academicJournals

Vol. 7(11), pp. 538-542, November 2013
DOI: 10.5897/AJPS2013.1048
ISSN 1996-0824 ©2013 Academic Journals
http://www.academicjournals.org/AJPS

African Journal of Plant Science

*Full Length Research Paper*

# Chromosome numbers and karyotype in three species of the genus *Vernonia* Schreber in Southern Nigerian

**Kemka-Evans, C. I.[1]* and Okoli, Bosa[2]**

[1]Alvan Ikoku Federal College of Education Owerri, Imo State, Nigeria.
[2]Regional Centre for Bioresources and Biotechnology, Rivers State, Nigeria.

Accepted 26 August, 2013

**Detailed cytological studies were carried out on three species of the genus *Vernonia* namely *Vernonia amygdalina* (bitter leaf and non-bitter leaf), *Vernonia cinerea* and *Vernonia conferta* to ascertain their chromosome number. The taxa studied showed diploid number of chromosome for *V. cinerea* (2n = 18) and *V. conferta* (2n = 20) and tetraploid number for *V. amygdalina* (2n = 36). The karyotype show nine (9) pairs of submetacentric chromosomes in *V. cinerea* and 10 pairs of submetacentric chromosomes in *V. conferta.* The karyotype of *V. amygdalina* (bitter leaf) varied from that of *V. amygalina* (non-bitter) by being larger in size and with a pair of telocentric chromosome. The studies of the pollen fertility suggest that *V. amygdalina* is an amphidiploid.**

**Key words:** Chromosome numbers, karyotype, polyploidy, *Vernonia*.

## INTRODUCTION

*Vernonia* is a large tropical genus with about 1,000 species both in the old and new worlds (Jones, 1976, 1979). *Vernonia* belongs to the family compositae (Asteraceae). The family Asteraceae belongs to the order Asterales. The family compositae is the largest family of the flowering plants, comprising 950 genera and 23,000 species (Gills, 1988). The genus *Vernonia* is represented by about 500 species all over the world and 49 species in Flora of Ethiopia (Mesfin, 2004).

Adedeji and Jewoola (2008) noted that the family compositae possess simple leaves with alternate or opposite leaf arrangement. Among the species found in Nigeria, *Vernonia amygdalina* Del, *Vernonia cinerea* (Linn) Less and *Vernonia conferta* Benth form an interesting group to study because *V. amygdalina* is treated as a shrub while *V. cinerea is* a herbaceous weed and *V. conferta* is a small tree. Also the occurrence of bitter and non-bitter leaves of *V. amygdalina* is of interest. Chromosomes have been used to assign organisms to different taxa as members of the same species have similarity in their chromosome sets and related species have related chromosome sets (Gill and Singhal, 1998; Stace, 2000). It has been realized from the early years of this century that in general, the number of chromosome in each cell of the individuals of a single species is constant. Moreover, except for simple multiples of that number the more closely related species are the more likely to have the same chromosome number, and the more distantly related, the more likely they are to have different number. This relative conservativeness and inability of the environmental factors to alter it renders chromosome number an important and much used taxonomic character. It is consistently recorded in standard floras and the like (Stace, 1980).

Chromosome number may change in various ways and results in a new chromosome set which has effect on the general biology of the organism (Schubert, 2007). Polyploidy is the commonest of all changes in chromo-

*Corresponding author. E-mail: kemkakate@yahoo.com.

some number,especially in plants (Stace, 2000). This increase in chromosome number by complete set is of two types based on the origin of the additional chromosome set. Instudying published chromosome lists, it becomes evident that closely related species (within one genus) may differ in chromosome number, the most frequent variations based on the phenomenon of polyploidy (Swanson, 1968). Ikechukwu (2011) studied two species of Abrus in Nigeria and reported that *Anolis pulchellus* is a polyploidy of *A. pulchellus.* The structure of the chromosome together with the size and number has been found extremely useful at all levels of the taxonomic hierarchy. For members of the genus *Vernonia*, some chromosome counts and their taxonomic importance have been given and examples include *V. cinerea* (n = 9) (Olorode, 1974), *V. cinerea* (n = 9) (Jones, 1976) *V. cinerea* (2n = 18) (Andhra, 1981). According to Jones (1976), there are several kinds of polyploidy number relationship in flowering plants. *Vernonia* in the old world has a dibasic chromosome number of n = 9 or 10 with polyploids of n = 18, 20 or 30, whereas in the New world it has basic chromosome number of n = 17 with polyploids of 34, 51, 58 or 68. This paper is aimed at reviewing the number of chromosome of *V. amygdalina*, (bitter variety), *V. cinerea* and *V. conferta*. The chromosome number of the *V. amygdalina* (non-bitter variety) was determined. It will also investigate their polyploidy level and construction of a Karyotype for the taxa studied.

