Ife Journal of Agriculture Vol. 10 Nos 1 & 2 1988

Indigofera pulchra: A potential fodder in West African savanna

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Abstract

The potential uses of *Indigofera pulchra* Wild., a wild herbaceous legume of West African Savanna were investigated in four different savanna zones.

It was observed that *I. pulchra* remains green throughout the critical period of the dry season when fodder is most limiting for livestock production. *I. pulchra* can also fix atmospheric nitrogen.

There is consistent evidence that *I. pulchra* grows in association with *Pennisetum pedicellatum* Trin., *Andropogon gayanus* Kunth., *Hyparrhenia involucrata* Stapf and *Ctenium* newtonii.

N_2-concentration encountered in *I. pulchra* is higher than ever recorded for any West African grass, with significant difference ($P<0.01$) among the plant parts and among the different savanna zones, though only at $P<0.1$)

The suggestion is being made that *I. pulchra* may be selected for use in improved ranges.

Introduction

The low quality and quantity of fodder grasses available for ruminant stock production in the dry season have prompted animal nutritionists and plant ecologists to find alternative fodder sources.

De Leeuw (1979) reported that *Indigofera pulchra* was readily consumed by goats and cattle at Shika, Northern Nigeria. Sanford (1985) also reported that *I. pulchra* is relished by livestock and can fix atmospheric nitrogen.

Available nitrogen is generally a limiting factor in West African soils (Jones and Wild, 1975) and plant nitrogen content is related to what is available in the soil (Isichei 1983). The unexploited N_2-fixing contributing potential of the West African wild and cultivated legumes has been remarked by National Academy of Science (NAS), 1979.

Sanford and Wamgari (1985) noted that exotic legume were not successful in managed ranges in Nigeria as they cannot compete with the native grasses. However, *I pulchra,* is widely distributed in most African savanna zones, (Hutchinson & Daiziel 1958). The plant is also able to continue active growth, flower and nodulate in the critical period of the dry season, when most grasses are fibrous and can only provide below-maintenance diet. The present work has been undertaken in an attempt to investigate the crude protein (CP) content of *I. pulchra,* the conditions under which it grows and possible interaction with other plant species.

Materials and methods:

In February 1982, in the middle of the dry season in Northern Nigeria, 10 samples of soil (10-15cm depth), plant specimens and 50 fruits each from 10 plants were randomly collected from each study site, measuring 100m x 100m, selected from the four major savanna zones (see Table 1 and Figure 1.)

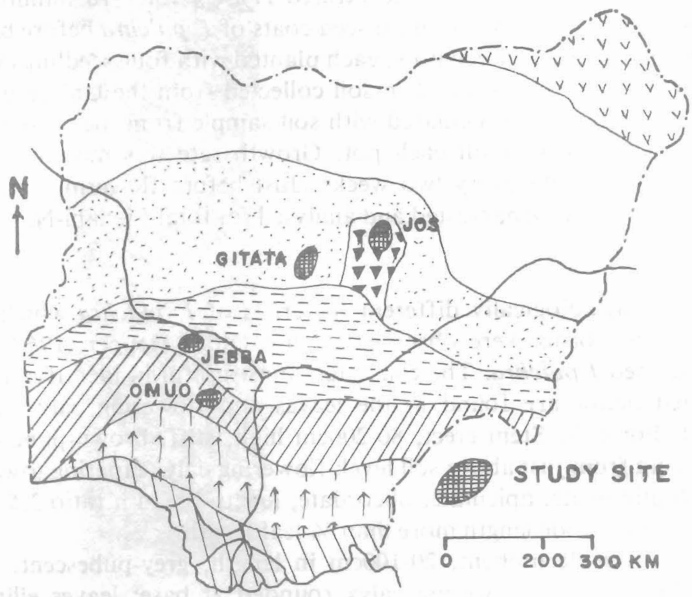
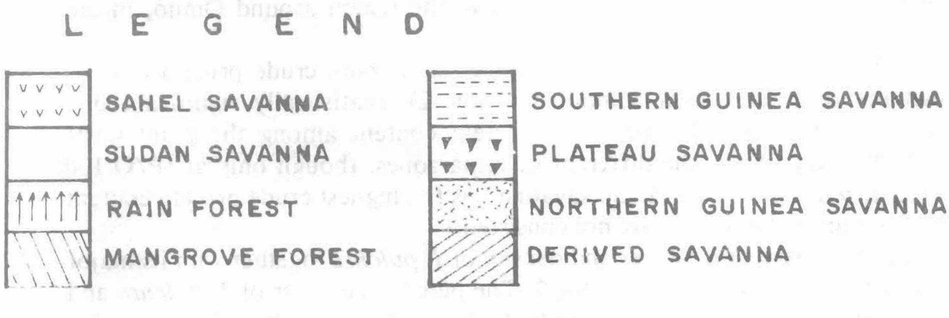


Figure 1. VEGETATION MAP OF NIGERIA SHOWING THE STUDY SITES



Livestock activity was a major hinderance in site selection, hence study sites were selected around farmlands in old fallows where livestock activity has been greatly controlled. Ten transects each measuring 100m x 100m were laid in each site.

