
Response of Tomato and Pepper to Monopotassium Phosphate-Based Starter Solutions 97-10

George J. Hochmuth¹

Introduction

Research with tomato and pepper responses to monopotassium phosphate-based starter fertilizers was conducted at the University of Florida Horticultural Sciences Research Unit in Gainesville, FL during the spring season of 1997. The objectives were to determine if tomato and pepper respond to starter fertilizer solutions and to compare several starter solution formulations for effects on tomato and pepper fruit yield.

The soil used for the research was Arrendondo fine sand that tested medium in K and high in P, Mg, Ca, and micronutrients. The soil was plowed and disked in preparation for bedding, fertilization, and planting. Beds were raised in rough fashion with bedding disks and 30 lbs N and 30 lbs K₂O per acre were applied to the pre-beds. Beds were then rototilled and pressed and were spaced 4 ft center-to-center and were 6 inches high and 24 inches across the top surface. Beds were fumigated with methyl bromide, drip tube was applied in bed center, and beds were covered with black polyethylene mulch.

Starter solutions tested were

1. 0 N - 10 P₂O₅ - 7 K₂O (monopotassium phosphate, MKP)
2. 10 N - 34 P₂O₅ - 0 K₂O (ammonium polyphosphate, APP)
3. 2 N - 14 P₂O₅ - 3 K₂O (1:2 ratio of monopotassium phosphate, MDP and monoammonium phosphate, MAP)
4. 3 N - 22 P₂O₅ - 15 K₂O (ammoniated MDP, AMKP)
5. A control treatment (no starter).

The experiment was conducted in two plantings (early, 25 March and late, 1 April) and tomato and pepper were used as the test crops. Tomatoes ('Agriset 761') and pepper ('Camelot X3R') were planted for both dates, tomatoes in single-row fashion on 18-inch spacing and peppers in twin-row fashion with 12-inches between plants and 12-inches between rows. Tomatoes were planted in plots 25 ft long and peppers in plots 20 ft long.

¹ George J. Hochmuth, Professor, Horticultural Sciences Department, University of Florida/IFAS, Gainesville FL 32611-0690

Starter solution rates were calculated based on 10 lbs P₂O₅ for tomatoes and applied in 250 milliliters of solution. The same solution and concentrations were used for pepper. Therefore, peppers received more starter on an acre basis due to higher plant population.

Tomato and pepper plants were irrigated by drip irrigation (Roberts Row-Drip) to maintain moisture at -10 centibars in the root zone. Insects and diseases were controlled by timely applications of labeled pesticides. No pest problems were encountered in the season.

On 30 April, one whole tomato plant at first flower was sampled from planting two for dry weight measurements. Plants from planting one were not sampled due to nonuniform plant stands. Whole pepper plants (two) at early buds were sampled from both plantings (30 Apr for planting one and 8 May for planting two).

Tomatoes were harvested on 6, 13, and 23 June and peppers were harvested on 3, 10, and 17 June for the first planting. For the second planting, tomatoes were harvested on 16, 23, and 30 June and peppers on 10, 17, and 24 June. Fruits were graded into extra large, large, medium, and cull fruits, and weighed. All data were analyzed by analysis of variance.

Results and Discussion

Tomato: There were no interactions of planting date and starter solution. Early tomato fruit yield was greater from the second planting compared to the earlier planting (Table 1). Total marketable early yields were 70% greater for the second planting. Cool temperatures and heavy rains inflicted damage on plants in the first planting soon after transplanting.

Early extra large fruit yield was greater with certain starter solutions compared to the control. Yields of extra large fruits, the most valuable fruits, were enhanced with MKP/MAP and APP starter solutions. Total early yield was not affected by starter solutions.

Seasonal yields were greater from planting one (Table 1). Even though plants in the first planting were exposed to stress and early yield was negatively affected, the plants recovered well and seasonal yield was greater than for planting two. Seasonal yield was not affected by starter solution.

Pepper: Yields of early extra large and total early marketable pepper fruits were affected by the interaction of planting date and starter solution (Tables 2, 3). Early extra large fruit yield in planting one was greatest with AMKP and in planting two was

greatest with MKP/MAP mixture and APP (Table 3). For total early marketable yield, the results were the same (Table 3).

Early large fruit yield was greater from planting one compared to planting two (Table 2). Early large fruit yield was not affected by starter solution. Yields of medium-sized fruits or cull fruits were not affected by planting date or starter solution.

Seasonal fruit production was greater for most grade categories in planting one compared to two (Table 3). Pepper fruit for the season was not affected by starter solution.

Starter solution benefited early but not total season fruit yield of pepper. However, there were not significant affects on early plant growth (Table 4). Beneficial effects could have originated in enhanced fruit growth and development during the early part of the season. Positive effects on extra large fruit yields are important since this grade is the most valuable fruit grade.

Summary

1. Starter solutions composed of MKP had positive effects on tomato and pepper fruit yields in a warm and wet season.
2. Positive effects were mostly on extra large fruits, especially for pepper. These are the most valuable fruits.

Treatments

Tomatoes = 25 foot plots = 17 plants/plot times 4 reps equals 68 plants/treatment

Pepper = 20 foot plots = 40 plants per plot times 4 reps equals 160 plants

Therefore: Calculate rate based on tomato. Tomato we want 10 lbs P_2O_5 per acre for plants on 18-inch spacing and on 4-ft centers = 7260 plants per acre. So, 10 lbs P_2O_5 per 7260 plants = 0.001377 lbs P_2O_5 per plant or 0.625 gr P_2O_5 per plant.

1. MKP (0-10-7) has 10.33 lbs/gal specific weight, which is 1.033 lbs P_2O_5 /gal or 469 gr P_2O_5 per gal.

For tomato: 0.625 gr P_2O_5 /plant x 68 plants equals 43 gr P_2O_5 needed. Therefore, 43/469 = 0.09 gal needed for each tomato plant.

