- to 9-year-old cashew trees in Centre-Benin and North-Benin

The N.P.K. mineral fertilizer formula applied to 7 to 9 years old cashew trees is N12P12K25. It was composed from simple fertilizers available on the market, namely:

- urea containing 46% nitrogen (N);
- triple super phosphate (TSP) containing 46% phosphate (P2O5)
- potassium sulphate (K2SO4) containing 50% potassium hydroxide (K2O).

This fertilizer formulation was applied at a rate of 1 kg per tree per year. The quantity of one (01) kg of this complex mineral fertilizer of formula N12P12K25 was composed from the quantities of the three simple fertilizers and is as follows:

- urea with 46% nitrogen (N): 544 g;
- triple super phosphate (TSP) at 46% P2O5: 544 g;
- potassium sulphate (K2SO4)" at 50% K2O: 1000 g.

Table 1 shows the details of this fertilization methodology.

Table 1: Composition and doses of N.P.K. fertilizer formulations applied to 7-9-year-old cashew trees in Central and Northern Benin

Age (years)	**elements fertilizers provided**	**Fertilizer formulas applied**	**Fertiliser formulas developed**	**Regions concerned**	**Recommended fertiliser rate (kg/tree/year)**	**Corresponding quantities of straight fertiliser applied (g)**
7-9	Nitrogen (N)	Urea containing 46% nitrogen	$N_{12}P_{12}K_{25}$	Benin-Centeret Benin-North	1	544
	Phosphorus (P)	Triple super phosphate (TSP) containing 46% phosphate (P2O5)				544
	Potassium (K)	Potassium sulphate (K2SO4) containing 50% potassium hydroxide hydroxide (K2O)				1000

- Formulations and doses of mineral fertilizers applied to 3 to 5 years old cashew trees in North Benin

In the North Benin region, the N15P15K17 formulation was applied to cashew trees aged 3 to 5 years at a rate of 0.80 kg/tree per year. This amount corresponds to 580 g urea, 580 g TSP and 533 g K2SO4.

This fertilizer formulation was composed from the same simple fertilizers available on the market, and previously described for the N12P12K25 formulation applied in Centre-Benin and North-Benin for 7 to 9 years old cashew trees.

Table 2 shows the details of this adopted methodology.

Table 2: Composition and doses of N.P.K. fertilizer formulations applied to 3 to 5 years old cashew trees in North Benin

Age (years)	**elements fertilizers provided**	**Fertilizer formulas applied**	**Fertiliser formulas developed**	**Regions concerned**	**Recommended fertiliser rate (kg/tree/year)**	**Corresponding quantities of straight fertiliser applied (g)**
3-5	Nitrogen (N)	Urea containing 46% nitrogen	$N_{15}P_{15}K_{17}$	Benin North	0,80	580
	Phosphorus (P)	Triple super phosphate (TSP) containing 46% phosphate (P2O5)				580
	Potassium (K)	Potassium sulphate (K2SO4) containing 50% potassium hydroxide hydroxide (K2O)				533

- Application of NPK mineral fertilizer formulations to cashew trees of different ages in Centre-Benin and North-Benin

The same methodology was adopted for the application of doses of different mineral fertilizer formulations in both regions (Centre-Benin and North-Benin) for cashew trees of both age classes.
The fertilizer doses were applied around the cashew trees at the edge of the foliage crown (Picture 2). A small hole about 5 cm deep is opened around the tree with a hoe. The fertilizer is spread in the hole, which is closed immediately afterwards. The application takes place as soon as the rains start in June and July.

Picture 2: Application of fertilizer around a cashew tree in June 2015 in a plantation in the commune of Bembéréké (Source: Photo Badou, 2015)Autres entretiens de conduite des plantations d'anarcadiers)

- **Other management maintenance of the tea tree plantations**

Before and after the application of mineral fertilizers, the plantations were mown during the months of June and July. This maintenance limits competition from weeds with cashew trees and prevents the herbaceous biomass of the undergrowth from serving as a niche for other pests such as insects and pathogens responsible for diseases. Indeed, Bello et al (2012) and Bello (2013) had observed that weeds are plant pests with negative impacts as important as those of insects and crop pathogens. Thus, these authors recommended that weeds be managed as best as possible to prevent cashew trees from benefiting less from mineral fertilizer.

A firebreak of at least 10 m was also built around the plantations, followed by a fire to spare them from a possible fire that may occur in the dry season.

- **Implication for development**

The application of mineral fertilizers of the formulations N12P12K25, and N15P15K17 resulted in higher cashew nut yields compared to the non-application of mineral fertilizer, which remained the farmers' practice until the start of the present study (Table 3).

