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RESEARCH ARTICLE

ROLE OF HIGH DENSITY PLANTING AND FERTIGATION ON GROWTH, YIELD AND QUALITY OF BANANA (*MUSA ACUMINATA* L.) CV. GRAND NAINE OF RATOON CROP.

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Abstract

The growth parameters of ratoon crop significantly were influenced by plant densities and fertigation levels. The highest pseudostem height (211.88 & 222.30 cm) at shooting stage was recorded in F_1 (100 % RDF) and S_2 (2 x 1.25 x 1.25 m) compared to other treatments. The highest pseudostem girth (66.22 and 65.29 cm), number of suckers per plant (11.32 and 12.07), total number of leaves per plant (31.52 and 31.21), green leaves per plant (13.05 and 13.53) and leaf area (8.80 and 9.42 cm^2) were registered in F_1 (100 per cent RDF) and S_1 (1.8 x 1.8 m) compared to other treatments at shooting stage of ratoon crop. The least (181.79 days) number of days taken for shooting was recorded in F_1, but, plant densities did not differ significantly. The least (102.84 and 101.73) number of days taken from shooting to harvesting was registered in F_1 and S_1. The crop duration was lowest (284.63 and 291.56 days) in F_1 and S_1. However, the lower levels of fertigation and high density planting (4414 pl/ha) recorded longest crop duration.

The highest bunch weight (27.49 and 26.50 kg) was recorded in F_1 and S_1 compared to high density planting and lower fertigation doses and the highest yield (81.64 and 89.74 t/ha) was recorded in F_1 (100 per cent RDF) and S_2 (2.0x2.5x1.25 m spacing). However, highest (6.55 & 6.50 %) reducing sugars and (11.89 & 12.24 %) total sugars was recorded in F_1 and S_1. The fertigation treatments did not influence TSS, titrable acidity (TA) and non-reducing sugars but in planting densities, highest TA (0.58 %) and non-reducing sugar (5.44 %) was noticed in S_1. The shelf life of fruits was found significantly influenced by plant densities. In the investigation the longest shelf life (9.43 days) was recorded in S_1.

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Introduction:-

Banana an important staple starch fruit for many topical countries, is a number of Musaceae. Banana is the most widely consumed food in the world and is considered as 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).

Increase in productivity of banana in India is essential to meet the growing demands of ever increasing population. Hence, innovative methods of production that can obtain higher sustainable yields to feed increasing population is the need of the hour. 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 implimented in fruit crops such as mango (Santhram, 1999), citrus (Goswami *et al*., 1993) and banana (Sathiamoorthy and Mustaffa, 2001), since it results in the optimum utilisation of natural resources.

Moreover, fertigation has vast potential in improving nutrient use efficiency, saving labour towards weeding, energy in application, reducing the cost of production, reducing the environmental pollution and helps in maintaining the soil health besides to meet the specific nutritional requirements of the crop. (Holder and Gumbs, 1983).Commercial banana plantations are now being irrigated through drip in India largely due to dwindling water resources and reducing water table. The drip fertigation can enhance the fertilizer use efficiency by substantial saving of fertilizers up to 30 per cent (Guerra *et al*., 2004) and thus results in significant increase in total mass of plant, improved phenological characteristics and bunch characteristics, higher fruit yield and quality of banana over conventional fertilizers application.

In this context, as there is dearth of information regarding optimal schedule of fertigation, and effects of high density planting under different agro climatic zones using cultivar Grand Naine as ratoon crop, which 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, the 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 of ratoon crop.

Material And Methods:-

The present investigation was conducted during 2013-15 at Horticultural Research Station, Aswaraopet, Khammam Dist. The study 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 Fertilizer). The soil of the experimental site is sandy clay loam (deep red to brown soils) and is endowed with good drainage. Field experiment was laid out in Factorial Randomized Block Design with three replications, and nine treatments in each block and they were allotted randomly. 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.

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 ratoon crop:-

F_1 – The total quantity of 652.0 g urea and 500 g MOP per plant were applied in 20 equal splits @ 32.6 g urea and 25.0 g MOP (each split) at weekly intervals.

F_2 – The total quantity of 489.0 g urea and 375.0 g MOP per plant were applied in 20 equal splits @ 25.0 g urea and 19.0 g MOP (each split) at weekly intervals.

