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TRANSLOCATION OF ASSIMILATES IN FRITILLARIA IMPERIALIS L. III. A TRACER STUDY ON THE VASCULAR CONNECTIONS BETWEEN FLORAL NECTARIES AND LEAVES

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SUMMARY

The vascular connections between a leaf of the vegetative shoot part and the nectaries of the inflorescence of *F. imperialis* have been traced with ^{14}C-photosynthates.

The conclusion, based on the earlier observed strictly longitudinal translocation of photosynthates in the vascular bundles of the stem, is that the phyllotactical arrangement of the flowers around the stem axis deviates from that of the leaves (2/5) and approximates a 3/8 pattern.

1. INTRODUCTION

In previous studies it was found that $^{14}CO_2$ supplied to a leaf of the vegetative shoot part of a *F. imperialis* plant was assimilated and translocated as ^{14}C-photosynthate to developing bulb and inflorescence, of which, however, only a 1/5 sector became labelled (VAN DIE *et al.* 1970; TIETEMA *et al.* 1972). This phenomenon could be directly related to the 2/5 phyllotactic pattern of the vegetative shoot part, which means that 5 orthostichies or vertical rows of leaves can be distinguished, each of which apparently corresponds to a particular group of vascular bundles. If a substance moves through such a group of bundles there is no appreciable loss of it in tangential direction, even if translocated over relatively large distances. It consequently arrives almost quantitatively in that particular sector of the bulb or inflorescence which has its vascular connections with one of the 5 rows of leaves.

In the case of the bulb the phyllotactic pattern exhibited by the bulb scales is a 1/2 arrangement. This means that the bulb scales are spaced around the axis with a divergence angle of 180°, while the sector of the bulb that becomes labelled after feeding $^{14}CO_2$ to a single leaf has an angle of approximately 72°. Consequently there will be bulb scales that remain unlabelled, others, of which only a very small part receives ^{14}C, but also some a large part of which becomes radioactive.

It has been shown that supplying a leaf with $^{14}CO_2$ results in the appearance of the major part of the label in the nectar of that flower which according to its position seems to be inserted in the orthostichy of the treated leaf. But some activity is also secreted by neighbouring flowers. This could mean that some loss of radio-activity occurs in radial or tangential direction during its movement through the bundles. But it could also mean that, as was found in the bulb sca-

les, the phyllotactic arrangement of the flowers is not 2/5, though often 5 flowers are present in one whorl. If the phyllotaxis of the inflorescence were 3/8 instead of 2/5, some flowers would only become partly labelled, while the major part of the ^{14}C would arrive in one flower. An indication for the view that a flower may have some vascular connections with several orthostichies, such that the inflorescence has not a 2/5 phyllotactic arrangement, was obtained by experiments with a dye (VAN DIE *et al.* 1970). The present paper gives additional evidence for that view and demonstrates that though a 1/5 sector of the inflorescence receives the label after $^{14}CO_2$ feeding of a single leaf, the phyllotactic arrangement of the flowers around the inflorescence axis approximates a 3/8 pattern.

2. MATERIAL AND METHODS

Details concerning the plants and most of the techniques used have been described in a previous paper (VAN DIE *et al.* 1970). $^{14}CO_2$ was supplied to one of the upper leaves of the vegetative shoot part, just after the onset of flowering. With intervals of 3 hours nectar samples of 5 µl were taken from all individual nectaries till the end of nectar secretion. The radio-activity of each sample was measured by liquid scintillation counting as described in the previous paper.

3. RESULTS AND DISCUSSION

Fig. 1 shows the distribution of the flowers around the inflorescence axis of *F. imperialis*. Each large circle represents a flower, indicated by a roman numeral (i.e. its actual number in the experiment) and by an arabic numeral (i.e. the sequence number it has in an assumed undisturbed whorl). The percentage given in

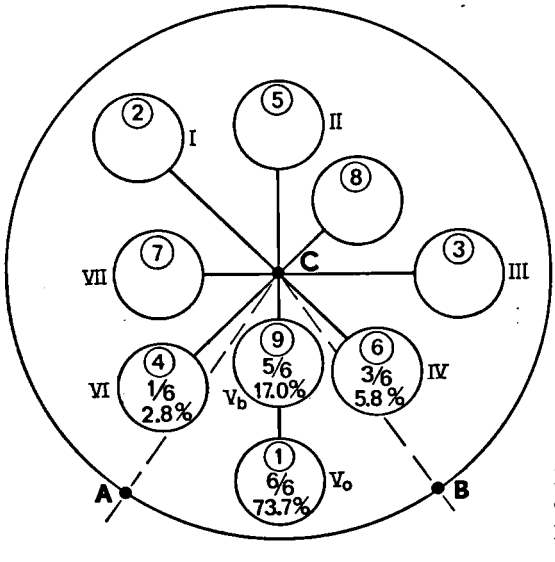

Fig. 1. Diagram representing a map of a Fritillaria inflorescence. For explanation see text.