The application of the mineral fertilizer formulation N12P12K25 at a dose of 1 kg/tree/year increased cashew nut yields by 39% to 160% in 7 to 9 years old plantations in the Centre-Benin and North-Benin regions. With the formulation of mineral fertilizer N15P15K17 at a dose of 0.80 kg/tree/year in the North-Benin region, cashew nut yields increased from 11% to 82% in plantations aged 3 to 5 years (INRAB/CCA-CORAF, 2017).

Table 3: Comparative nut yields (kg/tree) and improvement levels of NPK mineral fertilizer formulations applied at different rates in Central Benin and Northern Benin

	No application of mineral fertilizer	Application of mineral fertilizer at the following rates:	
		1 kg de $N_{12}P_{12}K_{25}$	0,80 kg de $N_{15}P_{15}K_{17}$
Regions	Benin Center end North	Benin Center and North	Benin North
Age of cashew trees (years)	3 to 9	7 to 9	3 to 5
Cashew nut yield (kg/tree)	2,08 ± 0,49 à 3,39 ± 0,45	2,89 ± 0,45 à 5,41 ±0,45	3,76 ± 0,49
Level of improvement (%)	-	139-260	111-182

These results highlight the need to use mineral fertilizer to increase cashew nut yields in cashew plantations that are subject to declining soil fertility. Nevertheless, efforts must be made within the framework of sustainable management of soil organic matter to support the effectiveness of the applied mineral fertilizer.

Bibliographiques references

ACA. 2017. Rapport annuel 2016. 28 p.
ACA. 2012. Annual report 2011. 16 p.
ADEGBOLA P. Y., G. CRINOT. 2016. Recensement des producteurs d'anacarde, des vergers d'anacardiers et des unités de transformation de cajou au Bénin. Rapport technique. Ministère de l'Agriculture, de l'Elevage et de la Pêche, (MAEP), Programme Cadre d'Appui à la Diversification Agricole (ProCAD), Projet d'Appui à la Diversification Agricole (PADA), Janvier 2016, 59 p.

BELLO S. 2013. Développement participatif d'un itinéraire technique de gestion intégrée de l'enherbement de l'oignon (*Allium cepa* L.) au Nord-Est du Bénin. Thèse de Doctorat Unique en Sciences Agronomiques, Université d'Abomey-Calavi, 359 p.

BELLO S., A. Ahanchédé, G. Amadji, G. Gbèhounou et N. Aho. 2012. Effet de la fumure minérale sur l'enherbement et la production de l'oignon (*Allium cepa* L.) au Nord-Est du Bénin. *Int. J. Biol. Chem. Sci. 6(6) : 4058-4070*, Décembre 2012. ISSN 1991- 8631. DOI : http : //dx.doi.org/10.4314/ijbcs.v6i6.16.

Site web : http://www.ajol.info/index.php/ijbcs.

DSA. 2017. Rapport de l'enquête d'estimation de rendement de l'anacarde au Bénin. MAEP, République du Bénin, 55 p.

INRAB/CCA-CORAF. 2016. Rapport d'activités 2015 du projet « Renforcement des capacités des acteurs de la chaîne de valeur anacarde en Afrique de l'Ouest ». INRAB/CRA-Centre, 30 p.

INRAB/CCA-CORAF. 2017. Rapport d'activités 2017 du projet « Renforcement des capacités des acteurs de la chaîne de valeur anacarde en Afrique de l'Ouest ». INRAB/CRA-Centre, 33 p.

PAC/DCM/SESP. 2009. Evolution du trafic marchandises : période 1999 à 2008.

PSRSA. 2011. Plan stratégique de relance du secteur agricole ; rapport du ministère de l'agriculture de l'élevage et de la pêche (MAEP), 109 p.

Tandjiékpon, 2010. Analyse de la chaîne de valeur du secteur anacarde du Bénin.

GTZ/iCA. 64 p.

Other references : MINISTRY OF AGRICULTURE, FARMING AND FISHERIES REPUBLIC OF BENIN 01 B P 884 Cotonou -Benin Tel. + 229 64 28 37 02 /+ 229 21 30 04 10 www.inrab.org National Institute of Benin Agricultural Research (INRAB) CENTER OF AGRICULTURAL RESEARCH CENTER (CRA-CENTRE / SAVÈ) B. P. 112 Savè (Benin) w Tel: (229) 22 55 00 89 w E-mail: cracentre@yahoo.fr N'DJOLOSSE Kouami BADOU Antoine BELLO Saliou MALIKI Raphiou KPERA Gnanki Nathalie OUIKOUN Gaston AZONTONDE Anastase.