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New Trimonoecious Strain in Cucumber, *Cucumis sativus* L.

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The strain 'GW' obtained by selfing in cucumber variety 'Hi-green', represented trimonoecious sex expression with hermaphrodite flowers similar to female flowers in shape. The hermaphrodite flowers usually turned into female flowers with rudimentary stamens in later stages of development, i.e. at upper stem nodes, and under low temperature conditions. From a genetic analysis, it was determined that the trimonoecious sex expression was controlled by a recessive gene tentatively designated h'.

INTRODUCTION

Normal flowers in common cucumbers most often are either male or female. A few exceptional varieties with hermaphrodite flowers are not unknown to them. For example, in the variety 'Lemon' the first flower at certain nodes is hermaphrodite and other ones are staminate. The sex expression according to Whitaker's terminology may be defined as andromonoecious (Whitaker, 1931). It has been known that the andromonoecious sex expression is determined by a single recessive gene *m* in the homozygous state and m acts pleiotropically, modifying to shorten and round the shape of ovaries and fruit (Kubicki, 1969).

On the other hand, the trimonoecious strain of the variety 'Borszagowski' introduced by Kubicki as an ethylene imine induced mutant forms hermaphrodite flowers with a normal ovary, similar to that which normally occurs in female flowers. Then the fruit developed from the hermaphrodite flowers do not differ from ones from female flowers in shape (Kubicki, 1974).

The strain 'GW' reported hereupon shows also trimonoecious sex expression with hermaphrodite flowers similar to female flowers in shape. 'GW was selected from the offspring of the F_1 variety 'Hi-green', without any mutagenic treatments, by Ootsuka (Kurume Genshu-ikusheikai Co.) in 1974. The present authors have been engaged in the studies in order to make clear the mode of inheritance of the trimonoecious sex expression and the factors for modifying the sex expression in 'GW'.

MATERIALS AND METHODS

1. Developmental behavior of sex differentiation

The trimonoecious strain 'GW', the monoecious strain 'KTK' and the F_1 'KTK x GW' were planted in a plastic structure on April 26, 1977. They were grown with routine culture practices. The observation on flower sex in sequence of leaf axils along the main stem was made till just the 30 th node.

2. Effect of temperature on flower sex type

'GW', 'KTK' and F_1 'KTK *x* GW' were used. Seeds were sown in plastic pots (15cm in diam.) filled with sand in a greenhouse on October 21, 1976. On November 15, they (2 nd leaf stage) were topped out at the 4 th node and were carried in the phytotron at Kyushu University to subject to given temperatures. The plants were grown with half-strength 'OK-F-l' solution. The observation on flower sex was made at the 1st node of the 3 rd lateral shoot.

3. Genetic analysis of trimonoeciousness

The F_1 hybrid and segregating populations obtained by crossing 'GW' with 'KTK' were analyzed to determine the mode of inheritance. The parental, F_1 and F_2 generations were planted in a open field on July 2, 1976. Then, the backcrosses to each of the parents were planted in a plastic structure on April **26,** 1977. All plants were classified by sex expression over the growing season into monoecious and trimonoecious phenotypes.

RESULTS

1. Developmental behavior of sex differentiation

As shown in Fig. 1, the sex expression of 'KTK' and F_1 'KTK x GW' was monoecious over all growing stages. On the other hand, the sex expression of 'GW' was andromonoecious under about the 15 th node in main stems and then turned to monoecious, namely, it was certainly trimonoecious.

The typical flowers are illustrated in Fig. 2. The hermaphrodite flowers had, unlike 'Lemon', a long ovary and a well-made stigma, and the fruit developed from them looked the same as the ones from female flowers in shape (Figs. 3, 4). The stamens were slightly small, but included many fertile pollen under 20" and 25°C conditions. Further, the hermaphrodite flowers of 'GW' were individually formed on each the hermaphrodite nodes.

2. Effect of temperature on flower sex type

Plants were grown under a natural light regime at 15°, 20°, 25°, and 30°C starting just after topping.

