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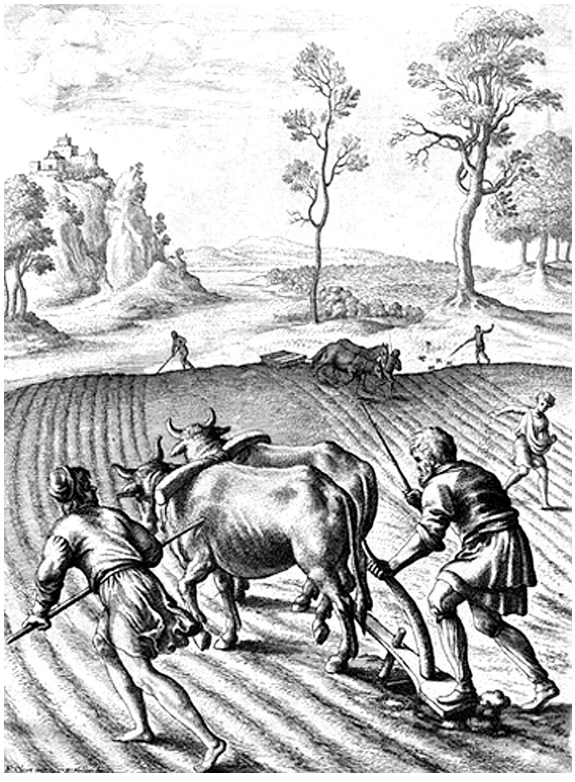

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Relative Efficiency of Controlled Release and Water Soluble Fertilizers on the Yield and Quality of Tomato (*Lycopersicon esculentum* Mill.)

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Abstract: A study was conducted at eastern block of Tamil Nadu Agricultural University, Coimbatore (11°N and 77° E) during (Aug-December) 1999 in Periyanayakkan palayam series, clay loam soil (Vertic ustropept) to study the effect of Controlled Release Fertilizers (CRF) and Water Soluble fertilizers (WSF) as against the conventional Straight fertilizers on tomato yield and quality. The results revealed that the soil application of 50% NPK+WSF (PS at 1 or 2 g L^{-1}) foliar spray found to be the best combination on the basis of cost benefit ratio (1:3.29 and 1:3.30) which had enhanced the tomato fruit yield (24.3 and 24.9 t ha^{-1} respectively) and fruit quality viz., ascorbic acid (15.46 and 15.92 mg 100 g^{-1}), TSS (3.5 and 3.6°B) and total sugar content (3.85 and 3.90%) as against the NPK control. Hence, the application of 50% NPK+WSF foliar spray treatment combinations could enhance the production potential of tomato which in turn increases the net return to the farmers.

Key words: Controlled release fertilizer, water soluble fertilizer, foliar spray

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is one of the most popular vegetables widely cultivated under varying agro-climatic conditions. It is important for their rich content of minerals, protein and various vitamins besides playing a vital role in Indian economy by virtue of its various modes of consumption in human diet. The productivity of the crop is being affected in various areas due to acute deficiencies of macro and micronutrients of soil (Kanwar, 1978; Arora *et al*., 1983) indicating the physiological causes resulting in the considerable losses in yield and quality of tomato. However, adequate and appropriate fertilizer applications are of prime importance for improving the yield and quality of fruits.

To improve the yield and quality of the produce, it is necessary to pay due attention on the optimum balanced use of nutrients through fertilizer application (Bruchholz, 1977; Korcak, 1980; Krishnamoorthy *et al*., 1981). Several straight and water soluble fertilizers, used for improving the crop yield and quality, produce some negative (or) side effects besides, leaching losses, thus hindering the supply of nutrients required by crops at critical phases of crop growth period. To overcome this problem Slow Release Fertilizers (SRF) or Controlled Release Fertilizers (CRF) were introduced. Controlled release fertilizers improve the yield and quality of plant products invariably compared to that of conventional fertilizers. These are environmentally safe and reliable, without much nutrient leaching loss and available to the plants throughout the entire crop growth period. It needs only less labour, time and quantity input compared to other fertilizers (Shaviv and Mikkelson, 1993). Therefore, an attempt was made to study the relative efficiency of these fertilizers (CRF and WSF) as against the conventional NPK fertilizers on tomato.

