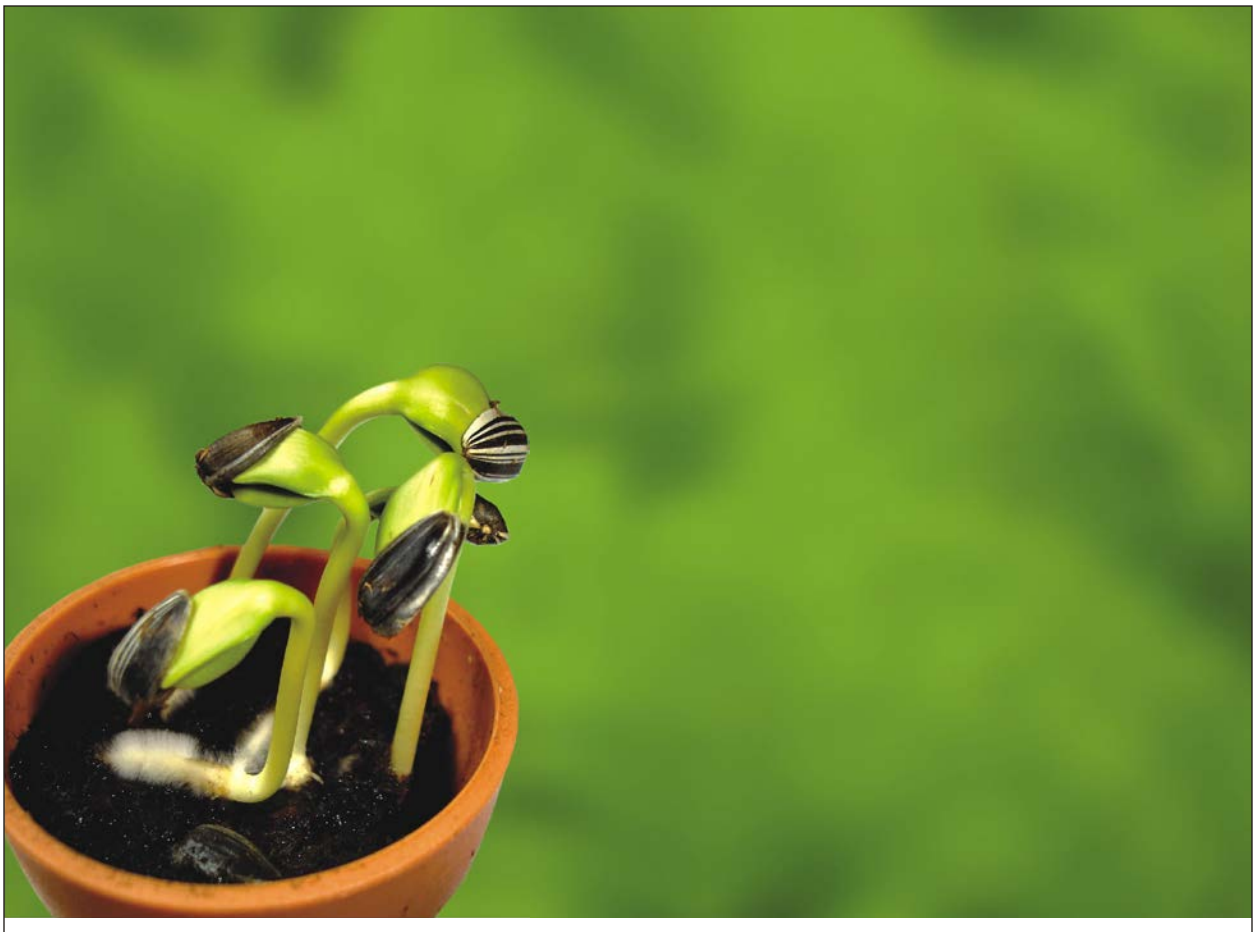

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Reproductive Ability as a Guide to the Selection of a Nigerian *Aloe* Linn. Most Suitable for Cultivation on a Commercial Scale