## MATERIALS AND METHODS

Stem cuttings of the four different taxa were collected and grown in the field in small pots filled with wet soil. Auxiliary buds emerged and roots ranging from 10 to 40 mm in length were produced after two to three weeks, healthy roots were excised and transferred to collection bottles containing 0.002 m aqueous solution of 8 - hydroxyquinoline. This pretreatment was carried out to accumulate metaphase through spindle fibre inhibition (Darlington and Lacour, 1975). After 3 h in this solution, root tips were fixed in 3:1 ethanol acetic acid (V/V) for at least 24 h. The root tips were used immediately and some were stored in 70% alcohol in a refrigerator.

For microscopic observation a little portion of the root-tip, about 1 mm from the apex was excised and squashed in a drop of F.L.P. orcein stain (2 g of Orcein dissolved in 100 ml of solution of equal parts of formic acid, lactic acid, propanoic acid and water) under a cover slip, flattened out and examined under a microscope following the method of Okoli (1983). Photomicrographs of the chromosomes were taken from good temporary slides, using a leitz - habolux-12-microscope fitted with WILD - WPS camera. The flower heads of the different taxa studied were collected and pollen from anthers teased out on a slide, stained with cotton-blue lactophenol and viewed under the microscope to ascertain the percentage of fertility.

## RESULTS

Mitotic studies of the four taxa studied show that *V. amygdalina* (bitter leaf) has mitotic chromosome number of 2n = 36, *V. amygdalina* (non-bitter leaf) 2n = 36, *V. cinerea* 2n = 18 and *V. conferta* 2n = 20 (Plates 1 to 4). The karyotype of *V. amygdalina* (bitter variety) consists of one (1) pair of telocentric chromosomes, one (1) pair of metacentric chromosomes and 16 pairs of submetacentric chromosomes (Plate 5A). *V. amygdalina* (non-bitter variety) consists of one (1) pair of telocentric chromosomes and 17 pairs of submetacentric chromosomes (plate 5B). *V. cinerea* consists of 9 pairs of large submetacentric chromosomes (Plate 5C). *V. conferta* consists of 10 pairs of submetacentric chromosomes (Plate D). Pollen fertility studies revealed that the fertility rate in *V. amygdalina* (bitter leaf) is 82.55% *V. amygdalina* (non-bitter leaf) is 74.57, 68.95% in *V. cinerea* and 66.00% in *V. conferta*

## DISCUSSION

The results of the chromosome number of the *Vernonia* species studied show that *V. amygdalina* (bitter and non-bitter leaves) have 2n = 36, *V. cinerea* 2n = 18 and *V. conferta* 2n = 20. The chromosome count of *V. cinerea* corresponds with the work of Jones (1976) and Andhra (1981).

In studying published chromosome lists, it becomes evident that closely related species (within one genus) may differ in chromosome number, the most frequent variations based on the phenomenon of polyploidy (Swanson, 1968). Groups of organisms in which there is a range of chromosome numbers representing different degrees of polyploidy (ploidy levels) are known as polyploidy series. Interspecific variation in chromosome numbers has proved to be one of the richest sources of cytological data of value to taxonomists. At this level, there is usually a fairly obvious single base-number, from which the variations in chromosome number have been derived to produce aneuploids and polyploids (Stace, 1980).

The 36, 18, 20 chromosome counts made on these *Vernonia* species studied could be regarded as a polyploidy series. *V. amygdalina* 2n = 36 is tetraploid, *V. cinerea* 2n = 18 is a diploid and *V. conferta* 2n = 20 is also a diploid. According to Jones (1976), there are several kinds of polyploidy number relationship in flowering plants. *Vernonia* in the old world has a dibasic chromosome number of n = 9 or 10 with polyploids of n = 18, 20 or 30, whereas in the New world it has basic chromosome number of n = 17 with polyploids of 34, 51, 58 or 68. The ploidy level of the *Vernonia* species studied suggest basic chromosome number of n = 9 or 10 because *V. cinerea* is a diploid plant with chromosome number 2n = 18 while *V. conferta* which is also diploid has a chromosome number of 2n = 20. The dibasic chromosome number of the *Vernonia* species studied suggests that they all belong to the genus *Vernonia* in the old world. This conforms to the work of Jones (1976).

