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Species: carnation; chrysanthemum; dahlia; freesia; lilac; stocks (Matthiola); Sweet William (Dianthus barbatus).
Key words: cut flower; keeping quality; water conductivity; carbohydrate.
Conclusion: see p. 53. 1 reference.

Aarts

AARTS '62

THE KEEPABILITY OF CUT FLOWERS

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The problem of the life span of a cut flower is very complex. I will discuss only two factors involved :

1. The waterconductivity of the stem
2. The carbohydrate supply of the flowers.

1. The waterconductivity of the stem

1.1. *Bacteria and their products*

The harmful effect of bacteria to cut flowers could be demonstrated by placing flowers in a sugar solution with and without those bacteria (Fig. 1).

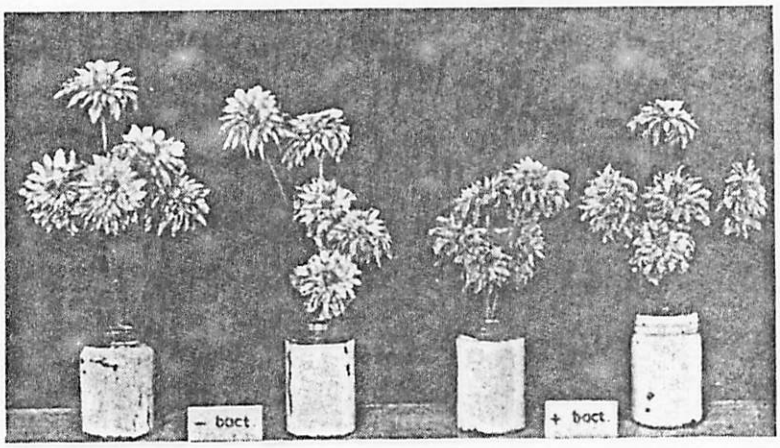


FIG. 1. — Influence of bacteria on the keepability of Dahlia, 9 days after cutting. Left : Sucrose 1 % without bacteria. Right : The same sucrose added concentration, obtained by dilution of a 10 % sucrose solution in which bacteria had been grown for 3 days.

Flowers placed in a vessel are not only damaged by a plugging action of the living bacteria themselves, however. For instance, water that has been used for 14 days for cut Dahlia's will damage new flowers immediately, even when the bacteria have been killed

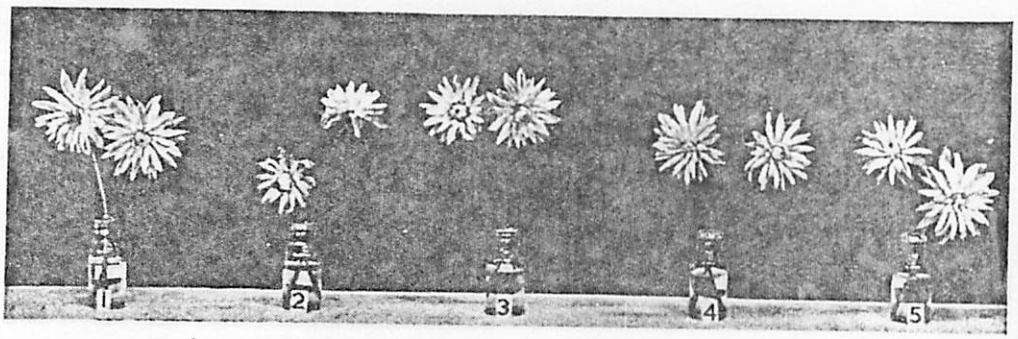


FIG. 2. — The harmful effect of water already used for Dahlia during 14 days. Condition after 7 days in 1. Fresh water ; 2. Used water ; 3. Used water, heated to 125°C ; 4. Used water, filtered through P7 ; 5. Used water, heated and filtered through P7.
Basal solution : Uspulun 0,02 % + citric acid 0,02 %.

