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RESEARCH ARTICLE

STUDIES ON THE EFFECT OF HIGH DENSITY PLANTING AND FERTIGATION ON VEGETATIVE GROWTH, YIELD AND QUALITY OF BANANA (*MUSA ACUMINATA* L.) CV. GRAND NAINE OF MAIN CROP

[1,*]Hanuman Naik, M., [2]Vanajalatha, K., [3]Prasanth, P. and [4]Mutyala Naidu, M.

[1]Horticultural Research Station, Aswaraopet, Khammam (Dist.), Telangana, India
[2]Sri Konda Laxman Telangana State Horticultural University, Hyderabad, India
[3]College of Horticulture, Mojerla, Mahabubnagar, India
[4]H.R.S., Darsi, Dr.Y.S.R. Horticultural University, India

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ABSTRACT

The investigation was carried by planting tissue culture banana plants of cultivar Grand Naine. The highest pseudostem height (234.51 & 233.51cm) at shooting stage was recorded in S_2 (2 x 1.25 x 1.25 m) and F_1 (100 % RDF) and their interaction compared to other treatments. However, the highest pseudostem girth (66.99 & 65.64 cm), number of suckers (8.33 & 7.33), number of leaves (32.59 & 34.36), green leaves per plant (14.02 & 14.11) and leaf area (12.68 & 12.11 cm^2) at shooting stage was noticed in S_1 (wider spacing) and F_1 (100 % RDF) respectively and their interactions.The leaf area index (LAI) was recorded highest (3.91) in S_1 (1.8 x 1.8 m) compared to S_2 (HDP). The least number of days taken for shooting to harvest (96.25 & 96.13) was recorded in S_1 and F_1. The lowest (319.56 & 326.30 days) crop duration was registered in S_1 and F_1 and highest (343.87 & 333.70 days) was noticed in S_2 and F_2(75% RDF). The longest crop duration was observed in high density planting and 75 per cent RDF and least in S_1 and F_1. The yield differed significantly due to planting densities and fertigation levels, recording highest (92.79 & 89.87 t/ha) in S_2 and F_1. In interaction between spacing and fertigation, the highest (103.81 t/ha) yield was noticed in S_2xF_1 compared to other interactions. The titrable acidity and shelf life was significantly influenced by fertigation and plant densities. The highest was registered in F_3 (0.57 per cent) and S_2 (0.59 per cent). The shelf life of the fruits was highest (8.92 days) in F_1 (100 per cent RDF) and S_1 (9.21 days).

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INTRODUCTION

Banana is the most widely consumed food in the world and is considered to be very important fruit crop in the country. In the world scenario, India is the largest producer of bananas accounting to 27.8 per cent of the world production (FAO, 2015). The suitable climatic conditions prevailing in the country favored extensive cultivation of banana. In India, banana is grown in almost all regions except frost prone and temperate regions. Among the fruit crops cultivated in India banana ranks first in production and third in area after mango and citrus. Its production surpassed mango, contributing 33.4 per cent of the total fruit production in the country. In India, banana is cultivated in an area of 8.11 lakh ha, producing 30.24 mt, with average productivity of 37.30 MT/ha (Indian Horticulture Data base, 2015). Telangana state is also bestowed with favorable climatic conditions for banana farming and is grown in an area of 8640 ha, producing 3.01 MT with an average productivity of 34.70 MT/ha (Indian Horticulture data base, 2014). It is one of the highly productive fruit corps with average productivity of 37 t/ha after papaya (42.3 t/ha) in the country. Increase in productivity of banana is very important in present scenario due to increase in demand for growing population in the country. In order to meet nutritional security in the country increase in production and productivity of banana is essential as it is most important fruit crop in respect of nutrition and affordability to the citizens of the country. High density planting (HDP) is one of the recent and novel concepts of increasing productivity without affecting the quality of fruits. This system of planting (HDP) has been successfully implicated in fruit crops such as mango (Santharam, 1999), citrus (Goswami *et al*., 1993) and banana (Sathiamoorthy and Mustaffa, 2001), since it results in the optimum utilisation of natural resources. In most of the regions, where banana is grown, solar radiation is abundant and thus productivity largely depends upon its efficient utilization. So, the density of planting needs to be designed to

***Corresponding author: Hanuman Naik, M.,**
Horticultural Research Station, Aswaraopet, Khammam (Dist.), Telangana, India.

