Proc. Indian Acad. Sci., Vol. 84 B, No. 4, 1976, pp. 124-127.

Micropyle formation in the ovule as an indicator of primitiveness in Angiosperms

S. SUNDARA RAJAN

924, 38*th Cross*, 22*nd Main*, *IV 'T' Block*, *Jayanagar*, *Bangalore* 560011

MS received 7 February 1976

ABSTRACT

It has been shown by statistical methods that in Angiosperms significant correlation exists between micropyle formation by both the integuments and six other floral and vegetative characters which are admittedly primitive. A subjective assessment of the primitiveness of the feature in question (*i.e.*, micropyle formation by both the integuments) supports the statistical findings.

1. INTRODUCTION

STATISTICAL correlations provide valuable guidance in the assessment of relative primitiveness or advancement of taxonomic groups. The use of statistical methods to solve the problems of evolutionary biology is fairly old. Bailey and Tupper[1] have shown that statistical correlations exist between many anatomical features which they have used in assessing the evolutionary status of several characters. Sporne[2–9] in dicotyledons and Lowe[10] in monocotyledons have successfully used statistical correlations in the evolutionary assessment of several floral and vegetative characters.

This paper is an attempt to use statistical correlations in assessing the evolutionary status of a character, *viz.*, micropyle formation in the ovule of Angiosperms. The paper presents statistical analysis as well as a subjective assessment which are mutually supporting.

2. OBSERVATIONS AND DISCUSSION

In Angiosperm ovules the number of integuments varies. Ovules may have none, one, or two integuments (rarely a third integument–Aril is also present). It has been widely accepted that bitegmic condition is more primitive than unitegmic condition. Support for this view is obtained both by subjective deduction [Eames[11] (p. 259) states "Two integuments clearly represent more primitive structure than one"] and by statistical correlations (Sporne[8]).

Having thus accepted that possession of two integuments is a primitive condition, one may try to assess certain other features in the ovule which require the participation of both the integuments. In the ovule the integuments do not cover the nucleus completely. They leave a small opening called the micropyle to facilitate the entry of the pollen tube during fertilisation and the exit of the radicle during germination. In bitegmic ovules there are three possibilities for the formation of the micropyle. They are (*a*) micropyle formed by outer integument only, (*b*) micropyle formed by inner integument only, and (*c*) micropyle formed by both the integuments. By a subjective deduction it is possible to analyse which of these conditions is most primitive.

If we accept that possession of two integuments is in itself a primitive feature, then naturally anything that needs the participation of both the integuments must be primitive. From this point of view micropyle formation by both the integuments is more primitive than micropyle formed by the inner integument alone. An interesting question arises now as to what about the instances where the micropyle is formed only by the outer integument? Could it be considered primitive? An answer to this depends mostly on the fact as to which integument is on the way out; the inner or the outer. There are evidences to show[12] (p. 56) that the outer integument is suppressed while the inner integument is well developed. This gives a clue that it is the outer integument which is on the way to elimination. Hence a feature (micropyle formed only by the outer integument) solely dependent on the outer integument is most primitive. Among the 208 families of angiosperms where the ovules are bitegmic[13] only in four, the micropyle is formed by the outer integument indicating its lack of selective value.

It will be interesting to assess a subjective judgement of this type by applying the statistical analysis. While no doubt micropyle formation by outer integument alone is most primitive, it cannot be subjected to statistical analysis as the instances of its occurrence are very few. Whereas the feature, *viz.*, micropyle formed by both the integuments has a wider distribution and can be subjected to statistical analysis. If this feature is indeed primitive, it must show positive significant correlations with certain other primitive floral and vegetative characters. Data are collected from 208 families of which, in 108 the micropyle is formed by both the integuments (This number includes some families also where mostly the micropyle is formed by both the integuments except for one or two genera). In 88 families the micropyle is formed by the inner integument. In four families the micropyle is formed by the outer integument. In the remaining the micropyle formation is variable within the family.

