Artificial induction of Pollen variability in *Daucus carota*

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With 20 Figures

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Introduction

The paper presents the results obtained on the effect of colchicine — gammexane treatment of the seedlings of *Daucus carota*. The pollen of these treated plants exhibited a great range of variability in size and shape while the control had only one type of bipolar radiosymmetric grains.

Materials and methods

Seeds were sown in 12" pots and the growing shoots of the seedlings were treated with colchicine - gammexane solution of .2% colchicine strength following the technique of combinations developed in this laboratory (RAGHUVANSHI & JOSHI 1965). Although the plants in the treated set showed signs of polyploidy by the presence of dark green and thickened leaves the mature plants were all 2n. Those plants which had polyploid characters did not survive to complete the life cycle and those which continued growth were found to be all 2n. The treated 2n plants exhibited pollen variability while the controls had normal bipolar grains. Besides cytology details of pollen shapes and their mode of origin from normal was studied. Pollen study was made from acetolysed grains following the technique of ERDTMAN 1952.

Observations and discussion

Cytologically the plants were normal having $2n = 18$ confirming the observations of HEISER & WHITAKER 1948, and GARDE & GARDE 1951. The PMCs had only bivalent configurations, the rods being more common than the rings, the range of chiasma per PMC was from

9 to 12 with an average of 10.8 per PMC. The forthcoming stages were normal.

However, the interesting feature of these 2n plants was in their pollen grains. While the pollen of the control plants was normal, bipolar, radiosymmetric, that of the 2n treated plants was asymmetric and nonfixiform. The variable grains may be trilobed, quadrilobed, triangular, dumbell shaped or have projections. Polar view circular or angular. Ectosexine tenuitegillate, bacula evenly developed and rarely local thickenings were noticed. Sculpture almost psilate.

Ontogenetic study has shown that during the course of development the individual round spores transform themselves into the variable grains. Depending upon our previous study of other genera of this family, the variable grains have been classified into types. In *Daucus carota* type Q is a new addition not so far encountered in the other genera (*Coriandrum, Anethum, Foeniculum, Pimpinella, Cuminum, Carum* etc.). Although the frequency of the variable grains in the present

Table 1

The proportion of the variable grains as observed in the 2n treated plants

Treatment	Level of Ploidy	Type of Pollen grains									Micro-pollen	Total
		A	C	D	E	F	G	O	M	Q		
Colchicine gammexane	2n	847	1	22	27	1	28	44	2	75	2	1049

material is quite low, yet, the spectrum of variability is broad enough to indicate that similar changes have been induced although, to a lesser extent. Table 1 gives the frequency of the variable grains and with the help of the transitional stages came across during the course of this study diagrammatic presentation of the development of the different grains is shown in Fig. 20.

The types observed in the present study are briefly described below. Type A (Fig. 1) control type bipolar, radiosymmetric and colporate. Type C (Fig. 10) a deviation from type A with a side protrusion at the equatorial region. Type D, a small rectangular grain. Type E (Figs. 11, 12) a trilobed grain, the three lobes connected at the equator. Type F (Figs. 13, 14) a triangular grain. Type G (Figs. 15—18) a quadrilobed grain, depending upon the plane in which the grain is placed it may show different angles of the same grain. Type O (Fig. 9) a dumbell shaped grain. Type M (Fig. 19) represents the polyads. Type Q (Fig. 6) is a new addition in the present study. It is likely to be derivation from dumbell shaped Type O in which the flat poles

