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Influence of various levels of fertigation with and without mulch on physico-chemical characteristics of pineapple var. Simhachalam

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Abstract

The present study evaluated the effect of different levels of fertigation with and without black polythene mulch on the yield and physico-chemical characteristics of the pineapple variety "Simhachalam". The study was conducted on plant and ratoon crops at Precision Farming Development Centre, Odisha University of Agriculture and Technology, Bhubaneswar, India. The experiment followed a randomized block design with seven treatments replicated three times. Treatments included 100, 80 and 60 % of the recommended dose of fertilizers (RDF) applied through fertigation with and without black polythene mulch and a control (100 % RDF applied conventionally without mulch). In the planted crop, fertigation at 100 % RDF with black polythene mulch produced the highest fruit weight without crown (1028.2 g), fruit length (18.4 cm), fruit circumference (37.5 cm), pulp weight (810.2 g), and yield (55.9 t/ha). Additionally, the 80% RDF with mulch treatment achieved the highest T.S.S (15.2 °Brix), T.S.S: titratable acidity ratio (40.1), reducing sugar (4.5%), and total sugar (12.3%). The highest benefit-cost ratio (2.17) was also recorded with 100% RDF and mulch. Similar trends were observed in the ratoon crop. Fertigation at 100% RDF with mulch resulted in the highest fruit weight without crown (932.7 g), fruit length (17.7 cm), fruit circumference (35.3 cm), pulp weight (732.8 g), and yield (46.8 t/ha). The 80% RDF with mulch treatment maintained the highest T.S.S (15.2 °Brix), T.S.S: titratable acidity ratio (33.8), reducing sugar (4.6%), and total sugar (12.1%). The benefit-cost ratio was highest (2.86) for 100% RDF with mulch. Treatments without mulch generally showed lower yields and poorer quality parameters than mulched treatments. The control treatment (conventional method without mulch) also demonstrated significantly lower performance across most parameters. These findings suggest that adopting fertigation with black polythene mulch, even at reduced fertilizer levels (80% RDF), significantly improves yield and quality parameters in pineapple cultivation, making it a cost-effective and productive approach.

Key words: Pineapple, fertigation, black polythene mulch, yield-attributing parameters, benefit-cost ratio

Introduction

Pineapple is an important commercial fruit crop, grown in India in diverse agro-ecological zones in an area of 105,600 hectares with 1,798,700 MT production and 17.0 MT Ha^{-1} productivity (Horticultural Statistics at a Glance, 2021). It can grow in moist to extremely dry conditions and at varying altitudes (D'Eeckenbrugge *et al.*, 2003). It has a very efficient moisture-conserving system that can survive under severe drought-like conditions. However, it produces good productivity under proper irrigation and rainfall. Under reduced soil moisture conditions, plant growth and yields are significantly reduced. Despite being a popular fruit in India, its yield is low due to non-adoption of improved variety, pests and diseases, weeds, nutritional imbalance, poor flowering control and fruit ripening, water deficit, genetic deformity and poor quality of vegetative propagating material. Of all these, nutritional imbalance and weed management are the two most important factors that affect the fruit yield of pineapple. Simhachalam is a local variety grown in the Vishakhapatnam district of Andhra Pradesh and southern parts of Odisha (Radha and Mathew, 2007). Commercial cultivation of local varieties of pineapple is limited to a few pockets of southern Odisha. The use of fertigation for pineapple production under open field conditions is not widely practiced in India as most of the growers are cultivating it as a rainfed crop because the water requirement of pineapple plant is low (1000-1500 mm throughout the year) and the crop can survive long dry periods through its ability to retain water in the leaves. Pineapple is a shallow-feeder and nutrient-demanding crop with high N and K requirements. In Indian soil conditions, a dose of N, P_2O_5 and K_2O at 12, 4 and 12 g/plant/year, respectively, is optimum (Devi *et al.,* 2013).

