Original Research Article

EVALUATION OF OPTIMUM FERTIGATION LEVEL FOR IMPROVING YIELD AND QUALITY ATTRIBUTES OF MANGO CV. PANT SINDURI

ABSTRACT

Improving fertilization management for greater productivity is critical to address the issues of deteriorating soil health conditions due to overuse use of fertilizers and lower fertilizer use efficiency. Fertigation is a technique that combines irrigation and fertilization, allowing for the precise and controlled application of fertilizers through irrigation systems while conserving resources like water and fertilizer.The aim of the study was to investigate the effect of drip fertigation on yield and quality attributes of mango cv. Pant Sinduri. The experiment was conducted at Horticulture Research Centre, Patharchatta, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand between 2017 and 2018. The experiment was organized in a randomized block design involving four replications and incorporated six treatments encompassing drip fertigation at 100, 80, 60, 40, and 20 percent recommended fertilizer dose and a control (wherein no fertilizers were applied). The outcome of experimentation revealed that treatment T_1 (fertigation with 100% recommended dose) recorded maximum fruit set (16.59%), fruit retention (2.87%), and minimal fruit drop (97.26%), subsequently leading to the highest fruit number (418) and yield (89.08 kg/tree) under this treatment. Similarly, fruit physical parameters as well as biochemical parameters were found highest under this treatment i.e., treatment $T_{1.}$ However, these parameters were statistically at par with treatment $T_{2,}$ i.e., fertigation with 80% recommended dose. On the other hand, significantly minimum values for these parameters were observed in the control. Therefore, it was concluded that drip fertigation at 80% recommended dose of fertilizers is economically advantageous for mango cv. Pant Sinduri.

Keywords: fertigation, Mangiferaindica, Pant Sinduri, RDF (recommended dose of fertilizer),treatment

1.INTRODUCTION

Worldwide, India is leading in mango (*Mangifera indica* L.) production followed by Indonesia, China, Mexico, and Pakistan. While, in India, major mango-producing states are Uttar Pradesh, Andhra Pradesh, Karnataka, Bihar, and Tamil Nadu [18]. India's share in world mango production is 45.13% followed by Indonesia (6.59%) and China (4.62%). However, the higher production of mango in India is mainly due to the large share (46.67%) of land under mango cultivation in India, compared to just 4.99% and 3.45% of land share under mango cultivation in nations like Indonesia and China, respectively. Therefore, despite India being the top producer of mango in the world, has much less productivity (9.59 t/ha) compared to other mango-producing countries like Indonesia (13.11 t/ha) and China (13.31 t/ha) [8].

Among several factors, impoverished nutrient and water management are the most critical factors, contributing to such low productivity. In addition, inappropriate/imbalanced fertilizer dose and application of fertilizer at improper stages of crop growth as well as faulty methods of fertilizer application (leading to poor nutrient use efficiency) is a common practice among Indian farmers. Imbalanced fertilizer application (generally the overuse of fertilizers) has not only increased our dependency on the import of fertilizers and degraded the soil health, but also decreased the crop response to applied fertilizers [2]. Between 2018-19 and 2020-21, India's fertilizer imports increased by almost 8%, from 18.84 million tonnes to 20.33 million tonnes, respectively [3]. Thus, highlighting the need for efficient and sustainable use of water and fertilizers. Fertigation is an efficient technique for the simultaneous improvement of water and fertilizer efficiency since it allows precise placement of nutrients directly to the root zone as well as flexibility in the nutrient application based on crop needs [23]. With the considerable increase in the adoption of drip irrigation by Indian farmers in recent years, due to unprecedented water stress and expeditiously declining water levels, fertigation has become more accessible with high nutrient use efficiency [11].