MATERIALS AND METHODS

A Study was conducted at eastern block of Tamil Nadu Agricultural University, Coimbatore (11°N and 77°E) during (Aug-April) 1999-2000 in Periyanayakkanpalayam series, clay loam soil (Vertic ustropept) having low Nitrogen (208 kg ha^{-1}), medium Phosphorus (17 kg ha^{-1}) and high Potassium (395 kg ha^{-1}) with a pH and EC of 8.6 and 0.2 dS m^{-1}, respectively., to study the effect of Controlled Release Fertilizers (CRF) namely Agroblen and Micromax and Water Soluble Fertilizers (WSF) viz., General Purpose (GP) and Plant Starter (PS) as against the conventional Straight fertilizers on tomato yield and quality. The field was prepared well and at the last ploughing

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farmyard manure was applied (12.5 t ha^{-1}) and incorporated. The experiment was conducted with the following treatments with three replications in Randomized Block Design. Viz., 100% NPK recommended dose (150:100:50 kg ha^{-1}) as straight fertilizers (control), 50% NPK plus WSF (GP and PS each at two levels as foliar spray, CRF (Micromax at two levels and Agroblen at three levels) alone as basal and CRF (Agroblen at three levels) basal plus WSF (GP and PS each at two levels) as foliar spray at different intervals viz., weekly once during 1st month, once in two weeks during 2nd and 3rd months and once in a month during 4th and 5th months throughout the crop growth period.

Tomato cultivar PKM-1, a mutant of local variety Anjali has duration of 135 to 150 days. For raising nursery the seeds were sown in beds on 01-07-99 and the seedlings of one month age were transplanted in main field on 06-08-99. The first picking of the fruits was commenced after 60 days of transplanting. Totally there were six pickings and the yield was recorded.

The water-soluble fertilizer was mixed with required quantity of water and applied (0.1 and 0.2%) as foliar spray through hand and knapsack sprayer while the CRF was applied in the soil directly by making holes using iron rod at 5-10 cm depth adjacent to the root zone of the plant. Controlled release fertilizers consist of water-soluble nutrient granules, coated with a semi permeable organic resin material. The coating controls the safe and reliable nutrient release without leaching problems even at high EC levels. The NPK status of CRF Agroblen and Micromax were 20:10:10 and 15:25:10, respectively. The WSF viz., General Purpose and Plant Starter having the NPK grade of 20:20:20 and 10:52:10, respectively. The recommended dose of NPK for tomato is at the rate of 150:100:50 kg ha^{-1}. The N was applied in two splits i.e., 75 kg N as basal and the remaining 75 kg N at 30 Days After Transplanting (DAT).

The quality parameters viz., TSS, Ascorbic acid, Titratable acidity, Sugars and Crude protein contents were assessed as per the standard procedure.

RESULTS AND DISCUSSION

Effect of treatments on fruit yield (t ha^{-1}) with cost benefit ratio

The tomato fruit yield in Table 1 and Fig. 1 revealed that there was non-significant impact of controlled release fertilizers and water soluble fertilizers when applied either through soil or through foliar application individually. Whereas combined application of soil plus foliar gave the impressive result viz., the soil application of agroblen at the rate of 30 g m^{-2} plus GP 2 g L^{-1} registered the yield of 27.2 t ha^{-1}(T_{18}).Which was closely followed by agroblen 30 g m^{-2} plus PS 2 g L^{-1} FS (27.0 t ha^{-1}) (T_{20}) and agroblen 30 g m^{-2} plus PS 1 g L^{-1} FS (26.2 t ha^{-1}) (T_{19}) treatments. This might be due to the increased availability of nutrients due to the controlled release nature of the fertilizer material throughout crop growth period. However, the yield obtained with application of 50% NPK plus WSF (GP/PS each at 1 or 2 g L^{-1}) (T_4 and T_5) was similar to that obtained with basal application of CRF (Agroblen or Micromax each at 10 or 20 g m^{-2}) and superior to control (T_1) treatment which recorded the least value (20.8 t ha^{-1}).