Conventionally, fertilizers are applied in the plant root zone at the time of planting and in split doses at critical growth periods. Most of the conventionally applied nutrients suffer leaching loss and become unavailable to the plants. To achieve the full yield potential and the economic efficiency of pineapple, fertilizers are overused, which not only reduces the efficiency of fertilizer use but also pollutes the environment. Efficient and judicious use of fertilizers is necessary for sustainable soil health care and to accomplish high yield and quality fruits. Fertigation allows adopting the correct amount and concentration of the applied nutrients to meet the crop's actual nutritional requirement throughout the growing season (Raina *et al.*, 2011). Drip irrigation in pineapple enhances growth and reduces the cost of weed management and fertilizer application (Ojeda *et al.*, 2012). The growth and yield of drip-fertigated plants were higher than surface irrigated and drip-irrigated plants (Maneesha *et al.*, 2022). Weeds pose a serious problem in the cultivation of pineapples, especially in the rainy season, when they exhibit rapid growth, compete with the crop for water, light and nutrients and cause yield reduction. When combined with mulch, the fertigation may further boost production by reducing evaporation losses, soil erosion and crop competition due to weeds. Major hindrances in the widespread use of drip irrigation technology and mulching in India are the high initial investment and the average Indian farmer's relative lack of technical proficiency. Doubling the farmer's income through maximizing production per unit drop of water and sustaining soil health is the national goal. There is a shortage of information on the application of nutrients through fertigation in pineapple. The research was done with the objective of evaluating the potential of fertigation technology with and without mulch on the yield and quality of pineapple.

Materials and methods

The investigation was conducted at the experimental research farm of Precision Farming Development Centre, Odisha University of Agriculture and Technology, Bhubaneswar, India from 2016-18 in plant crop and 2018-19 in ratoon crop. The soil of the experimental area is lateritic with a sandy loam texture with pH (4.6) and E.C. (0.014 dSm-1). The soil organic carbon content was 2.26 %. The soil had 93 kg/ ha available nitrogen, 4.9 kg/ ha available phosphorus and 67 kg/ ha available potassium at the time of planting. Uniform, disease-free suckers weighing 400-500 g were used for planting in trenches with 30 x 60 x 90 cm spacing (43500 plants/ ha). The experiment was laid out with pineapple var. Simhachalam was collected from Krishi Vigyan Kendra, Gajapati district of Odisha, India. The experiment was conducted using a randomized block design (RBD), with seven treatments replicated thrice. The land was divided into raised beds of 3.0 m x 1.8 m size separated by drainage channels, which was one experimental plot. Each plot comprised 30 plants. The beds were covered with black plastic mulch of 50-micron thickness. The source of water for irrigation was the well existing in the field. The fertigation system had a 2 Hp motor, 50 L sand filter, venturi system, 60 mm Polyvinyl chloride (P.V.C.) main line, 50 mm P.V.C. sub main line and 16 mm Low-density polyethylene pipe (LDPE) lateral lines. In-line emitters, spacing was 60 cm with 2 litres per hour discharge rate. The details of the treatments are given in the Table 1.

The plots were irrigated through drip irrigation at an interval of 2-3 days depending upon weather, soil, growth, and stage of crop. Water soluble fertilizers *viz.*, Urea, Sulphates of potash and Monoammonium phosphate were used in the experiment, which were applied through venturi. The 100 %, 80 % and 60 % RDF of water-soluble fertilizer were regulated by operating the tap connected at the starting end of each lateral. Drip laterals were laid along the length of each raised bed with a spacing of 0.60 m between two adjacent laterals. Fertigation to individual plots in each replication was controlled by a manual regulating valve fixed to each lateral line. Fertigation was scheduled at fortnightly intervals starting from the second month of planting till flower induction in plant crops. After fruit harvesting of plant crops, one healthy sucker was kept on the mother plant by de-suckering the other emerged suckers. In ratoon crops, fertigation was followed similarly after fruit harvest of the plant crop till its floral induction. In treatment, T_7, the conventional method of fertilizer application 100 % RDF (12:4:12 g N.P.K. per plant per year) was done by applying 1/4th quantity of N and K as basal and the remaining were given in three equal splits at three-month intervals till flowering induction. A full dose of phosphorus was applied as basal at planting. All the other treatments (T_1 to T_6) were fertilized with water-soluble fertilizer given through fertigation.