Excessive use of nitrogenous fertilizer particularly urea mainly driven by nutrient-based subsidies and low nitrogen use efficiency needs immediate attention as its overuse has disrupted the soil nutrient balance and has made the soil deficient in various micronutrients [16]. Studies report that the nutrient use efficiency of nitrogen goes up to the tune of 95% under drip fertigation as compared to 30-35% under soil application and ensures the saving of fertilizer by 40-60% [12]. Also, the application of fertilizers along with a drip irrigation system is reported to increase the yield by 25-30% compared to soil application [17]. Thus, indicating the effectiveness of drip fertigation techniques in tackling these problems. In addition to higher yield, fruit quality attributes have also drawn the farmer's attention in recent years as consumers have become more concerned about fruit quality in terms of physical appearance, organoleptic quality (as determined by TSS: acidity ratio), and nutritive values. The fruit quality is affected by nutrient level as both excess and deficient have a detrimental effect on fruit quality and even increases the incidence of pest and disease, for instance, increased attack of mango hopper under excess nitrogen [22]. Fertigation helps to improve the quality of fruits in terms of size, shape, weight, and nutritive values by ensuring optimum nutrient availability as we can regulate the supply of nutrients to the plant according to their needs. Production of quality mango will not only increase consumer preference in the domestic market but also in the international market, directly benefiting the grower in export. Thus, the present research was undertaken with the objective to standardize the fertigation schedule in the mango cv. Pant Sinduri and to examine the impact of different levels of drip fertigation on fruiting, yield, and quality attributes of mango. The results can provide a foundation for improving fruit yield and quality in a mango orchard.

2. MATERIAL AND METHODS

The present experiment was conducted at Horticulture Research Center, Patharchatta, GovindBallabh Pant University of Agriculture and Technology, Pantnagar, Distt. U.S. Nagar during the year 2017-18. It was laid out in a simple randomized block design with four replications on 12 years-old trees of mango cv. Pant Sinduri. A single tree served as a unit of treatment in each replication maintained under uniform cultural practices spaced at a 10×10 m distance. The recommended dose of fertilizers for individual tree NPK@ 1000 g: 750 g: 1000 g respectively. The experiment incorporated six treatments viz; $T_1$100% recommended dose of fetilizers via drip, T_2; 80% recommended dose of fertilizers via drip, T_3; 60% recommended dose of fertilizers via drip, T_4; 40% recommended dose of fertilizers via drip, T_5; 20% recommended dose of fertilizers via drip, T_6; No fertilizer applied (Control). N, P, and K were applied in the form of urea, monoammonium phosphate and sulphate of potash respectively. The scheduling of fertilizer was done weekly starting from the last week of February and was continued until the last week of May. Thus, fertilizers were applied in twelve equal split doses *via* the drip irrigation system.

Observations were recorded on various parameters such as flowering, fruiting, yield, and physicochemical attributes of mango cv. Pant Sinduriby Chandrashekar*et al.*[6]. The number of male and hermaphrodite flowers was counted on four selected panicles in all four directions during the flowering season (9^{th} to 27^{th} March) and represented as a percentage. The ratio between the male and hermaphrodite flowers was expressed as the flower sex ratio by Saheda*et al.* [20]. The fruit set was determined from four tagged panicles as per the formula given by Singh*et al*. [24]. While the fruit retention was determined at the maturity stage by counting the number of fruits retained on tagged panicles and dividing it by the total number of fruits at fruit set stage. Both fruit set and retention were expressed in percentage. The fruit yield was determined by weighing the harvested fruits per tree using a pan-weighing balance.

For fruit physical and biochemical analysis, five fruits were taken from each experimental unit tree. Fruit length and width were measured with a vernier calliper, and the average was mentioned in centimeters, while, fruit weight was recorded with physical weight balance and expressed in grams. Peel and stone were extracted from each fruit and then pulp weight (g) was determined by subtracting the peel and stone weight from the fruit weight. For chemical analysis, the juice of five randomly selected fruits per treatment was taken and strained through a muslin cloth. TSS (°Brix) was observed with the help of a Zeiss hand refractometer. Titratable acidity (%) was determined by titrating 10 ml fruit juice against N/10 NaOH solution with phenolphthalein as an indicator. Methods described by A. O. A. C. [4] and Devi [7] were used for the estimation of carotenoids and sugar content (total, reducing, and non-reducing sugar), respectively. 2, 6-dichloro-indophenol titration method was used for computing Vitamin C (mg/100 mL) content by Chandrashekar *et al.* [6]. The experimental data pertaining to various parameters were statistically examined by one-factor analysis of variance in the SPSS software package (SPPSS V26). Differences between treatment means were tested using the Tukey's-b test via the least significant difference at the P < .05 level ($LSD_{0.05}$). Pearson's correlation was done in the "METAN" package and Principal component analysis was done using “FactoMiner” in R software (R-4.2.1).

