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Effect of nursery raising practices of seedlings and phosphatic fertilizer management in tomato (*Solanum lycopersicum*) crop on growth and yield

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In recent times, growing seedlings in pro-trays using coco peat as the growth medium for transplantation has become very popular in most vegetable crops across the country. Pro-trays ensure good germination and uniform growth of seedlings that leads to minimal transplantation shock and uniform crop stand. The technique is especially useful in hybrid tomato and capsicum and other crops where seed cost is high (Prabhakar *et al.* 2004). In Indra F_1 hybrid capsicum (*Capsicum annuum)*, pro-tray raised seedlings were significantly more robust and produced higher yield as also resulted in improved P use efficiency when superphosphate was banded at 10cm depth compared to capsicum grown from raised bed seedlings and fertilizer banded at 5cm depth (Kotur 2008). Therefore, investigations were undertaken in Arka Ananya F_1 tomato (*Solanum lycopersicum* L.) to standardize fertilizer placement as well as P dosage in tomato raised in pro-trays *vis-à-vis* to attain high yield as well as to achieve high P use efficiency.

A field experiment was carried out during December 2009 – February 2010 on a red sandy loam (Typic Haplustalf) belonging to Thyamagondlu series. The soil had a pH of 6.6, organic matter of 0.65%, cation exchange capacity of 9.0 cmol (p+)/kg and available (Bray-I) P of 2.5 mg/kg. The experiment was laid out in a completely randomized factorial experiment consisting of 3 factors: (i) 2 methods of growing seedlings on raised bed using field soil and pro-tray using Arka fermented coco peat as the substrate; (ii) banding fertilizers at 2 depths at 5 cm and 10cm deep furrows and mulching with soil and (iii) 3 levels of P (60, 80 and 100% recommended dose) replicated 4 times. The seedlings were irrigated on alternate days while the tomato crop in the field was irrigated once every 4 days. The seedlings were transplanted at 50 × 60cm spacing (6 plants/ plot), in vats (plots) of 1.0 × 1.8m dimension of cement asbestos sheets embedded in soil to a depth of 50 cm. Superphosphate was labeled with ^{32}P carrier free isotope to provide a specific activity of 0.167mCi/g of P. The fertilizer dosage was 180:65:100 NPK kg/ha. Different pickings tomato fruits were pooled to determine yield, P content and ^{32}P activity in fruits. The observations recorded, sampling and their analysis is as detailed earlier (Kotur 2008).

At transplantation stage (25 days-old), the raised bed seedlings were more vigorous, longer (29.57 ± 1.572cm, n=10) and thicker (3.96 ± 0.430mm) than the pro-tray seedlings (27.85 ± 2.672cm and 2.52 ± 0.294mm respectively). As a result, the tomato plants grown from raised bed seedlings produced significantly higher fruit yield of 71.147 tonnes/ha which was 20.4% higher than in tomato grown from pro-tray seedlings (59.361 tonnes/ha). This was supported by a significantly higher production of dry matter (Table 1). There was also a significantly higher P content in the plant as well as the uptake of P. Phosphorus derived from fertilizer (Pdff, %) was significantly lower in the plants grown from raised bed seedlings, owing to dilution of P from fertilizer source due to substantially higher growth and production of dry matter by tomato plants. Banding of fertilizer at 5 cm depth showed higher fruit yield and biomass production by tomato plant. Shallower placement of superphosphate also caused higher P content in different parts as well as the total P uptake by the plant. However, fertilizer P uptake as well as fertilizer P utilization was significantly higher under 10cm deep banding. Among the doses of P, yield, dry matter in fruit as well as the total dry matter of the plant was significantly higher at 80% recommended P dosage. An opposite trend was evident in respect of the mean P content of plant. Lower P content at 80 and 100% P doses may be attributed to dilution affect. Uptake of P by the plant increased with increasing P dosage significantly and the maximum P uptake occurred at 80% recommended dose. In general, increasing P doses also increased phosphorus derived from fertilizer (Pdff, %) significantly. Fertilizer P uptake closely followed the trend shown by total P uptake except that at 80% P dosage, the

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Table 1 Effect of kind of seedling, depth of banding and P dose on fruit yield, dry matter production and different parameters of P use by Arka Ananya tomato