F_3 – The total quantity of 326.0 g urea and 250.0 g MOP per plant were applied in 20 equal splits @ 16.0 g urea and 12.5 g MOP (each split) at weekly intervals.
In the experiment of ratoon crop, five plants in the each plot were selected to record growth parameters

Growth Parameters like pseudostem height (cm), pseudostem girth, number of suckers ,total number of leaves, green leaves at shooting, green leaves at harvest were recorded at 3rd month, 5th month, 7th month after planting and at shooting stage from the base of the stem to the axil of the youngest leaf and expressed in centimeters. Flowering characters such as number of days taken for shooting, number of days taken from shooting to harvest, Fruit charactars such as bunch weight (kg), number of hands, number of fingers in second hand (from stalk end region) fruit length, fruit girth (cm), yield (t/ha) and fruit quality parameters such as TSS, total sugar content, reducing sugar content and titrable acidity ascorbic acid and shelf life were recorded at edible ripe stage.

Results And Discussion:-

GROWTH PARAMETERS

The data pertaining to growth parameters at shooting stage of banana cv. Grand Naine as influenced by plant density and fertigation are presented in table – 1.

Pseudostem Height (cm):-

At shooting stage, the highest pseudostem height (211.88) was recorded with F_1 significantly followed by F_2 (206.42) and F_3 (202.44). In plant densities, the highest pseudostem height (222.30) was noticed in S_2, which was significantly superior over S_3 (205.07) and S_1 (193.36). The interaction of plant densities and fertigation was found significant. The highest pseudostem height (198.42) was recorded in S_1xF_1, and was on par with S_1xF_2 (193.07), however it was inturn on par with S_1xF_3 (188.58). In all remaining interaction effects higher dose of fertigation with all densities recorded highest pseudostem height followed by lower doses.

The pseudostem height was highest in S_2 high density planting (4414 pl/ha) and higher dose of fertigation (RDF 100%). As the density increases and fertigation levels decreases the plant height got reduced. An increase in pseudostem height with increase in plant population might be due to increased plant population per unit area, which provided less space for individual plant and in search of light perhaps the plant attained tall growth. Stover and Simmonds (1987) observed intensification of inter-plant competition when two or more followers were allowed to develop till maturity. Similar results were also recorded by Athani *et al*. (2009) and Sarrwy *et al*. (2012).

Pseudostem Girth (cm):-

The highest pseudostem girth (65.29) was noticed in S_1, which was on par with S_3 (62.50), however it did not differ significantly with S_2 (60.13). The interaction effect was however non significant. The girth was significantly influenced by plant densities and fertigation at shooting stage. The highest girth (66.22) was recorded in F_1 which was superior over to F_3 (58.21) but on par with F_2 (63.48). In interaction effects, S_1 with three fertigation levels was non significant. However, S_2 and S_3 with higher dose of fertigation were superior over lower doses.

The thicker pseudostem in lower density planting (S_1) might be due to less competition for moisture, nutrient and sunshine. Height and girth of pseudostem are important attributes which decide the further reproductive traits. In general, the application of higher level of nutrients (F_1) increased the plant height and girth. This was in confirmation with earlier reports that the increased application of nitrogen and potash increases the plant height and girth (Srinivas *et al*. 2001 and Ashok *et al.* 2009). Hence, lower density planting and higher fertigation levels might have contributed towards thicker pseudostem in the present study compared to high density system.

Number of Suckers per Plant:-

At shooting stage, the highest number of suckers (11.32) were noticed in F_1, which was on par with F_2 (11.00), whereas, both the treatments were superior over F_3 (10.54). The plant densities significantly influenced the number of suckers per plant. The highest number (12.07) was recorded in S_1, which was significantly followed by S_3 (10.89) and S_2 (9.90). The interaction between S_2 and three levels of fertigation was significant. The highest number of suckers (10.62) were registered in S_2xF1 which was significantly superior over S_2xF_2 (9.94) and S_2xF_3 (9.14). The treatment S_1xF_1 (12.20) was on par with S_1xF_2 (12.14), but superior over S_1xF_3 (11.86). The interaction effect of S_3 with three fertigation levels was not significant. In the present study, the number of suckers per plant was more under higher fertigation levels and wider density planting system.In the lower density planting system the numbers

of suckers per plant were less. As the fertigation level decreases and density increases less number of suckers per plant was produced.

Total number of Leaves per Plant:-
At shooting stage, the highest number of leaves per plant (31.62) was recorded in F_1 followed by F_2 (31.11) and F_3 (28.33). In plant densities, the highest (31.21) leaves per plant was recorded in S_1 which was significantly superior over S_3 (30.28) and S_2 (29.57). The interaction of S_1, S_2, S_3 densities with F_1 recorded highest number of leaves per plant and with F_3 resulted lowest number of leaves.

