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Effect of fertigation dose and schedule on growth and yield of mango cv. Nuzvid Chinnarasam

K Radha Rani
Department of Horticulture, Dr. YSR-Mango Research Station, Nuzvid, Dr YSR Horticultural University, Andhra Pradesh, India

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Abstract
Mango is an important tropical and subtropical fruit crop grown in India contributing major share of country's production. However, systemic research on production practices like nutrient management, water management, crop regulation etc., in mango is essential for developing location specific recommendations that promote sustainable production. Hence, A field experiment was executed to know the effect of fertigation schedule and dose on growth and yield of mango at Dr YSRHU-Mango Research station, Nuzvid, Andhra Pradesh from 2022-25. The experiment consisted of five treatments and replicated four times in a Randomized Block Design. The results revealed that among treatments, 100% RDF given as fertigation in 3 splits @ N (40:40:20) P (60:40:00) and K (20:20:60) after harvesting, at fruit set and marble stage respectively recorded highest number of fruits (152.9) while 75% RDF given as fertigation in 3 splits @ N (40:40:20) P (60:40:00) and K (20:20:60) after harvesting, at fruit set and marble stage respectively recorded maximum fruit weight (309.84 g). However, highest yield per tree (37.35 kg) and per hectare (4.27 t) were recorded by 100% RDF as soil application (T_1) which was on par with T_2 - 100% RDF as fertigation (36.64 kg/tree and 4.09 t/ha) and T_3 - 75% RDF as fertigation (31.14 kg/tree and 3.60 t/ha).

Keywords: Fertigation, fertilizer dose and schedule, yield, mango

Introduction
Mango is one of the most important tropical and subtropical fruit crops grown in India, valued for its high nutritional content, unique flavor and economic significance in both domestic and export markets. India is the leading country for mango production in the world. In India, Andhra Pradesh and Uttar Pradesh are having the largest area under mango cultivation each with around 25% of the total area followed by Bihar, Karnataka, Kerala and Tamil Nadu. In Andhra Pradesh, mango is grown in 3.98 lakh hectare and producing 49.86 lakh tonnes (Anonymous, 2025) [1]. The major mango growing districts in Andhra Pradesh are Krishna, Vijayanagaram, Ananthapur, Kadapa, Srikakulam, West Godavari and Chittore.

Efficient nutrient and water management practices are essential to maximize the productivity and to improve the fruit quality in mango. Conventionally, fertilizers are applied through soil which often leads to low nutrient use efficiency due to leaching, volatilization and uneven nutrient distribution. However, under modern agricultural practices, fertigation has emerged as an effective technology for enhancing nutrient and water use efficiency in perennial fruit crops. Fertigation is a technology in which fertilizers are applied through irrigation. It improves the nutrient uptake efficiency, prevents soil degradation and reduces the cost of fertilizer besides improving the productivity and quality of the fruits. Water coupled with nutrient management is particularly important for improving input-use efficiency (Melgar *et al*., (2008) [8], Panigrahi *et al*., 2010) [9]. Further, fertigation ensures substantial saving in fertilizer usage and reduces leaching losses (Kumar *et al.,* 2007) [6]. If fertilizers were applied through broadcasting are not efficiently utilized by plants as proved by many workers. Fertigation ensures application of fertilizers directly to root zone, resulting in higher fertilizer use efficiency (Dheware *et al*., 2020) [3]. Fertigation allows for precise and timely delivery of nutrients directly to the root zone in soluble form enhancing better uptake by plants (Shirgure and Srivastava 2014; Devi *et al*., 2023) [2, 14]. In mango fertigation has the potential to improve tree growth, flowering, fruit set, yield and quality while reducing nutrient losses and environmental pollution.

Kumar and Singh (2002) [5] reported that the nutrient use efficiency of nitrogen was increased up to 95% under drip fertigation as compared to 30-35% under soil application and ensures the saving of fertilizer by 40-60% and increased the yield by 25-30%. However, fertigation schedules and nutrient concentrations must be optimized for different varieties, soil types and agro-climatic conditions to achieve maximum benefits. Therefore, systematic research approach on fertigation practices in mango is essential for developing location specific recommendations that promote sustainable production. Hence, this study was conducted to know the effect of different fertigation schedules and dose on growth, yield of mango cv. Nuzvid Chinnarasam which is a commercial and popular variety of Andhra Pradesh in general and Nuzvid in specific.