intercept the solar radiation effectively. An ideal density of plants is determined by complex interaction of factors like cultivars, soil fertility and management practices. HDP can significantly increase yield per unit area as the plants are planted closer than that in traditional planting methods (Mahalakshmi, 2000). Moreover, there was reduction in water and fertilizers to a tune of 30-40 per cent, besides appreciable increase in productivity for unit area under high density planting. As banana plant, mostly feeds from the surface of the soil, it is paramount important to maintain a high degree of soil fertility, if production is to be maintained at an economical level over long periods. The choice of fertilizers, dosage of nutrients, time and method of application, *etc*. vary widely with respect to agro-climatic conditions and cultivars. Banana crop gives good response to judicious fertilizer programmes and excess or deficit application of fertilizers will not exploit the full potential of its yield. Water and nutrients are the key important factors in banana cultivation and number of research experiments have clearly demonstrated that for high productivity of banana, application of recommended doses of essential nutrients at appropriate crop growth stage is necessary.

Hence, management of these resources in an efficient way is the need of hour. To increase fertilizer use efficiency application of nutrients along with irrigation (Fertigation) is the best method which can completely fulfills the nutrient requirement of banana. Moreover, this is particularly important for high density planting in order to maximize early growth and yield. However, there is dearth of information regarding optimal schedule of fertigation, and the studies on beneficial effects of high density planting under different agro climatic regions using cultivar Grand Naine. This clearly emphasises the need of research on Grand Naine with fertigation and high density planting, to provide appropriate information pertaining to schedule of fertigation and planting density to commercial growers for improving qualitative and quantitative yields. Therefore, based on the above facts present study was under taken to standardize fertigation and planting densities for banana cultivar Grand Naine under tropical field conditions of Telangana State for maximizing the quality and yield.

MATERIALS AND METHODS

The present investigation was conducted during 2013-15 at Horticultural Research Station, Aswaraopet, Khammam Dist. The investigation was carried out by planting tissue culture banana plant at three spacing levels *viz*., S_1-under 1.8x1.8 m (3086 pl/ha), S_2 -2.0x1.25x1.25 m (4414 pl/ha), S_3-2.5x1.25X1.25 m (3657 pl/ha) and three fertigation levels *viz.,* F_1-100 per cent, 75 per cent and 50 per cent (Recommended Dose of Fertilizer). The recommended dose of fertilizers was 300:300 g/plant N and K. For fertigation, straight fertilizers like urea and muriate of potash (granular form) were used whereas phosphorus was applied as basal @ 50 g/plant in the form of single super phosphate for all the treatments. Tissue cultured plants of banana cv. Grand Naine were used as planting material. A healthy, disease free uniform sized tissue culture plants of three months old were selected for planting in the pits. Before planting, Farm Yard Manure (FYM) @ 10 kg and 50 g of Phosphorus in the form of SSP (312.5 g) was applied to each pit as basal dressing.

Fertigation levels

F_1- 100 % N and K – 300 g N and 300 g K_2O plant^{-1} (652 g urea and 500 g MOP per plant).
F_2 – 75 % N and K – 225 g N and 225 g K_2O plant^{-1} (489 g urea and 375 g MOP per plant).
F_3 – 50 % N and K – 150 g N and 150 g K_2O plant^{-1} (326 g urea and 250 g MOP per plant).

Details of split application for main crop

In F_1level the total quantity of 652 g urea and 500 g MOP per plant were applied in 30 equal splits @ 22.0 g urea and 17.0 g MOP (each split) at weekly intervals.
In F_2level the total quantity of 489.0 g urea and 375.0 g MOP per plant were applied in 30 equal splits @ 16.0 g urea and 13.0 g MOP (each split) at weekly intervals.
In F_3 level the total quantity of 326.0 g urea and 250.0 g MOP per plant were applied in 30 equal splits @ 11.0 g urea and 8.0 g MOP (each split) at weekly intervals.

In the experiment, five plants in the each plot were selected to record growth parameters at various phenological stages of the crop and bunch characters in main crop. The growth parameters viz., pseudostem height , pseudostem girth ,total number of suckers ,total number of leaves ,green leaves, leaf area and physiological parameters like Absolute growth rate, Leaf area index were recorded.

AGR for pseudostem height

$H_2 – H_1$

Absolute growth rate of pseudostem height (cm day^{-1}):

$t_2 – t_1$

Where, H_1 and H_2 are pseudostem heights at times t_1 and t_2 respectively.

