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VARIABILITY IN GROWTH CHARACTERS AND ANTI-NUTRITIONAL PROPERTIES OF SICKLE POD (*Senna obtusifolia* L.)

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ABSTRACT

Variability in growth characters of crop species is critical in crop science; it forms the basis for breeding to improve yield, quality, and adaptation of crops to local climatic and soil conditions. Not much has been reported on the diversity of *Senna obtusifolia* L. in this agro-ecological zone. The study was carried out to assess the variability in growth characters and anti-nutritional factors in different accessions of *Senna obtusifolia.* Field and laboratory experiments were conducted at the Teaching and Research Farm of Department of Agronomy and Laboratory of Biochemistry Department, Bayero University, Kano (BUK) in the Sudan savannah Zone of Nigeria (latitude 11^0 58'N, longitude $8^0$25' and 45 m above sea level). Four accessions of *Senna obtusifolia* were used as the treatments and laid out in a Randomized Complete Block Design (RCBD), in three replicates. The result revealed significant differences ($p<0.05$) in number of pods per plant across the accessions, where accession 1 and 4 recorded the highest number of pods (250.33) and (175.20) respectively. The same trend was observed in number of branches per plant in accession 1 and 4 (15.47 and 9.73, respectively). The result of the anti-nutritional factors analysis revealed the presence of tannins, saponins, alkaloids, phenols, steroids, quinines and terpenoides in the seeds and leaves of *Senna obtusifolia*. Growth characters and anti nutritional properties of sickle pod varies with accessions evaluated, this therefore provides baseline information that could be used for breeding purposes in harnessing the huge potential benefits of *Senna obtusifolia*.

Keywords: *Sickle pod, Genetic diversity and Anti-nutrients*

INTRODUCTION

Senna obtusifolia L., (Irwin and Barneby, 1982) also called *Cassia obtusifolia* belongs to the subfamily Caesalpinioideae of the family Fabaceae. The crop is called by different names such as Sickle senna and Sickle pod (English), Jue Ming Zi (Chinese), Charota (Hindi) (Jain and Patil, 2010) and Tafasa (Hausa). *Senna obtusifolia* was previously mistaken for *Senna tora* (L., Roxb.) (Irwin and Berneby, 1982; Randell, 1995 and Mackey *et al*., 1997). The United States Department of Agriculture Botanical Laboratory considered the two names synonymous (Holm *et al*., 1997) while others reported them as separate species (Brenan, 1958; Bentham, 1971; Upadhyaya and Singh, 1986; Randell, 1988 and CABI, 2018). Haines (1922) is of the opinion that they are intraspecific taxas within the same species. Randell (1995), reported *S. tora* to have probably evolved in Asia from *S. obtusifolia* or is a race of *S. obtusifolia* resulting from rare mutation. In terms of agronomic importance, the two were also indicated to probably have little differences (CABI, 2018). Recently, Harry-O'kuru *et al*., (2012) mentioned *S. obtusifolia* to be synonymous with *Cassia tora* and *Cassia obtusifolia*. The plant is found throughout tropical and warm temperate regions of the world. It is native to southeastern Asia, Fiji, northern Australia, Africa, and Latin America. It also grows well in Japan, Burma, Bangladesh, Vietnam and India (Sarkar *et al.,* 2011). It commonly grows in the wild in northern Nigeria (Sudi *et al*., 2011). *Senna obtusifolia* is stress tolerant and can grow in a range of soil types from heavy-textured to aerated sandy soil (Irwin and Turner, 1960; Teem *et al.,* 1980 and CABI, 2018). As early as 4000 BC, *S. obtusifolia* have been used for medicinal purposes (Nickell, 1960). The leaves and seeds have been used in the treatment of a number of diseases (Parson and Cuthbertson, 1992; Maity *et al*., 1998 and Sarkar *et al*., 2011). It also has commercial importance as a source of gums and other compounds (Bosch, 2004). The seeds and leaves have nutritional values and some anti-nutritional factors. If the anti-nutritional factors are removed from it, it can act as a source of protein, carbohydrate, and minerals (Irwin and Berneby, 1982; Sudi *et al*., 2011 and Tambari *et al*., 2015).

There is little information available in the genetic diversity of *S. obtusifolia* in this agro-ecological zone, few work carried out centered only on proximate and phytochemical investigation for medicinal uses. For a long-term future of any crop, a broad genetic base is required to avoid inbreeding and to allow for the breeding of superior varieties for particular characteristics. It is critically important to base large-scale production on genotypes of reasonable yield and quality which are suitable to the local climatic and soil conditions. The size and form of the plant is also important to optimize seed yield, reduce wind damage and facilitate management and mechanical harvesting of the plant. Its stress tolerant can as well be exploited for breeding purposes. Besides, increasing population and economic crises in most developing nations (Nigeria inclusive), demand an urgent needs to focus on non-conventional wild plants for supply of nutrients (Hassan *et al.,* 2007).