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Abstract: The reproductive abilities of nine accessions of *Aloe* Linn. indigenous to Nigeria were investigated. Out of the nine accessions, four, namely *A. schweinfurthii*, *A. marcrocarpa* var *major*, *A. keayi* and *A. buettneri* have been described and defined while the remaining five-Taxon A, Taxon B, Taxon C, Taxon F and Taxon H-are new accessions yet to be defined but recently given taxonomic descriptions. Representative samples of the various accessions collected from different parts of Nigeria were brought into cultivation for six years in the experimental garden of the Department of Biological Sciences (now Department of Plant Science), University of Ilorin, Ilorin, Nigeria. The experimental design used was the Completely Randomised Design (CRD). Characters investigated are number of suckers produced per plant, number of flowers produced per plant, number of fruits formed per plant,% fruit formation per plant, number of seeds formed per fruit, number of seeds that germinated per fruit and % seed germination per fruit. For each character investigated, mean value per year for each accession was calculated from five randomly selected specimens. Data collected were subjected to analysis of variance and means separated using the Duncan's multiple range test. *A. schweinfurthii* was found to have the greatest ability to propagate itself both by the sucker and by the seed and, by inference, is the indigenous aloe plant most suitable for cultivation on a commercial scale in the Nigerian climates.

Key words: Reproductive ability, selection, Nigerian *Aloe*, cultivation, commercial

INTRODUCTION

Aloe Linn, a member of the family Liliaceae, is a tropical medicinal plant cultivated for its thick, fleshy leaves from which the drug aloes of commerce are obtained. By 2004, according to Anselm (2004), over 325 species of the genus, mostly native to tropical and South Africa, have been identified. Many of these species resemble the *Agaves* in their general form. They have beautiful flowers and are grown as ornamental plants in homes, gardens and yards (Akinyele, 2006). The resinous latex which exudes from the cut leaves has been used for centuries as a laxative and more recently to treat X-ray burns (Cobley and Stele, 1976). *A. vera*, the most popular species of *Aloe*, is commonly referred to as miracle plant for its numerous uses. The inner gel of the leaf, according to Swaminathan and Kochhar (1992), contains most of the plant's beneficial part. Apart from its medicinal importance, the essential amino acids that human body needs (McCauley, 1992), the enzymes that facilitate human metabolism (Blumenthal and Mark, 2000), the vitamins and minerals needed for healthy growth (Tyler, 1994), the essential oils needed by human body (Hect, 1981) and other essential components of food such as glutamic acid, aspartic acid and the likes (Davis *et al*., 2000) are all found in the gel of

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the leaf of *A. vera*. Basically, all the various species of *Aloe* are known to have similar chemical constituents but *A. vera* is more readily available for use because it propagates itself faster than any other known species of *Aloe* (Anselm, 2004).

Since the life of an individual plant is limited in duration, it becomes clear that in the absence of reproduction, a species will sooner or later be in danger of extinction. Simply put, reproduction is the process of producing offsprings. Biologically, according to Vines and Rees (1972), reproduction is the formation of new, separately existing individuals of a species from members already in existence. The significance of reproduction is obvious. For members of a species to continue to exist and multiply in number, successful reproductive processes must be established in that species. Hence, living organisms, at certain times in their lives, direct all their energies into reproductive activity, sometimes even at the expense of their own continued existence (Vines and Rees, 1972). In the opinion of Dutta (1979), natural reproduction in plants could be by any of three principal methods, namely vegetative propagation, sexual reproduction and asexual reproduction. In the *Aloe* plants, reproduction is either by seed (sexual reproduction) or by sucker (vegetative propagation). Some species of the genus are also known to propagate themselves by both the seed and the sucker (Akinyele, 1999).

