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Evaluation of control release fertilizers (CRF) on tomato

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Abstract
Controlled-release fertilizer (CRF) use is a best management practice that may reduce nutrient loss to the environment. Controlled-release fertilizers (CRF) are proposed as a solution to improve the nutrient use efficiency of plants, and hence considered an answer to address the problems due to the growth of world's population and water shortage. The heightened awareness concerning environmental preservation, resource scarcity, food safety and nutrition, has engendered the need for a more sustainable and resource-efficient agricultural production system. In this context, Control Release Fertilizers (CRF) were studied on tomato crop and resulted in highest plant height (112.5 cm), more number of branches per plant (5.8), more number of fruits per plant (70 no), fruit weight/ plant (g) ((285 g) and fruit yield (60.40 t/ha) was obtained in T_6 treatment *i.e.* CRF 18:18:18, 10:26:26, SSP, MOP and Urea. An economic evaluation indicates, Control Release Fertilizers (CRF) are economically feasible.

Keywords: Fertilizers, tomato, CRF

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 (Arora *et al*., 1983) [1] 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; Krishnamoorthy *et al*., 1981) [5]. 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 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) [7]. Therefore, an attempt was made to study the relative efficiency of these fertilizers (CRF) as against the conventional NPK fertilizers on tomato.

Materials and Methods
Trial was conducted at Krishi Vigyan Kendra (UAS Dharwad) with six treatments and four replications was arranged in Complete Randomized Block Design during Rabi-2019 to evaluate the Bio-efficacy Evaluation of Control Release Fertilizers (CRF) on Tomato. Observations on plant height (cm), number of branches per plant, number of fruits per plant, fruit weight per plant (g) and fruit yield 30, 60 and 90 days after planting, yields were recorded and expressed in terms of ton per hectare.

Treatment		Source of fertilizer	Time of application	Quantity of Fertilizer/Kg/ha
T_1	RDF of Maharashtra State (N: P_2O_5:K_2O) 300: 150: 150 kg/ha) through complex fertilizers	24.24.0, 10.26.26, MOP	1st dose at transplanting	288 Kg 10.26.26
			2nddoseat 30 days after transplanting (DAT)	288 Kg 10.26.26 + 175 Kg Urea
			3rd dose at 50 DAT	176 Kg Urea
			4th Dose at 70 DAT	176 Kg Urea
T_2	RDF of Karnataka state (N: P_2O_5:K_2O 250: 250 :250 kg/ha) through complex fertilizers	10:26:26 & Urea	1st dose at Transplanting	240 kg 10:26:26
			2nddose at 30 DAT	240 kg 10:26:26 + 111 kg Urea
			3rd dose at 50 DAT	240 kg 10:26:26+ 111 kg Urea
			4th dose at 70 DAT	240 kg 10:26:26+ 112 kg Urea
T_3	CRF equivalent to T_1	CRF 18.18.18, SSP, MOP & Urea	1st dose at transplanting	292 kg CRF 18.18.18 + 282 Kg SSP + 106 Kg Urea
			2nddoseat 30 DAT	292 kg CRF 18.18.18 + 75 Kg MOP + 106 kg Urea
			3rd dose at 50 DAT	106 kg Urea
			4th dose at 70 DAT	106 kg Urea
T_4	CRF equivalent to T_2	CRF 18:18:18, 10.26.26 & Urea	1st dose at transplanting	243 Kg CRF 18.18.18 + 312 Kg 10.26.26 + 61 Kg Urea
			2nddoseat 30 DAT	243 Kg CRF 18.18.18 + 312 Kg 10.26.26 + 61 Kg Urea
			3rd dose at 50 DAT	61 Kg Urea
			4th Dose at 70 DAT	61 Kg Urea
T_5	25% Reduction in N as per T_1	CRF 18:18:18, 10.26.26 & Urea	1st dose at transplanting	219 Kg CRF 18.18.18 + 137 Kg 10.26.26 + 65 Kg Urea
			2nd dose at 30 DAT	219 Kg CRF 18.18.18 + 137 Kg 10.26.26 + 65 Kg Urea
			3rd dose at 50 DAT	65 Kg Urea
			4th dose at 70 DAT	65 Kg Urea
T_6	25% Reduction in N as per T_2	CRF 18:18:18, 10.26.26, SSP, MOP, Urea	1st dose at transplanting	182 Kg CRF 18.18.18 + 325 Kg 10.26.26 + 506 Kg SSP
			2nddose at 30 DAT	183 Kg CRF 18.18.18 + 325 Kg 10.26.26 + 135 Kg MOP
			3rd dose at 50 DAT	61 Kg Urea
			4th dose at 70 DAT	61 Kg Urea

Results and Discussion

Plant height (cm): Plant height was highest (112.5 cm) with application of fertilizer recommendation –Through CRF grade 18:18:18 and 10.26.26, SSP, MOP, Urea (T_6) followed by CRF 18:18:18, 10.26.26 & Urea (108.3 cm) during both 30, 60 and 90 days after planting and lowest height was observed in RDF of Maharashtra State (T_1) (N:P_2O_5:K_2O) 300: 150: 150 kg/ha) through complex fertilizers (93.5 cm).

