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Influence of fertigation schedules on growth characters of cocoa (*Theobroma cacao* L.) grown under coconut plantation in coastal Andhra Pradesh

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Abstract
A field experiment was carried out to study the influence of fertigation on growth characters of cocoa grown under coconut plantation in a farmer's field in Ankampalem village of East Godavari District under Horticultural Research Station, Ambajipeta during 2019 to 2021. The experiment was laid out in randomized block design with seven treatments replicated thrice with different combinations of water soluble fertilizers applied through drip and soil application. The tree height, girth of the tree, height at first branching (HAFB), canopy spread (North-South and East-West) and canopy volume were recorded before drip fertigation and at final harvest in both the years. On a average, the results reported that the trees supplied with 100% recommended dose of fertilizers had recorded highest plant height of 4.58 m, plant girth of 64.05 cm and height at first branching of 1.37 m on a average. The results regarding average canopy volume (22.18), canopy spread (East- West) (3.86 m) and canopy spread (North-South) (3.78 m) were recorded highest in the plants treated with 125% RDF through drip irrigation. The above results indicated that application of 125% RDF as water soluble fertilizers through drip irrigation was recommended in black alluvial soils of Andhra Pradesh to promote growth characters of cocoa.

Keywords: Coastal, cocoa, coconut, growth, fertigation, intercrop

Introduction
Cocoa (*Theobroma cacao* L.) is one of the most important plantation crop grown under coconut in Andhra Pradesh known as 'Food of Gods' introduced into India in the early half of the 20th century, but the commercial cultivation of cocoa had started during 1960's only. Now, it had become one of the most important commercial crops grown for the production of chocolates. In India, it is cultivated as component crop in arecanut, coconut and oilpalm plantations and accounts to an area of 1, 03, 376 ha with a production of 27, 072 MT of dry beans and with average productivity of 669 kg/ha (DCCD, 2021) [1]. It is mainly cultivated in four southern states *viz.*, Kerala, Karnataka, Tamil Nadu and Andhra Pradesh. Andhra Pradesh ranks first in area of 39, 714 ha and production of 10, 903 MT with average productivity of 950 Kg ha^{-1} of 40% share of country production (DCCD, 2021) [1].
It is a tropical perennial crop that produces pods throughout the year grown under full sun to shade. In India, mostly the farmers adopt surface method of fertilizer application and irrigation leading to lower productivity, which requires frequent application of nutrients with sufficient moisture for better utilization of nutrients (Noordiana *et al*., 2007) [4] because more than 80 per cent of feeder roots are located within the radius of 30-60 cm. In the case of surface application, many physical processes such as leaching, runoff, volatilization *etc*. may leads to loss of applied nutrients besides affecting the environment (Krishnamoorthy and Rajamani, 2016) [6]. In the fertigation method, fertilizers can be applied in spilt doses throughout the crop growing season in a phased manner in desired concentration resulted in higher yield and quality of cocoa (Krishnamoorthy *et al.*, 2015) [7]. Hence, Fertigation has come in handy for this purpose. But fertigation schedules should be standardized in Andhra Pradesh to get good returns. Hence this experiment was carried out to know the influence of fertigation on growth characters on cocoa grown under coastal Andhra Pradesh.

Materials and Methods
The experimental site was located at farmer's field, Ankampalem village, East Godavari District, Andhra Pradesh which is about 50 km away from Horticultural Research Station,

