EFFECTS OF AN ORGANIC HYDROLYSATE CONTAINING α-KETO ACIDS ON TOMATO YIELDS

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ABSTRACT

Tests of an organic hydrolysate (AG-30) were conducted on tomatoes for the last four years. Seedlings were sprayed or drenched with AG-30, and variables were number of applications and concentration. Yields from plants treated with AG-30 were more concentrated, and total yields were higher than from untreated plants. Application of an improved formulation (AG-40) increased single harvest and total yields 60% and 56%, respectively. Early yields from plants treated with a mixture of pure keto acids were higher than from untreated plants but yield concentration from AG-40 treated plants was higher than from other treatments.

INTRODUCTION

Labor problems and foreign competition threaten the Florida tomato industry unless efficiency of production and harvest are improved. Considerable cost reduction may be obtained with mechanical harvesting and bulk handling (3). Total multiple hand harvest yields and single mechanical harvest yields can be improved with growth regulators (1, 7).

Alpha-keto acids are known to affect many metabolic processes in plants. These include protein, carbohydrate and fat metabolism (4). They may react with acids, bases, enzymes or other chemicals to form a wide variety of products including amino acids, fatty acids, alcohols (5, 8) and precursors of some plant growth regulators.

Recently some preparations (AG-30 and AG-40) containing high levels of α-keto acids have become available for experimentation. This paper reports the results of experiments designed to test their effect on yield and fruit set of tomatoes.

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EXPERIMENTAL METHODS

Complex proteins were hydrolysed by Marketing and Research Services, Inc. of Miami to form amino acids and α-keto acids for the AG-30 formulation. Further oxidation of the hydrolysate with a nitrite salt and an acid resulted in the AG-40 formulation.

Four randomized complete block experiments were used to evaluate AG-30 or AG-40 effects on tomato yields. They were conducted on Rockdale soil at the University of Florida, IFAS, Agricultural Research and Education Center or in a commercial tomato field near Homestead from 1967 to 1970. The following practices were similar for all experiments: 1) Young plants were grown in an artificial medium containing peat, vermiculite and essential nutrients in peat pots until transplanting; 2) foliar treatments were applied as complete coverage to run-off on plants with a 2 gallon hand sprayer; 3) drench treatments were applied with a sprinkler can; 4) all fertilizer was applied and incorporated in the beds before mulch was applied; 5) transplants were set in beds covered with black plastic mulch; 6) 15 to 18 plants per plot; 7) the usual commercial practices of irrigation, insecticide, fungicide and herbicide applications were used during the growth of the crops; 8) fruit was harvested 2 to 4 times for each experiment; classified as marketable, cull or small grades; and was counted and weighed.

Specific procedures for each experiment were:

1. *Fall 1967*: breeding line 407-D3-D1—transplanted Sept. 28 in a commercial field; 8,300 plants/acre; a factorial design with 4 replications was arranged with 0 (water) and either 4% or 8% AG-30 applied one, two or four times (2, 2 + 5 and 2 + 5 + 7 + 9 weeks, respectively, after transplanting).
2. *Spring 1969*: cultivar—'Tropi-Red' transplanted on Jan. 7; 21,000 plants per acre; a factorial design with 3 replications was arranged with 0 (water), and either 4% or 8% AG-30 applied in single, double or triple applications beginning when plants had 4 to 6 true leaves at least 1 inch long and 4 to 8 weeks later.
3. *Spring 1970*: breeding line-2153-D3—transplanted on Jan. 28; 19,700 plants per acre

replicated four times with 0 (water), 1 or 2 drench applications of 2%, 4%, 6% or 8% AG-30 when plants were 2 inches and 10 inches high.

4. *Spring 1971*: breeding line 2153-D5—transplanted on November 2; 19,300 plants per acre; a randomized complete block design with 4 replications was arranged with an untreated control and three concentrations each of a) AG-40 (800, 2670 and 8000 ppm); b) a mixture of 5 α-amino acids: aminophenyl acetic acid, aspartic acid, serine, threonine, and tyrosine, which were refluxed with sodium nitrite for conversion to α-keto acids (28, 93 and 280 ppm); and c) a mixture of 2 pure α-keto acids: phenylglyoxylic acid and prenylpyruvice acid (0.8, 2.7 and 8 ppm).