some of these circles indicate the amounts of ^{14}C secreted by these particular flowers. The fractional numbers given in the circles indicate the number of ^{14}C-secreting nectaries (numerator) in a particular flower over the total number of nectaries in each flower (denominator; always 6).

Fig. 1 demonstrates that in a whorl of 8 flowers 15 nectaries belonging to 4 flowers secrete 99.3% of all ^{14}C-nectar activity collected in this experiment. Out of these 4 flowers two were situated above each other, V_o and V_b (1 and 9).

Fig. 2 presents the amounts of ^{14}C-nectar secreted by the individual nectaries of the 4 active flowers. These amounts are depicted as percentages of the total ^{14}C collected. It is noteworthy that more than 50% of all radio-activity recovered was secreted by 3 out of the 48 nectaries.

From earlier work (VAN DIE *et al.* 1969; TIETEMA *et al.* 1972) it was known that ^{14}C-photosynthates from one leaf are distributed within a sector of approximately 72° in the inflorescence as well as in the bulb. In the latter the phyllotaxis is 1/2, in the former it could be 2/5 as in the vegetative stem part, since the major part of the activity recovered was secreted by one flower only. But the secretion of some activity by neighbouring flowers could point to a flower arrangement which slightly deviates from a 2/5 spiral pattern, e.g. that of a 3/8. Autoradiograms of these weakly active flowers support this assumption: only a few petals or petal parts became radio-active while the remainder did not possess ^{14}C (*fig. 3*). Also in *Lilium tigrinum* (GRELLER 1969) a phyllotaxis of 2/5 and one of 3/8 occur together in one shoot.

In calculations on the possible phyllotactic arrangement of the flowers it is obvious that one has to work with complete (single) spiral units. This means that the flower nr 9 (V_b) should be neglected since it represents the first flower of a second spiral unit.

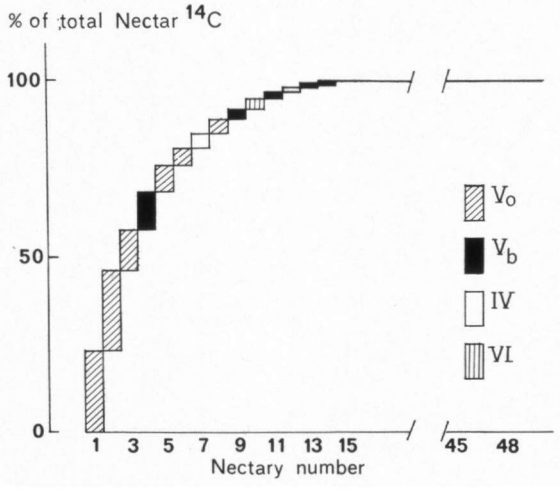

Fig. 2. Diagram showing the percentage of ^{14}C-labelled nectar secreted by the nectaries. Each block represents the amount of ^{14}C-labelled nectar of one nectary. It can be seen that flower V_o secretes the majority of labelled nectar.

Fig. 3. Photo and autoradiogram of a flower in the same position, showing that a flower can be labelled partially.

In the three active flowers remaining, 9 nectaries secrete appreciable amounts of labelled nectar, i.e. between 23.4 and 1.4% of totally recovered activity. The tenth nectary only gives 0.19%. These 9 or 10 nectaries correspond with 1/5 of the spiral unit, which consequently consists of 45–50 nectaries. This in turn corresponds with 8 flowers (48 nectaries). In the present experiment only 7 flowers were present in the spiral unit, but since abortion of young flower buds is very common in *Fritillaria imperialis* not much value should be attached to this discrepancy. From the present data the conclusion is drawn that beside the earlier reported 1/2 spiral pattern of the bulb scales and the 2/5 phyllotactic arrangement of the leaves around the vegetative part of the stem axis, the flowers probably are inserted in a 3/8 spiral manner on the axis of the inflorescence.

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