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Defoliation Effects on the Production of Cowpea Pods

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***Abstract* – In Sudano-Sahelian zone of Chad, cereals are the basis of food. The diversification of this diet requires the introduction of foods rich in protein and minerals and justifies the quantitative improvement of the leaves and seeds of cowpea. The purpose of this study is to determine the period when leaf removal has less impact on pod production. The effect of defoliation on pod production was verified on three pure lines grown in the field. The experimental device is a split plot with three repetitions with the three genotypes that constitute the main treatments and the nine modes of defoliation. The analysis of variance in the collection data shows a significant difference between the average number of leaves per plant and the number of pods per plant depending on the number of leaf samples. The removal of 5 leaves at 40 days after emergence stimulates pod production. This stage seems to be the ideal stage of sampling.**

***Keywords* – *Vigna Unguiculata*, Defoliation, Pod, Sudano-Sahelian Zone.**

I. Introduction

The cowpea [*Vigna unguiculata* (L.) Walp.] is a diploid legume [1] preferentially autogamous [2] cultivated mainly in the tropical and subtropical savanna regions of Africa, Asia and South America [3]. World production of cowpea seed amounts to about 6.4 million tones with an above-ground biomass of 888 kg / ha [4]. Cowpea is consumed from the seedling stage to the harvest (seedling, young leaves, young pods, immature pods, dry pods) and is used in several African dishes [5], [6]. Cowpea seeds are consumed in the form of steamed cake called koki and kosaiou donut [7], [8]. Seeds are also used in the formulation of simple weaning foods for children [9], [10], [11], [12]. Seeds contain many proteins, vitamins and minerals essential for human nutrition in poor countries [13], [14], [15]. Cowpea leaves are eaten as vegetables [6], [16]. In Botswana and Zimbabwe, water-baked cowpea leaves are kneaded and the resulting pulp is compacted into small pellets, which are then dried for preservation [17], [18]. The leaves are also used in the poultice to treat swelling, skin infections and dental pain [19]. Some varieties are grown as fodder and the tops are reserved for animal feed after harvesting the seeds [20], [21], [22]. Notwithstanding the benefits of cowpea seeds and leaves, leaves are harvested at all stages of plant development either for direct consumption (fresh leaves) or for storage (dry leaves) [23]. It is evident that seed yield and leaf production are correlated [24]. Therefore, it would be wise to determine the period when leaf removal has less impact on pod production.

II. Materials and Methods

Research was conducted at the experimental farm in Gassi (Ndjamena). Ndjamena is the capital of the Republic of Chad (12 ° 06 '59 "N latitude, 15° 04' 20" East longitude, 298m altitude). The relief of the study area is slightly flat. The area is the area of vertisols and hydromorphic soils. These soils, which are differentiated from one another by a slightly dissimilar hydric regime, are all argilo-sandy to clayey, with calcareous nodules quite rich in nutrients, phosphorus apart [25]. The study area has a tropical climate. It has two seasons, including a long dry season (7-8 months, from November to May) and a short wet season (3-5months, from May to October). The rainfall varies between 400 and 700 mm / year in the form of more or less violent showers. The observed temperatures in N'Djamena are between 20 ° C and 45 ° C in the dry season and between 18 ° C and 30 ° C in the rainy season [26].

The plant material consisting of 03 improved entries from the National and International Research Institutes was evaluated at the station under the conditions of the Sudano-Sahelian zone of Chad:

- ✓ Two improved varieties of IITA currently being popularized in the Sudano-Sahelian zone by the Institute for Agronomic Research for Development (IRAD), Maroua Station namely: IT93K-693-2 and IT97K-819-118;
- ✓ An improved variety from Burkina Faso in extension in Chad namely KVX414-22-2.