Number of Green Leaves per Plant:-
At shooting stage, the highest number of green leaves per plant (13.65) was recorded in F_1 followed by F_2 (12.96) and F_3 (11.94). In plant densities, S_1 produced highest number of green leaves per plant (13.53), which was superior over S_2 (12.46) and S_3 (12.56), but both the treatments were on par with each other. The interaction of S_1xF_1 recorded highest number of green leaves (14.95) compared to S_1xF_2 (13.02) and S_1xF_3 (12.63). The number of green leaves per plant was significantly influenced by plant densities and fertigation levels. The number of green leaves gradually increased up to 5^{th} months after ratooning, later decreased towards harvesting. At all the stages of crop growth, the highest number of green leaves per plant was recorded in higher fertigation (F_1) dose and wider spacing (S_1) and least in lower dose of fertigation and closer spacing (S_2). The highest number of functional leaves in lower plant destiny may be due to less competition for soil moisture, nutrient and light intensity at shooting and harvesting stages as compared to closer spacing (S_2) with higher plant population.

Leaf Area (sq. m. plant^{-1}):-
During shooting stage, the highest leaf area (8.80) was recorded in F_1, which was significantly superior over F_2 (8.41) and F_3 (8.20). In plant densities S_1 registered highest (9.42) leaf area, which was significantly followed by S_3 (8.16) and with lowest value in S_2 (7.84). In S_1, S_2 and S_3 interactions with fertigation levels, the highest values were recorded with F_1 level and lowest in F_3. The leaf area gradually increased during crop growth. At shooting stage highest leaf area was noticed. The leaf area was highest in higher dose of fertigation (F_1), wider plant spacing (S_1) and lowest in closer spacing (S_2) and lower dose of fertigation (F_3). The higher leaf area at shooting stage is due to a larger number of leaves accompanied with bigger size of leaves. Simmonds (1966) also reported that the leaves attain the maximum size towards the flowering and sharply decline towards the end. Similar results were recorded by Nankinga *et al*. (2005), Athani *et al*. (2009) and Sarrwy *et al*. (2012).

The total number of leaves produced during the growth was influenced by mineral nutrition. It was evident from the data that higher amount of nutrient application resulted in more number of leaves leading to increased leaf area and leaf area index. The increased production of leaves may help to synthesize more photosynthates and flowering stimulus which leads to early shooting. The effective leaf area available for photosynthetic activity might have positively influenced the growth and development of fruits and thus the total yield (Apshara and Sathiamoorthy, 1997 and Kumar and Nalina, 2001). The different workers on banana have reported that higher levels of nitrogen and potash promote production of more leaves resulting in increased leaf area which have positive correlation with bunch weight (Pandey *et al*., 2001 and Srinivas *et al*., 2001).

FLOWERING AND FRUITING CHARACTERS:-
The data recorded on flowering, fruiting and yield characters of ratoon crop of banana as influenced by plant density and fertigation are presented in table-2.

Number of days taken for shooting:-
The plant density did not differ significantly with respect of number of days taken for shooting (fig. 4.20). However, the fertigation differed significantly, the lowest number of days taken for shooting (181.79) was recorded in F_1, which was significantly followed by F_2 (197.37) and F_3 (194.70). In interaction of S_1 and S_3 with three fertigation levels was not significant. Whereas, S_2xF_1 registered lowest (182.89) days to shooting, and S_2xF_2 recorded higher number of days for shooting.

The extension of crop duration from planting to shooting and to harvest under narrow spacing (S_2) 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 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 increased duration especially under subtropical conditions.

Number of days taken from shooting to Harvesting:-

The plant densities and fertigation levels significantly influenced the days taken from shooting to harvesting (fig. 4.21). The least number of days (102.84) was registered in F_1, which was significantly superior over F_2 (108.83) and F_3 (114.94). In plant densities, S_1 recorded lowest number of days (101.73), which was superior over S_3 (110.47) and S_2 (114.41). The interaction of plant densities and fertigation was significant. In all the interaction effects S_1, S_2 and S_3 with F_1 recorded lowest number of days taken from shooting to harvesting. In the present study, days to shooting and harvesting were significantly influenced by plant density. The duration has increased with higher plant density (S_2). Reduced duration recorded in higher dose of fertigation (F_1) and wider spacing (S_1) may be attributed to higher number of leaves and more leaf area recorded during vegetative period leading to better photosynthetic activity. The other reason may be more leaf surfaces exposed to light in wider spacing (S_1), which increased the metabolism of the plant causing early physiological maturity and flowering. 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 has been indicated by Turner and Barkus (1982).