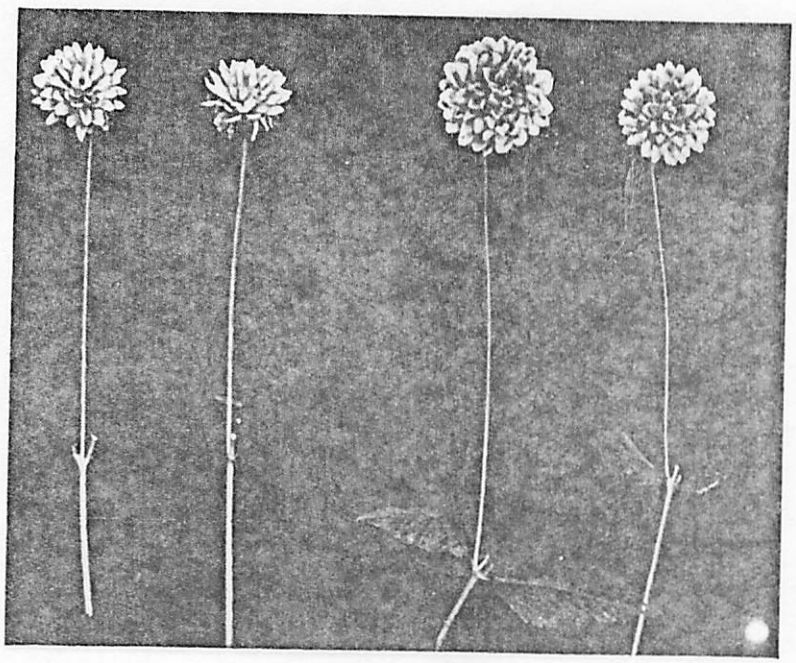


FIG. 3. — Influence of leaves (right) on the keepability and development of cut Dahlia flowers. 13 days after cutting. Basal solution ACAC. (= $AgNO_3$ 0,003 % + $Ca(NO_3)_2$ 0,1 % + AAradon 0,001 % + Cladox 0,025 %)

by chemicals, by heat or by filtering through a bacterial filter (Fig. 2). The harmful effect is much less if the used water is not only filtered but heated as well. This suggests a toxical substance in addition to the plugging action. By measuring the waterconductivity of stem pieces under vacuum pressure (for methods see ref. I) the plugging can be demonstrated after 6 days already (table 1).

To prevent this bacterial plugging a harmless bactericide has to be added, such as $AgNO_3$ 0,003 % + $Ca(NO_3)_2$ 0,1 %.

TABLE 1

Influence of some treatments on the water conductivity of the stem, expressed in % of fresh stem pieces

Treatment	days after cutting	Bactericide	Height from the base cm		
			0-8	8-16	16-24
Fresh water	5	ACAC	100	—	—
Used water (U. W.)		»	6	—	—
U. W. heated (120° C)		»	6	—	—
U. W. filtered through P 7		»	25	—	—
U. W. filtered and heated		»	65	—	—
U. W. filt.-heated-filtered		»	100	—	—
Bactericides	12	check	8	43	
		ACAC	28	80	
		Uspulun 0,03 %	4	80	
0-8 cm boiled	14	ACAC	130	22	70
0-16 cm boiled			126	114	34
8-16 cm steamed			67	108	92
550 cc water					
depth 6 cm	17	none	3	29	36
depth 15 cm			41	13	14
depth 30 cm			46	100	100
check	14	none	66	75	20
aerated			3	12	18
check	11	ACAC	10	77	74
vacuum-infiltration with water			56	58	51
All leaves	8	ACAC	100	29	16
3 side branches left			100	27	31
no leaves			96	103	101