Determinations of α-keto acids in AG-30, AG-40 and nitrited amino acids were made by Dr. C. A. Hare, Associate Professor of Chemistry at the University of Miami. Ultraviolet and infrared spectra showed amounts of α-keto acids ranging up to 25 g/liter of stock solution. Amino acid, oil and alcohol groups were also present.

Analyses indicated that amounts of inorganic nutrients in the AG-30 and AG-40 stock solutions were too small for the treatments to have nutritional effects.

Results and Discussion

Fall 1967:—Marketable yields were highest in the second harvest, and plants sprayed once with 8% AG-30 yielded significantly higher than those of other treatments (Table 1). The 4% treatment applied twice and the 8% treatment applied four times resulted in higher third harvest yields than were obtained from control plots. Total yields resulting from AG-30 treatments were not significantly higher than from untreated plots; but yields were higher from plots receiving the double 4% application and the single 8% application than from plots treated with water. Fruit size was not significantly affected by treatment.

Table 1. Effect of AG-30 concentration and number of applications on yield and size of 407-tomatoes, Fall, 1967.

Treatment			Marketable Yield (cwt/A)				Size (lb/fruit)	
Conc. (%)	No. Harv.:		1	2	3	Total	1	2
0	0		100	165a	31a	297abc	.27	.27
4	1		106	171a	28a	305abc	.28	.27
4	2		97	179ab	93 c	369 c	.27	.28
4	4		85	150a	30a	266a	.28	.27
	Mean:		96	167	50	313	.28	.27
8	1		89	219 b	46ab	354 bc	.29	.27
8	2		89	162a	31a	283ab	.29	.29
8	4		92	141a	75 bc	309abc	.27	.28
	Mean:		90	174	51	315	.28	.28

Numbers followed by the same letter (s) are not significantly different at the 5 per cent level.

Spring 1969.—The experiment revealed no statistical difference in yield or size between control and AG-30 treated plots; however, there was a greater yield concentration in the second harvest from the plots treated with a single 8% application (255 cwt/A) than from those treated with water (182 cwt/A).

Spring 1970.—The drench experiment showed no statistical differences between treatments; however, the single 8% AG-30 drench, the 4% + 4% and the 2% + 6% drenches resulted in higher concentrated yields in the second harvest (430, 426 and 421 cwt/A, respectively) than the control (368 cwt/A). The 8% and 4% + 4% AG-30 drenched treatments increased total yields.

Spring 1971.—The medium rate of α-keto acid (KA) and the low rate of nitrited amino acids (AA) resulted in significantly higher yields of U. S. No. 1 fruit (50 and 39 cwt/acre) in the second harvest than was obtained from untreated plots (20 cwt/acre). Plants treated with the high rate of AG-40 (AG) at the 8000 ppm concentration had a significantly higher marketable third harvest yield (177 cwt/acre) than the untreated plants 103 cwt/acre). This would mean a larger yield for once over machine harvest.

Comparisons of main effects of treatments show that first harvest yields were higher in KA treated plots than in control plots (Figure 1). KA treated plots yielded higher than control and AG treated plots in the second harvest. Third harvest yields were concentrated by AG and were higher than control or KA treated plots. Fourth harvest yields were not significantly influenced by treatments.

Yields of U. S. No. 1 and marketable fruit from plots treated with AG, AA and KA were significantly higher than from control plots (Figure 2). Yield of culls from AG treated plots were lower than those from other treatments. Treatments had no significant effect on the biological yield.

The AG treatment improved fruit size of third harvest and total marketable fruit (Figure 3).