After harvesting, ten fruits of each replication with an average representative weight were taken for physiochemical evaluations. Fruit length was measured with the help of a measuring tape from the base of the fruit to the end of the fruit, where the crown is attached to the fruit. Fruit circumference was measured with the help of a measuring tape from the widest portion of the fruit. The crown length was measured with the help of a measuring tape from the base of the crown to the top of the crown leaf. The crown: infructescence length ratio was calculated by taking the ratio between the crown length and the infructescence length (the length of the fruit without a crown). The fruits were weighed with the help of an electronic digital balance. The number of fruitlets was counted following the Fibonacci number pattern. The weight of the pulp, excluding the peel and core, was measured from the ten representative samples under each replication and treatment. The estimated yield with crown per hectare was recorded by multiplying per plant yield with plant density in a hectare. The total soluble solids content of fully ripened fruit was determined with the help of an Erma hand refractometer (range 0-32 °Brix). The percentage of titratable acidity was obtained by the method described by Ranganna, 1977. Sugar was estimated using Fehling 'A' and 'B' solutions by following the Lane and Eynon Method as described by Ranganna,1977. Ascorbic acid was estimated by the volumetric method using 2,6-dichloro phenol indophenol dye according to the procedure suggested by Ranganna (1977). The costs of cultivation, labour and other inputs were estimated for treatment and the cost of produce was calculated. Net return was calculated by subtracting the cost of cultivation from gross returns. The Benefit-cost ratio was calculated by dividing gross returns by the cost of cultivation involved.

Statistical analysis: The experiment was laid out in a randomized block design with seven treatments and three replications. The data were statistically analyzed in one-way ANOVA and Duncan's multiple range test (Snedecor and Cochran,1980) at P=0.05 was been used for mean separation. No statistical analysis was run on the economic data of the study.

Results and discussion

Fruit physical characters- In both plant and ratoon crops, the maximum fruit weight without a crown was observed in fertigation with 100 % RDF with mulch, which was statistically at par with 80 % RDF with mulch (Table 1). The highest value for fruit length without a crown was observed in T_4 (18.4 cm, 17.7 cm) in plant and ratoon crops, respectively. T_4 also registered the highest fruit circumference (37.5 cm, 35.3 cm) in both plant and ratoon crops, respectively (Table 2). The crown length obtained higher values in T_3 (40.4 cm, 35.2 cm) in both crops. The crown infructescence ratio was found to be highest when treated with 60 % RDF through fertigation without mulch (4.0, 3.9) in plant and ratoon crops, respectively. The maximum number of fruitlets (123.7,114.4), maximum pulp weight (810.2 g, 732.8 g) and pulp: peel weight ratio (3.9,3.4) was observed in T_4 in plant and ratoon crops, respectively (Table 2). The highest yield per hectare was also obtained in T_4 (55.9 t/ha, 46.8 t/ha) in both plant and ratoon crops (Table 2).

Fruit weight without crown, fruit length, crown length, crown: infructescence ratio, fruit circumference, number of fruitlets, pulp weight, pulp: peel weight and fruit yield significantly recorded highest in the plants under the treatment 100 % RDF by fertigation and mulching (T_4). However, 80 % RDF by fertigation and mulching (T_5) has shown at par results as T_4. Reduction of the crown is a desired factor for enhancing the marketability of pineapple. T_4 and T_5 have recorded minimum values in crown weight and crown: infructescence ratio. A higher vigour of a pineapple plant at flower induction time is associated with a higher infructescence weight, a lower crown weight and length and a lower ratio of the crown to infructescence length (Fassinou Hotegni *et al.*, 2014). Reduction of crown length on pineapple fruits with increasing N and K rates was also reported by Rios *et al.* (2018). Comparing the performance of fertigation treatments as a whole and the conventional method of fertilizer application, it was noticed that the treatments with fertigation with mulch have given higher results, even at lower levels of nutrients which might be due to the boosting of overall vegetative growth and higher biological efficiency of plants. The positive response of T_4 and T_5 on yield parameters could be directly linked to well-developed photosynthetic surfaces and increased physiological activities of the treated plants, leading to more assimilated produced and utilized for fruit development. It was noteworthy that both T_4 and T_1 were given 100 % RDF through fertigation and both showed significantly similar results, but T_4 recorded an 18.8 percent and 17.2 percent increase in yield than T_1 in plant and ratoon crops, respectively This showed the effects of mulching in restricting weed incidence and improving the yield. Kalita *et al.* (2022) recorded the highest yield and yield attributing characters with black polythene mulch in pineapple cultivation in Assam. Slow and frequent watering eliminated wide fluctuation of soil moisture under drip irrigation, which might have resulted in better growth and yield. The results conform with the findings of Perez *et al.* (2005), Malézieux *et al.* (2003) in pineapple and Pandey *et al.* (2005) in banana.