1.2. *Plugging without bacteria*

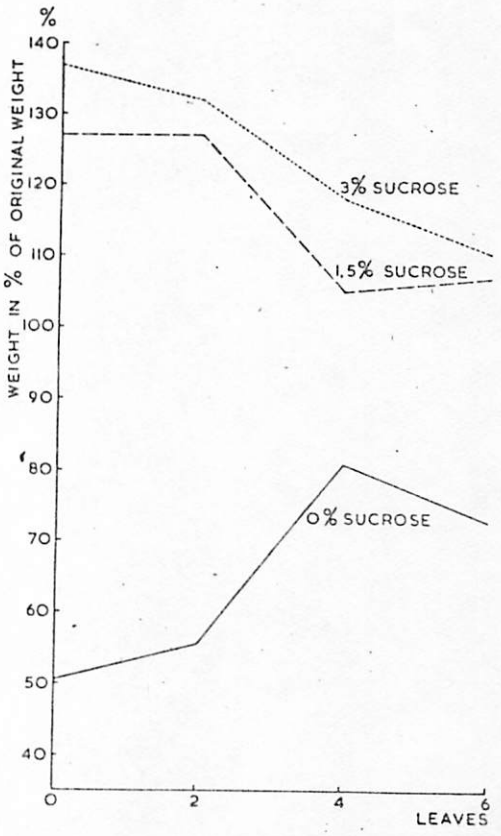
By measuring the waterconductivity of stem pieces it could be demonstrated that even in the case of complete sterility (obtained by the addition of silver nitrate or Uspulun) the stem became partially plugged (table 1). When the living cells were killed by heat

or chemicals, plugging did not occur in the dead part of the stem, but just above it in the living part (table 1).

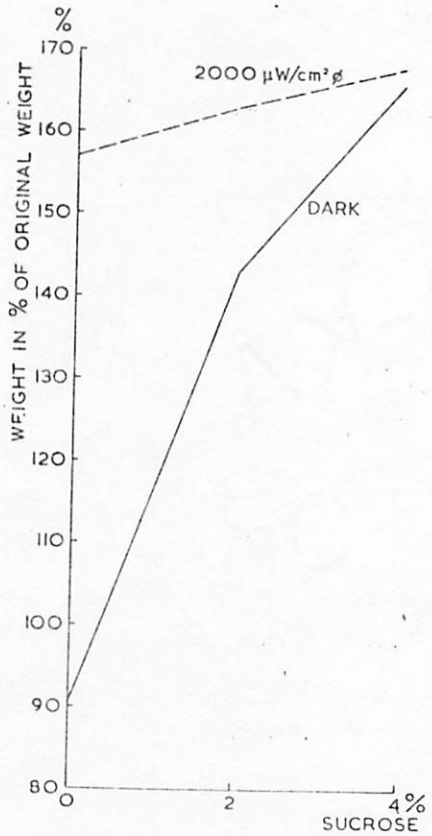
It is furthermore interesting to know that by placing the stem deeper in the water (of the same quantity) the waterconductivity remains higher and the keepability is longer. By aeration of the water the waterconductivity will be lowered. Reversely, vacuum-infiltration of the stem with water helps to maintain the waterconductivity. If the transpiration is decreased by removal of the leaves, the waterconductivity stays longer at the original level (table 1).

These facts together suggest an internal secretion as a reaction to wounding and abnormal intake of air.

How to prevent active plugging ? The solution of this problem is very difficult because the action of chemicals added to the water is not restricted to the stem. Apart from