AGR of pseudostem girth

$G_2 – G_1$

of pseudostem girth (cm day^{-1}) :

$t_2 – t_1$

Where, G_1 and G_2 are pseudostem girths at times t_1 and t_2 respectively.

Leaf Area Index (LAI)

Leaf area index was determined using the formula suggested by Watson (1952).

$$LAI = \frac{\text{Leaf area per plant}}{\text{Land area occupied per plant}}$$

The flowering characters like number of days taken for shooting ,number of days taken from shooting to harvest and the fruit characters like bunch weight (Kg), number of hands, number of fingers in second hand (from stalk end region) ,fruit length (cm), fruit girth (cm), yield (t/ha) were recorded, Quality parameters such as TSS, total sugar content, reducing sugar content and titrable acidity (Ranganna, 1986), ascorbic acid(AOAC, 1965) and shelf life were recorded at edible ripe stage.

RESULTS AND DISCUSSION

Growth parameters

The effect of plant density and fertigation on growth parameters at shooting stage of banana is presented in table – 1. The pseudostem height, pseudostem girth, number of active leaves, physiological attributes certainly influence the yield of banana (Robinson and Nel, 1989). In the present study, planting densities and fertigation levels profoundly influenced growth and yield attributing traits.

Pseudostem height (cm)

There were significant differences in pseudostem height due to spacing and fertigation levels at shooting stage. The maximum height of the pseudostem (233.51) was noticed in F_1 which was significantly superior over other two levels. In spacing levels S_2 recorded highest pseudostem height (234.51) and differed significantly with S_3 (228.60) and S_1 (224.23). The interactions between spacing and fertigation levels were also found significant. The height pseudostem height (239.30) was registered in S_2xF_1 and it was on par with S_2xF_2 and significant over S_2xF_3 and lowest was in S_1 x F_2 (220.34). The pseudostem height was highest in high density planting (S_2) compared to other levels and in interaction effect, it was highest in combination with F_1 (100 per cent RDF). The more pseudostem height in high density planting might be due to natural shading of plants resulting in competitive growth rate to intercept the light and also due to more availability of fertilizers, compared to other treatments. Similar results were also recorded by Sarrwy *et al.* (2012) and Gogai *et al*. (2015).

Pseudostem girth (cm)

The pseudostem girth at shooting stage due to spacing and fertigation differed significantly. In fertigation levels the highest girth (65.64) was recorded in F_1, which was on par with F_2 (63.67) and significantly superior over F_3 (61.72). The spacing treatments differed significantly in pseudostem girth, the highest girth (66.99) was recorded in S_1, which was superior over other two levels. The interaction between spacing and fertigation differed significantly, the highest girth (70.29) was recorded in S_1xF_1 compared to other interactions.
The highest pseudostem girth in wider spacing (S_1) at highest level of fertigation (F_1) might be due to reduced plant height, which led to more increase in stem girth due to more availability of nutrients compared to other treatments. The decrease in girth in HDP (S_2) was due to increase in height of the plant as a result of diversion of assimilates to increase in height at the expense of girth. The present result are in accordance with those Gogai *et al.* (2015).

Number of suckers per plant

At shooting stage, the number of suckers obtained per plant differed significantly. The highest number of suckers per plant (7.33) was recorded in F_1 treatment, which was on par with F_2 (7.03) and significant over F_3 (6.79). The spacing level S_1 registered highest number of suckers (8.33) per plant, followed by S_3 (6.93) and S_2 (5.89). In interaction effects between spacing and fertigation, significant difference was noticed at S_1 and S_3 planting density with three fertigation levels. The heighest number of suckers (8.63) was recorded in S_1xF_1, which was on par with S_1xF_2 (8.23) and superior over S_1xF_3 (8.12) among all the interactions lowest number of suckers were recorded in S_2 x F_3 (5.73). Wider spacing (S_1) and higher levels of fertigation (F_1) recorded more number of sucker per plant compared to other treatments. Maximum availability of nutrients (F_1) and ample spacing between plants (S_1) might have led to encouragement of more number of suckers in these treatments and their interactions. Similar results were reported by Husameldin *et al.* (2013) in cv. Grand Naine.