As shown in Table 1, both 'KTK' and F_1 'KTK *x* GW' formed a female flower at the 1st node of the 3rd lateral shoot under every temperature condition. But, 'GW' grown under 25" and 30°C formed a hermaphrodite flower, under 20°C formed either hermaphrodite or female flower in a ratio of 3 to 2 and under 15°C formed not a hermaphrodite but a female flower.

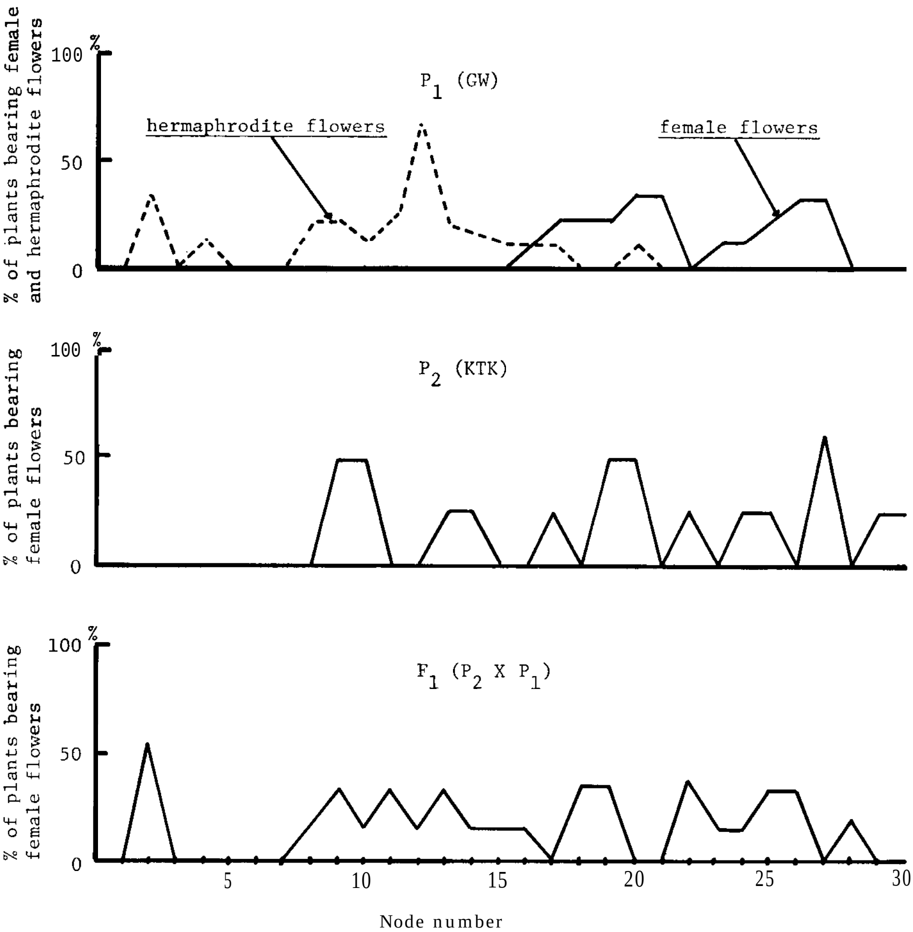

Fig. 1. Developmental behavior of sex expression in cucumbers.

Fig. 2. Typical flowers in cucumber 'GW'. Left; female flower, medium ; hermaphrodite flower, right; male flower.

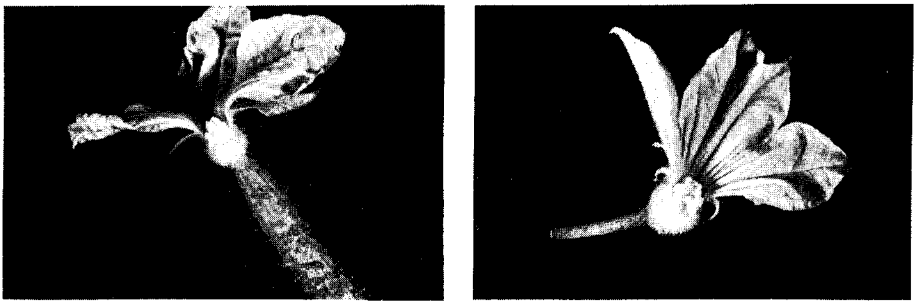

Fig. 3. Difference in the shape of hermaphrodite flowers. Left: 'GW', right ; 'Lemon'.