3.RESULTS AND DISCUSSION

Different doses of NPK fertilizers applied via a drip showed no significant effect on the male flower percentage, hermaphrodite flower percentage, and flower sex ratio (Table 1). The flowering mechanism in mango is a complex and still poorly understood phenomenon. It is influenced by several physiological (carbohydrate reserve, hormonal content, age), environmental (temperature, rainfall, relative humidity, photoperiod, and water stress), and genetic factors. Moreover, the present study was conducted for one season, which might have been insufficient to significantly influence flowering. Therefore, a long-term study is required to analyse the effect of fertigation on flowering. Shanmugasundaram and Balakrishnamurthy [20] also reported similar results where the total number of flowers per plant in pomegranate cv. Mridula remained insignificant among different drip fertigation treatments.

Significant variations were recorded for fruit set (%) and fruit retention (%) under different drip fertigation treatments (Table 1). Percent fruit set and retention were achieved maximum (16.59% and 2.87%) in treatment T_1 (fertigation given at 100 percent recommended dose of fertilizers) closely followed by treatment T_2 (16.54% and 2.76%). While the minimum fruit set (13.55%) and fruit retention percentage (1.25%) were recorded in treatment T_6 taken as control.

The improved fruit set and retention under fertigation treatments are perhaps due to better nutrient availability in these treatments in comparison to the control. The involvement of nutrients like nitrogen and potassium in leaf photosynthetic activities (which in turn provides photo-assimilates to the developing fruits), as well as the role of nitrogen in augmenting the supply of auxins to the fruits (which reduces abscission), have been well documented [1]. Further, fruit drop percentage was recorded as minimum in all the treatments receiving fertigation (ranging from 97.26% in T_1 to 97.95% in T_2), while, it was maximum (99.05%) in control. Since increasing levels of NPK fertilizers through drip augmented the availability of nutrients, hence, the treatments receiving higher doses of NPK fertilization anticipated minimal fruit drop.Kumawat *et al*. [14] reported a significant effect of drip fertigation on fruit set percentage and fruit retention percentage in guava cv. Lalit. A similar trend was documented by Suresh and Kumar [26] in aonla cv. NA-7 and Singh *et al.* [24] in litchi. The findings of Yadav *et al*. [27] are incongruity with these results who found a significant effect of fertigation on fruit drop percentage and reported that fertigation with 125 percent recommended doses of fertilizers recorded minimum fruit drop percentage in litchi cv. Rose Scented.

Table 1. Effect of fertigation on flowering and fruiting in mango cv. Pant Sinduri

Treatments	Male flower (%)	Hermaphrodite flower (%)	Sex ratio	Fruit set (%)	Fruit retention (%)	Fruit drop (%)
T_1 (100% RDF)	66.15^{a}	33.84^{a}	2.13^{a}	16.59^{a}	2.87^{a}	97.26^{a}
T_2 (80% RDF)	64.48^{a}	35.51^{a}	1.86^{a}	16.54^{a}	2.76^{ab}	97.95^{a}
T_3 (60% RDF)	75.53^{a}	24.46^{a}	3.18^{a}	$15.23b^{ab}$	1.78^{abc}	98.49^{bc}
T_4 (40% RDF)	76.91^{a}	23.08^{a}	3.64^{a}	14.78^{bc}	1.73^{abc}	98.55^{bc}
T_5 (20% RDF)	76.36^{a}	23.63^{a}	3.49^{a}	14.41^{bc}	1.53^{bc}	98.80^{c}
T_6 (Control)	76.91^{a}	23.08^{a}	3.65^{a}	13.55^{c}	1.25^{d}	99.05^{c}

*Note: The same letters in each column indicate non-significant differences at $P < .05$.

