Starter Phosphorus Fertilizer for Tomato Production

Henry G. Taber and Vince Lawson
Department of Horticulture

Soil test reports from the sandy soil region of Muscatine Island indicate that the phosphorus (P) level is high to very high. Thus, no preplant P is recommended for most vegetable crops. But starter fertilizers high in P are often used with the *Soalanaceous* crops such as potatoes and tomatoes. These crops are very responsive to P additions at the time of planting. Many states have reported no need for a starter fertilizer on high P testing soils and have dropped starter fertilizer from their recommendations.

Our objective was to evaluate various starter fertilizers for fresh market tomato production on the coarse, sandy soils of the Muscatine region. The soil test indicated a P level of 111 ppm P, extremely high. Any value over 31 ppm is considered very high by ISU soil test procedures.

General Methods: Tomato transplants, cv. Mtn. Spring, were set May 16, 2000, with black plastic mulch and a single line source trickle irrigation system. The rotational scheme was cereal rye for 3 years. Row width was 6 feet and in-row plant spacing was 21 inches with 16 plants per plot row. A border row separated each plot. The plants were not staked but ground grown. Normal weed control and pest management practices were followed. Trickle irrigation tubing (T-tape 508, delivering 0.34 gpm/100 feet) was offset 8 inches from the plants. Irrigation was applied uniformly to all plots to maintain the 6-inch depth tensiometer readings at 10-15 cbars.

The experimental design was a factorial, split-plot, randomized complete block with 4 replications. The whole unit was pre-plant P rates (0 or 50 lbs/acre as triple superphosphate) with the preplant P incorporated, banded over rows, just prior to laying the plastic mulch. A uniform application of 60 lbs N/acre as 34-0-0 and 180 lbs K_2O/acre as 0-0-60 was also incorporated. An additional 23 lbs N/acre (as 32% URAN) was applied through the trickle system in 9 applications in June and another 15 lbs N/acre applied in 5 applications in July. The subunit was 4 levels of starter fertilizer: none, 9-45-9, calcium nitrate, and potassium nitrate. All starter solutions were applied at 1 cup (8 oz.) per plant at the time of transplanting. The 9-45-9 was mixed at 3 lbs/50 gal of water. The N and P strength of this solution was 675 ppm N and 1485 ppm P. The calcium nitrate and potassium nitrate were mixed to give an N strength of 675 ppm.

Plant shoot growth development, measured on a dry weight basis, was determined on May 31, June 12, and June 23. Flower cluster number was determined June 12. Elemental content of whole shoots and/or leaves was evaluated on May 31, June 14, June 23, and July 26. There were three harvests: Aug. 3, 10, and 17th.

Results

Growth Rate

Growth rates of the transplants for 38 days after transplanting (DAT) was significantly ($P<.05$) affected by starter fertilizer treatment, but the preplant P level had no effect(Fig. 1). Initially, 15 DAT, all 3 starter types were better than the control with the 9-45-9 and the Ca nitrate superior to the K nitrate. By 38 DAT, June 23rd, the growth of the K nitrate treatment was equivalent to 9-45-9 and the Ca nitrate.

Shoot elemental content 15 DAT was affected by starter treatment only for N, P, K, Ca, B, and Mn (Table 1). The 9-45-9 had superior P levels compared with the other 3 treatments. This was expected because none of the other starters contained P. The 3 starters had similar N and K levels which were significantly higher than the control or no starter. As expected, the Ca nitrate treatment had the highest shoot Ca concentration at 3.24%, but the 9-45-9 gave the lowest at 2.94%. Compared to the 9-45-9 the Ca and K nitrate starters reduced shoot B and Mn content. This was probably the result of increased soil solution pH because of the nitrate anion.

Flower cluster production was measured 27 DAT, June 12, and all starter treatments significantly increased cluster number, by 64%, compared with no starter (Fig. 2); but they did not differ from one another.