CROP DURATION (Days):-

The crop duration was lowest (284.63) in F_1,followed by F_2 (306.22) and F_3 (309.64). Plant densities significantly influenced crop duration, with least duration (291.56) in S_1 followed by S_3 (300.99) and S_2 (307.94). The interaction effect of densities and fertigation was significant S_1,S_2 and S_3 interaction with F_1 recorded lowest was crop duration and rest of interactions were on par to each other with highest duration (fig).

FRUIT PARAMETERS:-

Bunch weight (kg):-

The bunch weight in ratoon crop was significantly affected by plant density and fertigation levels. The highest bunch weight (27.49) was recorded in F_1, which was significantly followed by F_2 (26.10) and F_3 (24.38). In plant densities, S_1 recorded highest bunch weight (26.50) and was superior over S_3 (26.06) and S_2 (25.41). The interaction was also significant, S_1 x F_1 registered highest bunch weight (28.14) and lowest in S_2xF_3 (23.38).

The reduction of bunch weight with increasing plant density (S_2) may be due to excessive interception of light by the enhanced canopy, which lead to increased growth characters like plant height in search of light at expense of fruit characters. In contrast, when the plant population was low (S_1), more leaf surface was exposed to sunlight and indirectly greater amount of assimilates accumulated in plant leading to increased bunch weight. Moreover, more availability of nutrient at higher fertigation dose (F_1) resulted in more bunch weight.

Number of hands and fingers in second hand:-

The effect of plant densities and fertigation levels was not significant pertaining to number of hands and fingers in second hand in ratoon cropping.

Fruit length and girth (cm):-

The fruit length and girth were not significantly affected by plant densities and fertigation levels. In the present study, even though physical parameters were statistically non-significant, variations were noticed. It was observed that member of hands, fingers per hand fruit length and strength have decreased with increasing plant population and increased with higher density and higher fertigation levels.

YIELD (t/ha):-

The fruit yield was significantly influenced by plant densities and fertigation levels. The highest yield was recorded in F_1 (81.64), which was significantly superior over F_2 (77.51) and F_3 (72.23). In plant densities the highest yield was registered in S_2 (89.74), which was significantly superior over S_3 (76.25) and S_1 (65.39).

The interaction effects of plant densities and fertigation levels was significant. Similar trend was noticed in all interaction effects with highest yield in F_1 interaction with S_1, S_2, S_3 followed by F_2 and F_3. However, S_2xF_1 recorded highest yield (96.14) and significantly followed by S_2xF_2 (90.53) and S_2xF_3 (82.55).

It can be concluded from the data that highest yield was noticed in higher dose of fertilizers along with high density planting system compared to lower density planting. The increased number of hands, fingers and finger girth might have resulted in increased bunch weight per plant under wider spacing S_1 (1.8×1.8 m). However, the per hectare yield was reduced under normal spacing (S_1) due to lesser plant density as compared to closer spacing (S_2). The increase in yield per unit area under HDP can be attributed to increase in plant population per unit area (Ahmed and Mannan, 1970). The higher yield in F_1 and F_2 treatments may be attributed to constant and continuous supply of nutrients in solution form at optimum level to the wetted area of the root zone.

FRUIT QUALITY:-

The data pertaining to fruit quality parameters of banana cv. Grand Naine ratoon crop as influenced by plant density and fertigation are furnished in table-3.

Total soluble solids (^{o}Brix):-

The results related to TSS as influenced by plant densities and fertigation are presented in table. The TSS of fruits was not affected by plant densities and fertigation levels in cv. Grand Naine in ratoon crop. Similar, result was also reported by Chaudari and Baruah (2010) in cv. Jahaji (AAA) of banana.

Reducing Sugar, Non–reducing Sugar and Total sugars (%):-

The effect of plant densities and fertigation on reducing and total sugar content in fruits was found to be significant. The highest content of reducing sugars (6.55) was observed in F_1 and lowest in F_3 (6.16). In plant densities, the highest reducing sugar content (6.80) was noticed in S_1, significantly followed by S_3 (6.28) and S_2 (6.01) .The interaction of plant densities and fertigation showed significant influence on reducing sugars in S_1 and S_2 interaction but not in S_3. The highest content of reducing sugar (7.08) was noticed in S_1xF_1 and lowest S_2xF_3 (5.60).