The cost benefit ratio was worked out based on the crop yield of tomato (Table 1). The cost benefit ratio ranged from 1: 1.14 in agroblen at 30 g m^{-2} (T_8) to 1:3.30 in 50% NPK plus WSF PS at 2 g L^{-1} (T_5). The control treatment (T_1) recorded a cost benefit ratio of 1: 2.38 which was higher than that obtained for the basal application of

Table 1: Effect of Controlled Release Fertilizers (CRF) and Water-soluble Fertilizers (WSF) on fruit yield (t ha^{-1}) and cost benefit ratio of tomato

Treatments	Fruit yield (t ha^{-1})	B:C ratio
T_1. 100% NPK	20.8	1:2.38
T_2. 50% NPK+ GP 1 g L^{-1} FS	23.4	1:2.38
T_3. 50% NPK + GP 2 g L^{-1} FS	23.8	1:3.17
T_4. 50% NPK + PS 1 g L^{-1} FS	24.3	1:3.15
T_5. 50% NPK + PS 2 g L^{-1} FS	24.9	1:3.30
T_6. Agroblen 10 g m^{-2}	22.2	1:1.81
T_7. Agroblen 20 g m^{-2}	23.3	1:1.37
T_8. Agroblen 30 g m^{-2}	24.4	1:1.14
T_9. Agroblen 10 g m^{-2} + GP 1 g L^{-1} FS	22.0	1:1.69
T_{10}. Agroblen 10 g m^{-2} + GP 2 g L^{-1} FS	22.3	1:1.65
T_{11}. Agroblen 10 g m^{-2} + PS 1 g L^{-1} FS	22.4	1:1.71
T_{12}. Agroblen 10 g m^{-2} + PS 2 g L^{-1} FS	22.8	1:1.68
T_{13}. Agroblen 20 g m^{-2} + GP 1 g L^{-1} FS	24.5	1:1.38
T_{14}. Agroblen 20 g m^{-2} + GP 2 g L^{-1} FS	25.9	1:1.42
T_{15}. Agroblen 20 g m^{-2} + PS 1 g L^{-1} FS	25.7	1:1.45
T_{16}. Agroblen 20 g m^{-2} + PS 2 g L^{-1} FS	25.3	1:1.45
T_{17}. Agroblen 30 g m^{-2} + GP 1 g L^{-1} FS	25.9	1:1.16
T_{18}. Agroblen 30 g m^{-2} + GP 2 g L^{-1} FS	27.2	1:1.19
T_{19}. Agroblen 30 g m^{-2} + PS 1 g L^{-1} FS	26.2	1:1.17
T_{20}. Agroblen 30 g m^{-2} + PS 2 g L^{-1} FS	27.0	1:1.18
T_{21}. Micromax 10 g m^{-2}	21.5	1:1.75
T_{22}. Micromax 20 g m^{-2}	23.3	1:1.37
CD (p = 0.05)	0.78	

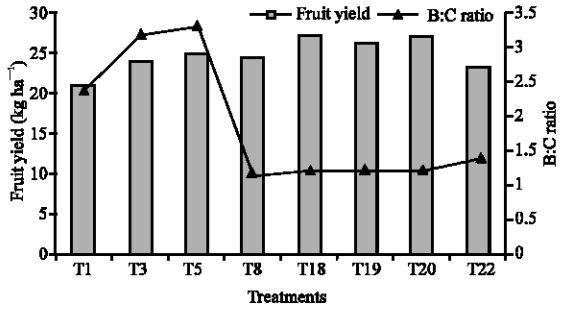

Fig. 1: Effect of treatments on tomato fruit yield (kg ha^{-1}) and B: C ratio

CRF (Agroblen 1:1.14 to 1:1.81 or Micromax 1:1.37 to 1:1.75) alone or the basal application of CRF along with WSF (GP or PS each at 1 or 2 g L^{-1}; 1:1.16 to 1:1.18).