After delineation, plowing of the plots using the hoe and the shovel and making mounds, a semi by hand with 3 to 4 seeds coated with Insector-T® (Imidacloprid 350 g / kg + Thiram 100g / kg DS) per pouch was performed. The spacings between the pockets were 0.8 m on the line and 0.50 m between the pockets [27]. After unmarking at 2 plants per plant at 2 weeks post-emergence, treatment and maintenance operations such as weeding were carried out [27]. A first pass of Optimal® 20 SP Insecticide (Acetamiprid 200g / kg, SP) was performed at 2 weeks after germination following ants attack onset. A second pass was made 10 days after the first pass. Other passages of this insecticide have been made as needed. During flowering and fruiting, treatments with Cypercal® (Cypermethrin + Dimethoate at doses of 30g + 250g a.i / L, respectively) had allowed the control of pests. Mineral fertilizer NPK 10.10.10 was applied to the plots three weeks after sowing at a rate of 60 kg / ha.

The experimental setup is a split plot with three repetitions with the three genotypes that constitute the main treatments and the nine modes of defoliation (T0: no defoliation, T1: 5 leaves taken at 40 days after emergence,

T2: 10 leaves taken at 40 days after emergence, T3: 5 leaves taken at 45 days after emergence, T4: 10 leaves taken at 45 days after emergence, T5: 5 leaves taken at 60 days after emergence, T6: 10 leaves taken at 60 days after emergence, T7: 5 leaves taken 75 days after emergence, T8: 10 leaves taken 75 days after emergence).

Of the plants previously selected, 5 leaves were taken manually on one and 10 leaves on the other respectively at 40 days, 45 days, 60 days and 75 days after emergence. Five plants are retained and labeled by repetition. The measured parameters are:

- ✓ Number of leaves per plant (NLP) : the NLP parameter was measured on 5 plants for each replicate. On pre-selected plants at different stages after leaf collection, the number of leaves was determined using a marker (counted leaves were identified to facilitate counting);
- ✓ Number of pods per plant (NPP). On plants selected beforehand at different stages after leaf collection, the pod per plant (NPP) was obtained by counting the viable pods borne by mature plants.

III. Results

Analysis of field observations shows that cowpea varieties have a 100% emergence rate at 6 days. Flowering occurred 55 days after emergence, 61 days after sowing. At 75 days after sowing, cowpea seedlings had already produced pods. Some pods were already fresh, so they were ready to be harvested as vegetables or condiments. At this time, the plants were at the same time flower buds, blooming flowers, immature pods and mature green pods. These observations also show delayed flowering as a function of leaf samples. Leaf sampling (5-10) results in a flowering shift of about one week.

Analysis of variance of the sampling data shows a significant difference between the average number of leaves per plant and the number of pods per plant based on the number of leaf samples (Table 1).

Table 1. Evolution of the number of pods according to the leaf samples.