Fig. 4. Fruit obtained from hermaphrodite flowers. Left: 'GW', right; 'Lemon'.

Table 1. Effect of temperature on flower sex types in cucumbers.

Parentage	Number of flowers							
	15°C		20°C		25°C		30°C	
	Female	Hermaphrodite	Female	Hermaphrodite	Female	Hermaphrodite	Female	Hermaphrodite
GW (P_1)	5	0	2	3	0	5	0	5
KTK (P_2)	5	0	5	0	5	0	5	0
F_1 ($P_2 \times P_1$)	5	0	5	0	5	0	5	0

Observation was made on the flower of the 1st node of the 3rd lateral shoot. Temperature treatments consisted of 5 plants each.

These results led us to the suggestion that the primordia of the staminodia of hermaphrodite flower were prone to lay down at the early stage under low temperature conditions.

3. **Genetic analysis of trimonoeciousness**

From an analysis of the F_1, F_2, and BC data (Table 2) it was determined that trimonoecious sex expression was controlled by a recessive gene tentatively designated h'. The chi-square values in F_2 and BC fully support this

Table 2. Sex expression in cucumbers: Parents, F_1, F_1BC, and F_2.

Year	Parentage	Sex expression		Total	Exp. ratio	Chi-square	P
		Monoecious	Trimonoecious				
1976	P_1 (GW)	0		51			
	P_2 (KTK)	50	50	50			
	F_1 ($P_2 \times P_1$)	49	0	49			
	F_2 ($P_2 \times P_1$)	74	28	102	3: 1	.327	.59
1977	P_1 (GW)	0	10	10			
	P_2 (KTK)	10	0	10			
	F_1BC ($P_2 \times P_1$) $\times P_1$	61	54	115	1: 1	.426	.51
	($P_2 \times P_1$) $\times P_2$	105	0	105			

conclusion. This finding has agreed with the case of Kubicki's mutant (Kubicki, 1974).

DISCUSSION

'GW' must belong to 'Shindome' group, judging from the origin and appearances. But, we can not reveal whether the gene for determination of trimonoecious sex expression came from the parent or the gene arised from natural mutation during the selection process.

It is certain that the gene differs from *m* of 'Lemon' that acts pleiotropically, modifying their ovaries to shorten and round in shape. On the other hand, the gene may be the same as *h* for determination of trimonoecious sex expression of Kubicki's mutant, though it has not been identified yet. Because, both 'GW' and Kubicki's mutants form hermaphrodite flowers with normal ovary and both hermaphrodite flowers usually have rudimentary stamens in later stages of development, and then both genes for determination of trimonoecious sex expression are recessive. Then the gene of 'GW' was provisionally symbolized as *h'*.

It is conceivable that the gynomonoecious varieties can be bred by means of the cross breeding between 'GW' and gynoecious varieties. In a practical point of view, as Kubicki stated, they are superior to gynoecious varieties in possessing their pollen, and thus can be cultivated as a stable variety.

On the other hand, it should be more careful that the mother stock lines of F_1 varieties may be possessed by *h'*. If such a case happened, the F_1 seeds mixed with the selfed seeds of the mother stock line will be produced. Therefore, mother stock lines should carefully be checked it.

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REFERENCES

Kubicki, B. 1969 Investigations on sex determination in cucumber (Cucumis *sativus* L.). VII. Andromonoecism and hermuphroditism. *Genetica Polonica*, 10: 101–122

Kubicki, B. 1974 New sex types in cucumber and their uses in breeding work. *Proc. XIX Int. Hort. Congr.*, *3:* 475–485

Rosa, J. T. 1928 The inheritance of *flower* types in Cucumis and *Citrullus. Hilgardia, 3: 235-250*

Whitaker, T. W. 1931 Sex ratio and sex expression in the cultivated cucurbits. Amer. *J. Bot.*, 18: 359-366