Domestication of *Senna obtusifolia*, an Important Leafy Vegetable for the Sahel

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Abstract

***Senna obtusifolia* (syn. *Cassia obtusifolia*) is a herbaceous plant, grows in the Sahelian and the Sudano regions of sub-Saharan Africa and regarded as one of the leading indigenous leafy vegetables of the Sahel. In 2006, two sets of trials were carried out at the Sadore station of ICRISAT in order to evaluate the potential of *S. obtusifolia* as a new rain-fed crop for the Sahel. The high density planting (0.5 x 0.5 m) gave significantly higher leaf, seeds and stems yields (1, 1 and 2.5 t/ha respectively) on a dry matter basis than the lower density treatments. *S. obtusifolia* can provide food to the rural population during August and September at a time that grain reserves from the previous year harvest have been exhausted. *S. obtusifolia* is high in protein, fibers, and minerals. *S. obtusifolia* gave high leaf yield (1 t/ha dry weight) when planted as an intercrop in young *Acacia senegal* plantations both on sandy and on degraded lateritic soils but a very low leaf yield (100 kg/ha) when planted in a mature *A. senegal* plantation. *S. obtusifolia* has a good potential to serve as a new important field crop for the Sahel.**

INTRODUCTION

Senna obtusifolia (= *Cassia obtusifolia*) is an annual plant belonging to the family Caesalpiniaceae. It grows wild throughout the Sahelian and the Sudano regions of Africa, in disturbed soils probably due to effective colonization of its roots system with endomycorrhizal fungi (Duponnois et al., 2001). *S. obtusifolia* is considered to be one of the important leafy vegetables of the Sahelian region (Seck et al., 1999; Diouf et al., 1999). In the Sahelian region of Sudan it is used, after fermentation, as a meat substitute due to its high protein content (Dirar, 1984). In Niger it is ranked among the most popular leafy vegetables. It is consumed fresh and dry during the rainy season or dry during the rest of the year. It is mostly collected from the wild but farmers started growing it in small plots on the borders of cereal fields or in rain-fed home gardens.

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)-Niger initiated a program of crop diversification for the Sahel. *S. obtusifolia* was selected as a species for domestication because of its importance as a food in the Sahelian region and its relatively high market value and tradability in the rural and urban markets. In addition, *S. obtusifolia* has an apparent high productivity rate, seeds germinate readily, and leaves are not palatable by ruminants. This paper reports the first year of research that should lead to the domestication of this leafy vegetable.

MATERIALS AND METHODS

Two activities were carried out: A field trial to study optimal planting density of *S. obtusifolia* on leaf, seeds and stems biomass yield and secondly, observations on the use of *S. obtusifolia* as an intercrop in *A. senegal* plantations.

The trial was conducted at ICRISAT Sadore Research Station in Niger. The soil is sandy (93%) siliceous isohyperthemic Psammentic Paleustalf. The cation exchange capacity is of 0.9 Cmol/kg, and organic matter content less than 0.2%. The soil is acidic with pH (KCl) of 4.1, and phosphorus is less (Bray-1 P is 2.8 mg/kg). The experimental field was planted with cowpeas in the previous season. Three planting densities: (0.5 x 0.5, 0.5 x 1.0 and 1.0 x 1.0 m) between plants was arranged as a fully randomized blocks

design with five replications. Prior to planting a basal dose of a compound fertilizer 15:15:15 (N-K_2O-P_2O_5) was applied at a rate of 200 kg/ha. Urea was applied twice during the rainy season each time at a rate of 50 kg/ha. Boiling water was poured over the seeds and seeds were soaked in water for 24 h prior to sowing. The field was planted on the 09/07/2006 at five seeds/hill. After germination, seeds were thinned to 1 plant/hill.

Leaves were harvested three times on 14/09, 4/10 and 26/10 when plants started to wilt due to moisture deficit. In each harvest occasion samples were taken from two $100m^2$ plots per replication. Seeds and stem biomass yields were sampled in mid November after the seeds ripened. Leaves were dried in the shade and were divided into two groups; one group was cooked for 3 hours as is the custom in Niger, and the other part remained uncooked. Leaves were analyzed for total N content (Houba et al., 1995), lignin (Soest et al., 1991) and P content (Houba et al., 1995). Ca, Mg, K and Fe contents were analyzed using a Perkin-Elmer Analyst 400. All results were subjected to an ANOVA using the GENSTAT software.

In another experiment *S. obtusifolia* was intercropped in a one-year old *A. senegal* plantation in a sandy soil, in a young *A. senegal* plantation in a degraded lateritic soil (both plantations being situated at Sadore) and in a ten years old *A. senegal* plantation on a sandy loam soil near Niamey. Seeds were planted on the 15/09/06 in small pits holes at a density of 1.0 x 1.0 m. Prior to sowing about 100 g of dried manure was applied to each pit hole.

RESULTS AND DISCUSSION

Rain was distributed reasonably as it seemed that the crop did not suffer from water stress. Total rain for the growing period was 536 mm.