In addition to the four species identified by Hepper (1968), five new accessions of *Aloe* were recently encountered in Nigeria (Akinyele, 2005). This increases the number of Nigerian accessions of *Aloe* to nine. *A. vera*, which is readily available for use because of its ability to propagate itself rapidly, is not native to Nigeria. All attempts made so far in Nigeria to cultivate *A. vera* on a large scale in the fields have been to no avail. This is chiefly because the sum total of the environmental conditions in Nigeria does not support a successful cultivation of the plant species. Pockets of *A. vera* grown in Nigeria are found in homes, yards and gardens where they are given special attention to prevent them from dying. This kind of special treatment is not available in the field, hence, it is difficult to successfully cultivate the species on a large scale. Since, basically, all the representatives of *Aloe* have similar constituents, a representative indigenous to Nigeria that does not have any difficulty in propagating itself should be identified for the purpose of cultivating it for its uses. The aim of this research, therefore, is to investigate the reproductive abilities of the nine Nigerian accessions of *Aloe* with a view to suggesting which of them would be suitable for cultivation on a commercial scale. The outcome of this investigation will, no doubt, reduce the dependence of Nigeria and the neighbouring African countries upon imported *Aloe* products.

MATERIALS AND METHODS

The plant materials investigated are nine Nigerian accessions of *Aloe* out of which four, namely *A. schweinfurthii*, *A. macrocarpa* var *major*, *A. keayi* and *A. buettneri* have been identified by Hepper (1968). The remaining five-Taxon A, Taxon B, Taxon C, Taxon F and Taxon H-are new accessions recently given taxonomic descriptions by Akinyele (2005), voucher specimens of which are preserved in the University of Ilorin Herbarium (ULH). Figure 2 shows the vegetative habit of the nine *Aloe* accessions. The places from which collections were made are as stated by Akinyele (1999) and the routes taken during survey and collection trips are shown in Fig. 1. Representative samples collected were brought into cultivation for six years in the experimental garden of the Department of Biological Sciences (now Department of Plant Science), University of Ilorin, Ilorin, Nigeria. The experimental design adopted was the Completely Randomized Design (CRD).

Characters investigated are number of suckers produced per plant, number of flowers produced per plant, number of fruits formed per plant, % fruit formation per plant, number of seeds per fruit, number of seeds that germinated per fruit and % seed germination per fruit. For each character investigated, mean value per year for each accession was calculated from five randomly selected specimens. Data collected were subjected to analysis of variance and means separated using the Duncan's multiple range test.

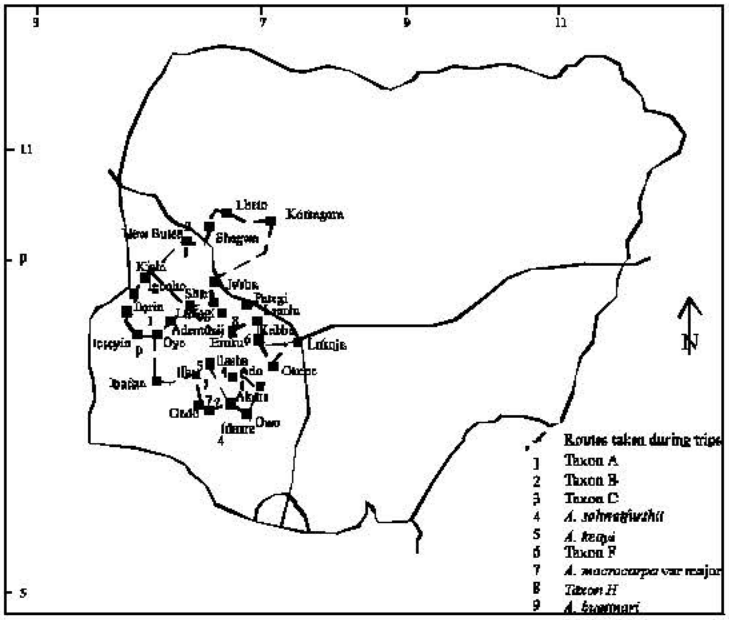

Fig. 1: Map of Nigeria showing areas of major sampling and routes taken during field survey and collection trips