Fruit quality parameters: In both plant and ratoon crops, the maximum T.S.S were observed in T_1, T_4 and T_5 while, the maximum values for T.S.S: titratable acidity ratio was observed in T_5 (Table 3). The result on titratable acidity and ascorbic acid content was not affected by the levels of fertigation with and without mulch in both crops. Reducing sugar and

Table 1. Effect of different levels of fertigation with and without mulch on fruit weight without crown, crown weight, fruit and crown length and crown: infructescence ratio of pineapple var. Simhachalam

Treatment	Fruit weight without crown (g)		Crown weight (g)		Fruit length (cm)		Crown length (cm)		Crown: infructescence ratio	
	PC	RC	PC	RC	PC	RC	PC	RC	PC	RC
T_1-FERT 100 % RDF, no mulch	896.2^{ab}	705.2^{bc}	159.7^{a}	198.0^{a}	16.2^{ab}	15.6^{ab}	33.2^{ab}	27.5^{abc}	2.1^{c}	1.8^{cd}
T_2 – FERT 80 % RDF, no mulch	766.4^{bc}	640.9^{bcd}	169.0^{a}	170.0^{a}	15.1^{ab}	13.9^{bc}	32.1^{ab}	31.2^{ab}	2.1^{c}	2.3^{bc}
T_3- FERT 60 % RDF, no mulch	542.8^{c}	434.3^{d}	223.7^{a}	200.3^{a}	10.1^{c}	9.1^{d}	40.4^{a}	35.2^{a}	4.0^{a}	3.9^{a}
T_4- FERT 100% RDF, with mulch	1028.2^{a}	932.7^{a}	217.0^{a}	136.0^{a}	18.4^{a}	17.7^{a}	26.5^{c}	22.1^{c}	1.4^{c}	1.2^{d}
T_5- F.E.R.T. 80% RDF, with mulch	912.7^{ab}	811.5^{ab}	227.7^{a}	135.3^{a}	17.3^{ab}	16.4^{ab}	28.2^{bc}	23.5^{bc}	1.6^{c}	1.4^{d}
T_6- F.E.R.T. 60% RDF, with mulch	627.5^{c}	517.9^{cd}	186.0^{a}	222.3^{a}	11.3^{c}	9.3^{d}	34.5^{ab}	24.1^{bc}	3.0^{b}	2.6^{b}
T_7 – Drip,100 % RDF, no mulch	773.0^{bc}	578.4^{cd}	230.7^{a}	230.7^{a}	14.6^{b}	12.3^{c}	29.2^{b}	27.6^{abc}	2.0^{c}	2.3^{bc}
S.E.m (±)	71.81	61.35	41.50	25.24	1.05	0.81	2.62	2.58	0.27	0.21
C.D. (5 %)	223.70	191.14	NS	NS	3.29	2.54	8.15	8.05	0.86	0.66

*P.C.: plant crop, R.C.: ratoon crop. *Means followed by the same letter in each column are not significantly different at a 5 % level of significance based on D.M.R.T.