Ambajipeta having an area of one acre under black alluvial soil conditions with drip irrigation. The experiment was laid out in a randomized block design with 7 treatments in 3 replications having 6 trees in each replication of 14 years age planted under coconut plantation having age of 40 years and cocoa having a spacing of 2.5 m x 2.5 m which contain combinations of water soluble fertilizers, complex and straight fertilizers. The treatments combinations are T_1: 75% RDF as water soluble fertilizers through drip irrigation (75: 30: 105 g NPK/ plant/ year), T_2: 100% RDF as water soluble fertilizers through drip irrigation (100: 40: 140 g NPK/ plant/ year), T_3: 125% RDF as water soluble fertilizers through drip irrigation (125: 50: 175 g NPK/ plant/ year), T_4: 75% RDF as water soluble fertilizers through drip irrigation (150: 60: 210 g NPK/ plant/ year), T_5: 175% RDF as water soluble fertilizers through drip irrigation (175: 70: 245 g NPK/ plant/ year), T_6: 200% RDF as water soluble fertilizers through drip irrigation (200: 80: 280 g NPK/ plant/ year) and T_7: 100% RDF as soil application (control). Pruning was performed every year during the month of July to ensure adequate ventilation in the garden. Fertilizers were applied in three different stages *i.e.*, flowering stage, pod development stage and pod maturity stage in 30%, 40% and 30% respectively in weekly intervals. From treatment combination T_1 to T_6, water soluble fertilizers were applied through drip irrigation system and T_7, conventional fertilizers were applied to the soil. Conventional fertilizers were weighed and applied in three split doses during the months of June, October and February. Basins were made up to a radius of 60 cm away from the tree and the fertilizers were incorporated into the soil by forking. The observations were recorded immediately after pruning (before fertigation) and at final harvest (after fertigation) in each treatment each having six trees for three replications. Elain Aphsara *et al*., (2008) had laid out standard procedures for recording growth parameters of cocoa and statistical analysis was carried out as per Panse and Sukhatme (1975). The height of the plant was measured from the ground level up to the tip of the canopy using a scale and expressed in meters (m) and tree girth was measured at 15 cm above the ground level using a tape and expressed in centimeters (cm). Height of the first jorquette was measured as the vertical distance from ground level up to the first jorquetting point using a measuring tape and expressed in meter (m).The canopy volume was calculated by the height of tree and average of spread in both the direction by using the formula πrl and expressed in m^3, whereas, r= EW+NS/ 4, l= $\sqrt{r^2 + h^2}$,h= canopy height (obtained by plant height- HAFB), HAFB= Height at first branching (Elain Apshara *et al*., 2008) [2]. The canopy spread (East-West & North- South) in both the direction was measured using a scale and recorded in meters (m).

Results and Discussion

The non-significant differences among the treatments with respect to tree height, girth and Height at first branching were observed before and after fertigation. However, the trees treated with 100% RDF through fertigation had recorded highest tree height values of 4.53 m and 4.62 m during 2019 and 2020 respectively. Pooled mean value of 4.58 m was recorded highest in the same treatment. The lowest tree height values of 3-86 m and 3.94 m were recorded in 175% RDF through fertigation in 2019 and 2020 respectively (Table 1). The results regarding girth of the tree were also non-significantly different having highest values of 62.97 cm and 65.13 cm recorded highest in the trees treated with 100% RDF through fertigation in 2019 and 2020 respectively. The highest pooled value of 64.05 cm was recorded in the same treatments. The lowest girth of the tree was recorded in T_5 (175% RDF through fertigation) treated plants having a pooled value of 55.26 cm. The highest height at first branching was recorded in the trees treated with 175% RDF through fertigation having a pooled value of 1.37 m. However, the highest values of 1.36 m and 1.38 m were recorded in the trees supplied with 175% RDF through fertigation in 2019 and 2020 respectively. Significant results were observed regarding canopy volume and highest was recorded in the trees treated with 125% RDF through fertigation of 21.49 m^3 and 22.86 m^3 in 2019 and 2020 respectively. The highest pooled mean of canopy volume (22.18 m^3) was recorded in the trees treated with 125% RDF through fertigation (Table 2). The lowest pooled value of canopy volume (15.15 m^3) was recorded in the plants treated with 125% RDF through fertigation. The treatment T_2 was recorded on par regarding canopy volume of 21.55 m^3. Results regarding canopy spread in both directions were recorded non-significant in two years with respect to all fertigation treatments. The highest canopy spread (East – West) was recorded in T_3 treated plants of 3.80 m and 3.92 m in 2019 and 2020 respectively with a pooled mean of 3.86 m. The lowest canopy spread (East –West) was reported in treatment T_5 (175% RDF through fertigation) of 3.10 m (Table 3). The canopy spread (North- South) was recorded highest in the treatment T_3 having the values of 3.67 m and 3.89 m respectively during 2019 and 2020 with pooled mean of 3.78 m (Table 3).

Among various fertigation levels, 100% RDF through fertigation showed better vegetative growth of the plant especially plant height might be due to better nutritional pool in the root zone by continuous application of fertilizers through fertigation which was reported by Ravichandar and Paramaguru, 2014. The continuous supply and uptake of nutrients at appropriate doses at proper time may also helps in the synthesis of auxins which directly stimulates the action of Indole Acetic Acid, leading the cells to elongate faster than other fertigation treatments increasing the trunk girth. These findings are in accordance with Krishnamoorthy *et al.,* (2013) [5]. There was no considerable difference regarding height at first branching, as the pruning and training operations performed in the early age of the tree will decide the factor irrespective of fertilizer application. This was also reported by Elain Apshara *et al.* (2008) [2]. The canopy volume is one of the deciding factors to get higher yields in any crop which might be due to optimum moisture levels in the root zone eliminating water stress with constant supply of water and nutrients which helps in proliferating cells through fertigation also reported by Krishnamoorthy *et al.,* (2013) [5] and Haneef *et al.,* (2014) [3].