First, second and third harvesting were carried out 29, 49 and 71 days after planting, respectively (Fig. 1). In 2006, rains started 25 days later than average and therefore planting was delayed until 7 July. In a normal year, when the crop is planted in mid June, one would expect 4-5 harvests per season. Leaf yield at the highest density was higher than in the other two densities. Yield dry weight yield of the best treatment was 1 t/ha. At a selling price of 0.33 $/kg one hectare of *S. obtusifolia* could give a revenue of $330. *S. obtusifolia* can produce about 1 t kg of seeds/ha (Fig. 3), and could be an additional source of income. Seed yields of the high density planting were significantly higher than that of the sparser planting. If stems remain in the field after leaf and seeds are harvested, they can become an effective means to reduce wind based soil erosion and help trap atmospheric dust during the *Harmatan* (strong dust laden winds from the Sahara) season. Later on the stems can be used as mulch.

Planting Senna in an old *A. senegal* plantation resulted in very low yield, probably due to the shading effect of the mature trees and perhaps also from competition for water (Fig. 4). When *S. obtusifolia* was intercropped with young *Acacias* in a sandy and a lateritic soil leaves yield were very high (1 t/ha) which might be attributed to the organic manure given to each individual plant prior to sowing.

Senna leaves are usually cooked for 3 h to eliminate the strong smell of the leaves (Dirar, 1984) and perhaps also to reduce the level of tannin that interferes with nitrogen assimilation in the digestive system. *S. obtusifolia* is a leguminous plant and the high protein content in leaves is typical to many species in this family (Table 1). In addition, we harvested very young leaves that normally have a higher level of protein content than older leaves. Boiling did not significantly affect the protein and minerals but significantly increased the concentration of lignin in the leaves.

CONCLUSIONS

Results of this first year study clearly demonstrate that *S. obtusifolia* has the potential of becoming a new field crop for the Sahelian region. Harvesting senna leaves begins one month after planting. The period June-October is called the "Hunger Period" in the Sahelas as most farmers have exhausted their grains supply from the previous harvest and food is very scarce. Senna leaves contain a very high level of protein and

reasonable levels of carbohydrates and can provide food to the local population during the hunger period. It can also provide income at a time of big need for cash.

The planting of *Senna* in young *A. senegal* plantations will significantly contribute to the sustainability of the *Acacia* plantations since *A. senegal* start yielding gum Arabic only after five years from planting. The intercropped *S. obtusifolia* will ensure income from these plantations already from the first year from planting. Its intercropping with *A. senegal* can perhaps repel livestock from browsing the young *Acacia* trees.

The domestication of *S. obtusifolia* has just begun. There will be a need to screen and breed best varieties from among plants collected in a broad range of eco-regions, to optimize production and to integrate *S. obtusifolia* into existing production systems.

ACKNOWLEDGMENTS

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Tables

Table 1. Some nutritional components (in g/100g dry weight) of shade dried *Cassia obtusifolia* leaves before (-) and after (+) cooking for three hours.

Lignin		Protein		Ca		P		K		Mg		Fe	
-	+	-	+	-	+	-	+	-	+	-	+	-	+
3.5	11.7	30	31	1.7	2.0	0.3	0.4	1.5	1.2	0.4	0.3	0.2	0.2

Figures

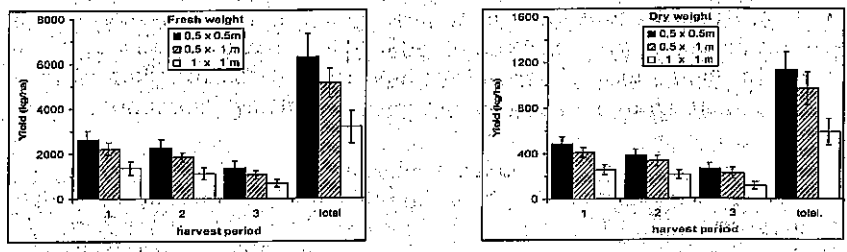

Fig. 1. Fresh and dry weight of *Cassia obtusifolia* leaves at three planting densities for three harvests (± SE).

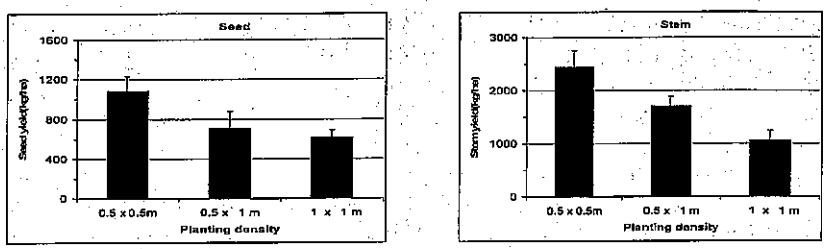

Fig. 2. Seed and stem dry weight of *Cassia obtusifolia* at three planting densities (± SE).

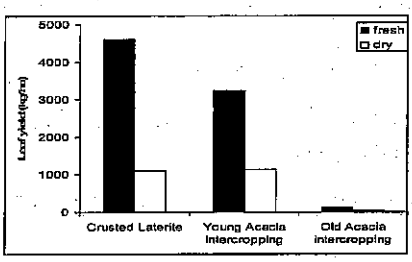

Fig. 3. Fresh and dry weight of *Cassia obtusifolia* leaves planted in young *A. senegal* plantations in a sandy and a lateritic soil and in an old *A. senegal* plantation.