XI. POLYPLOIDY AND VITAMIN C.

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(*Received November 25th, 1935.*)

As a result of some observations made on the relationship between vitamin C and polyploidy in apples [Crane and Zilva, 1931; 1932] we took the opportunity a few years ago [Sansome and Zilva, 1933] to extend this investigation to the tomato, a fruit which is much more amenable to the induction of polyploidy. The results obtained in our inquiry strengthened in a clear-cut fashion the view previously indicated by the experiments on apples, that polyploidy is associated with a higher vitamin C content of the fruit. The antiscorbutic activity of the tetraploid tomatoes was found to be double that of the diploid fruits. Furthermore, this observation held true in tetraploids derived from diploid stock of the genetic constitutions **DOPR**, **dopr**, **DOPr** and **dopR**. The possibility of other factors exercising an influence in this connection was, however, pointed out at the time. In pursuing the investigation we found that this was indeed the case; in fact, in the crops of the following years the disparity in the vitamin contents of the two forms was much less than that found originally (unpublished work). The evidence we have so far obtained does not enable us to draw conclusions, but reference to the subject in a recent publication by McHenry and Graham [1935] calls for a few remarks.

These workers, determining the ascorbic acid by indophenol titration in comparable fruits belonging to tetraploid and diploid forms, found that the latter tomatoes contained about 84 % of the ascorbic acid found in the former, a difference considerably less than that recorded in our published work. They further found that small tomatoes possessed a higher concentration of ascorbic acid than the larger fruits and suggested that part at least of the differences found by us was due to the differences in the sizes of the two forms of the fruits. We are of the opinion that the size of the fruit, in the range used in our experiments, even if it were to have a bearing on the vitamin C concentration, is not a factor of any significance controlling the difference in concentration of ascorbic acid in the two forms of the fruit.

In our original communication we have already pointed out in a general statement that larger fruits did not show a lower concentration of ascorbic acid than did smaller fruits in the same form. We now take the opportunity of giving more details of this observation. The experiments in question were performed in 1933. As pointed out by us then, the tomatoes were collected twice weekly, and in Table I are given the average weights of the tomatoes of each collection and the average ascorbic acid content per 100 ml. of juice (determined daily) for each collection. In these experiments the tetraploid were much smaller than the corresponding diploid tomatoes. It will, nevertheless, be observed that

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Table I.

	dROP		drop		DROP		DrOP	
	Average wt. of fruit	Average ascorbic acid con- tent per 100 ml. juice	Average wt. of fruit	Average ascorbic acid con- tent per 100 ml. juice	Average wt. of fruit	Average ascorbic acid con- tent per 100 ml. juice	Average wt. of fruit	Average ascorbic acid con- tent per 100 ml. juice
	g.	mg.	g.	mg.	g.	mg.	g.	mg.
Tetraploid	20	25.0	20	32.9	20	38.6	19	39.9
	20	36.4	19	40.4	20	40.8	18	37.3
	20	32.0	18	37.3	18	45.6	14	41.7
	17	39.5	14	41.7	18	43.9	12	39.5
	15	44.8	12	39.5	17	40.8	12	27.6
	14	42.5	12	29.8	15	48.2	12	33.3
	14	32.9	12	33.8	15	39.5	10	38.6
	12	32.9	10	39.5	15	35.1	10	35.1
	11	43.0	10	35.1	15	27.2	10	35.1
	10	39.5	10	35.1	15	26.3	9	38.2
	10	35.0	9	38.6	15	29.4	8	38.2
	10	32.9	8	35.1	12	43.9	8	43.9
	10	30.7	8	35.1	—	—	8	34.2
	7	39.5	8	34.2	—	—	—	—
Average	13.6	36.2	12.1	36.3	16.2	38.3	11.5	37.1
Diploid	65	17.5	60	24.1	90	19.7	51	18.4
	60?	15.8	50	22.8	62	19.7	46	24.1
	55	24.1	48	23.2	60	21.0	44	19.3
	55	20.6	44	29.4	55	20.6	40	24.1
	50?	14.0	40	17.5	55	25.0	40	24.6
	44	18.0	40	30.7	52	15.4	40	26.3
	42	18.4	40	22.8	48	21.9	40	24.1
	40?	15.4	40	19.7	40	22.8	36	24.1
	40?	20.6	35	18.9	35	24.1	35	19.7
	40?	14.5	32	26.3	30	23.2	30	19.7
	40	13.2	30	26.3	30	17.5	30	38.2
	40	26.3	30	21.9	27	17.5	30	24.1
	25	28.5	30	21.0	25	36.4	—	—
	25	25.4	22	15.4	—	—	—	—
Average	44.4	19.4	38.6	22.9	46.8	21.9	38.3	23.6

? Slight doubt exists as to the absolute accuracy of these weights.

Table II. DROP.

Tetraploid			Diploid		
Wt. of fruit	Diameter mm.	Ascorbic acid content per 100 ml. juice	Wt. of fruit	Diameter mm.	Ascorbic acid content per 100 ml. juice
g.		mg.	g.		mg.
77	57	15.4	70	50	21.9
40	44	20.6	70	50	21.9
36	38	31.1	42	38	21.0
32	32	25.9	26	25	24.6
30	38	27.2	26	38	17.5
29	32	34.2	24	25	15.8
29	32	22.4	23	38	27.2
27	32	21.5	21	32	19.3
24	38	45.6	15	25	26.8
21	32	24.6	9	13	
19	32	26.8	10	19	28.5
15	25		13	25	
Average	31.6	26.8	29.1	31.5	22.4

there is no evidence that the ascorbic acid content is conditioned within any form by the size of the fruit. Similar evidence was obtained by us during 1934 and 1935. In Table II we give the results recorded in single fruits. This experiment was performed with the special purpose of testing McHenry and Graham's suggestion. Unfortunately, owing to the fact that their communication came to our notice early in October, we could only utilise fruits gathered at the end of the 1935 season, a circumstance which limited our scope. These figures also do not seem to suggest that the size of the tomato has any bearing on the anti-scorbutic potency of its juice.

In continuing our investigation during 1934 and 1935 we were struck by the fact that we could not record again such a great inequality between the ascorbic acid contents of the tetraploid and diploid forms as that observed in 1933. In the latter experiments, the evidence was clear-cut and, as already mentioned, the disparity found was of the same high order in four sets of tomatoes of different genetic constitution. It therefore seems to us that an unknown factor or factors enter into the scheme which is capable of modifying the unequal content of ascorbic acid in the two forms. We were unable so far to obtain any definite evidence on this point, being greatly handicapped by the facts that this work can only be carried out during a short period of the year and that in planning the test experiments the conditions can only be partially controlled by the worker who is otherwise greatly dependent on the elements. We hope, however, that in time favourable conditions may aid this search.

It is appropriate to mention here that all the titrimetric estimations of ascorbic acid with the exception of those contained in Table II have been checked by biological tests.

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