Table 2. Effect of different levels of fertigation with and without mulch on fruit circumference, number of fruitlets, yield, pulp, peel weight and pulp: peel weight ratio of pineapple var. Simhachalam

Treatment	Fruit circumference (cm)		Number of fruitlets		Yield / hectare (t/ha)		Pulp weight (g)		Peel weight (g)		Pulp: peel weight	
	P.C.	R.C.	P.C.	R.C.	P.C.	R.C.	P.C.	R.C.	P.C.	R.C.	P.C.	RC
T_1 -FERT 100 % RDF, no mulch	31.5^{bc}	30.8^{ab}	111.9^{abc}	103.6^{ab}	45.8^{b}	38.9^{b}	686.9^{ab}	589.8^{abc}	208.7^{a}	236.7^{a}	3.3^{ab}	2.5^{b}
T_2 -FERT 80 % RDF, no mulch	27.8^{cde}	26.7^{abc}	104.7^{abc}	96.9^{b}	40.6^{bcd}	34.9^{bc}	615.8^{abc}	520.5^{bc}	209.4^{a}	221.9^{a}	2.9^{bc}	2.4^{b}
T_3-FERT 60 % RDF, no mulch	23.2^{e}	21.6^{c}	79.7^{d}	73.7^{d}	30.6^{d}	26.8^{c}	322.0^{d}	209.9^{d}	183.9^{a}	180.8^{a}	1.5^{e}	1.2^{c}
T_4-FERT 100 % RDF, with mulch	37.5^{a}	35.3^{a}	123.7^{a}	114.4^{a}	55.9^{a}	46.8^{a}	810.2^{a}	732.8^{a}	205.7^{a}	212.9^{a}	3.9^{a}	3.4^{a}
T_5-FERT 80 % RDF, with mulch	33.7^{ab}	31.3^{ab}	113.8^{ab}	104.4^{ab}	49.9^{ab}	40.9^{ab}	772.8^{a}	688.8^{ab}	199.0^{a}	213.4^{a}	3.9^{a}	3.3^{a}
T_6-FERT 60 % RDF, with mulch	24.3^{de}	23.3^{bc}	94.2^{cd}	80.4^{cd}	34.8^{cd}	31.9^{bc}	449.4^{cd}	481.4^{c}	218.8^{a}	201.9^{a}	1.9^{de}	2.0^{b}
T_7-Drip,100 % RDF, no mulch	28.8^{bcd}	26.6^{abc}	103.5^{bc}	92.4^{bc}	43.9^{bc}	33.7^{bc}	503.0^{bcd}	564.6^{abc}	212.2^{a}	198.4^{a}	2.4^{cd}	2.1^{b}
S.E.m (±)	1.58	2.62	5.73	4.94	3.29	2.90	63.12	59.44	7.85	12.21	0.24	0.18
C.D. (5 %)	4.91	8.16	17.85	15.40	10.26	9.04	196.67	185.19	NS	NS	0.75	0.56

*P.C.: plant crop, R.C.: ratoon crop *Means followed by the same letter in each column are not significantly different at a 5 % level of significance based on D.M.R.T.

total sugar was also observed highest in 80 % fertigation and mulching in plant crop and ratoon crop, respectively. To attain higher fruit quality in pineapple, the major nutrients should be given in adequate doses at determined intervals. T_4 and T_5 registered the highest quality parameters in terms of T.S.S., total sugar, reducing sugar and soluble solids/ titratable acidity ratio. It was noted that 100 % RDF through fertigation with mulching and 80 % RDF through fertigation with mulching has shown comparatively higher T.S.S. than soil fertilization without mulch (T_7). Film mulching increased the characteristic aroma components of pineapple fruits (Liu *et al.*, 2011). Increased T.S.S., acidity and ascorbic acid content with film mulching were also reported by Panwar *et al.* (2007). However, in the present study, no significant variation was found concerning titratable acidity and ascorbic acid content among the treatments. SS/TA ratio is used to evaluate fruit flavour, which represents the balance between sugar and acid ratio. Monthly fertigation with K increases fruit quality, fruit mass and yield (Ribeiro *et al.*, 2019). Results analogous to the above findings were reported by Shirgure and Srivastava (2013) and Bonomo *et al.* (2020).