Total Number of leaves per plant

At shooting stage, there were significant differences in total number of leaves per plant. The highest number of leaves per plant (32.59) was recorded in F_1, which was on par with F_2 (31.30) and significantly least number of leaves was noticed in F_3 (29.49). The plants responded significantly to spacing levels, the highest number of leaves (34.36) was recorded in wider spacing *i.e.,* S_1 and was superior over S_3 (30.44) and S_2 (28.59). The interaction of spacing with fertigation levels was significant. The highest number of leaves was recorded in S_1xF_1 (34.80) which was on par with S_1 x F_2 (34.32), S_1 x F_3 (33.95) and S_3xF_1 (32.20) and lowest number of leaves was registered in S_2 x F_3 (26.15). The total number of leaves per plant was highest in higher fertigation dose (100 per cent RDF) and wider spacing (S_1). Whereas, in interaction effects, even though higher fertigation dose recorded more number of leaves but it was not statistically significant with other fertigation levels. The highest number of green leaves was recorded in F_1 (14.11) and in S_1 (14.02). The more number of leaves at higher fertigation and wider spacing may be due to adequate availability of nutrients to induce more leaves, provided with ample space for more light interception and air movement under tropical conditions. Whereas, less number of leaves was noticed in HDP. Sufficient number of leaves will harness the light energy and synthesise adequate photosynthates for biomass production. More number of functional leaves produced by banana is an indication of the vigour, reflecting on yield and quality of fruits as they act as the source for the developing bunches (Husameldin *et al.* 2013).

Leaf area (sq. m. plant^{-1})

Similar trend was observed at shooting stage, with highest leaf area in F_1 (12.11) and S_1 (12.68) followed by other treatments. The highest leaf area was recorded in S1 x F1 (12.75) which was on par with S_1 x F_2 and S_1 x F_3 and lowest was noticed in S_2 x F_3 (11.16). The leaf area was highest in wider spacing and at higher levels of fertigation, and as the density increased and fertigation levels decreased the leaf area was reduced. In the present study, higher leaf area was noticed in the conventional planting density (S_1). It is well known that the leaf area has the greater influence on photosynthetic efficiency through higher light interception, as well as higher light assimilation.

Physiological parameters: The effect of plant density and fertigation on physiological parameters of banana at shooting stage was presented in table-2.

Leaf Area Index (LAI)

At shooting stage, the leaf area index was not significant due to fertigation levels and interactions between plant densities and fertigation. However, the plant densities influenced the leaf area index, with highest (3.91) leaf area index in S_1, followed by S_3 (3.61) and S_2 (3.03).Wider plant density recorded highest leaf area index and it decreased with increase in plant density in this experiment. The reason for increased leaf area index might be due to higher fertigation levels, enhanced vegetative growth in respect of number of leaves and leaf area which simultaneously enhanced leaf area index, as reported by Hazarika and Ansari 2010) in banana.

Absolute Growth Rate (AGR) for pseudostem height and girth (cm day^{-1})

The Absolute Growth Rate (AGR) at 3rd-5th month after planting did not differ significantly due to fertigation and spacing levels. At 5th-7th month after planting, the fertigation did not show significant influence on absolute growth rate for plant height. However, the plant densities differed significantly, with highest (0.84) at S_2, which was on par with S_3 (0.83) and significantly superior over S_1 (0.68). The interactions were found non significant. The absolute growth rate for psecudostem girth at 3rd-5th month after planting due to fertigation levels was non significant. However, the plant densities significantly influenced the absolute growth rate for pseudostem girth, with highest (0.39) in S_1, followed by S_3 (0.29) and S_2 (0.24) .The interaction effect of plant densities and fertigation at this stage was non significant. At 5th-7th month after planting the absolute growth rate for pseudostem girth was not influenced by fertigation levels and interaction effects of plant densities and fertigation. Whereas, absolute growth rate differed significantly, due to different plant densities. The highest absolute growth rate (0.30) was recorded in S_1, which was on par with S_3 (0.28), which inturn was non significant with S_2 (0.23). The highest absolute growth rate in wider spacing may be due to enhanced growth parameters. Any crop management practice should aim in keeping the physiological processes of the plants in an active condition so that these plants can produce more biomass with least destructive process. Higher photosynthetic activity is a good indication of physiological efficient plants in banana (Kuttimani *et al*. 2013).

Flowering and fruiting characters

The data pertaining to influence of plant density and fertigation on flowering, fruiting and yield of banana are presented in table- 3.