Yield increases with the pure KA mixture and the nitrited AA mixture (which reacted to form

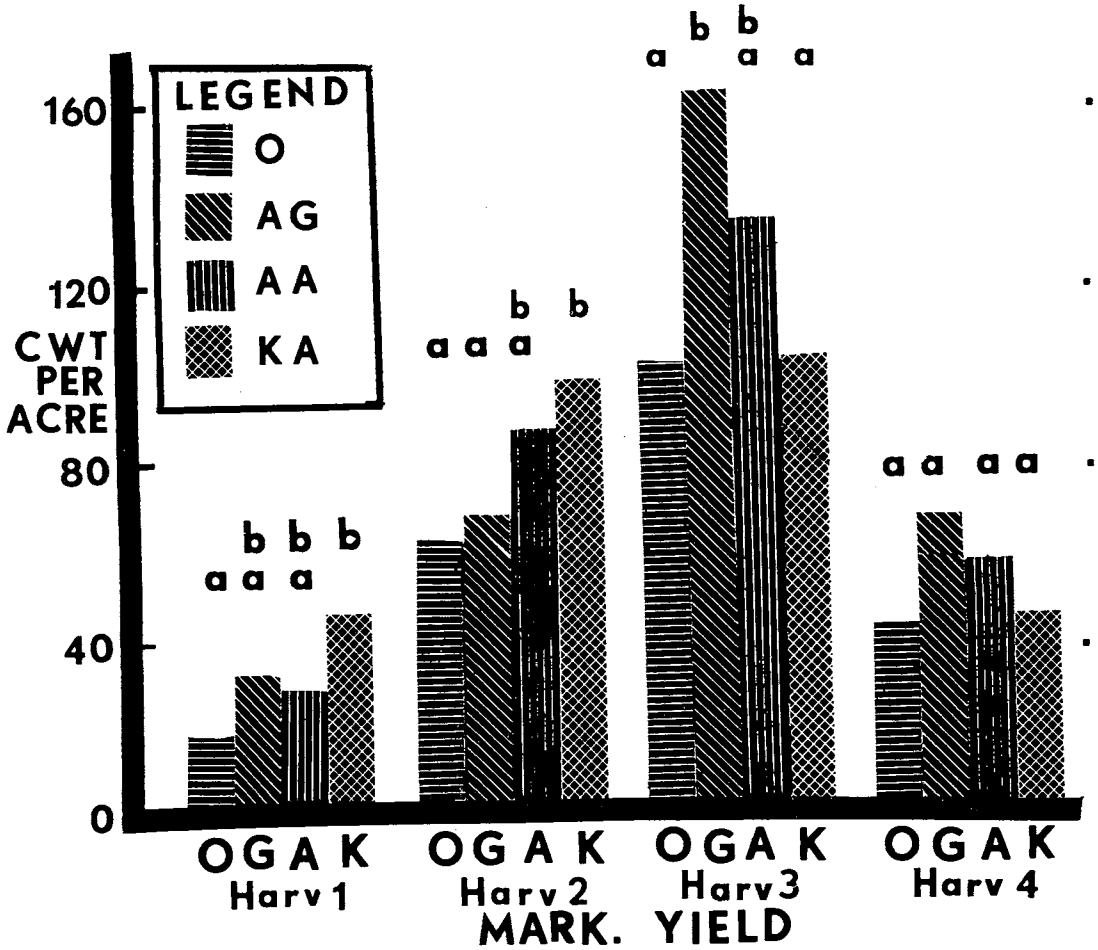

Figure 1.—Main effects of AG-40 (AG) Nitrited amino acids (AA) and keto acids (KA) on marketable yields of 2153-D5 tomatoes, Spring 1971. Columns with similar letters in each group are not significantly different at the 5% level.

keto acids) show that tomatoes responded to these chemicals tested in the field. AG contains more numerous keto acids, amino acids, oils and other natural compounds to which plants may respond than does the AA or KA; thus yield and size responses were generally greater for AG than the two pure chemical mixtures.

The potential of AG-30 and the improved formulation, AG-40, to concentrate fruit set and enhance marketable yields may make them useful for mechanical once-over harvest as well as for multiple hand harvest of tomatoes. The size response to AG-40 further emphasizes the economic advantage which may result from its use.