Fruit physical quality attributes such as fruit weight, fruit length, fruit width, and fruit volume were significantly improved under various fertigation treatments (Table 2). Fruit weight and fruit volume increased by 7.53% and 7.2% under treatments T_1 (fertigation with 100% RDF) and T_2 (fertigation with 80% RDF), respectively compared to the control treatment. On the other hand, fruit physical attributes were inferior under control (T_6) as indicated by minimum average fruit weight (198.31 g), fruit length (9.91 cm), fruit width (5.81 cm), and fruit volume (187.97 ml) recorded under this treatment. Improved fruit physical attributes in terms of fruit weight, fruit size, and fruit volume under drip fertigation treatments can be ascribed to better and more efficient nutrient uptake which is involved in plant physiological processes such as photosynthesis, production, and translocation of metabolites to the developing fruit. Moreover, under optimum nutrient levels, the synthesis of growth hormones like cytokinin and gibberellic acid is also augmented, thereby increasing fruit weight, size (fruit length and width), and volume. Pulp weight is significantly positively correlated with fruit weight (r=0.76***) and fruit size (fruit length, r= 0.71*** and fruit width, r=0.66***) (Figure 2). Thus, in our experiment, significantly higher pulp weight (151.38 g and 151.26 g) under drip fertigation treatments T1 and T_2 indicated corresponding higher average fruit weight and fruit size observed under these treatments. However, pulp: stone ratio (4.17) and edible portion (71.10%) were observed maximum under treatment receiving fertigation with 80% recommended dose (T_2) which were statistically at par with treatment receiving fertigation with 100% recommended dose (T_1). Specific gravity which is an indicator of fruit maturity did not differ significantly among various fertigation treatments. The results are supported by Shanmugasundaram&Balakrishnamurthy[21] and Yadav*et al.* [27] in pomegranate cv. Mridula and in litchi cv. Rose Scented, respectively.

Table 2. Effect of fertigation on fruit physical parameters of mango cv. Pant Sinduri

Treatments	Fruit weight (g)	Fruit length (cm)	Fruit width (cm)	Fruit volume (ml)	Pulp weight (g)	Stone weight (g)	Pulp: Stone Ratio	Edible Portion (%)	Specific gravity
T_1 (100% RDF)	213.25^{a}	10.57^{a}	6.38^{a}	205.24^{a}	151.38^{a}	37.28^{a}	4.10^{a}	71.02^{a}	1.03^{a}
T_2 (80% RDF)	212.78^{a}	10.51^{a}	6.33^{a}	204.20^{a}	151.26^{a}	37.14^{a}	4.17^{a}	71.10^{a}	1.04^{a}
T_3 (60% RDF)	205.47^{ab}	10.20^{ab}	6.03^{ab}	200.86^{a}	136.34^{b}	40.05^{a}	3.43^{ab}	66.37^{ab}	1.02^{a}
T_4 (40% RDF)	201.51^{b}	10.12^{b}	6.08^{ab}	202.96^{a}	132.92^{bc}	37.25^{a}	3.58^{ab}	65.96^{ab}	0.99^{a}
T_5 (20% RDF)	200.84^{b}	9.92^{b}	5.91^{ab}	199.13^{a}	130.34^{bc}	43.30^{a}	3.02^{b}	64.85^{b}	1.00^{a}
T_6 (Control)	198.31^{b}	9.91^{b}	5.81^{b}	187.97^{b}	127.71^{c}	44.66^{a}	2.86^{b}	64.40^{b}	1.05^{a}

*Note: The same letters in each column indicate non-significant differences at *P*< .05.

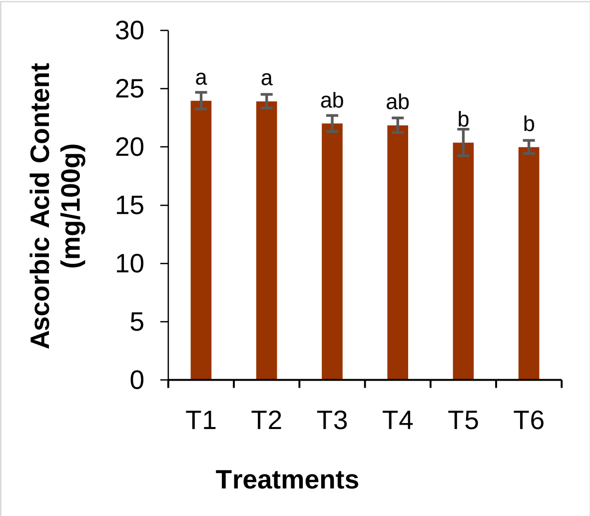
In general, fruit chemical quality parameters like TSS (^{0}brix), titratable acidity (%), total sugar (%), reducing sugar (%), ascorbic acid (mg/100g), and total carotenoids (mg/100 g of pulp) differed significantly among various fertigation treatments. Fruits from fertigation treatments receiving 100% recommended dose showed 16.27% higher TSS and 9.47% higher total sugar in comparison to the control (Table 3). With respect to percent titratable acidity, it was 24% lower under treatment T_1 compared to the control. Likewise, the TSS:acid ratio was significantly improved under drip fertigation treatments T_1 (98.69) and T_2 (91.83) compared to the control (63.85). Total soluble solids (measuring the sugar content mainly the sucrose) and acidity composition in the fruit are important organoleptic components and the balance between soluble solid content and acidity (signified by tss:acid ratio) is directly correlated with fruit flavor[5]. The role of mineral nutrients especially P and K in improving soluble solid content and TSS:acidity ratio in fruit crops is well documented [28] with the correspondent increase in activities of enzymes like Sucrose synthase (SS), sucrose phosphate synthase leading to more metabolite accumulation (fructose, glucose, and sucrose) and subsequently higher total soluble contents.