	IT93K-693-2		IT97K-819-118		KVX414-22-2		Means	
	NLP	NPP	NLP	NPP	NLP	NPP	NLP	NPP
T0	$45.67^{b} \pm 5.13$	$29.66^{b} \pm 2.08$	$43.52^{b} \pm 3.02$	$27.15^{c} \pm 4.10$	$44.23^{b} \pm 2.15$	$28.72^{c} \pm 3.03$	44.47 ± 1.09	28.51 ± 1.27
T1	$49.02^{a} \pm 1.12$	$30.12^{a} \pm 3.23$	$45.08^{a} \pm 1.65$	$27.87^{a} \pm 2.88$	$45.25^{a} \pm 1.09$	$30.55^{a} \pm 3.01$	46.65 ± 2.23	29.51 ± 1.44
T2	$44.33^{d} \pm 4.16$	$28.88^{f} \pm 2.13$	$40.12^{e} \pm 4.04$	$26.76^{f} \pm 2.06$	$42.78^{d} \pm 3.93$	$29.02^{b} \pm 1.80$	42.41 ± 2.13	28.22 ± 1.27
T3	$45.10^{c} \pm 3.51$	$29.01^{e} \pm 2.53$	$42.98^{c} \pm 3.01$	$26.84^{e} \pm 2.10$	$43.55^{c} \pm 2.88$	$28.15^{e} \pm 2.76$	43.88 ± 1.10	28.00 ± 1.09
T4	$42.00^{e} \pm 3.46$	$28.33^{g} \pm 0.58$	$41.12^{d} \pm 3.26$	$26.32^{g} \pm 0.86$	$41.75^{e} \pm 3.13$	$27.14^{g} \pm 1.01$	41.62 ± 0.45	27.26 ± 1.01
T5	$39.33^{f} \pm 6.03$	$27.00^{h} \pm 1.00$	$38.02^{f} \pm 1.34$	$25.68^{h} \pm 2.02$	$38.45^{f} \pm 2.01$	$26.04^{h} \pm 1.74$	38.60 ± 0.67	26.24 ± 0.68
T6	$34.33^{g} \pm 6.02$	$25.67^{i} \pm 0.58$	$32.85^{g} \pm 1.46$	$22.98^{i} \pm 0.69$	$33.08^{g} \pm 1.97$	$23.52^{i} \pm 1.00$	33.42 ± 0.80	24.06 ± 1.42
T7	$27.67^{h} \pm 3.51$	$29.46^{c} \pm 2.18$	$25.12^{h} \pm 2.10$	$27.45^{b} \pm 4.67$	$24.42^{h} \pm 1.98$	$28.65^{d} \pm 2.50$	25.74 ± 1.71	28.52 ± 1.01
T8	$12.68^{i} \pm 1.20$	$29.09^{d} \pm 2.36$	$10.56^{i} \pm 2.57$	$26.85^{d} \pm 4.01$	$10.09^{i} \pm 1.68$	$27.98^{f} \pm 2.01$	11.11 ± 1.38	27.97 ± 1.12

T0: no defoliation, T1: 5 leaves taken at 40 days after emergence, T2: 10 leaves taken at 40 days after emergence, T3: 5 leaves taken at 45 days after emergence, T4: 10 leaves taken at 45 days after emergence, T5: 5 leaves taken at 60 days after emergence, T6: 10 leaves taken at 60 days after emergence, T7: 5 leaves taken 75 days after emergence, T8: 10 leaves taken 75 days after emergence, NLP: number of leaves per plant, NPP : number of pods per plant.

The collection of 10 leaves at 60 days post-emergence results in an extreme reduction in the average number of pods per plant (24.06 ± 1.42) while the removal of 5 leaves at 40 days after emergence stimulates pod formation (29.51 ± 1.44). Averages in table 1 show that leaf samples at 40 days after emergence increase pod production. On the other hand, when the sampling threshold is 10 sheets, the opposite occurs. Collection of 5 leaves at the 40 day stage seems to be the best time to take leaves. At 45 days after emergence, 5 leaf samples do not have sufficient impact on the number of pods per plant. On the other hand, samples of 10 leave instigate a rather severe reduction in the number of pods per plant. Therefore, it would be advisable to take 5 leaves at the 45 day stage.

At 60 days, regardless of the number of leaves taken (5 or 10 leaves), the samples have very negative effects on the number of pods per plant. It turns out that the 60 day stage is not conducive to sampling.

Leaf samples at 75 days, whether 5 leaves or 10 leaves, have no effect on the number of pods per plant. At this stage, the pods have already reached maturity. On the number of leaves per plant, it should be noted that the collection of leaves at 75 days reduces the average number of leaves per plant by half. The 75 day stage seems to be a magnificent leaf-picking stage (5 or 10 leaves). The only problem is that at this stage there are not enough young leaves prized by consumers.

IV. Discussion

Analysis of the average number of leaves per plant and the number of pods per plant showed a great variability within the genotypes studied. Similar results were obtained by [28] on cowpea leaves.