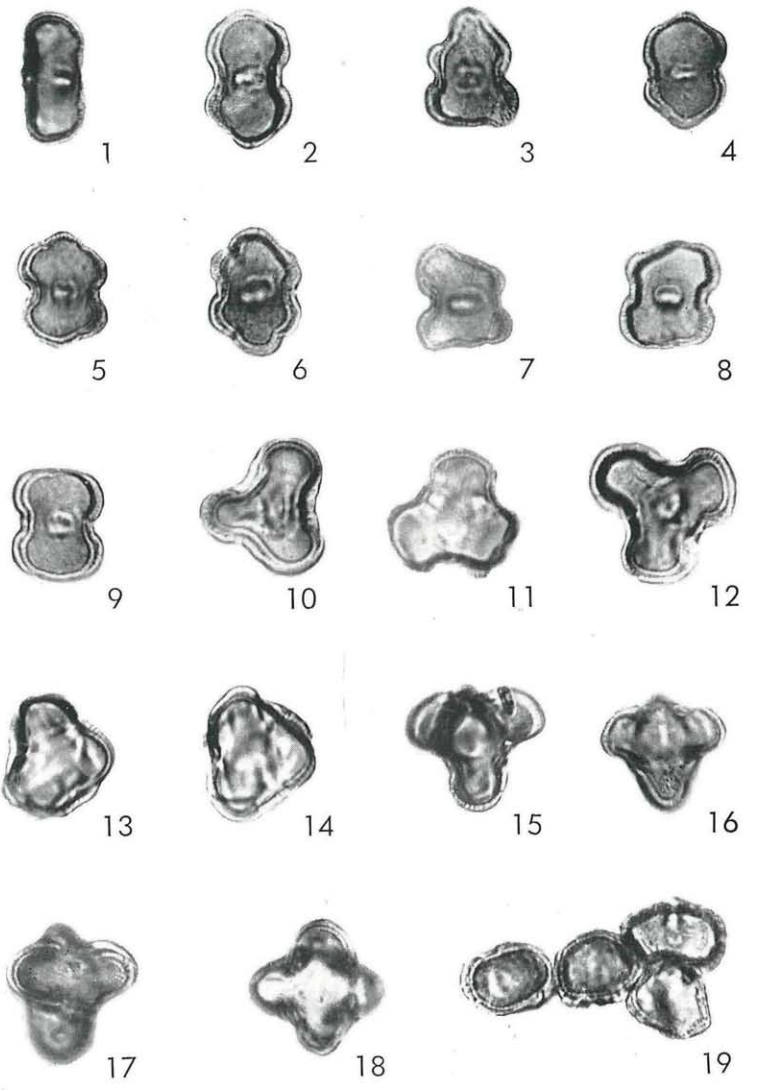

Fig. 1—19. Pollen grains. — Fig. 1. Control type A. Figs. 2—5, 7 and 8. Transitional stages of type Q. Fig. 6. Type Q. Fig. 9. Type O. Fig. 10. Type C. Figs. 11, 12. Type E. Figs. 13, 14. Type F. Figs. 15—18. Type G. Fig. 19. Type M.

have been replaced by 3 curves at each pole, Figs. 2—5, 7 and 8 show the possible mode of development. This type is frequently came across in *Daucus carota* and was not encountered in the other genera. Micropollen represents the development of grains from strays and laggards.

CERCEAU-LARRIVAL 1965 has studied the pollen of *Dauceae* and from her work it is clear that the pollen grains depict fixed shape and size in nature. The pollen variability induced by the chemical treatments indicate the effect of the chemicals on the pollen grains while their cytological behaviour is normal like the controls. Our study of other

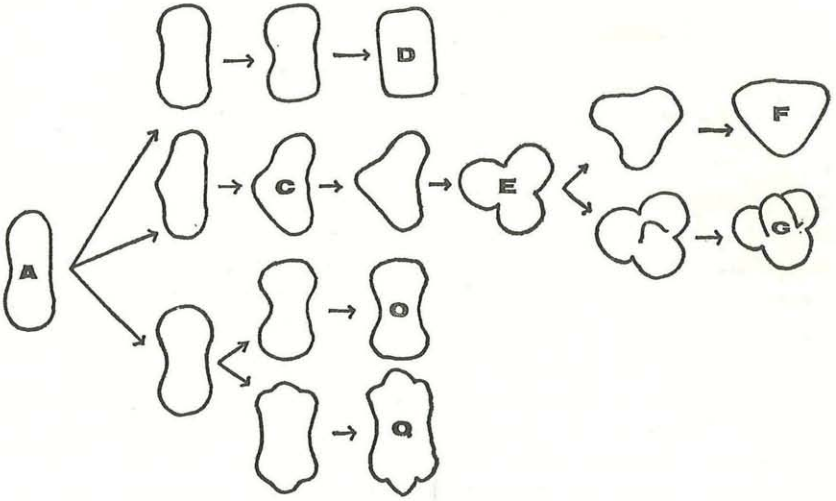

Fig. 20. Diagrammatic representation of the scheme of development of variable grains.

genera of the *Umbelliferae* also indicate the instability of pollen shape in the plants when subjected to various chemicals. Hence it is suggested that pollen variability may be due to change in expression of genes controlling pollen shapes caused by the treatment with colchicine-gammexane. These different shapes result due to disturbance in polarity of grains.

Summary

Treatment of seedlings of *Daucus carota* with colchicine-gammexane solution ultimately resulted in pollen variability while the controls had only bipolar radiosymmetric pollen grains. As this pollen variability has been observed in treated plants of other Umbellifers and some of the pollen shapes are common so to determine their frequency they have been classified into different types. *Daucus carota* has types A, C, D, E, F, G, O, M and Q. Type Q has not been observed in other Umbellifers.

It is suggested that treatment of seedlings with colchicine-gammexane ultimately results in change in expression of genes controlling the pollen shapes.

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