Out of 110 families where the ovules are bitegmic, and crassinucellate with a nuclear endosperm (two primitive characters) in 71, the micropyle is formed by both the integuments and in only 39, the micropyle is formed by the inner integument. Similarly in 32 families where the ovules are bitegmic and tenuinucellate (the latter is an advanced character) in 50% the micropyle is formed by the inner integument, in 28% the micropyle is formed by both the integuments and in the remaining 30% the character is not constant within the family.

In addition to the above findings it has been observed that positive significant statistical correlations exist between micropyle formed by both the integuments and six floral and vegetative characters providing some more evidence. The proven primitive characters selected for finding out correlations are, (1) trees or shrubs, (2) flowers actinomorphic, (3) petals free, (4) endosperm nuclear, (5) placentation axile and (6) ovule crassinucellate. Details of these correlations are provided in table 1 where:—

x = number of families showing the character X.

y = number of families showing the character Y.

n = total population for which facts are known.

m = total number of families in which character x and y actually occur together.

$m' = (xy/n)$ = expected number of families exhibiting both characters (x and y) assuming them to be distributed at random among the n number of families.

Table 1. Data regarding positive significant correlations between type of micropyle formation and six other floral and vegetative characters.

	Character X	Character Y	x	y	n	m	m'	p
1.	Micropyle formed by both the integuments	Trees or shrubs	108	108	325	63	34·0	0·000000
2.	do.	Flowers Actinomorphic	108	165	325	83	54·8	0·000000
3.	do.	Petals free	108	149	325	78	49·5	0·000000
4.	do.	Endosperm nuclear	108	161	288	80	60·3	0·000001
5.	do.	Placentation axile	103	113	325	57	37·5	0·000001
6.	do.	Ovule crassinucellate	103	179	314	77	61·2	0·000092

To find out the probability of significance the exact value of p has been calculated (instead of the chi square) to show that the value observed for m is significantly more than the calculated value m'. The value of p indicates the mathematical probability that the correlation is not a significant one and that the value obtained for m is merely fortuitous. For example a value of $p = 0{\cdot}01$ indicates a 1% probability that the correlation is not genuine. This value of p is set as the basic value and any correlation where p is greater than 0·01 is regarded as not significant. To calculate the value of p the following formula taken from Bailey (1959) is applied.

$$p = \frac{x!\ (n-x)!\ y!\ (n-y)!}{n!\ m!\ (x-m)!\ (y-m)!\ (n+m-x-y)!}$$

for the purposes of calculation an IBM 360/44 digital 44 PS computer has been used.

The values for p given in table 1 clearly show that all the values are far less than the threshold value of 0·01. This is a definite indication of the existence of positive significant correlation.

Hence it is concluded that in the ovule of Angiosperms the micropyle formed by both the integuments is a primitive character.

ACKNOWLEDGEMENTS

I am thankful to N. Gopala Swamy and M. Sukumaran of the Indian Institute of Science, Bangalore, for help in the use of the computer.

REFERENCES

1. Bailey, I. W. and Tupper, W. W., *Proc. Am. Acad. Arts. Sci.* **54** 149 (1918).
2. Sporne, K. R., *Proc. Linn. Soc. Lond.*, 160th Session **40** (1948).
3. Sporne, K. R., *New Phytol.* **48** 259 (1949).
4. Sporne, K. R., *Evolution*, Lancaster, P.A. **8** 55 (1954 *a*).
5. Sporne K. R., *Phytomorphology* **4** 275 (1954 *b*).
6. Sporne, K. R., *Biol. Rev.* **31** 1 (1956).
7. Sporne, K. R., *Proc. Linn. Soc. Lond.*, 171st Session **83** (1960).
8. Sprone, K. R., *New. Phytol.* **68** 555 (1969).
9. Sporne, K. R., *New Phytol.* **72** 1173 (1973).
10. Lowe, J., *New Phytol.* **60** 355 (1961).
11. Eames Arthur, J., *Morphology of the Angiosperms*, McGraw-Hill Book Co., New York (1961).
12. Maheshwari, P., *An Introduction to the Embryology of the Angiosperms*, McGraw-Hill Book Co., New York (1950).
13. Davis, G. L., *Systematic Embryology of the Angiosperms*, John Wiley & Sons, Inc., New York (1966).
14. Bailey N. T. J., *Statistical Methods in Biology*, English Univ. Press, London (1959).