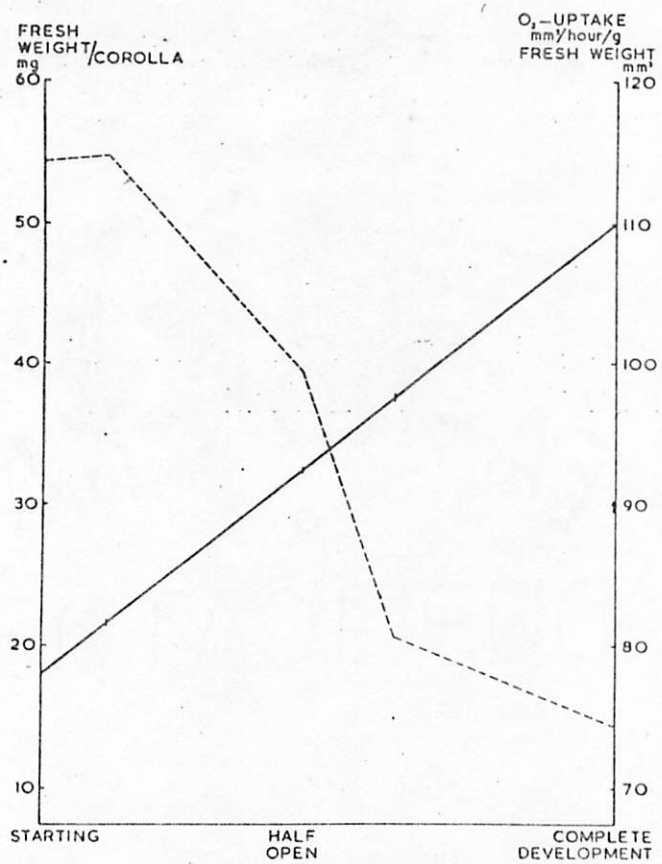


GRAPH. 1. Influence of number of leaves and sucrose on the keepability of cut Matthiola flowers. Keepability expressed as weight after 13 days in % of original weight. Basal solution ACAC



GRAPH. 2. The keepability of cut Matthiola in light and dark with and without sucrose. Basal solution ACAC

this the quantity of the chemical that reaches the living cells depends on such variable factors as the transpiration stream. In practice the best results have been obtained by the addition of $Ca(NO_3)_2$ 0,1 %, lowering the *p*H to 4-5, and placing the stems deeply in the water.

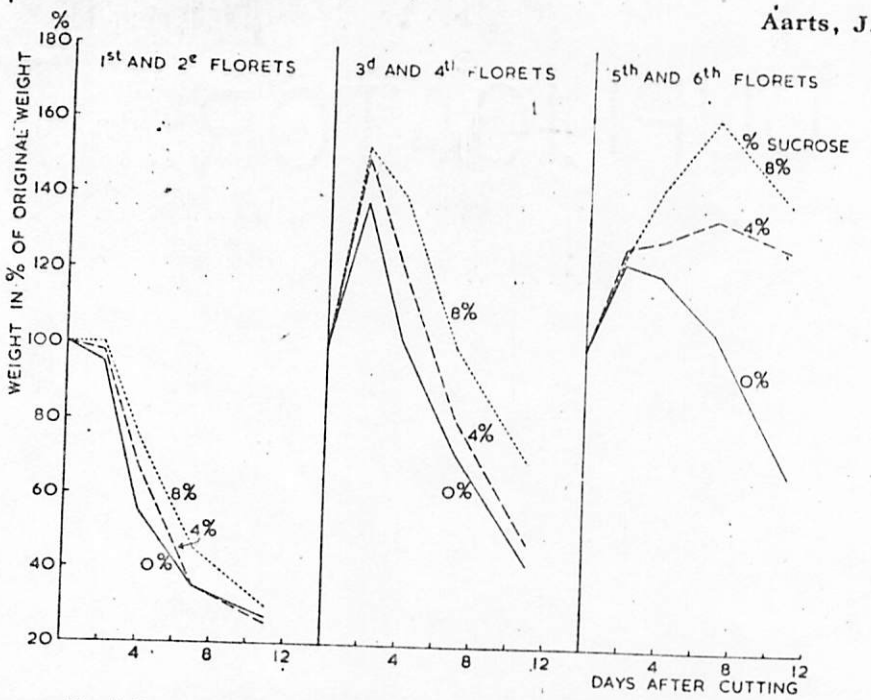


GRAPH. 3. O^2-uptake (– – –) and fresh weight (—) of the petals of Dianthus barbatus in different stages of development