Cost economics: In plant crop, cost of cultivation (₹ 4,64,429), gross income (₹ 10,07,640 @ fruit sale rate of ₹ 18,000/ t), net return (₹ 5,43,211) and benefit: cost ratio (2.17) were highest in T_4. In ratoon crop, the cost of cultivation, gross income, net- return and benefit: cost ratio was highest in T_4 (Table 4). Economics is the major consideration for farmers when deciding between adopting new technology. The economic yield with the highest net return (₹ 5,43,211 and ₹ 4,86,551) and benefit-cost ratio (2.17 and 2.86) in plant and ratoon crops, respectively, were recorded in T_4. T_5 recorded substantially close values to T_4 regarding B.C.R. (2.02 and 2.71) in plant and ratoon crops, respectively, saving 20 percent of fertilizers. The conventional fertilization of 100 % RDF without mulching resulted in a B.C.R. of 1.75 and 2.17 in plant and ratoon crops, respectively. Fertigation reduces the labour cost involved in the maintenance of crops. The initial investment in installing a fertigation unit is costlier but, once established, reduces the labour cost involved. Though the cost of cultivation of T_4 is the highest among all the treatments, it recorded the highest yield and B.C.R. in both crops. The high initial investment cost for the system and the cost of water-soluble fertilizers are the major constraints but considering its benefits in water saving, increased crop productivity and higher returns, it can be more economically viable. The findings of the study agree with those of Maneesha *et al.* (2019), Maneesha *et al.* (2022), Singh *et al.* (2016) and Mathew *et al.* (2017).

From the study, it is concluded that the adoption of fertigation at 100 and 80 percent RDF with mulching showed superior results in terms of yield and yield-attributing parameters in both plant and ratoon crops. However, the adoption of 80 % RDF under fertigation with mulching in pineapple cultivation was more productive and profitable than a full dose of fertilizers as it saved 20 percent of the fertilizer requirement.

Author's contribution: Dr. Satyanarayan Dash contributed to planning, supervising, designing the experiment and analysis of the results. Pratichee Mohapatra and Pradyot Nayak contributed to interpreting the results. All the authors provided critical feedback and helped shape the research, analysis, and manuscript.

References

Table 3. Effect of different levels fertigation with and without mulch on T.S.S., titratable acidity, SS/TA ratio, reducing, non-reducing and total sugar and ascorbic acid of pineapple var. Simhachalam

Treatment	Total soluble solids (°Brix)		Titratable acidity (%)		Soluble solids: titratable acidity		Reducing sugar (%)		Non-reducing sugar (%)		Total sugar (%)		Ascorbic acid (mg/100 g pulp)	
	P.C.	R.C.	P.C.	R.C.	P.C.	R.C.	P.C.	R.C.	P.C.	R.C.	P.C.	R.C.	P.C.	R.C.
T_1 -FERT 100 % RDF, no mulch	14.7^{a}	14.9^{a}	0.4^{a}	0.5^{a}	32.8^{ab}	27.6^{ab}	3.4^{b}	3.7^{ab}	7.3^{a}	7.2^{a}	10.9^{ab}	11.3^{ab}	31.3^{a}	28.9^{a}
T_2 -FERT 80 % RDF, no mulch	14.0^{ab}	14.5^{a}	0.5^{a}	0.6^{a}	27.5^{bc}	23.7^{bc}	2.7^{bc}	3.5^{bc}	7.2^{a}	6.3^{ab}	10.2^{b}	10.0^{b}	30.5^{a}	30.1^{a}
T3-FERT 60 % RDF, no mulch	10.6^{c}	10.5^{c}	0.6^{a}	0.6^{a}	18.4^{c}	17.5^{c}	2.0^{c}	2.4^{d}	3.5^{b}	4.8^{b}	5.7^{d}	7.5^{c}	30.8^{a}	28.5^{a}
T_4-FERT 100 % RDF, with mulch	15.0^{a}	14.8^{a}	0.4^{a}	0.5^{a}	34.5^{ab}	28.2^{ab}	3.8^{ab}	4.2^{ab}	7.5^{a}	6.6^{a}	11.6^{a}	11.6^{ab}	34.2^{a}	30.1^{a}
T_5-FERT 80 % RDF, with mulch	15.2^{a}	15.2^{a}	0.4^{a}	0.5^{a}	40.1^{a}	33.8^{a}	4.5^{a}	4.6^{a}	7.4^{a}	7.2^{a}	12.3^{a}	12.1^{a}	30.9^{a}	30.5^{a}
T_6-FERT 60 % RDF, with mulch	12.9^{b}	12.8^{b}	0.5^{a}	0.6^{a}	24.0^{bc}	20.5^{c}	2.2^{c}	2.7^{cd}	4.2^{b}	5.0^{b}	6.6^{cd}	7.9^{c}	30.8^{a}	27.9^{a}
T_7-Drip,100 % RDF, no mulch	12.9^{b}	12.7^{b}	0.5^{a}	0.6^{a}	28.6^{bc}	21.5^{bc}	2.8^{bc}	3.5^{bc}	4.6^{b}	6.1^{ab}	7.6^{c}	9.9^{b}	30.9^{a}	27.4^{a}
S.E.m (±)	0.39	0.38	0.06	0.04	3.36	2.07	0.34	0.29	0.55	0.44	0.41	0.52	1.23	1.18
C.D. (5 %)	1.22	1.18	NS	NS	10.48	6.44	1.06	0.91	1.71	1.37	1.28	1.621	NS	NS