Table 3. Effect of fertigation on chemical parameters of mango cv. Pant Sinduri

Treatments	TSS (^{0}brix)	Acidity (%)	TSS:acid ratio	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)
T_1 (100% RDF)	18.79^{a}	0.19^{a}	98.69^{a}	17.45^{a}	5.67^{a}	11.78^{a}
T_2 (80% RDF)	18.75^{a}	0.20^{ab}	91.83^{a}	17.43^{a}	5.63^{a}	11.80^{a}
T_3 (60% RDF)	16.45^{b}	0.23^{b}	70.15^{b}	16.30^{ab}	5.20^{a}	11.10^{a}
T_4 (40% RDF)	16.39^{b}	0.21^{b}	75.74^{b}	16.24^{ab}	4.93^{a}	11.31^{a}
T_5 (20% RDF)	16.17^{b}	0.22^{c}	71.14^{b}	16.13^{b}	4.64^{a}	11.49^{a}
T_6 (Control)	16.16^{b}	0.25^{d}	63.85^{b}	15.94^{b}	3.60^{b}	12.34^{a}

*Note: The same letters in each column indicate non-significant differences at *P* < .05.

The data presented in Figure 1 further showed that antioxidant compounds such as ascorbic acid and total carotenoids in fruits showed a positive response to applied NPK fertilizers through drip and were found 19.85% and 26.05% higher under treatment T_1 compared to control. However, the concentration of ascorbic acid and carotenoids were statistically at par with treatment T_2 (19.60% and 23.75%). The above results are in conformity with Kumawat *et al*. [15] in guava and Haneef *et al.* [9] in pomegranate cv. Bhagwa. Similar results have been reported by Srivastava *et al*. [25] in their study on the effect of fertigation on the quality attributes of guava cv. Lalit. They found that fertigation with a 75% recommended dose of fertilizer increased the total soluble solids by 23.97% and ascorbic acid by 8.69% over control (soil application of fertilizer with basin irrigation).



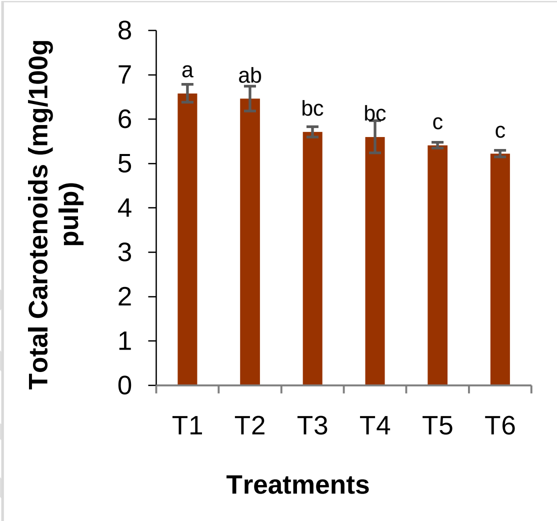


Fig. 1. Effect of fertigation on ascorbic acid and total carotenoid content in mango cv. Pant Sinduri

*Note: Treatment details are provided in the material and methods.