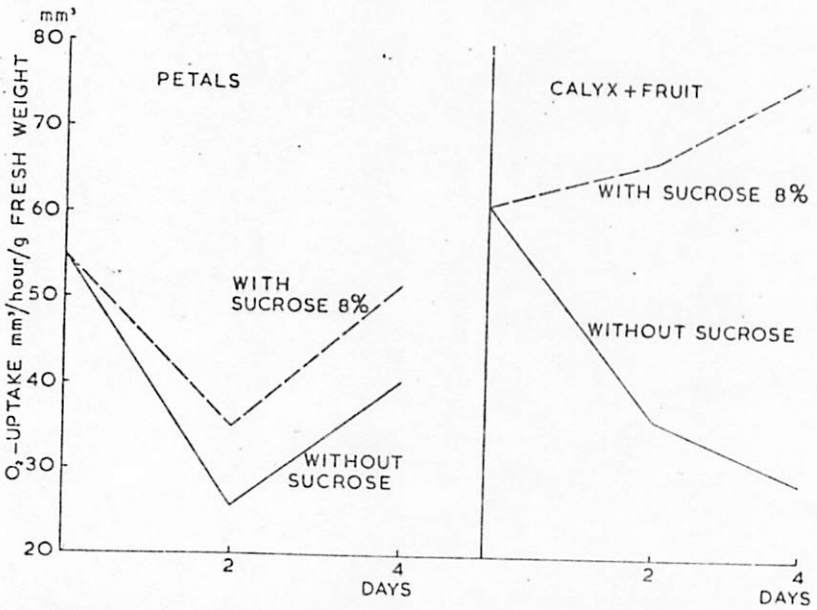
2. The carbohydrate supply of the flowers

2.1. *Photosynthesis*

It could bo demonstrated in the greenhouse, that the presence of leaves had a favourable effect on the keepability of Dahlia, Chrysanthemum, Pyrethrum and Mathiola (Fig. 3). However, if sucrose was added, the presence of leaves didn't have any effect on the keepability of the flowers, and in the case of Matthiola and Pyrethrum the leaves even



GRAPH. 4. The influence of sucrose on florets of the same inflorescence of Freesia. Keepability expressed as weight in % of original value. Basal solution ACAC



GRAPH. 5. Influence of sucrose 8 % on the O_2 uptake per g of fresh weight of petals and calyx + fruit, measured separately, in Lathyrus

yellowed (graph 1). In the dark the leaves don't have any effect, but the product of photosynthesis can be replaced by sucrose in the water (graph 2).

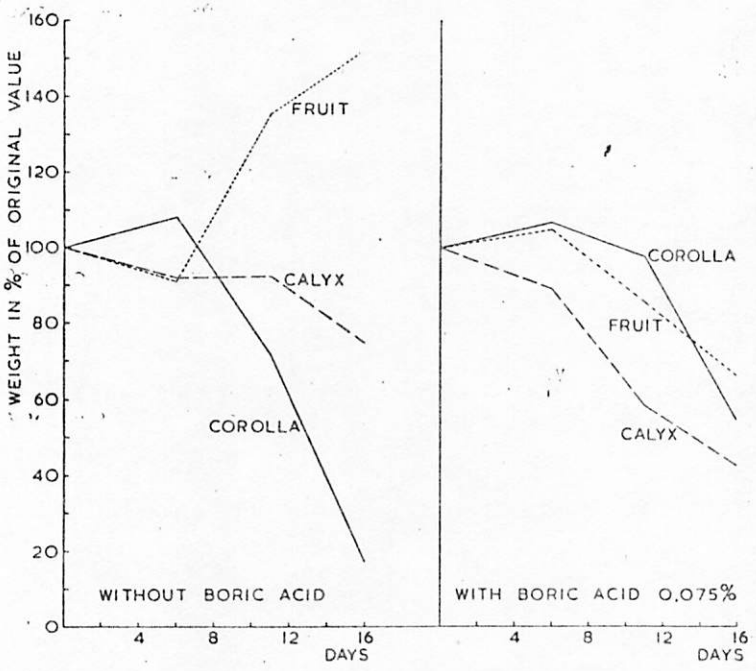
2.2. *Respiration*

It has been stated [1] that the respiration rate of the flowers is related to the keepability. Low temperature results in a low respiration rate and prolongs the life of the cut flower.