For the emergence rate, the results are much higher than those obtained by [29]. This difference is explained by the fact that [29] evaluated the emergence rate at 3 days. The rate of emergence may vary depending on the number of days. The averages obtained for the number of leaves per plant are similar to those obtained by [24] in the high Guinean savanna zone of Cameroon. These authors reported a range of 25.5 to 72.6 leaves per plant. In this same area, [23] also obtained a number of leaves per plant in the range of [24]. As foliar production of cowpea varies

with genotypes, our genotypes used adapt well to the pedoclimatic conditions of the study area for this parameter. Concerning the averages of the number of pods per plant, our averages are similar to those obtained by [24], by [29] in Benin and by [30] in Ivory Coast.

Samples from 5 leaves to 40 days after emergence stimulate pod production. It is possible that this sampling encourages the entry into action of the meristems of expectations responsible for the production of lateral leafy branches at the origin of the additional production of pods. In addition, [23] recommend harvesting young leaves because of the accumulation of a large amount of minerals needed for photosynthesis by old leaves. [31] Noted that the protein content of cowpea leaves ranged from 43g/100g for 10 day old leaves to 30.5g/100g for 25 day old leaves.

Samples of 10 leaves at 45 days and 5 and 10 leaves at 60 days have negative effects on the number of pods per plant. It appears that flowers and immature pods require a maximum of nutrients during flowering and fruiting, and that leaf sampling, the seat of synthesis of these nutrients, results in a decrease in the distribution of nutrients. The elaborate sap causing the fall of newly formed flowers and pods.

Leaf samples at 75 days, whether 5 leaves or 10 leaves, have no effect on the number of pods per plant. The reduction in the number of leaves would cause the pods to mature quickly because the plant will seek to store the substances in the seeds for the survival of the species. On the number of leaves per plant, it should be noted that the collection of leaves at 75 days reduces the average number of leaves per plant by half. This drop rate is explained by the senescence of the old leaves associated with the samples [32].

V. Conclusion

Defoliation has positive effects on pod production by 40 days after emergence and maximum harvest is about five leaves per plant. Defoliation at this stage stimulates the production of leaves and pods.

References

[1] Faris DG. (1964). The chromosomes of *Vigna sinensis* (L.) *Savi. Canad. J. Genet. Cytol.*, **6**, 255-258.

[2] Tchuenguem FFN, Ngakou A, Kengni BS. (2009). Pollination and yield responses of cowpea (*Vigna unguiculata* L. Walp.) to the foraging activity of *Apis mellifera adansonii* (Hymenoptera: Apidae) at Ngaoundere (Cameroon). *African Journal of Biotechnology,* **8**, 1988-1996.

[3] Maréchal R. (1970). Donnees cytologiques sur les especes de la sous-tribu des Papilionaceae – Phaseoleae - Phaseolinae (Cytological data on species of the Papilionaceae-Phaseoleae-Phaseolinae subtribe). Deuxieme série. *Bull. Jard. Bot. Nat. Belg.,* **40**, 307-348.

[4] Yoka J., Loumeto J.J., Djego J.G., Houinato M. & Aouango P. (2014). Adaptation d'un cultivar de niébé (of a cowpea cultivar) (*Vigna unguiculata* L. (Walp.) aux conditions pédoclimatique de la zone de Boundji (République du Congo) (the pedoclimatic conditions of the Boundji area (Republic of Congo)). *Afrique Science,* **10, 1**, 217-225.

[5] Akundabweni LS, Paul CP, Singh BB. (1991). Evaluation de lignées d'élite de niébé pour un (of cowpea elite lines for a) usage double (feuilles/fourrage et graines). *In : la recherche à (research at) IITA,* ***3,*** *6-7.*

[6] Abizari A, Pilime N, Armar-Klemesu M, Brouwer I.D. (2013). « Cowpeas in Northern Ghana and the Factors that Predict Caregivers' Intention to give them to Schoolchildren ». *PLoS One*, **8**, 8.