The studies conducted on wild and non-cultivated plants from Burkina Faso, Niger Republic and Cameroun revealed that edible wild plants of Sickle pod have very high nutritional content (Smith *et al.,* 1996 and Mary, 2013). Market survey conducted on *S. obtusifolia* revealed that the plant can gradually evolve from a mere weed in bushes and farmlands to an export commodity in northern Nigeria (Anonymous, 2016). The leaves of Sickle pod are used as a substitute for Moringa leaves which is scarce and very costly, with a bag of

50 kg of Moringa selling at about 16000 naira. The report indicated a bag of *Senna* leaves sells at 800-1000 naira in Katsina state of Nigeria which is almost 16 times less compared to that of Moringa (Anonymous, 2016). Extensive research on the plant therefore is imperative to explore its potentials. This research was designed to investigate variability in growth characteristics and anti-nutritional factors of *Senna obtusifolia* to provide relevant information for breeding programs and study of the Sickle pod.

MATERIALS AND METHODS

The experiment was conducted at the Teaching and Research Farm of the Department of Agronomy and Biochemistry Laboratory, Department of Biochemistry both at Bayero University, Kano (lat. 11°58'N long. 8°25' and 45m above sea level) during the 2017 wet season. The treatments consisted of four accessions of *S. obtusifolia* sourced from Dawanau International Grain Market in Kano State, Nigeria. They were planted and laid out in a Randomized Complete Block Design (RCBD) and repeated three times.

The land used for the experiment was ploughed, harrowed to a fine tilth and ridged using tractor drawn implements. Each plot was made up of six ridges spaced at 0.75 m of 4 m long. Seeds were soaked in cold water for 12 hours to soften it and dried under shade for another 12 hours before sowing. Three (3) seeds were sown per hole at 25 cm intra row spacing and later thinned to two (2) plants per stand one week after sowing (WAS). Weeding was done manually using hoe at 3, 6 and 9 WAS.

Data were collected from five (5) randomly selected plants in each plot and their means computed. Data were collected on days to first emergence, days to 50% germination, days to first flowering, days to 50% flowering, leaf area (measured using leaf area meter), chlorophyll content (measured using Minolta SPAD chlorophyll meter), plant height at maturity (measured using meter rule), number of branches per plant, number of pod per plant and pod length (measured using meter rule), Leaf area and chlorophyll content were measured 14 weeks after sowing using chlorophyll meter whereas number of branches per plant, number of pod per plant and pod length were measured 2 weeks later.

Qualitative analyses of phytochemical constituents were also done to assess the presence or absence of photochemical. Fresh leaves of *S. obtusifolia* and seeds were randomly collected from each accessions, bulked and oven dried. The dried samples were then ground separately into powder using electric grinding mill, sieved with a one millimeter sieve and kept in an air tight container before being subjected to phytochemical screening using methods described by Sahu *et al*. (2014). Three gram each of the ground sample was separately transferred into sterilized beaker of 100 ml capacity, 50 ml distilled water was added and incubated for 2 hours at room temperature. Thereafter, the extracts were filtered through Whiteman No.1 filter paper. The filtrate was collected separately, labeled and used for the screening of the phytochemicals: tannins, saponins, alkaloids, flavonoids, phenols, steroids, lignin, glycosides, quinines and terpenoides according to the method described by Harbone (1973) and Trease and Evans (1978).

Means of the data collected from the field were subjected to statistical analysis of variance (ANOVA) using SAS analytical software (SAS institute, 2015) and treatment means were separated using Student Newman's Keule (SNK), (Newman, 1952).