Yield

There was no affect of starter fertilizer on marketable or total fruit yield. Total yield was reduced 17% by the preplant P application, from 589 to 488 cwt/acre (Table 2). Cull yield was not affected. The effect of the P treatment was to reduce fruit size and fruit number for the 3 harvest periods; but the strongest effect was in fruit size reduction which was significant at all 3 harvest dates (Table 3). The reduction averaged 0.9 oz. per fruit, with fruit size ranging from 10.8 to 9.9 oz.

Whole leaf analysis

Leaf analysis over the growing season to one week prior to first harvest (from June 14 to July 26) showed that the preplant P level affected only P, S, and Mn concentration (Table 4). There was no affect of starter fertilizer on any of the 14 elements tested. Nor was there an interaction of preplant P and starter. Mn and S concentration increased through the growing season. The preplant P treatment increased S concentration slightly in mid-June, from 0.22 to .24% with no further effect. The Mn concentration was reduced by 10% only at preharvest sampling date. P concentration dropped from 0.66% in mid-June to 0.40% by the end of July. As expected, preplant P treatment maintained a significantly higher leaf concentration throughout the season compared with no P. However, the leaf P concentration, as well as S and Mn, was within the established sufficiency range for top production.

Table 1. Effect of starter fertilizer on elemental content of the whole tomato shoot on May 31, 15 DAT, Fruitland, IA, 2000.

	Shoot concentration, dry weight basis					
Starter Trt.	N,%	K,%	P, %	Ca, %	B, ppm	Mn, ppm
None	4.34 B	3.48 B [1]	.65 B	3.07 B	15 AB	74 AB
9-45-9	4.67 A	3.63 A	.79 A	2.94 C	16 A	82A
Ca nitr	4.43 AB	3.51 AB	.65 B	3.24 A	14 B	67B
K nitr	4.55 AB	3.61 AB	.65 B	3.06 B	13 B	72 B

[1] Values within a column followed by the same letter are not statistically different by the DMRT, 5% level.

Table 2. Effect of preplant P on the yield characteristics of Mtn. Spring tomato.

Preplant P Treatment	Total Yield Cwt/acre	Cull Yield Cwt/acre	Fruit Size Oz./each	Fruit Number Per plot
None	589	172	10.8	127
50 lbs/acre	488	133	9.9	115
Sign., P > F	**	Ns	**	*

Table 3. Effect of preplant P on fruit number and fruit size at each harvest date.

	Fruit Number/plot			Mkt. Fruit Size, oz. each		
Harvest Date	0	50 lbs	Sign.	0	50 lbs	Sign.
Aug. 3	19.2	18.0	Ns	9.7	9.0	**
Aug. 10	41.8	38.8	Ns	11.9	10.6	**
Aug. 17	66.0	62.3	Ns	10.8	10.2	*

Table 4. Effect of preplant P on the P, S, and Mn whole leaf concentration over the growing season. Concentration expressed as % for P and S, and ppm for Mn.

Preplant P	June 14			June 23			July 26		
Trt.	P	S	Mn	P	S	Mn	P	S	Mn
None	.62	.22	43	.51	.21	43	.39	.37	64
50 lbs	.70	.24	41	.56	.23	45	.42	.39	59
Sign., P > F	*	*	Ns	*	Ns	Ns	*	Ns	*