The application of different levels of fertigation during the experimentation significantly influenced the number of fruits/tree and fruit yield (kg/tree and q/ha) over control (Table 4). Among various treatments, T_1 (fertigation with 100% RDF) showed the highest fruit number (418) which was 103.6% higher than the control treatment (205.25). Further, drip fertigation increased the fruit yield by 119.62% in treatment T_1 and 118.76% in treatment T_2 compared to the control. While fertigation with a 20% recommended dose of fertilizer recorded just a 3.35% percent increase in yield over control. Higher fruit number and yield as observed under treatments T_1 and T_2 could be attributed to better fruit retention and minimum fruit drop under these treatments. This can be further correlated with the fact that drip fertigation enables the application of water and nutrients directly near the active root zone, thus, maintaining adequate nutrient availability throughout the cropping season due to its split use, reduced leaching losses, uniform nutrient distribution, and many more, resulting better absorption and accumulation of nutrients by plants [19]. On the other hand, the minimum number of fruits and yield registered under control might be due to the reduced availability of nutrients, as it did not receive any fertilizers. Kumar *et al*. [12] in their study on the effect of drip fertigation on yield attributes in banana crops found significantly highest fruit yield (95.2 t per ha) under drip fertigation at 100 percent recommended dose of NPK followed by fertigation with 80 percent recommended dose of NPK (87.6 t per ha). Similar results have also been reported by Jeyakumar *et al.* [10] in papaya.The overall fertilizer use efficiency (NPK) followed the trend: $T_5>T_4>T_3>T_2>T_1$. The higher fertilizer use efficiency for the treatment T_5 was mainly attributed to lower dose fertilizer application under this treatment. A similar trend was reported by Kumar *et al*. [12]in banana.

Table 4. Effect of fertigation on the number of fruits per tree, fruit yield and fertilizer use efficiency of mango cv. Pant Sinduri

Treatments	Number of fruits per tree	Fruit yield (Kg/tree)	% Increase over control	Fruit yield (q/ha)	Nitrogen use efficiency (qha^{-1}/qha^{-1})	Phosphorous use efficiency (qha^{-1}/qha^{-1})	Potassium use efficiency (qha^{-1}/qha^{-1})
T_1 (100% RDF)	418.00[a]	89.08[a]	119.62	0.89[a]	89.08	118.77	89.08
T_2 (80% RDF)	416.50[a]	88.73[a]	118.76	0.88[a]	110.91	147.88	110.91
T_3 (60% RDF)	338.50[b]	69.54[b]	71.44	0.69[b]	115.90	154.53	115.90
T_4 (40% RDF)	333.00[b]	67.08[b]	65.38	0.67[b]	167.70	223.6	167.70
T_5 (20% RDF)	209.50[c]	41.92[c]	3.35	0.41[c]	209.60	279.466	209.60
T_6 (Control)	205.25[c]	40.56[c]	-	0.40[c]	-	-	-

*Note: The same letters in each column indicate non-significant differences at *P* < .05.

To elucidate the relationship between yield and quality attributes of mango cv. Pant Sinduri with leaf nutrient composition (N, P, and K) under various drip fertigation treatments, a correlation analysis was performed and is shown in Figure 2. Fruit yield and fruit size (fruit length and fruit width) showed a significant positive correlation with leaf N, P, and K. Thus, higher yield in drip fertigated treatments might be attributed to higher leaf nutrient content (N, P, and K) reported in the plants subjected to drip fertigation. While, fruit drop showed a significantly negative correlation with leaf N, K and fruit yield (p<0.001). Though leaf K showed significantly negative correlation with fruit acidity (-0.71***), however, it was strongly positively correlated with carotenoids, total sugar (p<0.001) as well as ascorbic acid (p<0.01), and total soluble solids (p<0.05).