[7] Mbofung CMF, Ribgy N, Waldron KW. (1999). Use of two varieties of hard-tocook beans (*Phaseolus vulgaris*) and cowpea (*Vigna unguiculata*) in the processing of koki (a steamed legume product). *Plant Food Hum. Nutr.,* **54**, 131-150.

[8] Kaptso KG, Njintang NY, Hounhouigan JD, Scher J, Mbofung CMF. (2007). Production of Bambara groundnut (*Voandzeia subterranean*) flour for use in the preparation of koki (a steamed cooked paste): Effect of pH and salt concentration on the physicochemical properties of flour. *International Journal of Food Engineering*, **3, 3**, 1-20.

[9] Oyeleke OA, Morton ID, Bender AE. (1985). The use of cowpeas (*Vigna unguiculata*) in improving a popular Nigerian weaning food. *British Journal of Nutrition,* **54**, 343-347.

[10] Mensa-Wilmot Y, Phillips RD, Hargrove JL. (2001). Protein quality evaluation of cowpea-based extrusion cooked cereal/legume weaning mixtures. *Nutrition Research,* **21**, 849-857.

[11] Egounlety M. (2002). Production of legume-fortified weaning foods. *Food Research International,* **35**, 233-237.

[12] Magda SM, Dalia MEN. (2013). Nutritional evaluation of weaning food blends fortified with some carotenoids-rich vegetables. *J. Appl. Sci. Res.,* **9, 3**, 1573-1582.

[13] Hall E, Cissé N, Thiaws S, Elaward HOA, Eblers JD, Ismail AM, Fery RL, Robert PA, Kitch LW, Murdock L, Boukar O, Phillips RD, Mc Walters KH. (2003). Development of cowpea cultivars and germoplasm by bean/cowpea CRSP. *Field Crops Research*, **82**, 103-134.

[14] Vasconcelos IM, Maia FMM, Farias DF, Campello CC, Carvalho AFO, Moreira RA, Abreu de Oliveira JT. (2010). Protein fractions, amino acid composition and antinutritional constituents of high-yielding cowpea cultivars. *J. Food Compos. Anal.,* **23**, 54-60.

[15] Sreerama YN, Sashikala VB, Pratape VM, Singh V. (2012). Nutrients and antinutrients in cowpea and horse gram flours in comparison to chickpea flour: evaluation of their flour functionality. *Food Chem.,* **131**, 462-468.

[16] Fofiri Nzossie EJ, Ndame JP, Temple L, Ndjouenkeu R, Simeu Kamdem M. (2008). Croissance urbaine et innovations dans les (and innovations in) filieres vivrieres: Cas du maïs et du niébé dans les savanes du Cameroun (Case of maize and cowpeas in the savannahs of the Cameroon). 2èmes journées de recherches en sciences sociales (2nd days of research in social sciences). INRA SFER CIRAD, 11-12 décembre (December) 2008, Lille, France, 24p

[17] Pasquet RS, Baudoin JP. (1997). Le niébé, *Vigna unguiculata (The cowpea, Vigna unguiculata). In: Charrier A., Jacquot M., Hammon S. & Nicolas D. (eds.).* L'amélioration des plantes tropicales (The improvement of tropical plants). Montpellier, France: CIRAD-ORSTOM, 483-505.

[18] Langyintuo AS, Lowenberg-DeBoer J, Faye M, Lambert D, Ibro G, Moussa B, Kergna A, Kushwaha S, Musa S, Ntoukam G. (2003). Cowpea supply and demand in West and Central Africa. *Field Crops Research,* 82, 215-231.

[19] Grubben GJH, Denton OA. (2004). *Ressources Végétales de l'Afrique Tropicale: Legumes,* (Vol. **2**). Fondation PROTA Backhuys Publishers: Wageningen - Leyden, 737p.