* P.C.: plant crop, R.C.: ratoon crop. *Means followed by the same letter in each column are not significantly different at a 5 % level of significance based on D.M.R.T.

Table 4. Effect of different levels of fertigation with and without mulch on economic analysis of pineapple var. Simhachalam in plant and ratoon crop

Treatment	Gross income (₹)		Cost of cultivation (₹)		Net return (₹)		B: C ratio	
	PC @ ₹ 18000 t^{-1}	RC @ ₹16000 t^{-1}	PC	R.C.	P.C.	R.C.	P.C.	RC
T_1 -FERT 100 % RDF, no mulch	823620	623680	450611	247210	397550	376470	1.82	2.52
T_2 -FERT 80 % RDF, no mulch	731340	558880	430504	227104	333595	331776	1.77	2.46
T3-FERT 60 % RDF, no mulch	551160	429600	410367	206967	140793	222633	1.34	2.08
T_4-FERT 100 % RDF, with mulch	1007640	748480	464429	261929	543211	486551	2.17	2.86
T_5-FERT 80 % RDF, with mulch	898380	654720	444323	241823	454056	412897	2.02	2.71
T_6-FERT 60 % RDF, with mulch	625680	509600	424186	221686	258914	287914	1.61	2.30
T_7 - Drip,100 % RDF, no mulch	789300	539520	451510	248110	393050	291410	1.87	2.17

* P.C.: plant crop, R.C.: ratoon crop

Bonomo, R., M. Zucoloto, J.M. Souza, A.M.P. Magalhães, P.H.S. Baldotto and A. Campanharo, 2020. Production and quality of 'Pérola' pineapple under fertigation. *Emir. J. Food Agric.,* 32(2): 109-116.

D'Eeckenbrugge, G.C. and F. Leal, 2003. *Morphology, Anatomy and Taxonomy. The Pineapple: Botany, Production and Uses*. Bartholomew DP, Paull RE and Rohrbach KG. C.A.B.I. Publishing, Oxon, UK.13-32.

Devi, S.P., M. Thangam, M.S. Ladaniya and N.P. Singh, 2013. P*ineapple-A profitable Fruit for Goa*. Technical Bulletin no. 35, I.C.A.R. (R.C.), Goa.

Fassinou Hotegni, V.N., W.J.M. Lommen, E.K. Agbossou and P.C. Struik, 2014. Heterogeneity in pineapple fruit quality results from plant heterogeneity at flower induction. *Front. Plant Sci*., 5: 670.

Horticulture Statistics at a Glance, 2021. Horticulture statistics division, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and farmers welfare, New Delhi.

Kalita, N., S. Dutta, L. Kataki, S. Maibangsa, S. Bhuyan and N. Manoronjan, 2022. Effect of mulch types on soil moisture, soil fertility, growth and yield of pineapple (*Ananas comosus*) in hill zone of Assam. *Ann. Plant Soil Res*., 24(3): 391-395.

Liu, C., Y. Liu and G. Yi, 2011. Effects of film Mulching on aroma components of pineapple fruits. *J. Agric. Sci.*, 3(3).