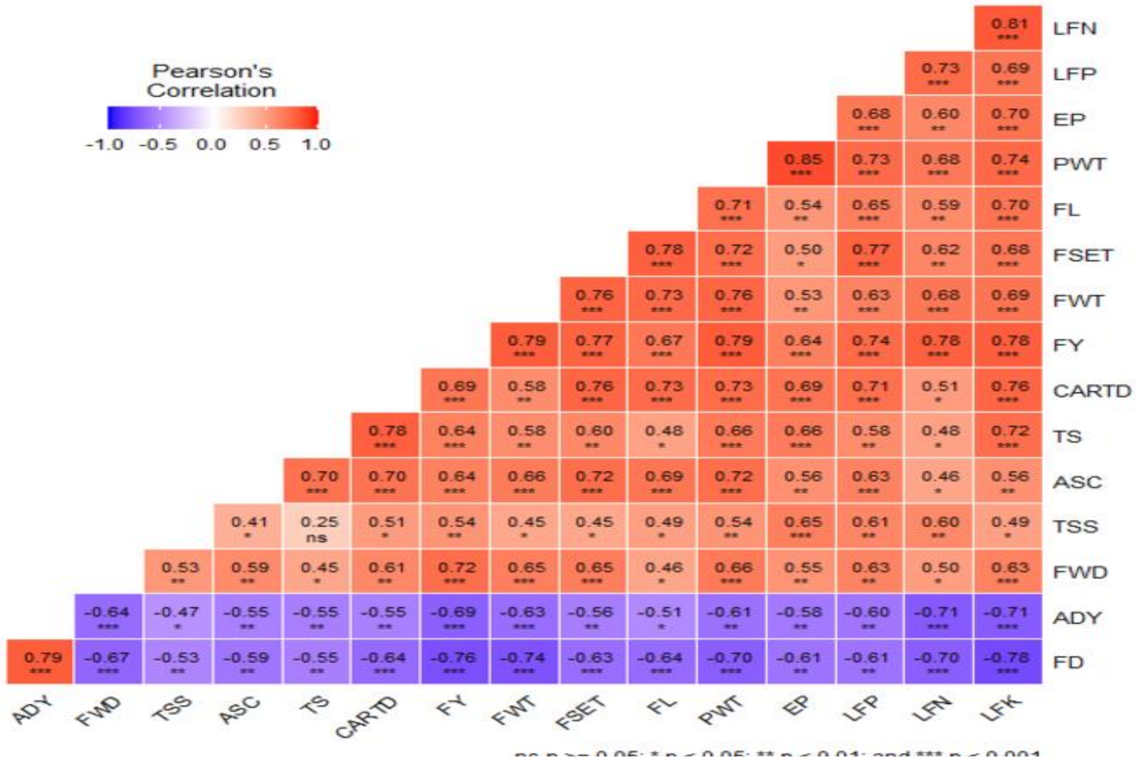


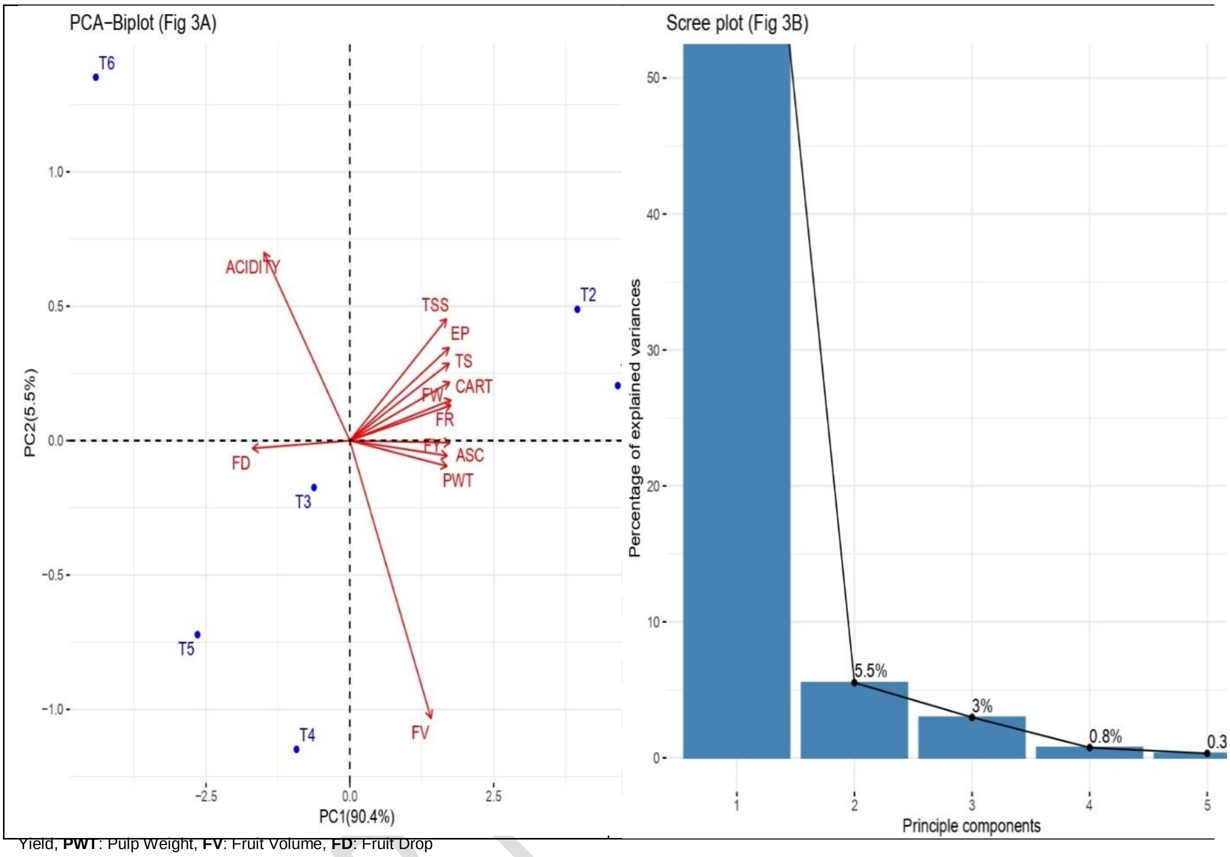
Fig. 2. Heat map showing Correlation (r) among various yield and fruit quality attributes with leaf N, P, and K in mango cv. Pant Sinduri.