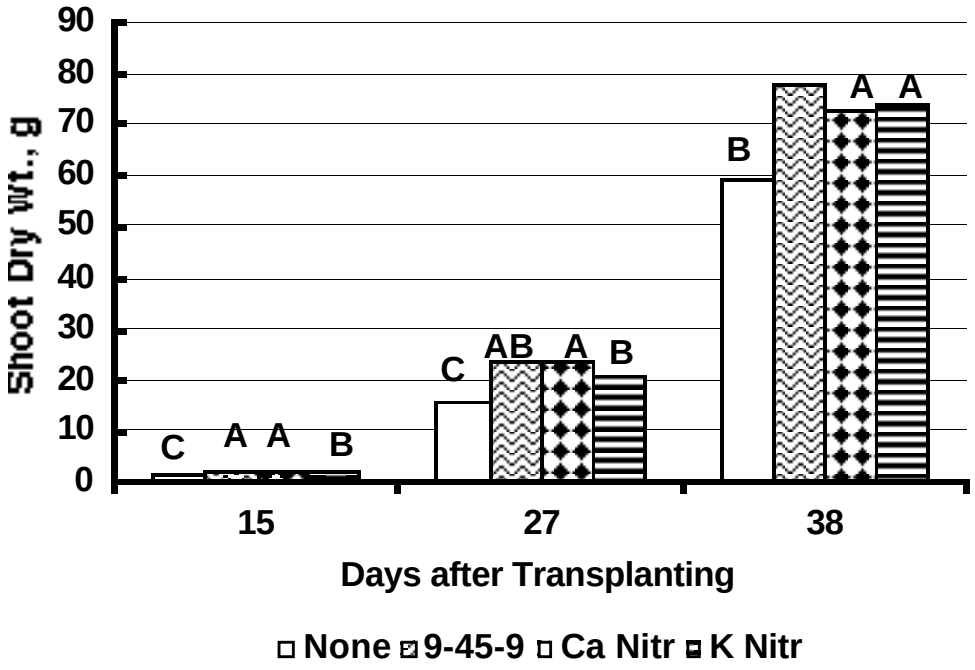

Figure 1. Effect of starter fertilizer on shoot growth of Mtn. Spring tomato, Fruitland, IA.

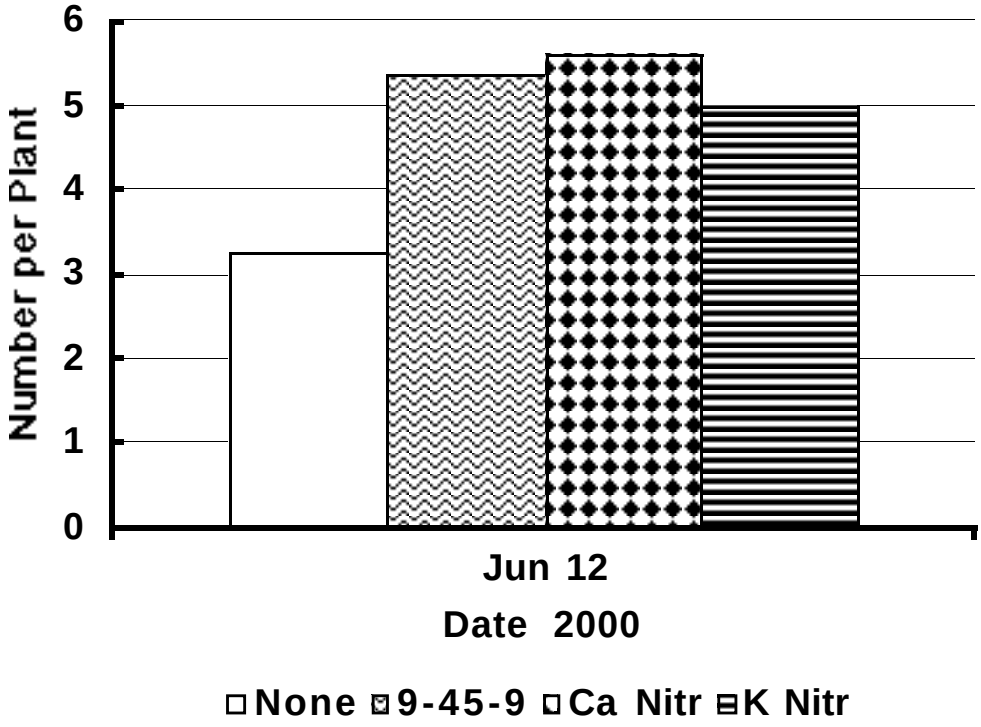

Figure 2. Effect of starter fertilizer on flower cluster development of Mtn. Spring tomato.