[20] Magha L. (1984). L'amélioration du niébé *Vigna unguiculata* (L) au Niger. *In : les légumineuses alimentaires en Afrique.*

[21] Medugu CI, Mohammed G, Raji AO, Barwa E, Andi Zhinma A. 2012. Utilization of different forages by growing rabbits. *I.J.A.B.R.,* **2, 3**, 375-381.

[22] Hassan MR, Amodu JT, Muhammad IR, Jokthan GE, Abdu SB, Abdullahi B, Adamu HY, Musa A, Sani I, Akpensuen TT. (2014). Forage yield and quality of lablab (*Lablab purpureus* L. Sweet) intercropped with maize (*Zea mays* L.) with flooded irrigation system in the semi-arid zone of Nigeria. *Journal of Agricultural Science,* **6, 11**, 196-211

[23] Megueni C, Awono ET, Ndjouenkeu R. (2011). Effet simultané de la dilution et de la combinaison du Rhizobium et des mycorhizes sur la production foliaire et les propriétés physico-chimiques des jeunes feuilles de *Vigna unguiculata* (L.) Walp. *J. Appl. Biosci.,* **40**, 2668 – 2676.

[24] Noubissié TJB, Youmbi E, Njintang YN, Ndogonoudji AA, Nguimbou MR, Bell JM. (2011). Genetic architecture of some leaf yield and quality attributes in dual-purpose cowpea (*Vigna unguiculata* L. Walp.). *American Journal of Experimental Agriculture,* **1, 4**, 400-413.

[25] Guelmbang ME. (2010). Les aspects socioéconomiques: état des lieux et diagnostic initial pour la foresterie urbaine et périurbaine de N'Djaména. Rapport d'étude thématique (Socio-economic aspects: state of play and initial diagnosis for urban and peri-urban forestry in N'Djamena. Thematic study repor). 41p.

[26] Pias. (1972). *Les formations sédimentaires tertiaires et quaternaires de la cuvette tchadienne et les sols qui en dérivent (Tertiary and Quaternary sedimentary formations of the Chadian basin and the soils derived from it)*. OROSTOM. Paris. 398 p.

[27] Dugje IY, Omoigui LO, Ekeleme F, Kamara AY, Ajeigbe H. (2009). *Production du niébé en Afrique de l'Ouest: Guide du paysan (Cowpea production in West Africa: A peasant's guide)*. IITA, Ibadan, Nigeria. 20p.

[28] Stoilova T, Pereira G. (2013). Assessment of the genetic diversity in a germplasm Collection of cowpea (*Vigna unguiculata* (L.) Walp.) using morphological traits. *African Journal of Agricultural Research,* **8, 2**, 208-215.

[29] N'gbesso FDPM, Fondio L, Dibi Bek, Djidji HA, Kouame CN. (2013). Étude des composantes du rendement de six variétés améliorées de niébé (Study of yield components of six improved varieties of cowpea) [*Vigna unguiculata* (L.) Walp]. *Journal of Applied Biosciences,* **63**, 4754 – 4762.

[30] Gbaguidi AA, Assogba P, Dansi M, Yedomonhan H, Dansi A. 2015. Caractérisation agro morphologique des variétés de niébé cultivées au Bénin (Agro-morphological characterization of cowpea varieties grown in Benin). *Int. J. Biol. Chem. Sci*., **9, 2**, 1050-1066.

[31] Bubenheim DL, Mitchell CA, Nielsen SS. 1990. Utility of cowpea foliage in crop production for space. *In: Janick, J., Simon, J.E. (Eds).* Advances in new crops. Timber Press, pp. 535-538.

[32] Triboi-Blondel A.M., Bonnemoy B., Falcimagne R., Martignac M., Messaoud J., Philippon J., Vear F. (2000). The effect of temperature from flowering to maturity on seed composition of high oleic sunflower inbred and mid-oleic hybrids. *In: Proceedings of 15th International Sunflower Conference,* 12-15/06 2000, Toulouse, France, A66-72.