Total N in soil and plant material was determined by the Kjedahl method, available soil P by Bray I Method and soil and carbon by Walkley-Black Method (Allen, Grimshaw, Parkinson, Quadrinby and Robbert, 1976).

Seed samples were treated with concentrated H_2SO_4 for 8-10 minutes in order to break the dormancy due to hard seed coats of *I. pulchra* before being germinated in petri dishes. Sixteen pots, each planted with four seedlings were established for each savanna zone. Top soil collected from the University of Ife Biological Gardens and innoculated with soil sample from the corresponding study site were used to fill each pot. Growth rate was monitored by measuring the plant height every two weeks. Just before flowering, branch spices, stems and roots were harvested and analysed for total-kjedahl-N.

Results

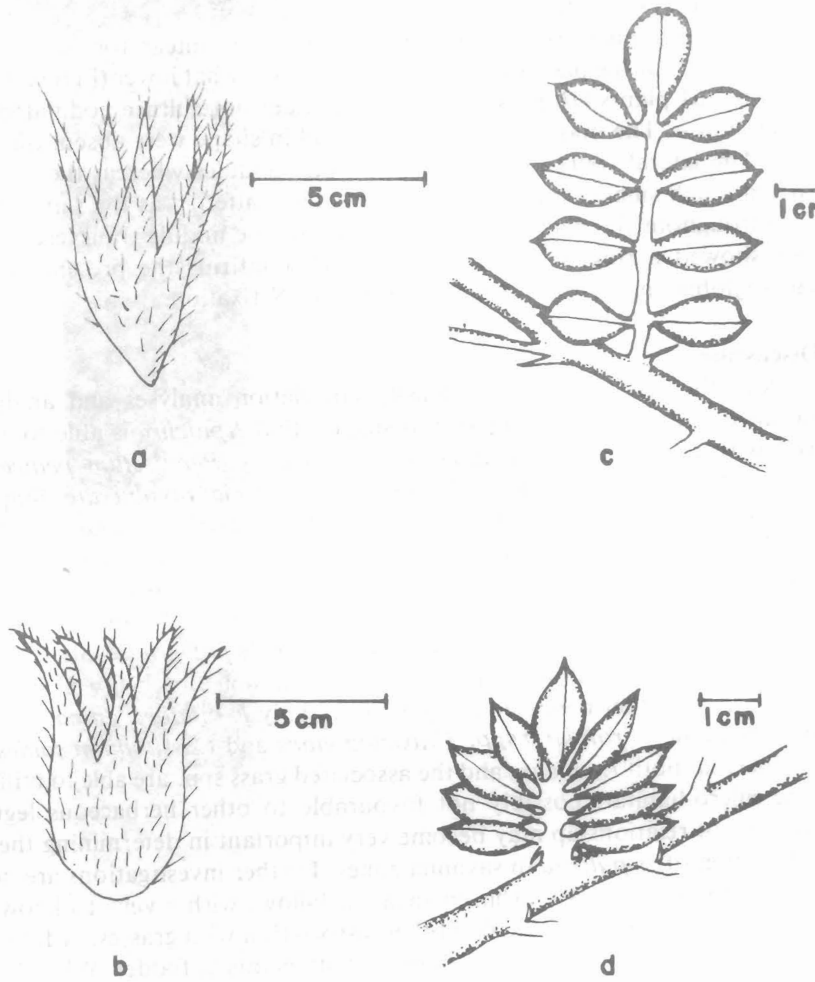
Two slightly morphologically different materials of *I. pulchra* which are here referred to as forms were observed in this study. Hepper (1968) has previously described *I pulchra*. The characters most useful in identifying the forms described below are found in the leaves and flowering calyx lobes (Figures 2a-d). Form A: Stem erect, 80-200cm high, stiff, brown-pubescent woody, branching from just above soil level; flowering calyx tapering towards base; leaves elliptic-ovate, apiculate, obcordate, length-breadth ratio 2.5-2.7, not overlapping, internode length more than ¾ leaf length.

Form B: Stem often decumbent, 20-100cm in length, grey-pubescent, soft woody, branching ⅓ up; flowering calyx rounded at base; leaves elliptic, apiculate, overlapping, length breadth ratio 3.0-3.6, internode length less than ¼ leaf length.

The form B is more commonly distributed while the form A with well separated leaves appear to be restricted to the region around Omuo, in the derived savanna zone (Figure 1).