Number of branches/plant: More number of branches per plant was observed with application of fertilizer recommendation –Through CRF grade 18:18:18 and 10.26.26, SSP, MOP,Urea (T_6) (5.8) and CRF 18:18:18, 10.26.26 & Urea followed by CRF 18:18:18, 10.26.26 & Urea (T_4) (5.8) during both 30, 60 and 90 days after planting and lowest number of branches was observed in RDF of Maharashtra State (N:P_2O_5:K_2O) 300: 150: 150 kg/ha) through complex fertilizers (4.5) and similar results were observed by Senthil Valavan and K.R. Kumaresan (2006) [6] Number of fruits/ plant: More number of fruits per plant was observed with application of fertilizer recommendation –Through CRF grade 18:18:18 and 10.26.26, SSP, MOP, Urea (T_6) (70 No) and CRF 18:18:18, 10.26.26 and Urea followed by CRF 18:18:18, 10.26.26 and Urea (T_4) (70 No) during both 60 and 90 days after planting and lowest number of fruits was observed in RDF of Maharashtra State (N:P_2O_5:K_2O) 300: 150: 150 kg/ha) through complex fertilizers (53 No) and Carson, L.C. & Ozores-Hampton, M (2013) [3] reported similar results.

Fruit weight/ plant (g) 60 and 90 DAP: Highest fruit weight per plant was observed with application of fertilizer recommendation –Through CRF grade 18:18:18 and 10.26.26, SSP, MOP, Urea (T_6) (285 g) and CRF 18:18:18, 10.26.26 and Urea followed by CRF 18:18:18, 10.26.26 and Urea (T_4) (276 g) during both 60 and 90 days after planting and lowest fruit weight was observed in RDF of Maharashtra State (N:P_2O_5:K_2O) 300: 150: 150 kg/ha) through complex fertilizers (195 g).

Fruit Yield (t/ha): Highest fruit yield was observed with application of fertilizer recommendation –Through CRF grade 18:18:18 and 10.26.26, SSP, MOP, Urea (T_6) (60.40 t/ha) and CRF 18:18:18, 10.26.26 and Urea followed by CRF 18:18:18, 10.26.26 and Urea (T_5) (57.20 t/ha) during consecutive picking and lowest fruits yield was observed in RDF of Maharashtra State (N:P_2O_5:K_2O) 300: 150: 150 kg/ha) through complex fertilizers (51.9 t/ha) similar results by Hegde, D.M. and K. Srinivas in 1990 [4].

Tables

Table 1: Effect Control Release Fertilizers (CRF) on height of plant (30, 60 and 90 days after planting)

Treatments	Height of plant in cm (30 DAP)	Height of plant in cm (60 DAP)	Height of plant in cm (90 DAP)
T_1	43.5	62.7	93.5
T_2	45.3	65.5	95.2
T_3	49.2	70.2	98.5
T_4	52.3	73.5	101.5
T_5	55.4	76.1	108.3
T_6	58.5	79.5	112.5
S.E m	1.45	1.60	1.87
CD (p=0.05)	4.38	4.81	5.64

Table 2: Effect Control Release Fertilizers (CRF) on Number of branches per plant (30, 60 and 90 days after planting)

Treatments	Number of branches (30 DAP)	Number of branches (60 DAP)	Number of branches (90 DAP)
T_1	1.5	3.5	4.5
T_2	1.6	4.2	5.6
T_3	1.5	3.5	5.4
T_4	1.8	5.7	5.8
T_5	1.5	3.9	5.3
T_6	1.9	4.9	5.8
S.E m	0.08	0.22	0.20
CD p=0.05)	0.24	0.65	0.60

Table 3: Effect Control Release Fertilizers (CRF) on Number of fruits per plant 60 & 90 days after planting

Treatments	Number of fruits per plant (30 DAP)	Number of fruits per plant (60 DAP)	Number of fruits per plant (90 DAP)
T_1	0	27	53
T_2	2	42	67
T_3	1	38	65
T_4	1	44	70
T_5	0	38	46
T_6	2	44	70
S.E m	-	1.80	2.50
CD (p=0.05)	-	5.44	7.53

Table 4: Effect Control Release Fertilizers (CRF) on Fruit weight per plant (g) and Yield (t/ha)

Treatments	Fruit weight per plant (60 DAP)	Fruit weight per plant (90 DAP)	Yield (t/ha) (6 consecutive pickings)
T_1	132	195	51.9
T_2	148	213	50.2
T_3	173	238	55.7
T_4	212	276	54.8
T_5	191	256	57.2
T_6	220	285	60.4
S.E m	8.75	10.15	2.03
CD (p=0.05)	26.36	30.60	6.11

Conclusion

From the study it could be concluded that treatment T_6 and T_5 using CRF with 25% reduction in N dose has recorded higher yield than all other treatments in comparison, this indicates that CRF is found to be useful in reduction of N fertilizers to the tune of 25%.

The important outcomes of the study should be mentioned in this section.

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