The highest content of total sugars (11.89) in cv. Grand Naine fruits of ratoon crop was recorded in F_1, superior to F_2 (11.65) and F_3 (11.32). In plant densities S_1 registered highest content of total sugars (12.24) which was significantly followed by S_3 (11.61) and S_2 (11.00). The interaction effect of plant densities and fertigation on levels of total sugars of fruits was found significant. In all interaction effects the plant densities with higher dose (100 per cent RDF) of fertigation registered highest total sugars and it reduced with decrease in fertigation levels.

The influence of fertigation levels and interaction of plant densities and fertigation was found non significant for non reducing sugars of banana fruit. However, the plant densities significantly influenced the content of non-reducing sugars. The highest content of non-reducing sugars was recorded in S_1 (5.44), which was on par with S_3 (5.33) and significantly lowest content of non-reducing sugars of fruits was registered in S_2 (5.00). The sugar content in banana fruit increased with wider spacing and higher fertigation doses and decreased with increase in spacing and decrease in fertigation levels.

Ascorbic acid (mg/100g pulp):-

The ascorbic acid content of fruit affected by plant densities and fertigation levels in cv. Grand Naine is presented in table.The results recorded revealed that, the ascorbic acid content of fruit was not significantly influenced due to plant densities, fertigation levels and their interactions.

SHELF LIFE (Days):-

The shelf life of banana fruit as influenced by fertigation levels and interaction of plant densities and fertigation was found non significant. However, the plant densities significantly influenced the shelf life of fruits. The longest shelf life (9.43) was recorded in S_1, which was on par with S_3 (8.70) and superior over S_2 (7.48). The shortest shelf life was observed in high density planting (S_2). The longest shelf life in wider spacing (S_1) may be due to more synthesis of photoassimilates and accumulation of maximum starch compounds in the fruits compared to high density planting. This higher accumulated sugars and acids might have acted as substrates for respiration during storage and enhanced storage life.

Table:1:- Effect of Spacing and fertigation on Growth parameters at shooting stage of Banana cv.Grand Naine (Ratoon Crop).

Tretments	Pseduostem height (cm)	Pseduostem girth (cm)	No of suckers/plant t^{-1}	Total no of leaves/plant t^{-1}	Green leaves/plant t^{-1}	Leaf area(sq.m.plant t^{-1})
Factor A Spacing						
S_1	193.36	65.29	12.70	31.21	13.53	9.42
S_2	222.30	60.13	9.90	29.57	12.46	7.84
S_3	205.07	62.50	10.89	30.28	12.56	8.16
Factor B Fertigation						
F_1	211.88	66.22	11.32	31.62	13.65	8.80
F_2	206.42	63.48	11.00	31.11	12.96	8.41
F_3	202.44	58.21	10.54	28.33	11.94	8.20
Factor AxB Spacing and Fertigation intaractions						
S_1xF_1	198.42	68.76	12.20	32.18	14.95	9.94
S_1xF_2	193.07	64.32	12.14	31.84	13.02	9.27
S_1xF_3	188.58	62.78	11.86	29.62	12.63	9.06
S_2xF_1	228.43	63.92	10.62	30.86	12.96	8.13
S_2xF_2	20.32	62.84	9.94	30.62	12.87	7.83
S_2xF_3	218.15	53.64	9.14	27.24	11.54	7.55
S_3xF_1	208.78	65.99	11.14	31.83	13.05	8.34
S_3xF_2	205.86	63.28	10.92	30.88	12.98	8.13
S_3xF_3	200.58	58.22	10.62	28.14	11.64	8.00
Factor A (SE m ±)	1.42	1.58	0.12	0.06	0.08	0.05
Factor A (CD 5%)	4.29	4.77	0.37	0.20	0.26	0.15
Factor B (SE m ±)	1.42	1.58	0.12	0.06	0.08	0.05
Factor B (CD 5%)	4.29	4.77	0.37	0.20	0.26	0.15
Factor Ax B(SE m ±)	2.47	2.75	0.21	0.11	0.15	0.09
Factor AxB (CD 5%)	7.43	8.26	0.64	0.35	0.46	0.26

Table 2:- Effect of Spacing and Fertigation on flowring, fruiting and yield caracters of Banana cv.Grand Naine (Ratoon Crop).