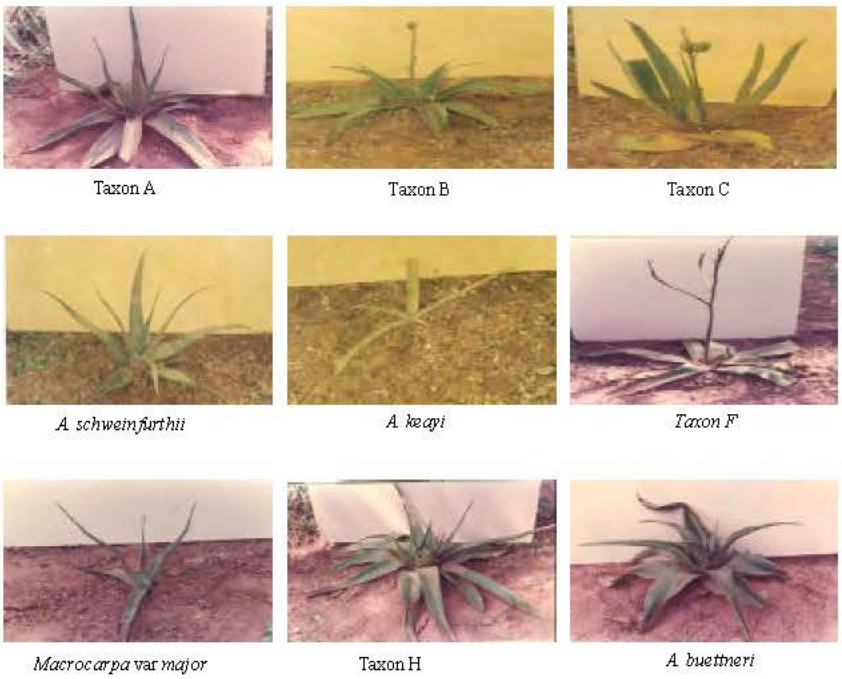

Fig. 2: The vegetative habit of the nine Nigerian *Aloe* accessions

Table 1: The mean values of number of occurrence of characters

Accession	No. of suckers/ plant	No. of flowers/ plant	No. of fruits/ plant	% fruit formation/ plant	No. of seeds/ fruit	No. of seeds that germination/ fruit	% Seed germination/ fruit
A. schweinfurthii	4.60±0.51^{c}	32.80±1.56^{a}	5.20±0.58^{d}	13.00±1.30^{d}	15.60±0.87^{d}	11.20±0.80^{e}	52.20±3.53^{a}
A. macrocarpa var *major*	_^{a}	29.20±1.24^{a}	2.60±0.25^{bc}	8.80±1.02^{c}	10.60±0.68^{bc}	_^{a}	_^{a}
A. keayi	2.60±0.40^{b}	22.40±1.25^{a}	_^{a}	_^{a}	_^{a}	_^{a}	_^{a}
A. buettneri	_^{a}	86.60±3.47^{d}	4.20±0.58^{cd}	2.80±0.66^{b}	14.00±0.89^{d}	3.80±0.66^{cd}	29.00±1.98^{cd}
Taxon A	_^{a}	72.20±2.52^{bc}	12.00±1.64^{e}	19.00±1.41^{e}	14.20±1.43^{d}	4.20±0.58^{cd}	24.00±2.65^{c}
Taxon B	_^{a}	89.00±5.26^{d}	1.60±0.25^{ab}	1.60±0.25^{ab}	8.40±1.21^{b}	2.20±0.49^{b}	13.80±1.43^{b}
Taxon C	_^{a}	81.60±5.73^{cd}	5.80±0.97^{d}	7.80±0.86^{c}	11.40±0.51^{c}	2.80±0.37^{bc}	24.60±2.38^{c}
Taxon F	_^{a}	70.40±2.60^{b}	2.20±0.37^{bc}	2.20±0.37^{ab}	14.60±0.51^{d}	3.80±0.37^{cd}	25.40±2.34^{c}
Taxon H	_^{a}	88.60±5.26^{d}	2.60±0.40^{bc}	2.60±0.25^{b}	14.40±0.51^{d}	4.80±0.37^{d}	34.60±2.02^{d}