Number of days taken for shooting, shooting to harvest and crop duration

The data pertaining to influence of plant density and fertigation on number of days to shooting stage, to harvest and crop duration are presented in table - The number of days taken for shooting was not significant. There were significant differences for days taken from shooting to harvesting. The least number of days (96.13) taken from shooting to harvesting was recorded in F_1, which was superior over F_2 (103.16) and F_3 (104.23). The plant density levels significantly influenced number of days taken from shooting to harvesting. The least number of days (96.25) was recorded in S_1, followed by S_3 (100.34) and S_2 (106.93). In Interaction levels, the lowest number of days taken from shooting to harvest was registered in S_3 x F_1 (93.61) and it was on par with all S_1 interaction with three fertigation levels. The highest number of days taken in S_2 x F_2 (115.59) and wider spacing resulted in least number of days from shooting to harvesting and highest number of days was taken in high density planting (S_2). The least crop duration (326.30) was recorded in F_1 which was significantly superior over F_2 (333.7) and F_3 (332.85). In respect of effect of plant densities, the lowest duration (319.56) was observed in S_1 which was followed by S_3 (329.41) and S_2 (343.87). The high density planting system (S_2) influenced the crop duration with longest period compared to other densities. The lowest crop duration was recorded in S_1 x F_1 (316.79) which was on par with S_1 x F_2 and S_1 x F_3 and highest crop duration was registered in S_2 x F_2 (351.61). The extension of crop duration from planting to shooting and to harvest under high density (S_2 - 2.0×1.25×1.25m) could be attributed to lower leaf production and poor photosynthetic activity. Such extended vegetative or reproductive cycle with increase in plant density were in line with the results of Mahalakshmi (2000), Murugan (2003), Badgujar and Gowade (2007), Sarrwy *et al*. (2012). Robinson and Nel (1988) suggested that reduced temperature inside the canopy under high density planting could be the reason for enhanced crop duration especially under subtropical conditions. The early shooting in wider spacing may be attributed to higher number of leaves and more leaf area recorded during vegetative period leading to better photosynthetic activity. The above results are in conformity with the results of Apshara and Sathiamoorthy (1997), Kumar and Nalina (2001) and Pandey *et al*. (2001). The positive effect of nitrogen and potash in production of more number of leaves with better photosynthetic activity resulted in higher C:N ratio for early shooting and faster bunch development (Turner and Barkus 1982). Belatcazar *et al.* (1994) opined that extended duration under HDP could be compensated by higher yield per unit area. So the farmers could afford to wait for extra three to four months which may be compensated by higher returns.

Bunch weight (kg), Number of hands and fingers in second hand

The fruit characters significantly differed due to plant densities and fertigation levels. In fertigation treatments the highest bunch weight (30.36) was recorded in F_1, which was significant, followed by F_2 (28.13) and F_3 (23.55). In spacing levels, the highest bunch weight (28.24) was registered in S_1, and least bunch weight (26.28) was noticed in S_2. The interaction effect the highest bunch weight was noticed in S_1 x F_1 (32.11) followed by S_3 x F_1 (29.59) and S_2 x F_1 (29.40). The lowest bunch weight was recorded in S_2 x F_3 (22.20) which was on par with S_3 x F_3 (24.24). The highest number of hands (10.93) in a bunch was recorded in F_1, which was superior over F_2 (10.63) and F_3 (9.43). In plant densities S_1 (11.02) registered highest number of hands, followed by S_3 (10.18) and S_2 (9.79). The interaction of plant densities and fertigation levels was also found significant. In all interaction effects recorded highest number of hands and lowest in S_2 x F_3 (9.10) S_1 x F_1 (11.88). The number of fingers in second hand recorded significant differences, the highest number of fingers (18.52) in second hand was registered in F_1 ,which was on par with F_2 (18.33) and superior over F_3 (17.68). The spacing levels differed significantly with highest number (19.29) of fingers in second hand in S_1 and remaining two levels were on par to each other, with least number (17.59) in S_3. The interaction of plant density and fertigation levels was found significant in S_1 with the highest (19.84) number of fingers in second hand was recorded in S_1xF_1 which was on par with S_1xF_2 and S_1xF_3. Among all the interaction levels S_2xF_3