There are 68 plants x 250 ml/plant = 17 liter. Therefore, we need 0.09 gal 0-10-7 in 17 liter.

Make 10% excess, so 0.10 gal in 19 liter or 378 ml 0-10-7 in 19 liter.

For pepper: Use same recipe so we have same concentration but total rate per acre will differ.

2. AMKP (3-22-15) is 12.245 lb/al specific weight equals 2.694 lb P_2O_5 per gallon equals 1223 gr P_2O_5 /gal.

We want 0.625 gr P_2O_5 per plant, which equals 0.625 x 68 plants per treatment equals 43 gr P_2O_5 needed.

43 gr/1223 = 0.03516 gal x 3780 ml/gal equals 132 mls of 3-22-15 plus 10% excess equals 145 mls in 19 liters.

For pepper: use same recipe.

3. APP (10-34-0) has 11.58 lb/gallon equals 3.937 lbs P_2O_5 /gal or 1787 gr P_2O_5 /gal.

Therefore: 43 gr/1787 = 0.02406 gal = 91 ml plus 10% excess = 100 ml 3-22-15 in 19 liters for tomato.

For pepper: use same recipe.

4. MKP + MAP (1:2)

Tomato: we want 0.625 gr P_2O_5 /plant equals 68 plants x 0.625 = 43 gr P_2O_5 MDP = MAP in 1:2 weight Mixture is a 5-58-11 salt.

Therefore: 43 gr/0.58 = 74 gr of the mixture.

Mixture: 1/3 from MKP = 24 gr plus 10% = 27 gr

2/3 from MAP = 50 gr plus 10% = 55 gr

Mix 27 gr MKP plus 55 gr MAP in 19 liters

For pepper - use same recipe.

5. Control - no starter solutions, only water

Table 1. Effects of planting and starter solution on tomato fruit yield and grade, Gainesville FL. Spring 1997.

Planting	Starter Solution	Yield (25-lb ctn/acre)					Marketable No.
		Extra Lg	Large	Medium	Cull	Market	
----- Early (first harvest) -----							
One		507	315	64	11	886	43211
Two		598	654	253	4	1505	81043
Signif. ^z		NS	**	**	**	**	**
	AMKP	471	488	137	8	1095	59513
	APP	565	496	170	7	1323	68062
	MKP	488	432	173	8	1092	65830
	MKP/MAP	661	502	151	5	1314	57934
	Control	488	502	161	8	1152	59296
	LSD (.05)	160	NS	NS	NS	NS	NS
----- Season (3 harvests) -----							
One		1316	1646	740	62	3703	220914
Two		1017	1384	792	60	3192	194974
Signif. ^z		**	**	NS	NS	**	**
	AMKP	1022	1481	778	53	3283	204187
	APP	1303	1582	785	63	3671	218889
	MKP	1148	1490	808	43	3447	209904
	MKP/MAP	1272	1463	674	63	3410	198742
	Control	1087	1555	784	84	3428	207999
	LSD (.05)	NS	NS	NS	NS	NS	NS

^z Treatments significant 1% (**) or 5% (*) probability level or not significant (NS).

Table 2. Effects of planting and starter solution on pepper fruit yield and grade, Gainesville FL. Spring 1997.

Planting	Starter Solution	Yield (28-lb ctn/acre)					Marketable No.
		Extra Lg	Large	Medium	Cull	Market	
----- Early (first harvest) -----							
One		408	14	0	0	422	26380
Two		673	8	1	2	681	41245
Signif. ^z		**y	*	NS	NS	**y	**
	AMKP	570	18	0	1	589	37434
	APP	536	9	0	0	546	32330
	MKP	460	13	1	1	474	29880
	MKP/MAP	602	6	0	1	608	35529
	Control	530	9	0	1	539	33895
	LSD (.05)	*y	NS	NS	NS	*y	NS
----- Season (3 harvests) -----							
One		1189	58	4	47	1251	85785
Two		1064	104	20	17	1187	79551
Signif. ^z		*	**	**	**	NS	NS
	AMKP	1107	99	9	27	1215	84397
	APP	1166	77	13	30	1256	86031
	MKP	1080	75	10	26	1164	79088
	MKP/MAP	1185	78	13	40	1275	84533
	Control	1093	76	14	37	1184	79292
	LSD (.05)	NS	NS	NS	NS	NS	NS

^z Treatments significant 1% (**) or 5% (*) probability level or not significant (NS).

^y Interaction significant.

Table 3. Interaction of planting date and starter fertilizer material for extra large and total marketable pepper fruit yield.

Planting ^z	Starter Solution ^z	Yield (28-lb ctn/acre)	
		Extra large	Total Marketable
One	AMKP	514	535
	APP	320	332
	MKP	407	425
	MKP/MAP	356	363
	Control	440	450
Two	AMKP	628	641
	APP	753	760
	MKP	513	523
	MKP/MAP	847	853
	Control	621	628

^z LSD (.05) = 130 for comparing any two means for extra large fruit and LSD (.05) = 133 for comparing any two means for total marketable fruit.

Table 4. Effects of starter solution on tomato and pepper early plant growth, Gainesville FL. Spring 1997.

Starter Solution	Tomato ^y	Pepper ^z	
	30 April	30 April (1)	8 May (2)
	----- g/plant -----		
MKP	9.8	6.0	5.9
AMKP	10.0	6.3	5.6
APP	13.6	6.7	7.4
MKP/MAP	12.0	5.8	6.4
Control	12.3	6.6	6.9

^z Pepper sampling was for early growth samples at early bud for first planting (1) and for second planting (2).

^y tomato sample for first flower open for planting 2 only.