Values are means±SEM for five replicates. Mean values in the same column followed by different superscripts are significantly differently ($p<0.05$)

RESULTS

Out of the nine *Aloe* accessions investigated, only two, namely *A. schweinfurthii* and *A. keayi* were found to produce suckers. Though flower production was observed in all the accessions, *A. macrocarpa* var *major* and *A. keayi* did not produce flowers in the first three years and no fruit was formed in *A. keayi* due to abortion of all of its flowers 2-3 days after flower opening. It was also observed that, throughout the period of experimentation, no seed produced by *A. macrocarpa* var *major* was found to germinate. In all, seven characters were investigated, results of which are presented in Table 1.

DISCUSSION

Generally, natural reproduction in *Aloe* plants is either by seed or by sucker (Hepper, 1968). In some members, reproduction is both by seed and by sucker (Akinyele, 1999). Out of the nine aloe accessions investigated, only *A. macrocarpa* var *major* and *A. keayi* were found to produce suckers, with *A. schweinfurthii* having a greater ability to propagate by sucker (Table 1). The sucker is a lateral branch developing from the underground or the lower part of the stem at its node. It grows obliquely upwards and directly gives rise to a leafy shoot of a new plant (Dutta, 1979).

While other accessions were found to blossom annually, *A. macrocarpa* var *major* and *A. keayi* did not produce flowers in the first three years. These two accessions are, therefore, most likely to be hybrids caught in the process of internal organization to stabilize their genetic systems. According to Lewis (1966), the establishment of any new kind of organism is faced with two indispensable situations, namely the stabilization of its genetic system and the restoration or acquisition of sexual fertility. In most cases, as suggested by Oyewole (1984), the achievement of these two situations proceeds simultaneously, with stabilization preceding restoration or acquisition of fertility. In spite of the fact that *A. macrocaerpa* var *major* and *A. keayi* did not produce flowers until the fourth year of experimentation, their flowers were also not produced annually. It is logical, therefore, to opine that the two aloe accessions are yet to fully restore or acquire sexual stability. This opinion is further strengthened by the fact that flowering in *A. keayi* did not lead to fruit/seed formation. Since reproduction by seed is still not reliable in *A. macrocarpa* var *major* and *A. keayi*, it is most likely that they are still struggling to overcome the danger of extinction by establishing themselves vegetatively through the production of suckers.

Though flower production was observed in all the nine *Aloe* accessions, ability to reproduce by seed differs from one accession to the other as revealed in Table 1. This is most likely to be influenced by the degree of fertility which is an inherent attribute that also differs from plant to plant. The most

important determinants of plant's ability to reproduce by seed in this investigation are the number of fruits that is formed per plant and the number of seeds that germinate per fruit , the product of which is the total number of seeds that germinate per plant . With this in mind, it becomes very clear that *A. schweinfurthii*, with a total number of 58.24 seeds germinating per plant (Table 1) exhibits the greatest ability to reproduce by seed.

CONCLUSIONS

Since *A. schweinfurthii* has the greatest ability to produce sucker and the greatest ability to reproduce by seed, it is reasonable to conclude that *A. schweinfurthii* is the Nigerian aloe with the greatest ability to propagate itself and, therefore, the indigenous aloe plant most suitable for cultivation on a commercial scale in the Nigerian climates.

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