Table 1: Effect of different fertigation schedules on tree height (m) and girth of the tree (cm) of cocoa in the different years

Treatments	Tree height (m) before fertigation			Tree height (m) after fertigation			Girth of the tree (cm) before fertigation			Girth of the tree (cm)after fertigation		
	2019-20	2020-21	Pooled mean	2019-20	2020-21	Pooled mean	2019-20	2020-21	Pooled mean	2019-20	2020-21	Pooled mean
T_1	2.73	3.53	3.13	4.07(1.34)	4.34 (0.81)	4.21 (1.08)	57.33	57.72	57.52	57.61 (0.28)	58.39 (0.67)	58.00 (0.48)
T_2	3.35	3.73	3.54	4.53 (1.18)	4.62 (0.89)	4.58 (1.04)	61.59	63.77	62.68	62.97 (1.38)	65.13 (1.36)	64.05 (1.37)
T_3	3.16	3.69	3.43	4.45 (1.29)	4.52 (0.83)	4.48 (1.05)	58.50	61.05	59.78	59.33 (0.83)	62.00 (0.95)	60.66 (0.88)
T_4	2.78	3.59	3.18	4.22 (1.44)	4.32 (0.73)	4.27 (1.09)	56.87	58.66	57.77	57.81 (0.94)	59.51 (0.86)	58.66 (0.89)
T_5	2.72	3.22	2.98	3.86 (1.14)	3.94 (0.72)	3.90 (0.92)	51.99	54.11	53.05	53.59 (1.60)	56.94 (2.83)	55.26 (2.21)
T_6	2.78	2.97	2.88	4.42 (1.64)	4.17 (1.20)	4.29 (1.41)	59.20	61.39	60.29	60.35 (1.15)	62.20 (0.89)	61.28 (0.99)
T_7	2.66	3.63	3.15	4.38 (1.72)	4.19 (0.56)	4.29 (1.14)	56.44	57.55	57.00	57.07 (0.63)	60.01 (2.46)	58.54 (1.54)
SEM ±	0.31	0.25	0.20	0.22	0.15	0.13	3.53	3.68	3.60	3.49	3.84	3.64
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV%	19.01	12.87	11.28	8.91	6.27	5.42	8.06	8.29	10.70	7.90	8.54	10.60

RDF- Recommended dose of fertilizers Figures in parenthesis indicate tree height and girth of the tree values

Table 2: Effect of different fertigation schedules on height at first branching (HAFB) (m) and Canopy volume (m^3) of cocoa in the different years

Treatments	Height at first branching (HAFB) before fertigation			Height at first branching (HAFB) after fertigation			Canopy volume (m^3) before fertigation			Canopy volume (m^3) after fertigation		
	2019-20	2020-21	Pooled mean	2019-20	2020-21	Pooled mean	2019-20	2020-21	Pooled mean	2019-20	2020-21	Pooled mean
T_1	1.25	1.27	1.26	1.27 (0.02)	1.28 (0.01)	1.28 (0.02)	8.01	12.09	10.05	15.92 (7.91)	18.32 (6.23)	17.13 (7.08)
T_2	1.33	1.36	1.35	1.36 (0.03)	1.38 (0.02)	1.37 (0.02)	10.62	13.96	12.29	20.49 (9.87)	22.61 (8.65)	21.55 (9.26)
T_3	1.28	1.30	1.29	1.29 (0.01)	1.34 (0.04)	1.32 (0.03)	9.97	13.46	11.72	21.49 (11.52)	22.86 (9.40)	22.18 (10.46)
T_4	1.30	1.34	1.32	1.32 (0.02)	1.37 (0.03)	1.35 (0.03)	9.38	12.84	11.11	18.56 (9.18)	19.55 (6.71)	19.06 (7.95)
T_5	1.28	1.30	1.29	1.29 (0.01)	1.34 (0.04)	1.32 (0.03)	6.82	10.31	8.56	14.47 (7.65)	15.82 (5.51)	15.15 (6.59)
T_6	1.24	1.33	1.29	1.26 (0.02)	1.34 (0.01)	1.30 (0.01)	10.26	12.55	11.41	18.60 (8.34)	18.29 (5.74)	18.44 (7.03)
T_7	1.33	1.36	1.35	1.35 (0.02)	1.37 (0.01)	1.37 (0.02)	7.04	10.86	8.95	16.56 (9.52)	17.11 (6.25)	16.83 (7.88)
SEM ±	0.05	0.04	0.04	0.05	0.04	0.04	1.56	1.10	1.16	1.45	1.20	0.98
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	4.46	3.71	3.03
CV%	7.06	5.78	6.25	6.97	5.43	6.01	30.55	15.60	19.00	13.94	10.85	9.15

RDF- Recommended dose of fertilizers Figures in parenthesis indicate height at first branching canopy volume of the tree values

