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Effect of foliar sprays of uracil, xanthine and caffeine on the nucleic acid and protein content of leaves and fruiting of Thompson Seedless grapes

by

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Der Einfluß von Sprühbehandlungen mit Uracil, Xanthin und Coffein auf den Nukleinsäure- und Proteingehalt der Blätter sowie den Fruchtansatz bei Thompson-Seedless-Reben

Zusammenfassung. — Reben der Sorte Thompson Seedless wurden mit wässrigen Lösungen von Uracil, Xanthin und Coffein (50 ppm) zweimal während der Wachstumsperiode gesprüht, und zwar bei einer Trieblänge von 30—40 cm Länge und eine Woche später.

Uracil förderte die DNS- und Proteinsynthese sowie die Fruchtbarkeit in stärkerem Maße als Coffein und Xanthin. Der Zuckergehalt der Beeren war gegenüber der Kontrolle erhöht, der Säuregehalt jedoch nur wenig verändert. Der Zeitpunkt der Fruchtreife wurde nicht beeinflußt.

Introduction

As early as 1951, Skoog *et al.* reported that certain purines can favour bud formation and increase the nucleic acid content of the cells. Kessler *et al.* (1959) found that foliar sprays of uracil, xanthine and caffeine increased RNA/DNA ratio and protein content of leaves and fruitfulness in grapevine buds. Jákó (1969, 1970) obtained increased fruitfulness in buds of Ezereves Magyarorsag emleke, a Hungarian table grape, and a corresponding increase in the average weight of the bunches and sugar content and nucleic acid and protein content of leaves by treatment with adenine. The effect of purine is consonant with the earlier observations of Cheban (1968) on the positive correlation between nucleic acid content of buds and the fertility in different varieties of grapes.

When compared to other varieties grown commercially in India, Thompson Seedless is a moderate bearer. It was of interest to examine whether foliar treatment of this variety with certain purines and pyrimidines would enhance its fruiting capacity. The results of a three year study of the effects of xanthine, caffeine and uracil on the protein and RNA, DNA content of leaves and the fruiting capacity of Thompson Seedless variety are presented in this communication.

Materials and Methods

Four year old Thompson Seedless vines growing in the vineyard of the institute were used for the study. The vines were trained on an arbour 2.1 metres above ground level consisting of a roof of wire netting supported on angle iron pillars. Periodic intercultivation and spraying against pests and diseases were attended to as and when required. All care was taken to give uniform treatment to all the vines. The vines were pruned to a uniform number of buds. Six vines were used for each treatment. During the last week of March, 1967, 1968, and 1969, the vines were sprayed with an aqueous solution of 50 ppm of uracil, xanthine and caffeine using

Table 1

Effect of uracil, xanthine and caffeine on the protein and nucleic acid content of leaves in Thompson Seedless vines

Der Einfluß von Uracil, Xanthin und Coffein auf den Gehalt an Protein und Nukleinsäure in Blättern von Thompson-Seedless-Reben

Year	Uracil	Xanthine	Caffeine	Control
		Protein mg/g		
1967	5.11	3.10	5.88	2.97
1968	6.02	3.11	6.62	3.15
1969	6.08	3.00	6.55	3.06
Mean	5.74	3.07	6.35	3.06
CD 5%				0.02
		RNA mg/g		
1967	1.10	0.98	1.07	0.69
1968	1.02	0.95	1.00	0.76
1969	1.11	1.00	0.98	0.82
Mean	1.08	0.98	1.02	0.76
CD 5%				0.022
		DNA mg/g		
1967	0.37	0.41	0.45	0.48
1968	0.37	0.40	0.46	0.44
1969	0.40	0.43	0.46	0.44
Mean	0.38	0.41	0.46	0.45
CD 5%				0.037
		RNA/DNA		
1967	2.94	2.39	2.39	1.44
1968	2.74	2.37	2.16	1.73
1969	2.75	2.35	2.15	1.86
Mean	2.81	2.37	2.23	1.68
CD 5%				0.32

2% Teepol (Burmah Shell Co.) as a wetting agent. The spray was repeated on the young shoots after a week.