Treatment	Fruit yield (tonnes/ha)	Total dry matter (tonnes/ha)	P content (%)	P uptake (kg/ha)	Pdff (%)	Fertilizer P uptake (kg/ha)	Fertilizer utilization (%)
Method of raising seedlings							
Raised bed	71.147	5.434	0.321	18.994	9.45	1.825	11.01
Pro-tray	59.361	5.070	0.296	16.367	9.91	1.654	9.48
SEm (±)	0.8378	0.0846	0.0022	0.2333	0.098	0.0188	0.117
CD(P=0.05)	2.4112	0.1398	0.0064	NS	0.281	NS	NS
Depth of fertilizer placement (cm)							
5	66.611	5.378	0.315	18.263	7.72	1.373	8.20
10	63.717	5.124	0.301	17.084	11.64	2.106	12.32
SEm (±)	0.8378	0.0486	0.0022	0.2333	0.098	0.0188	0.117
CD(P = 0.5)	2.4112	NS	0.0064	NS	0.281	0.0541	0.336
Level of P dose (% of recommended dose)							
60	60.356	4.795	0.316	16.522	9.05	1.558	11.40
80	69.183	5.514	0.310	18.828	9.81	1.873	10.41
100	65.878	5.444	0.298	17.594	10.19	1.787	8.44
SEm (±)	1.0261	0.0595	0.0027	0.286	0.120	0.0230	0.143
CD(P = 0.5)	2.9539	0.1712	0.0078	0.8233	0.344	0.0662	0.411

tomato plant showed the highest uptake of fertilizer P. Fertilizer P utilization decreased as P dosage increased which is expected. Tomato grown from raised bed seedlings at 80% P dose banded at 5cm depth produced nearly 2-fold higher weight of tap- (8.451 ± 0.8450g) and secondary- (4.261 ± 0.2625g) than that obtained from pro-tray seedlings (4.853 ± 0.5529 and 2.383 ± 0.2711 respectively). The length of tap root and the girth of the plant at soil surface were substantially higher in tomato plants grown from raised bed seedlings (12.17 ± 0.825cm and 2.41 ± 0.263mm respectively) than those raised from pro-tray seedlings (9.32 ± 0.397cm and 1.58 ± 0.343mm (Fig 1). It is noteworthy that tomato plant produced a tuft of thin and hirsute secondary roots midway at around 5cm from soil surface, especially in the raised bed seedlings (Fig 2). In tomato crop raised from pro-tray seedlings the differences between the two depths of placements were significant only at 80% recommended P dose (Table 2). In tomato grown from raised bed seedlings, 82.706 tonnes/ha fruit yield was obtained that was 49.3% higher than 55.383 tonnes/ha of tomato grown from pro-tray seedlings when 80% P dose was banded at 5cm depth prior to transplantation. In the case of mean P content of tomato plants, the differences among 3 levels of P doses were significant only when superphosphate was applied at 10cm depth in tomato crop grown from both the kinds of seedlings. In both the cases, the mean P content of tomato plant was the lowest at 100% recommended P dose (0.273%). In respect of total P uptake, application of 60% recommended P did not show any significant change due either to the kind of seedlings or the depth of fertilizer placement. However, at 80% P dose, tomato grown from raised bed seedlings showed distinctly higher total P uptake but the values between 5 and 10cm deep placements were *at par*. The highest total P uptake by

Fig 1 Pro-tray (left) and raised bed (right) seedlings of Arka Ananya tomato seedlings at transplanting

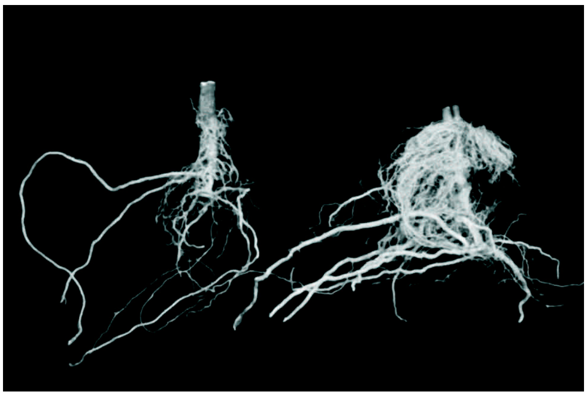

Fig 2 Roots of pro-tray (left) and raised bed (right) seedlings of Arka Ananya tomato seedlings at harvest; there is a dense tuft of secondary roots at 5cm below soil surface, especially in the plants grown from raised bed seedlings (right)

Table 2 Interaction effect of kind of seedling, depth and level of P application on fruit yield and total fertilizer P utilization by Arka Ananya tomato