Graph 3 shows that the respiration is not the same in all stages of development. During the early stages the respiration rate is higher and the sugar requirement also (graph 4). So it may occur, that in one inflorescence the eldest flowers do not need sugar, but the younger ones still do. Even the different parts of one flower do not react in the same way. Petals and sepals react differently to the addition of sugar (graph 5). We have to conclude, that the keepability of the corolla not only depends of the quantity of sugar available for the whole inflorescence, but that there must be a mechanism that regulates the carbohydrate stream.

2.3. *Boric acid*

In only one case it appeared to be possible to affect the regulating mechanism in a favourable way. In Dianthus spec., boric acid prevented the loss of carbohydrate from the corolla to sepals and ovary (graph 6). Boric acid had a favourable effect also in Lathyrus,



GRAPH. 6. Influence of boric acid 0,075 % on the development (fresh weight in % of original value) of corolla, calyx and ovary of Dianthus caryophyllus.
Basal solution ACAC

Convallaria and Syringa. In other cases it was not successful. Gibberellic acid prolonged the life of Matthiola, but not of other flowers. In both cases a lower respiration rate of the petals could be demonstrated. It is doubtful, however, if this is the primary cause of the effect.

3. Conclusion

The mean prerequisite for a long life of cut flowers is an undisturbed water uptake. In addition, sugar may have a strong effect. The optimal concentration depends on the species and the stage of development.

REFERENCES

[1] Aarts, J. F. Th. — *Meded. Landbouwhogescho ', Wageningen*, 1957, **57** (9), 1-62

DISCUSSION

Q. — Hess (U.S.A.) : Have you tried respiratory inhibitors to try to reduce the utilization of sugars by cut flowers.

R. — Yes, but the question is, how to get those inhibitors at the right place without disturbing the other essential processes in the living cells such as the water uptake.

Q. — Kuhlen (West Germany) : Welcher Art ist die Verstopfung der Gefässe nach Abtöten der Stengelenden durch heisses Wasser ?

R. — Eine Gummi-Sekretion aus den lebendigen Zellen.

Q. — Ist die Wirkung von $Ca(NO_3)$ und die Erniedrigung des *p*H-Wertes nicht u. a. ein Hydratationseffekt ?

R. — Ich glaube nicht, denn sonstige Nitrate haben nicht den gleichen Erfolg.

Q. — Ist die Wirkung von Zuckerlösungen ein Ernährungseffekt oder eine Verbesserung der Wasserversorgung auf Grund einer Erhöhung der Viskosität des Gefässwassers ?

R. — Es muss ein Ernährungseffekt sein, denn andere Substanzen mit Viskositätseffekten, zum Beispiel, Glyzerin oder Maltose haben in keiner Konzentration den gleichen Erfolg.

Q. — Ist das, was wir gemeinhin als Welken von Schnittblumen bezeichnen, nicht wenigstens in 2 verschiedenen Vorgängen aufzuteilen ?
a) Welken der Blütenblätter infolge Zelleiweissabbaues (Schumacher 1928)
b) Welken der Laubblätter infolge Wassermangels z. B. durch Verstopfung der wasserleitenden Gefässe.

R. — Nicht nur die Laubblätter sondern auch die Blütenblätter welken als Folge von Wassermangel. Nach meiner Meinung spielt Kolhydratmangel eine Rolle in dem Abbau des Eiweisses.