The karyotype of *Vernonia* species studied shows telo-centric, metacentric and often submetacentric chromo-

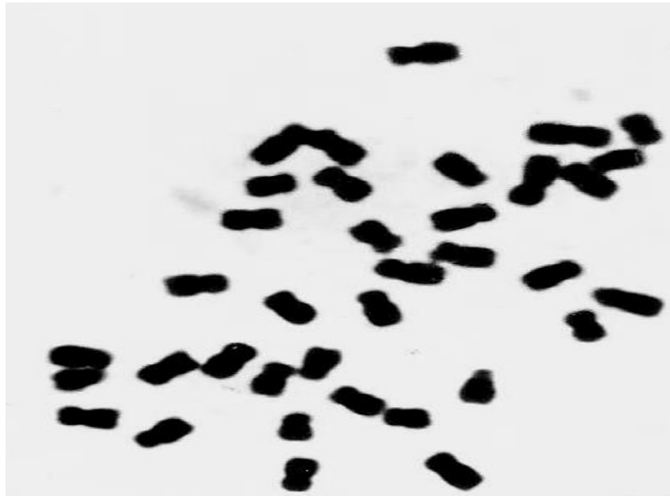

**Plate 1.** Mitotic chromosomes of *V. amygdalina* (bitter leaf), 2n = 36. 100x.

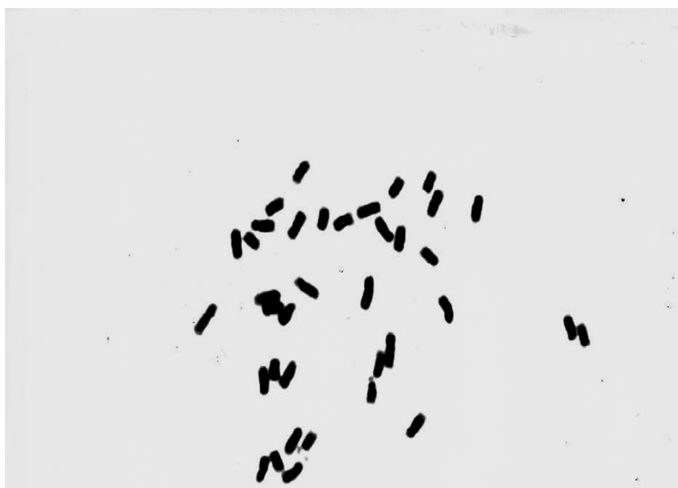

**Plate 2.** Mitotic chromosomes of *V. amygdalina* (non-bitter leaf) 20 = 36 100x.

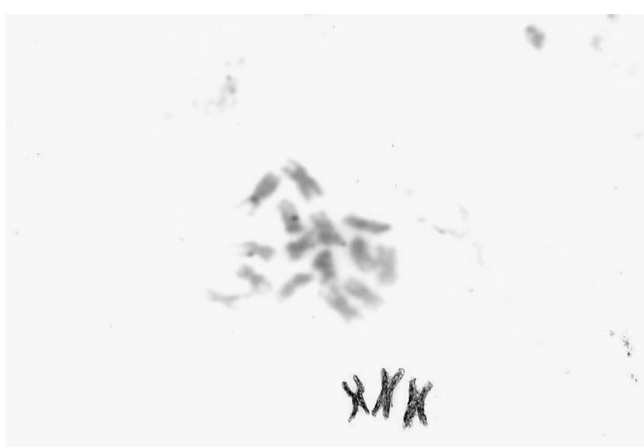

**Plate 3.** Mitotic chromosomes of *V. cinerea* 2n = 18. 100x.

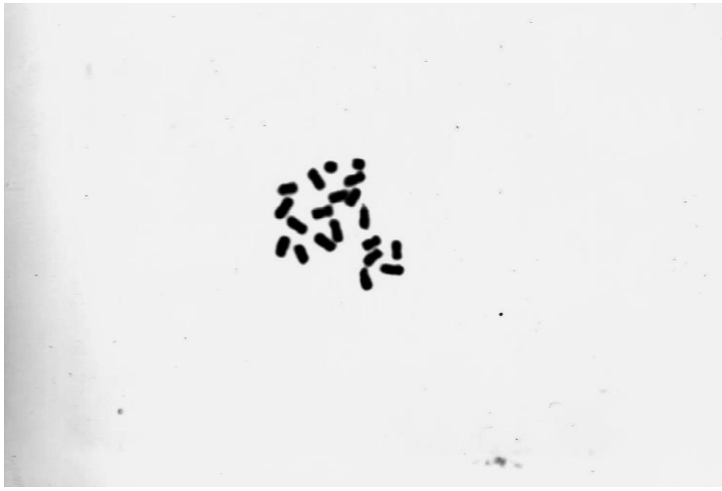

**Plate 4.** Mitotic chromosomes of *V. conferta* 2n = 20. 100x.

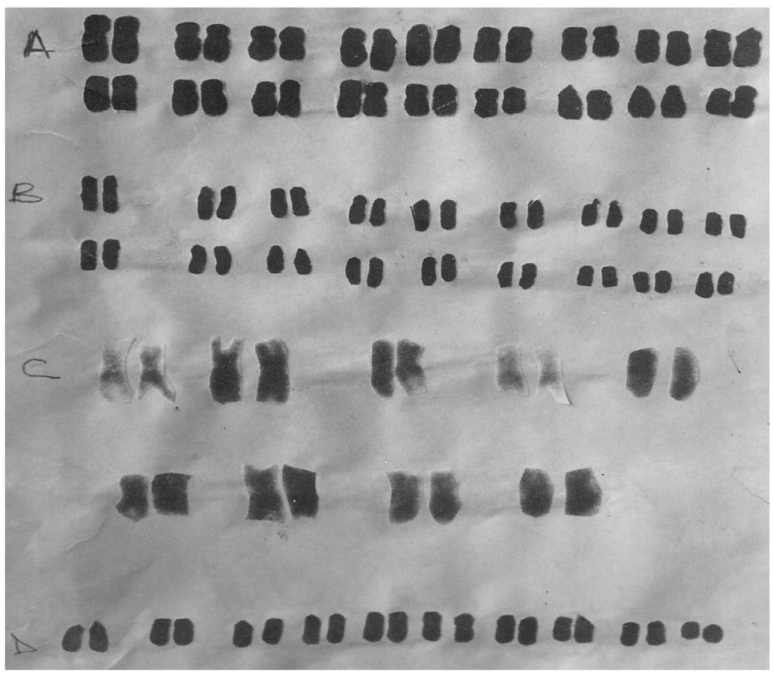


**Plate 5.** Karyotype of *Vernonia* species A: Tetraploid *V. amygdalina* (bitter leaf) 2n = 36. B: Tetraploid *V. amygdalina* (non-bitter leaf) 2n = 36. C: Diploid *V. cinerea* 2n = 18. D: Diploid *V. conferta* 2n = 20.

chromosome. The large nine pairs of submetacentric chromosome in *V. cinerea* suggest that the species is more primitive than the other *Vernonia* species studied. Polyploidy has been utilized in the past, as a positive marker of the direction of evolution which would indicate the primitive and the derived groups or at least derivations which are not possible using the negation principle. It has been widely held that diploids are more primitive forms from which polyploids arose and that this change is irreversible (Stace, 1980).

The study of the pollen fertility reveals that all the taxa of *V. amygdalina* are pollen-fertile. These suggest that both *V. amygdalina* (bitter leaved) and *V. amygdalina* non-bitter leaf which are polyploidy, are amphidiploids.