(17.28) recorded lowest number of fingers in second hand. Higher fertigation dose, wider spacing and their interaction recorded highest bunch weight, number of hands and fingers in second hand compared to other treatments. However, the fertigation levels F_1 and F_2, did not show significant difference in fruit characters. The increased number of hands, fingers and finger girth might have resulted in increased bunch weight per plant under normal spacing S_1 (1.8×1.8m). However, the per hectare yield was reduced under normal spacing (S_1) due to lesser plant density as compared to closer spacing (S_3). In general, though total yield per unit area has been high in HDP, the bunch grade as measured by the number of hands and fingers was inferior when compared to wider planting densities. In most of the cases, reduction in bunch weight was manifested by reduction in number of hands, number of fingers or size of the fingers. Sometimes the finger filling is comparatively poorer in high density treatment as pronounced by lower finger girth. Such situation was observed in few of the bunches in the present study. This reason might be, during finger development phase the growing bunches act as a heavy sinks and better assimilate partitioning will result if the physiological efficiency is maximized. Better development of the finger results with high assimilate flow from the built-up reserves, primarily from the pseudostem and from the leaves. Lower number of functional leaves and lower functional area of leaves could be the responsible factors for reduced photosynthetic efficiency and subsequent bunch weight per plant in plants under high density. Reduction in leaf number by pruning caused poor filling and low bunch weights in cv. Williams (Robinson 1996). In the present study, lower bunch weight, reduced number of hands, fingers and lesser finger girth were recorded at high density planting, and such reduction in finger parameters can be attributed to higher inter plant competition for light and lesser ventilation and for photosynthates and nutrients. Under high density planting production system, reduced bunch weights and finger traits were also recorded in other cultivars *viz*., Poovan (Manivannan, 1994), Nendran (Apshara and Sathiamoorthy, 1997), Robusta (Mahalakshmi, 2000 and Nalina *et al*. 2003), Ney poovan (Murugan, 2003), Rajapuri (Athani *et al*. 2009) and Williams banana (Sarrwy *et al*. 2012). It was in contrary to Sathayanarayana and Rao (1985) and Shanmugavelu *et al*. (1987) stating not much influence of closer spacing on the bunch weight, number of hands and fingers per bunch.

Fruit length and Girth (cm)

The effect of plant density and fertigation on fruit length was found non significant. However, the fruit girth showed significant difference due to plant density and fertigation levels. The highest fruit girth (13.19) was recorded in F_1, which was on par with F_2 (12.90) the lowest fruit girth was noted in F_3 (12.77). The fruit girth was significant due to plant densities, the highest (13.29) was observed in S_1 and closely followed by S_3 (12.92) and S_2 (12.65). The interaction of densities and fertigation was non significant. The fruit girth was highest in higher does of fertigation and wider spacing. The lowest girth was noticed in high density planting system.

Yield (t/ha)

The yield variations due to plant densities and fertigation in cv. Grand Naine are depicted in table. The yield differed significantly recording highest (89.87) in F_1 and followed by F_2 (83.46) and F_3 (69.70). The influence of plant densities on yield showed significant differences. The highest yield (92.79) was recorded in S_2 and significantly superior over S_3 (80.55) and S_1 (69.69). The interaction effect of plant densities and fertigation was also significant. The interaction of S_2xF_1 recorded highest yield (103.81) followed by S_2xF_2 (96.18) and S_3xF_1 (86.58) and lowest were recorded in S_1F_3 (59.52). The higher yields in higher dose of fertigation may be attributed to constant and continuous supply of nutrients at optimum levels at root zone. The scheduling of potash in different splits at optimum levels increased bunch weight in the present study. The higher yields in high density (S_2) planting might be due to higher plant population per unit area.

Fruit quality

The influence of plant density and fertigation on quality parameters of banana was presented in table – 4. The result revealed that, the TSS, ascorbic acid, non-reducing sugar, reducing sugar and total sugars of fruits did not show any variation due to plant densities and fertigation. However the titrable acidity differed significantly due to plant density and fertigation levels. The interaction effect of plant density and fertigation was also significant.

Shelf life (Days)

The effect of plant densities and fertigation showed significant differences in shelf life. The highest shelf life (8.92 days) was recorded in F_1, which was on par with F_2 (8.69 days), but both treatments were superior over F_3 (8.29 days). In plant densities the highest shelf life of fruits was registered in S_1 (9.21 days), which was followed by S_2 (8.36 days) and S_3 (8.32 days). The interaction effect of plant densities and fertigation level was also significant. Among all the interaction effects the highest shelf life (9.34) was recorded in S_1xF_1, which was on par with S_1xF_2 (9.27) and S_1xF_3 (9.02) and lowest shelf life was recorded in S_3xF_3 (7.62).

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