In all the savanna zones, branch apices have more crude protein content than the roots and stem combined (Table 2). Statistically significant differences were found in the crude protein content among the plant parts (PO/.01) and among the different savanna zones, though only at (P/O.100). While *I. pulchra* in the Plateau savanna has the highest crude protein content in all its parts other results are not consistent.

Results of percentage cover and density of *I. pulchra* together with its major competitors are presented in Table 3. The percentage cover of *I. pulchra* and grass are not statistically significantly different in the sites but significant differences in percentage cover of *I. pulchra* and other legumes occured in all the sites. Similarly, the density of *I. pulchra* and grass were not statically significantly different in the sites but significant difference in density of *I. pulchra* and other legumes occured in all the sites. While positively significant correlations exist between *I. pulchra* and the major spp. of grass in all the sites, correlations between grass and other legumes were negative and significant. The four sites contained different geomorphological soil formations (Table 1)



Figures 2 a–d (a) FLOWERING CALYX OF THE FORM A,
(b) FLOWERING CALYX OF THE FORM B,
(c) LEAFLET OF THE FORM A,
(d) LEAFLET OF THE FORM B.

with generally low available N, C and P contents suggesting that the soils were impoverished (Table 2).

Growth rate measured in the screen house were linear for most savanna zones except for the plateau savanna which is somewhat lower (Figure 3).

All the 64 plants (16 pots for each site) under pot culture nodulated in the screen house. The nodules which were round in shape were absent on the tap root. The lateral roots carry fewer but alrger nodules whereas the root hairs carried much smaller but numerous ones. The pattern was the same more or less throughout the plants. On examination of the nodule transvere sections, they showed a ring of redish region which confirms the presence of met-haemoglobin and strongly suggesting effective N-fixation.

Discussion

From the results of cover, density correlation analyses and analysis of variance, there is strong evidence to suggest that *I. pulchra* is able to co-exist well with a number of savanna grasses, notably, *Pennisetum pedicellatum* Trin., *Andropogon gayanus* Kunth., *Hyparrhenia involucrata* Stapf and *Ctenium newtonii* Hack, but not well with other herbaceous legumes. Removing the effect of other legumes, the partial correlation between *I. pulchra* and grass increased positively. But when the effect of grass was removed, the partial correlation between *I. pulchra* and other legumes further decreased negatively. This relationship suggests that while *I. pulchra* is able to co-exist well with a number of savanna grass spp. it cannot establish well in fallows dominated by other herbaceous legumes; notably *I. mildbraedinna, Stylosanthes fructicosa, Crotolaria spp. Eriosama glans* and *Cassia mimosoides*. It is possible that both *I. pulchra* and the associated grass spp. are able to utilize the same micro-habitat, possibly not favourable to other herbaceous legumes. This sort of relationship may become very important in determining the local distribution of *I. pulchra* in savanna zones. Further investigations are needed into legume-grass relationship in savanna fallows with a veiw to knowing if herbaceous legumes are specific in their association with grasses. A finding of this nature may enhance the usefulness of both plants as fodder. While Ezedinma, Agbim and Onyekwelu (1979) observed that herbaceous legumes in general were more abundant in Fallows dominated by *Hyparrhenia, Pennisetum* and *Andropogon* spp. than in *Loudetia* and *Imperata* dominated fallows, all the same the claim to specificity in legume-grass relationship has not been made before for any wild West African legume.

That soil-N and C are generally low in all the four soil formations is in tune with previous findings of Jones & Wild (1975) who observed that available N is a limiting factor in West African soils. It further suggests that *I. pulchra* will establish on impoverished soils not preferred by many other plants and consequently building up the low N reserve of the soil through N-fixation.

The dry season crude protein of *I. pulchra* is remarkably higher when compared with results obtained for grasses during the same season by other workers e.g. Crampton and Harris (1969) obtained below 5% and *Brinchman* and de Leeuw (1979) obtained below 4%. Whereas de Leeuw (1979) recommended minimum CP content of 5-6% for livestock in the dry season, the CP content of *I. pulchra* branch apices ranges between 16-19%.

The suggestion is being made that the form B of *I. pulchra* with some tendency to accumulate more crude protein and is more widely distributed could be sown into improved range with selected grass species. This would, no doubt ease the problem of low protein grazing for livestock which is characteristic of the dry season in the West African savanna zones.

Acknowledgement

The author is indebted to Prof. W.W. Sanford (retired) who made funds available through the UNESCO to finance the field trips and analyse the plant and soil samples at the IITA, Ibadan. He also made several suggestions on this work. I strongly appreciate the comments of Dr. A.O. Isichei, Professor O. Olorode and Mr. J. Muoghalu, all of Botany Department, University of Ife.

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