RESULTS AND DISCUSSION

The result of the analysis revealed no significant differences in the number of days to emergence, days to flowering, chlorophyll content, leaf area, plant height at maturity and pod length (Table 1). However, the result of the days to emergence fell outside the normal range values (3-9 days) reported by Teem *et al*. (1980) and Parsons and Cuthberson (1992), which may be due to shortage of rainfall experienced during the period of the research. Another possible reason for the variation could be attributed to genetics as the plant was reported to be relatively resistant to drought (Hoveland and Buchanan, 1973). The plant's ability to germinate under low soil moisture, coupled with the high seed production may be the reason why it can colonize bare soils and do well on sandy soils which dry out quickly (Hoveland and Buchanan, 1973). Days to 50 percent emergence also followed the same trend with days to first emergence. However, the mean values obtained in days to first flowering were within the normal range (43-84 days) as reported by Retzinger (1984). The mean values for chlorophyll content obtained were not statistically significant and were in the range of 91.41 to 74.19. Kim and Cho (1989) reported a chlorophyll content of 82.33 in related specie (*Cassia alata*). The mean values for leaf area and plant height at maturity were also not significant and fall within the range of 23.80 to 19.62 cm^2 and 96.83 to 114.20 cm, respectively and were in accordance with the values reported by Parsons and Cuthberson (1992); Holm *et al*. (1997) and Brenan (1967). Significant differences were observed on number of branches per plant ($p<0.05$) and number of pod per plant ($p<0.01$). Accession 1 recorded the highest mean values of 15.47 and 250.33, respectively and there seemed to be a positive correlation between the two. Mackey *et al*., 1997, reported that number of pods per plant varies from 63 to 342, signifying the values obtained in this study to be within the normal range. Number of seeds per plant could reach 5280 – 8520 (average of 8000) as reported by Retzinger, 1984 and Hall and Vandiver, 1996). Pod lengths were statistically similar among all the Accessions and fell within normal range (10-25 cm), (Brenan, 1967 and CABI, 2018).

The results of the phytochemical analysis to check for anti-nutritional factors availability or otherwise of the seeds and leaves extracts (Table 2 and 3) revealed the presence of flavonoids, glycosides, quinines, and terpenoids in all the accessions in both leaves and seeds extracts of *Senna obtusifolia*. These corroborated the findings of Doughari *et al*., (2008); Gill *et al*., (2011) and Sudi *et al*., (2011). In addition, steroids were found in the seeds of all the accessions. Variability was observed in saponins, tannins and alkaloids in both cases and they follow similar trends and seemed to be linked in the accessions evaluated. Alkaloids were absent in accession 2, 3 and 4, tannins were absent in accessions 2 and 3 and saponins were absent in only accession 2 in both seeds and leaves extracts. These variations could therefore be attributed to genetic makeup of the crops as all the accessions were subjected under similar condition and management practices.

Table 1: Genetic variability in growth characters and pod characteristics of *Senna obtusifolia* accession

Treatments	DE	DFE	DF	DFF	CC	LA	PHM	NBP	NPP	PL
Accession 1	12.67	27.33	65.67	78.00	89.79	22.10	114.20	15.47[a]	250.33[a]	15.23
Accession 2	13.00	28.33	68.67	82.67	74.19	23.80	103.30	12.27[b]	197.80[b]	14.92
Accession 3	12.67	26.00	70.00	82.67	76.02	19.62	103.23	11.67[b]	194.73[b]	14.56
Accession 4	13.00	23.00	70.33	83.67	91.41	22.24	96.83	9.73[b]	175.20[c]	14.44
Mean	12.83	26.17	68.67	81.75	82.85	21.94	104.39	12.28	204.52	14.79
SE	1.11	2.63	2.61	2.51	7.42	1.96	4.63	0.62	3.51	0.33
CV	14.98	17.39	6.59	5.32	15.50	15.48	7.67	8.68	2.98	3.85

Means with different superscripts within the same column are significantly different at ($p<0.05$) level of probability. DE = Days to first emergence, DFE = Days to fifty percent emergence, DF = Days to first flowering, DFF = Days to fifty percent flowering, CC = Chlorophyll content, LA = Leaf area, PHM = Plant height at maturity, NBP = Number of branches per plant, NPP = Number of pods per plant, PL = Pod length, SE = Standard Error of Mean and CV = Coefficient of Variability.

Table 2: Antinutrients status in leaves of *Senna obtusifolia*

Antinutrients	Accession 1	Accession 2	Accession 3	Accession 4
Tannins	+	-	-	+
Saponins	+	-	+	+
Alkaloids	+	-	-	-
Flavonoids	+	+	+	+
Phenols	-	-	-	-
Glycosides	+	+	+	+
Sterols	+	+	+	+
Lignins	-	-	-	-
Quinines	+	+	+	+
Terpenoids	+	+	+	+

Key: (+) means there is Antinutrients and (–) means there is no Antinutrients

Table 3: Antinutrients status in seeds of *Senna obtusifolia*

Antinutrients	Accession 1	Accession 2	Accession 3	Accession 4
Tannins	+	-	-	+
Saponins	+	-	+	+
Alkaloids	+	-	-	-
Flavonoids	+	+	+	+
Phenols	-	-	-	-
Glycosides	+	+	+	+
Sterols	+	+	+	+
Lignins	-	-	-	-
Quinines	+	+	+	+
Terpenoids	+	+	+	+

Key: (+) means there is Antinutrients and (–) means there is no Antinutrients

CONCLUSION

The result of this research provides baseline information on the variability among the accessions of *Senna obtusifolia* examined. The information could be used for breeding and production purposes in harnessing the huge potential benefits of *Senna obtusifolia*. More research with larger accessions is however recommended to validate this result.

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