Materials and Methods
The experiment was conducted at Mango Research Station, Nuzvid, Dr.YSR Horticultural University, Andhra Pradesh during 2023 to 2025. The experimental site was geographically situated at 16º 46' 48'' N latitude and 80º 50' 59''E longitude. The orchard soil type is red loamy soil. The experiment was laid out in Randomized Block Design (RBD) with four replications consisting of five treatments. The treatment details were presented in Table 1. Need based plant protection measure were taken uniformly in all treatments. Nitrogen, Phosphorus and Potassium nutrients were given through Urea, Single Super phosphate and Muriate of Potash respectively. Urea and Muriate of Potash

were given through drip irrigation while Single Super Phosphate was given as soil application in all treatments. Fertilizers were applied through drip irrigation in 3 split doses *viz.,* after harvesting of fruits (June), during fruit set (February) and at marble stage of fruit growth (March) in all treatments except in control where the recommended dose of fertilizers were given as soil application in single dose after harvest of the fruits (June). The experiment was done on Chiinarasam variety of mango which is a popular variety in Andhra Pradesh and especially in Nuzvid of Eluru district. The data was recorded on the growth and yield characters and were statistically analyzed as per the method suggested by Panse and Sukhatme, (1985) [10]. The fruit length and width were measured by digital venire calipers and expressed in centimeters (cm). The total soluble solids (TSS) values were recorded by using hand refractometer (Erma, Japan). The shelf life of fruits was also estimated by counting days from ripening to till consumable. The relative economics were estimated in each treatment considering the cost of fertilizers, chemicals for plant protection, labour cost for irrigation, weeding, sprayings etc. Based on the marketable quality of the produce in different treatments during the study period and market rate fluctuations, the gross income was calculated. The cost of production per each treatment varied due to variation in the input cost, hence, the net income was calculated by deducting the cost of production from gross returns under each treatment. Accordingly, the Benefit-Cost ratio was calculated.

Table 1: Treatment details of the experiment

Treatments	N	P	K	Remarks
T_1	1000g	1000g	1000g	100% Recommended Dose of Fertilizers (RDF) as soil application
T_2	N-40%	P-60%	K – 20%	100% RDF as fertigation in 3 splits
	N-40%	P-40%	K – 20%	
	N-20%	P-0%	K – 60%	
T_3	N-25%	P-50%	K – 15%	75% RDF as fertigation in 3 splits
	N-20%	P-25%	K – 15%	
	N-30%	P-0%	K – 45%	
T_4	N-20%	P-30%	K – 10%	50% RDF as fertigation in 3 splits
	N-20%	P-20%	K – 10%	
	N-10%	P-0%	K – 30%	
T_5	N-10%	P-20%	K – 5%	25% RDF as fertigation in 3 splits
	N-10%	P-5%	K – 5%	
	N-5%	P-0%	K – 15%	

Result and Discussion

The pooled data from 2022 to 2025 on different growth and yield parameters were analyzed statistically and presented in Table 2,3&4.

Table 2: Effect of fertigation dose on growth parameters of mango

Treatments	Tree height (m)	Canopy spread (E-W) (m)	Canopy spread (N-S) (m)	Canopy volume (m^3)	Stem girth (cm)
T_1	5.19	5.18	5.23	68.90	55.58
T_2	5.06	5.12	5.13	63.20	52.33
T_3	4.74	4.64	4.48	51.53	51.20
T_4	5.13	4.63	4.64	48.64	51.90
T_5	4.72	4.53	4.79	37.42	48.66
SEM±	0.14	0.13	0.12	4.80	0.64
C.D(0.05P)	NS	0.39	0.37	14.96	1.99
C.V%	5.69	5.28	4.95	17.81	2.46