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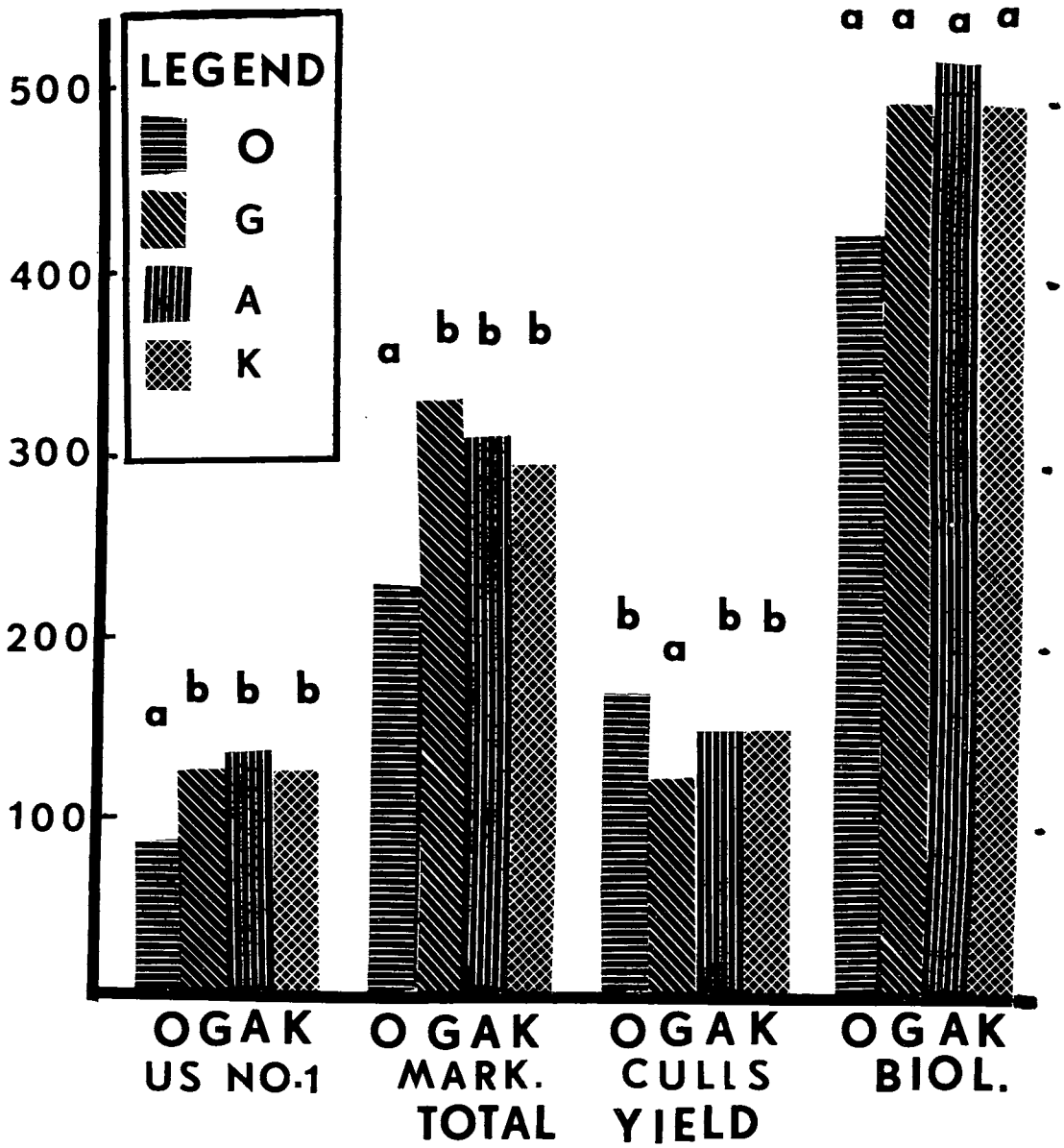

Figure 2.—Main effects of AG-40 (G), nitrited Amino acids (A) and keto acids (K) on total yields of 2153-D5 tomatoes Spring 1971. Columns with similar letters in each group are not significantly different at the 5% level.