Effect of treatments on quality parameters: The uptake of nutrients by plants at initial growth phases (flowering to fruit setting) which enhances the fruit qualities of tomato especially with the application of controlled release and water soluble fertilizers wherein the loss of nutrients are negligible. Anand, (1973) reported that ascorbic acid content was increased with N application. Other possibility being greater nutrient uptake by fruits, which are interlocked with enzymatic mechanisms that activated the nutrient metabolisms (Hegde and Srinivasan, 1990) in plants. The enhanced uptake of N and K might be influenced by the controlled release and water soluble fertilizers, which are essential for quality of fruits (Wilcox, 1964).

The experiment results revealed that the soil application of CRF agroblen 30 g m^{-2} plus WSF Plant starter 2 g L^{-1} (T_{20}) as foliar spray significantly reduced the titratable acidity (0.43%) whereby enhanced the quality of fruit through registering higher level of ascorbic acid (20.86 mg 100 g^{-1}), total soluble solids (5.2°B), crude protein (1.75%) and sugars (total, reducing and non-reducing 4.90, 4.39 and 0.51%, respectively). The

Table 2a: Effect of Controlled Release Fertilizers (CRF) and Water-soluble Fertilizers (WSF) on quality of tomato (Var.PKM-I)

Treatments	Ascorbic acid (mg/100 g)	TSS (°Brix)	CP (%)	Titrable acidity (%)
T_1. 100% NPK	14.87	3.3	1.04	0.73
T_2. 50% NPK + GP 1 g L^{-1} FS	15.02	3.5	1.09	0.67
T_3. 50% NPK + GP 2 g L^{-1} FS	15.38	3.6	1.18	0.64
T_4. 50% NPK + PS 1 g L^{-1} FS	15.46	3.5	1.29	0.62
T_5. 50% NPK + PS 2 g L^{-1} FS	15.92	3.6	1.32	0.53
T_6. Agroblen 10 g m^{-2}	15.94	3.5	1.45	0.51
T_7. Agroblen 20 g m^{-2}	16.38	3.7	1.48	0.49
T_8. Agroblen 30 g m^{-2}	16.72	3.9	1.49	0.53
T_9. Agroblen 10 g m^{-2} + GP 1 g L^{-1} FS	16.94	3.6	1.24	0.50
T_{10}. Agroblen 10 g m^{-2} + GP 2 g L^{-1} FS	16.96	3.7	1.35	0.56
T_{11}. Agroblen 10 g m^{-2} + PS 1 g L^{-1} FS	16.82	3.9	1.37	0.53
T_{12}. Agroblen 10 g m^{-2} + PS 2 g L^{-1} FS	17.02	4.0	1.41	0.59
T_{13}. Agroblen 20 g m^{-2} + GP 1 g L^{-1} FS	18.00	4.3	1.44	0.57
T_{14}. Agroblen 20 g m^{-2} + GP 2 g L^{-1} FS	18.24	4.4	1.47	0.58
T_{15}. Agroblen 20 g m^{-2} + PS 1 g L^{-1} FS	18.48	4.6	1.52	0.55
T_{16}. Agroblen 20 g m^{-2} + PS 2 g L^{-1} FS	18.96	4.7	1.58	0.52
T_{17}. Agroblen 30 g m^{-2} + GP 1 g L^{-1} FS	19.04	4.7	1.62	0.47
T_{18}. Agroblen 30 g m^{-2} + GP 2 g L^{-1} FS	19.84	4.9	1.72	0.44
T_{19}. Agroblen 30 g m^{-2} + PS 1 g L^{-1} FS	19.98	5.0	1.71	0.48
T_{20}. Agroblen 30 g m^{-2} + PS 2 g L^{-1} FS	20.86	5.2	1.75	0.43
T_{21}. Micromax 10 g m^{-2}	17.14	4.7	1.34	0.54
T_{22}. Micromax 20 g m^{-2}	17.94	4.9	1.42	0.59
CD (p = 0.05)	0.19	0.28	0.06	0.05