Table 3: Effect of different fertigation schedules on spread of canopy (EW) (m) and spread of canopy (NS) (m) of cocoa in the different years

Treatments	Spread of canopy (EW) (m) before fertigation			Spread of canopy (EW) (m) after fertigation			Spread of canopy (NS) (m) before fertigation			Spread of canopy (NS) (m) after fertigation		
	2019-20	2020-21	Pooled mean	2019-20	2020-21	Pooled mean	2019-20	2020-21	Pooled mean	2019-20	2020-21	Pooled mean
T_1	2.51	2.73	2.62	3.00 (0.49)	3.36 (0.63)	3.18 (0.56)	2.61	3.00	2.81	3.28 (0.67)	3.34 (0.34)	3.31 (0.50)
T_2	2.62	3.05	2.84	3.52 (0.90)	3.78 (0.73)	3.65 (0.81)	2.80	3.19	3.00	3.63 (0.83)	3.78 (0.59)	3.71 (0.71)
T_3	2.88	2.85	2.86	3.80 (0.92)	3.92 (1.07)	3.86 (1.00)	2.43	3.14	2.79	3.67 (1.24)	3.89 (0.75)	3.78 (0.99)
T_4	2.49	2.88	2.68	3.37 (0.88)	3.50 (0.62)	3.44 (0.76)	2.92	3.14	3.03	3.60 (0.68)	3.69 (0.55)	3.65 (0.62)
T_5	2.27	2.74	2.51	2.99 (0.72)	3.20 (0.46)	3.10 (0.59)	2.23	2.80	2.52	3.17 (0.94)	3.37 (0.57)	3.27 (0.75)
T_6	2.89	3.22	3.05	3.30 (0.41)	3.41 (0.19)	3.36 (0.31)	3.03	3.26	3.15	3.32 (0.29)	3.57 (0.31)	3.44 (0.29)
T_7	2.64	2.68	2.67	3.20 (0.56)	3.35 (0.67)	3.28 (0.61)	2.20	2.58	2.39	3.02 (0.82)	3.32 (0.74)	3.17 (0.78)
SEM ±	0.20	0.13	0.15	0.17	0.15	0.15	0.24	0.17	0.17	0.17	0.16	0.13
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

CV%	13.43	8.01	9.65	9.02	7.53	8.00	16.57	9.97	10.44	8.83	7.85	6.89

RDF- Recommended dose of fertilizers Figures in parenthesis indicate tree canopy spread (EW &NS) values

Conclusion

The present study concluded that application of fertilizers through fertigation at appropriate dosage at constant rate will increase the growth of cocoa which ultimately improves the yield. The above results indicated that application of 125% RDF through fertigation was recommended in black alluvial soils of coastal Andhra Pradesh for higher returns.

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References

1. DCCD. Directorate of Cashew and Cocoa Development, 2021. (http://dccd.gov.in/stat2.htm).
2. ElainApshara S, Bhat VR, Nair RV. Comparative studies on elite cocoa progenies in their initial years of growth. Journal of Plantation Crops. 2008;36(1):38-44.
3. Haneef, Kaushik RA, Sarolia DK, Mordia A, Mahesh Dhakar. Irrigation scheduling and fertigation in pomegranate cv. Bhagwa under high density planting system. Indian Journal of Horticulture. 2014;71(1):45-48.
4. Noordiana N, Syed Omar SR, Shamshuddi J, Nik Aziz NM. Effect of Organic based and Foliar Fertilizers on Cocoa (*Theobroma cacao* L.) grown on an Oxisol in Malaysia. Malaysian Journal of Soil Science. 2007;11:29-43.
5. Krishnamoorthy C, Rajamani K. Effect of Fertigation through Drip and Micro Sprinkler on Plant Biometric Characters in Cocoa (*Theobroma cacao* L.). Pakistan Journal of Biological Science. 2013;16:1950-1956.
6. Krishnamoorthy C, Rajamani K. Drip and micro sprinkler irrigation on pollen characteristics in cocoa (*Theobroma cacao* L.). International Journal of Agricultural Sciences. 2016;6(10):1178-1182.
7. Krishnamoorthy C, Rajamani K, Mekala S. Trickle and micro sprinkler fertigation on soil microbial population in cocoa (*Theobroma cacao* L.). African Journal of Microbiology Research. 2015;9(12):872-879.
8. Panse VG, Sukhatma PV. Statistical methods for Agricultural workers. ICAR, New Delhi, 1985, 145-55.
9. Ravanachandar A, Paramaguru P. Effect of Fertigation Scheduling on Growth Characters in Cocoa (*Theobroma cacao* L.). Trends in Biosciences. 2014;7(13):1512-1515.