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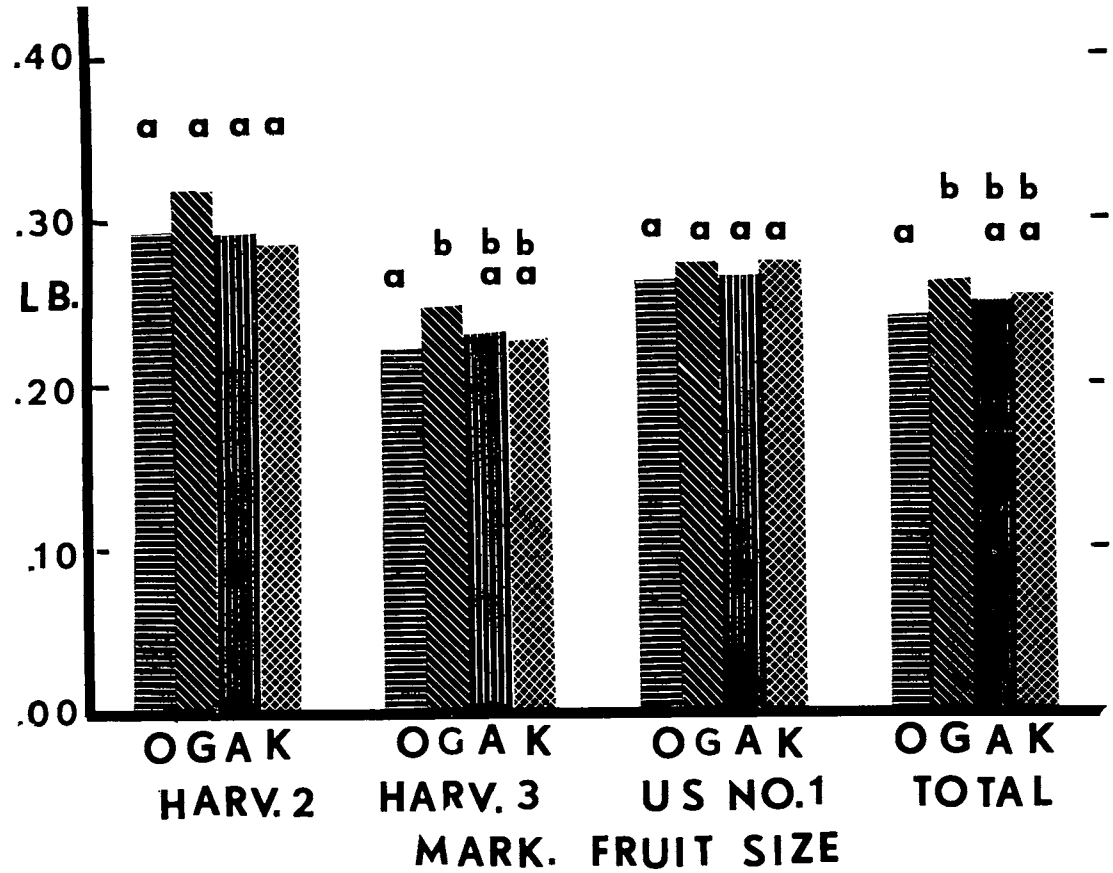

Figure 3.—Main effects of AG-40 (A), nitrited amino acids (A) and keto acids (K) on fruit size of 2153-D5 tomatoes. Spring 1971. Columns with similar letters for each group are not significantly different at the 5% level.

EVALUATION OF PAPER AND POLYETHYLENE-COATED PAPER MULCHES AND FERTILIZER RATES FOR TOMATOES

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ABSTRACT

Polyethylene (plastic) coated and un-coated papers were compared to 1.5 mil black polyethylene film for use as full-bed soil mulches during a fall and a spring season for unstaked tomatoes. In both tests an unmulched treatment was included. All mulch treatments were factorially combined with three rates of fertilizer.

Tomato fruit yields in the fall season were generally higher with un-coated paper than with coated paper or with black plastic. Yields were also better with tan paper than with black paper or black plastic. However, in the spring season fruit yields were higher with black coated paper

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