Table 2b: Effect of Controlled Release Fertilizers (CRF) and Water-soluble Fertilizers (WSF) on quality of tomato (Var.PKM-I)

Treatments	Total sugar (%)	Reducing sugar (%)	Non reducing sugar (%)
T_1. 100% NPK	3.55	3.17	0.38
T_2. 50% NPK + GP 1 g L^{-1} FS	3.80	3.43	0.37
T_3. 50% NPK + GP 2 g L^{-1} FS	3.89	3.49	0.40
T_4. 50% NPK + PS 1 g L^{-1} FS	3.85	3.46	0.39
T_5. 50% NPK + PS 2 g L^{-1} FS	3.92	3.51	0.41
T_6. Agroblen 10 g m^{-2}	3.93	3.50	0.43
T_7. Agroblen 20 g m^{-2}	4.05	3.60	0.45
T_8. Agroblen 30 g m^{-2}	4.15	3.67	0.48
T_9. Agroblen 10 g m^{-2} + GP 1 g L^{-1} FS	4.22	3.81	0.41
T_{10}. Agroblen 10 g m^{-2} + GP 2 g L^{-1} FS	4.47	4.00	0.47
T_{11}. Agroblen 10 g m^{-2} + PS 1 g L^{-1} FS	4.51	4.06	0.45
T_{12}. Agroblen 10 g m^{-2} + PS 2 g L^{-1} FS	4.55	4.07	0.48
T_{13}. Agroblen 20 g m^{-2} + GP 1 g L^{-1} FS	4.57	4.08	0.49
T_{14}. Agroblen 20 g m^{-2} + GP 2 g L^{-1} FS	4.60	4.19	0.41
T_{15}. Agroblen 20 g m^{-2} + PS 1 g L^{-1} FS	4.67	4.23	0.44
T_{16}. Agroblen 20 g m^{-2} + PS 2 g L^{-1} FS	4.75	4.31	0.44
T_{17}. Agroblen 30 g m^{-2} + GP 1 g L^{-1} FS	4.78	4.30	0.48
T_{18}. Agroblen 30 g m^{-2} + GP 2 g L^{-1} FS	4.84	4.36	0.48
T_{19}. Agroblen 30 g m^{-2} + PS 1 g L^{-1} FS	4.88	4.38	0.50
T_{20}. Agroblen 30 g m^{-2} + PS 2 g L^{-1} FS	4.90	4.39	0.51
T_{21}. Micromax 10 g m^{-2}	4.26	3.84	0.42
T_{22}. Micromax 20 g m^{-2}	4.32	3.88	0.44
CD (p = 0.05)	0.04	0.04	0.03

fruit quality of this treatment was found to be superior to the quality of fruit obtained from all other treatments. However, the treatments agroblen 30 g m^{-2} plus PS 1 g L^{-1} FS (T_{19}), agroblen 30 g m^{-2} plus GP 2 g L^{-1} FS (T_{18}) and agroblen 30 g m^{-2} plus GP 1 g L^{-1} FS (T_{17}) were on par with each other and at agroblen 30 g m^{-2} plus PS 2 g L^{-1} statistically (Table 2a and b). While the application of 50% NPK plus WSF (GP or PS at the rate of 1 or 2 g L^{-1} foliar spray though recorded higher yield, the quality of fruit seems to superior than control (Table 2a and b). Similar results were also reported by Ferguson (1980).

CONCLUSIONS

Though, the yield and quality of tomato enhanced by the controlled release fertilizers with water soluble fertilizers is more, its cost-benefit ratio is considerably less as compared to that of 50% NPK with WSF. Hence, application of 50% NPK along with water soluble fertilizers is beneficial in increasing tomato fruit yield and its quality. Hence, these combinations of fertilizer application might be recommended to the farmers.

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