Level of P	Raised bed seedling		Pro-tray seedling	
(% of recommended dose)	5 cm	10 cm	5 cm	10 cm
		Fruit yield (tonnes/ha)		
60	69.208	61.307	55.276	55.624
80	82.706	76.693	55.383	61.944
100	71.865	63.706	64.925	63.021
SEm (±)	2.0522			
CD (P = 0.05)	5.9073			
		Mean P content (%)		
60	0.333	0.328	0.316	0.289
80	0.319	0.327	0.304	0.292
100	0.316	0.302	0.302	0.273
SEm (±)	0.0055			
CD(P = 0.05)	0.0175			
		Total P uptake (kg/ha)		
60	15.894	16.700	17.417	16.078
80	20.739	20.083	15.833	18.656
100	17.583	20.980	18.783	17.456
SEm (±)	0.5722			
CD(P = 0.05)	1.6472			
		Total fertilizer P utilization (%)		
60	8.87	14.44	10.51	11.77
80	7.41	12.7	9.71	11.83
100	5.66	10.29	5.97	10.40
SEm (±)	0.286			
CD (P = 0.05)	0.822			

tomato plants was observed in tomato plant grown from pro-tray seedlings when fertilizer was placed at 5 cm depth. The highest fertilizer P uptake (1.700-2.409 kg/ha) was evident at 10 cm deep placement irrespective of the kind of seedling. The interaction effects of fertilizer P utilization showed that the utilization by tomato raised from pro-tray seedlings were *at par* between 60 and 80% P doses when fertilizer was banded at 10cm depth. To summarize, the interaction effects emphasize that tomato grown from raised bed seedlings and when fertilizer was banded at 5cm depth, showed maximum total P uptake, a high of 12.70% total fertilizer P utilization and yielded the highest fruit yield among the treatments.

Three important points emerge from this experiment. Firstly, distinctly vigorous raised bed seedlings of Arka Ananya tomato produced distinctly higher dry matter and yield upon transplantation (Table 2) although the coco peat was more fertile and endowed with distinctly higher nutrient content than the soil. The low pH (5.5), highly carbonic nature (12.5% organic carbon) and other biochemical constituents present in the coco peat may have caused the poor growth of the root, especially of the tap root of tomato seedlings. Highly porous medium of coco peat did not favour root growth. Conversely, the weaker tap root of the pro-tray seedlings, perhaps, resulted in less vigorous plants upon transplantation performed poorly. These results are contrary to that reported in Indra capsicum (Kotur 2008). In capsicum, however, the pro-tray seedlings were distinctly more vigorous and produced significantly higher yield compared to that grown from raised bed seedlings. In essence the vigour of the seedling at the time of transplantation played a crucial role on the crop vigour and productivity. Partial damage of the root system of the raised bed seedlings when pulled out from the bed before transplanting may also have encouraged the better growth of the transplants. Amelioration of coco peat may have to be attended to urgently to restore the seedling growth since pro-tray technology is adopted widely in raising seedlings of a large number of crops including tobacco, sugarcane, pigeon pea, marigold and others in addition to the transplanted vegetable crops. Substantial reduction cover 20% tomato yields grown from pro-tray seedlings can have significant influence on the profitability of tomato production. Secondly, in banding of fertilizer at 5cm depth proved superior on account of the profuse growth of secondary roots at 5cm depth although the root grew much deeper which appears to be a characteristic of tomato plant but was more pronounced in tomato plants grown from raised bed seedlings. Thirdly, in the crop grown from raised bed seedlings of Arka Ananya tomato, banding of fertilizers at 5cm depth resulted in 80% of recommended P dosage outperforming 100% dosage leading to a saving of 20% P fertilizer input. The importance of such savings is crucial when the implications of the national import bill of phosphatic fertilizers and the undesirable build up of P in soil leading to induced Zn deficiency are kept in view.

SUMMARY

The raised bed seedlings produced significantly higher fruit yield of 20.4% (71.147 tonnes/ha) than the tomato grown from pro-tray seedlings (59.361 tonnes/ha). Banding of superphosphate along with other fertilizers at 5cm depth showed significantly higher yield, dry matter production, P content as well as P uptake. The fruit yield and dry matter obtained were the highest at 80% recommended P dose. In the tomato grown from raised bed seedlings, 82.706 tonnes/ha fruit yield was obtained that was 49.3% higher than 55.383 tonnes/ha of tomato grown from pro-tray seedlings when 80% P dose was banded at 5cm depth.

REFERENCES

Kotur S C. 2008. Fertilizer management of capsicum (*Capsicum annuum*) as influenced by method of raising seedlings, depth of placement and doses of P using ^{32}P-labelled superphosphate. *Indian Journal of Agricultural Sciences* **78**: 757–60.

Prabhakar M, Prabhakar B S, Mandhar S C, Hebbar S S, Srinivas V, Eswar Reddy S G and Anjula N. 2004. Quality vegetable seedling production. Technical Bulletin No. 24. Indian Institute of Horticultural Research, Bangalore, p 16.