The treatments were completely randomized. The number of clusters on the treated shoots was counted at the time of natural flowering in the following years, i. e., 1968, 1969, and 1970. Samples of leaves consisting of 300 discs of one square cm, each cut from the basal and middle portions of the shoots from treated and control vines were collected after 15 days of the second spray. RNA and DNA were determined according to Volkin and Cohn (1954) and protein according to Lowry *et al.* (1951). Reducing sugars and acidity were determined by A.O.A.C. method. All chemical determinations were carried out on triplicate samples.

Table 2

Effect of uracil, xanthine and caffeine on yield and quality of Thompson Seedless grapes
Der Einfluß von Uracil, Xanthin und Coffein auf Ertrag und Qualität bei Thompson-Seedless-Reben

Year	Uracil	Xanthine	Caffeine	Control
		Number of bunches		
1967	14.0	12.0	11.0	13.0
1968	21.0	20.0	19.0	15.0
1969	29.3	24.5	23.3	15.7
1970	23.3	20.0	18.0	15.0
Mean	21.9	19.1	17.8	14.7
CD 5%				2.28
		Fresh weight per vine (g)		
1967	4020	3870	4160	4020
1968	6100	6000	5900	4400
1969	7440	7780	7000	4560
1970	7410	5600	6760	4800
Mean	6243	5813	5955	4445
CD 5%				589.
		Weight of 100 berries (g)		
1967	160	162	155	158
1968	169	163	167	160
1969	171	169	163	159
1970	166	167	170	161
Mean	166.5	165.3	163.8	159.5
CD 5%				5.17
		Reducing sugars %		
1967	18.0	18.5	17.9	18.2
1968	19.1	19.2	18.8	18.5
1969	17.5	17.3	18.0	17.0
1970	17.6	17.0	17.7	17.0
Mean	18.1	18.0	18.1	17.7
CD 5%				0.58
		Acidity %		
1967	0.50	0.51	0.51	0.50
1968	0.44	0.52	0.48	0.51
1969	0.54	0.56	0.54	0.56
1970	0.52	0.59	0.56	0.62
Mean	0.50	0.54	0.52	0.55
CD 5%				0.07

Results and Discussion

The results of the analyses of leaf punches for RNA, DNA and proteins for three years, 1968, 1969, 1970 and harvest data for four years — 1967 to 1970 — are given in Tables 1 and 2 respectively.

The vines responded to all the three chemicals, although there were differences in the degree of response. Uracil was found to be more effective in increasing number of clusters, berry weight and yield of fresh fruit per vine than xanthine and caffeine. The mean sugar concentration also showed an increase but the differences between the treatments were slight. The lower values of sugar for 1969 and 1970 were due to rains and inclement weather prevailing during berry development and harvest. Acidity of the juice was not affected by the treatment.

The application of uracil, xanthine and caffeine increased the RNA and protein content of the leaves without affecting the DNA content. The increase in protein content was greater with caffeine and in RNA with uracil. This was accompanied by an increase in the activities of acid phosphatase and malate dehydrogenase (unpublished data).

The effects of uracil, xanthine and caffeine in increasing RNA and protein content of leaves are in agreement with those reported by various workers (4, 5, 6, 8, 9, 11, 12). But their effects in increasing the yield with no improvement in the quality do not support the findings of some workers. Antcliff (1967) did not observe any increase in berry set and fresh weight of Sultana vines with uracil. Dass and Randhawa (1968) found a significant increase in the total soluble solids of Pusa Seedless berries with uracil.

Summary

Thompson Seedless vines were sprayed with aqueous solutions of uracil, xanthine and caffeine at 50 ppm twice during the growing season: when the shoots were 30—40 cm long and again a week later.

Uracil was found to be more effective than caffeine and xanthine in its promoting influence on the synthesis of RNA and fruitfulness. The sugar content of the berries on the treated vines was increased but there was little change in acid content. The time of fruit maturity was not affected.

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