Malézieux, E., F. Cote and D.P. Bartholomew, 2003. Crop environment, plant growth and physiology, *The Pineapple, Botany, Production and Uses.* D.P. Bartholomew, R.E. Paull and K.G. Rohrbach (eds). Wallingford, UK: C.A.B. International, pp: 69-108.

Maneesha, S.R., P.D. Shunmuganantham, R.M. Vijayakumar and K. Soorianathasundaram, 2019. Cost-benefit analysis of drip fertigation and flower induction in pineapple (*Ananas comosus* L. Merr.) variety 'Giant Kew' in Goa, India. *Int. J. Curr. Microbiol. Appl. Sci.,* 8(4): 2010-2019.

Maneesha S.R., D. Sujeet, S.P. Devi and J.G. Mathala, 2022. Estimation of crop water requirement of pineapple (*Ananas comosus* L. Merr.) for drip fertigation. *Int. J. Biores. Stress Manag.*, 13(9): 973-980.

Mathew, S., S.S. Wadkar and P.J. Kshirsagar, 2017. Economic analysis of pineapple production in Sindhudurg district of Maharashtra. *Int. Res. J. Agric. Eco. Stat*., 8 (2): 351-356.

Ojeda, R., M. Pire, M.P. de Camacaro and N. Mogolln, 2012. Effects of irrigation on growth, flowering and fruit quality of pineapple 'Red Spanish'. *Acta Hortic.,* 928: 171–178.

Pandey, V., D. Kumar and S. George, 2005. Response of micro propagated 'Robusta' banana to varying combination of N, P and K nutrition in lateritic soils of coastal Orissa. *Indian J. Hortic.,* 62: 122-126.

Panwar, R., S.K. Singh, C.P. Singh and P.K. Singh, 2007. Mango fruit yield and quality improvement through fertigation along with mulch. *Indian J. Agric. Sci.,* 77(10): 680-684.

Perez, P.G., M.P.G García, L.M. Rebolledo, D.A Uriza, A.A.C Tinoco and A.M. Rebolledo, 2005. Planting densities and plastic mulching for "smooth cayenne" pineapple grown in an aw2 climate fluvisol soil in Veracruz, Mexico. *Acta Hortic.,* 666: 271- 275.

Radha, T. and L. Mathew, 2007. *Tropical fruits. Fruit crops -Horticulture Science Series*, Vol. 3, Peter KV (ed), New India Publishing Agency, New Delhi, pp: 91-115.

Raina, J.N., T. Sharma and S. Suman, 2011. Effect of drip fertigation with different fertilizers on nutrient distribution in soil, leaf nutrient content and yield of apricot (*Prunus armeniaca* L.). *J. Indian Soc. Soil Sci*., 59 (3): 268-277.

Ranganna, S. 1977. *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. Tata McGraw-Hill Publishing Company Limited, New Delhi

Ribeiro, A.M.A.S., R. Bonomo, M. Zucoloto, F.O.R Silva, M.V. Barroca, A.L. Nascimento, A.M.P. Magalhães, A. Campanharo, G. Oliosi and L.D. Ciarnoschi, 2019. Potassium and nitrogen fertigation frequency on pineapple yield and fruit quality. *J. Agric. Sci.,* 11(6): 2019.

Rios, E.S.C, R.M.N. Mendonça, E.A. Cardoso, J.P. Costa and S.M. Silva, 2018. Quality of 'Imperial' pineapple infructescence in function of nitrogen and potassium fertilization. *Agrária.,* 13: 1-8.

Shirgure, P.S. and A.K. Srivastava, 2013. Plant growth, leaf nutrient status, fruit yield and quality of Nagpur mandarin (*Citrus reticulate* Blanco) as influenced by potassium (K) fertigation with four potash fertilizer sources. *Sci. J. Crop Sci.*, 2(3): 36-42.

Singh, N.A., R. Singh, S.M. Feroze and R.J. Singh, 2016. Analysis of cost and returns of the pineapple cultivation in Manipur. *Indian J. Hill Farm.*, 2(1): 50-64.

Snedecor, G.W. and W.G. Cochran, 1980. *Statistical methods*. The Lowa State University Press, U.S.A, pp. 232-237

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