*Note: **FD:** Fruit Drop, **ADY**: Acidity, **FWD**: Fruit Width, **TSS**: Total Soluble Solids, **ASC**: Ascorbic acid, **TS**: Total Sugars, **CARTD**: Carotenoid Content, **FY:** Fruit Yield, **FWT**: Fruit Weight, **FSET**: Fruit Set, **FL**: Fruit Length, **PWT**: Pulp Weight, **EP**: Edible Portion, **LFP**: Leaf Phosphorus, **LFN**: Leaf Nitrogen, **LFK:** Leaf Potassium

Principal component analysis (PCA) was done using 13 variables representing yield and quality traits in Pant Sinduri and six fertigation treatments (Fig 3). PCA divided the whole dataset of 13 variables and six fertigation treatments into six principal components as shown in the scree plot (Fig 3B), of which the maximum percentage of the variance (90.4%) was contributed by principal component 1 (PC1). PCA-biplot (Fig 3A) between different variables and treatments showed that fertigation treatments T1 and T2 positively improved the yield and quality traits such as fruit yield, fruit weight, TSS, ascorbic acid content, and carotenoid content in Pant Sinduri.

Fig. 3. Principal component analysis among various yield/fruit quality attributes and fertigation treatments in mango cv. Pant Sinduri using a PCA-biplot (Fig 3A) and Screen plot (Fig 3B).

*Note: **TSS**: Total Soluble Solids, **EP**: Edible Portion, **TS**: Total Sugars, **FW**: Fruit Weight, **FR**: Fruit Retention, **CART**: Carotenoid Content, **ASC**: Ascorbic acid, **FY:** Fruit Yield, **PWT**: Pulp Weight, **FV**: Fruit Volume, **FD**: Fruit Drop



4. CONCLUSION

Based on experimental results, it can be concluded that drip fertigation with NPK enhanced fruit set percentage, and fruit retention percentage and minimized fruit drop at the harvest stage. Similarly, fertigation significantly increased the fruit number and yield (per tree and hectare) over control. Fertigation with a 100% recommended dose was superior in these parameters, but statistically at par with fertigation at an 80% recommended dose. Likewise, fruit quality parameters in terms of fruit weight, pulp weight, Total soluble solids, acidity, and ascorbic acid content showed better performance under fertigation scheduled with a 100% recommended dose, however, was statistically at par with fertigation at 80% recommended dose. Thus, fertigation at 80% recommended dose is economically profitable for mango cv. Pant Sinduri as it resulted in yield and improved fruit quality and at the same time in saving the fertilizer by 20% without affecting yield.

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