The results (Table 2) indicated that tree height was not influenced by different fertigation levels in the present study. However other growth parameters showed significant difference among the treatments. Out of all the treatments, T_1 (100% RDF applied in basin after harvesting of fruits) recorded significantly maximum canopy spread in East-West direction (5.18 m), in North-South direction (5.23 m), canopy volume (68.90 m^3) and stem girth (55.58 cm) which was on par with T_2 (100% Recommended Dose of Fertilizers as fertigation were given in 3 splits @ N (40:40:20) P (60:40:00), K (20:20:60) after harvesting, at fruit set and marble stage respectively) which has recorded canopy spread of 5.12 m (East-West) and 5.13 m (North-South); canopy volume of 63.20 m^3 and stem girth of 2.33 cm. However, T_5 (25% of RDF was given as fertigation @ N (10:10:05), P (20:05:00), K (05:05:15) in 3 splits) has recorded lowest canopy spread for East-West direction (4.53 m), canopy volume (37.42 m^3) and stem girth (48.66 cm). The maximum growth of canopy and stem girth might be due to optimum level of nutrients absorption. Hendre *et al*., (2020) [4] and Singh and Kumar, (2024) [15] had also observed similar results with 100% RDF through fertigation in mango.

Table 3: Effect of fertigation schedule on yield and yield parameters of mango

Treatments	No. of fruits/tree	Ave. fruit weight (g)	Fruit length (cm)	Fruit width (cm)	Yield /tree (kg)	Yield/ha (k g)	B-C ratio
T_1	137.75	273.82	13.25	11.22	37.35	4.27	1.6
T_2	152.90	243.69	13.52	11.01	36.64	4.09	1.2
T_3	99.98	309.84	12.92	10.83	31.14	3.60	2.5
T_4	101.52	259.49	13.02	10.72	25.91	2.92	0.8

T_5	85.32	321.00	13.25	10.98	27.72	3.16	1.4
SEM±	7.92	17.34	0.23	0.19	2.66	0.27	-
C.D(0.05P)	24.67	54.02	NS	NS	8.28	0.84	-
C.V%	13.71	12.32	3.56	3.45	16.74	14.86	-

Results pertaining to yield and yield parameters were presented in Table 3 revealed that T_2 recorded significantly highest number of fruits per tree (152.9) while lowest (85.32) was recorded in T_5. The highest number of fruits might be due to the constant and adequate availability of moisture in the plant rhizosphere during fruit developmental stages that eventually enhanced the fruit retention capacity of the plant (Hendre *et al*., 2020) [4]. These results are in conformity with those of Ravikanth *et al*., (2025) [13] in mango and Panigrahi *et al*., (2010) [9] in Nagpur mandarin sweet orange. Average fruit weight was found significantly maximum (309.84 g) in T_3 while minimum (243.69 g) was observed in T_2. Both fruit length and fruit width were not affected by fertigation schedules in the present study. Similar results were reported by Rao *et al*., (2022). Among the treatments, T_1 recorded highest yield per tree (37.35 kg) and per hectare (4.27 t) which was on par with T_2 (36.64 kg/tree and 4.09 t/ha), T_3 (31.14 kg/tree and 3.60 t/ha). The higher yields under these treatments might be due to the fact that high yield contributing parameters like number of fruits and fruit weight. These findings are in collaboration with the findings of Pawar and Dingre, (2017) [11] in Banana. However, Benefit-Cost ratio was found highest (2.5) in T_3 followed by T_1 (1.6) and T_2 (1.2) and lowest was observed in T_4 (0.8).

Table 4: Effect of fertigation schedule on TSS, Acidity and shelf life of mango

Treatments	TSS (Brix)	Acidity (%)	Shelf-life (days)
T_1	13.9	1.18	6.5
T_2	14.5	1.15	6.5
T_3	15.4	0.98	6.4
T_4	14.7	1.05	6.3
T_5	14.7	1.07	6.3
SEM±	NS	0.07	NS
C.D(0.05P)	0.42	0.02	0.09
C.V%	5.76	3.91	2.91

None of the treatments showed significant results for TSS (Table 4). This may be due to accumulation of nutrients which are responsible for increasing TSS was not vary with fertigation treatments. Similar trends were observed in pomegranate by Martínez-Nicolás *et al*., (2019) [7] and Rao *et al.,* (2022) [12]. Similarly, Acidity (%) and shelf life (days) of the fruits were also not influenced by the fertigation doses and schedules in the present study.

Conclusion

the results of the study showed that among the different fertigation schedules and doses, 100% RDF was given in 3 splits @ N (40:40:20) P (60:40:00) and K (20:20:60) after harvesting, at fruit set and marble stage respectively was found superior to get high number of fruits and fruit yield per tree. However, high benefit cost ratio was recorded with 75% RDF @ N (25:20:30), P (50:25:00) and K (10:10:30) in 3 splits after harvesting, at fruit set and marble stage.

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