## REFERENCES

Andhra PW (1981) Chromosome number report *Vernonia*, *Taxon* 23:411- 420.

Darlington CD, Lacour LF (1975). The Handling of Chromosome 4th ed,

Aliens and Unwin Ltd, London. p. 519.
Gill BS, Singhal VK (1998). Chromosomes, chromosomal techniques and chromosomal evolution. In: Forest Genetics and Tree Breeding, pp.168-193.
Ikechukwu OA (2011). Karyotype Analysis on Two *Abrus* Adanson (Papilionaceae) Species in Nigeria. Int. J. Bot. 7:118-121.
Jones SB (1976) Revisions of *Vernonia* (compositae) subsection paniculate, series unbeli tormes of the Mexican Highlands. *Rhodora* 78:108-206.
Jones SB (1979). Synopsis and pollen morphology of *Vernonia* (Compositae Vernonieae) in the New World. *Rhodora* 81:425- 447.
Mesfin T (2004). Flora of Ethiopia and Eritrea. Volume 4 part 2: *Asteraceae* (*Compositae*) Addis Ababa University, Addis Ababa, Ethiopia and Uppsala University, Uppsala Sweden. pp. 408.
Okoli BE (1983) Hybridization, Polyploidy and apomixes is *Andropogon tectorum* Schum and Thonn (Gramineae).New Phytol. 93:591-597.
Olorode O (1974). Chromosome numbers in the Nigerian compositae, Botanical J. Linn. Soc. 68:329-335.
Schubert I (2007). Chromosome evolution. Curr. Opin. Plant Biol. 10:109-115.
Stace CA (2000). Cytology and cytogenetics as a fundamental taxonomic resource for the 20$^{th}$ and 21$^{st}$ centuries. Taxon. 49:451-477.
Swanson CP (1968). Cytology and cytogenetics 2$^{nd}$ ed. Prentice - Hall Inc. New Jersey. p. 137.