Tretments	No. of .days taken for shooting	No. of. days taken from shooting to harvesting	Crop Duration(days)	Bunch weight (kg)	no .of hands	No of fingers in 2nd hand	Fruit length(cm)	Fruit girth (cm)	Yield (t/ha)
Factor A Spacing									
S_1	189.81	101.73	291.56	26.50	10.42	18.80	18.63	13.97	65.39
S_2	193.53	114.41	307.94	25.41	9.15	17.84	17.53	13.18	89.74
S_3	190.52	110.47	300.99	26.06	9.63	18.12	18.04	13.55	76.25
Factor B Fertigation									
F_1	181.79	102.84	284.63	27.49	9.92	18.42	18.31	13.77	81.64
F_2	197.37	108.83	306.22	26.10	9.76	18.27	18.04	13.56	77.51
F_3	194.70	114.94	309.64	24.38	9.52	18.07	17.85	13.37	72.2

									3
Factor AxB Spacing and Fertigation intaractions									
S_1xF_1	180.84	95.96	276.80	28.14	10.67	19.01	18.96	14.20	69.44
S_1xF_2	194.76	102.84	297.67	26.31	10.36	18.85	18.62	13.92	64.93
S_1xF_3	193.82	106.38	300.20	25.05	10.22	18.54	18.32	13.79	61.82
S_2xF_1	182.89	109.84	292.73	27.23	9.25	17.92	17.84	13.38	96.14
S_2xF_2	200.96	112.72	313.68	25.64	9.21	17.84	17.50	13.26	90.53
S_2xF_3	196.74	120.68	317.42	23.38	9.00	17.76	17.24	12.90	82.55
S_3xF_1	181.64	102.72	284.36	27.12	9.84	18.33	18.14	13.74	79.35
S_3xF_2	196.38	110.94	307.32	26.35	9.72	18.12	18.00	13.50	77.09
S_3xF_3	193.54	117.76	311.30	24.72	9.33	17.92	17.98	13.41	72.33
Factor A (SE m ±)	1.93	1.70	1.42	0.12	0.39	0.73	0.57	0.35	0.11
Factor A (CD 5%)	NS	5.13	4.27	0.39	NS	NS	NS	NS	0.35
Factor B (SE m ±)	1.93	1.70	1042.00	0.12	0.39	0.73	0.57	0.35	0.11
Factor B (CD 5%)	5.80	5.13	4.27	0.39	NS	NS	NS	NS	0.35
Factor Ax B(SE m ±)	3.34	2.95	2.46	0.24	0.67	1.28	1.00	0.61	0.20
Factor AxB (CD 5%)	10.05	8.88	7.40	0.79	NS	NS	NS	NS	0.61

Table 3:- Effect of spacing and fertigaion on fruit quality parameters of Banana cv.Grand Naine (Ratoon crop).

Tretments	**TSS ^{0}(Brix)**	**Titrable acidity(%)**	**Non-Reducing Sugars(%)**	**Total Sugars (%)**	**Reducing Sugars(%)**	**Ascorbic acid(mg/100g pulp)**	**Self life(days)**
Factor A Spacing							
S_1	19.31	0.48	5.44	12.24	6.80	10.39	9.43
S_2	17.90	0.58	5.00	11.00	6.01	9.96	7.48
S_3	18.05	0.58	5.33	11.61	6.28	10.05	8.70
Factor B Fertigation							
F_1	18.74	0.50	5.34	11.89	6.55	10.50	8.75
F_2	18.82	0.55	5.26	11.65	6.39	10.02	8.58
F_3	17.71	0.59	5.17	11.32	6.16	9.87	8.28
Factor AxB Spacing and Fertigation intaractions							
S_1xF_1	19.62	0.44	5.52	12.60	7.08	10.94	9.50
S_1xF_2	20.20	0.49	5.49	12.19	6.70	10.26	9.45
S_1xF_3	18.12	0.52	5.32	11.94	6.62	9.98	9.33
S_2xF_1	18.15	0.55	5.05	12.29	6.24	10.23	7.76
S_2xF_2	18.00	0.57	4.98	11.16	6.18	9.84	7.43
S_2xF_3	17.56	0.63	4.96	10.56	5.60	9.80	7.26
S_3xF_1	18.46	0.52	5.45	11.77	6.32	10.34	8.98
S_3xF_2	18.25	0.59	5.32	11.60	6.28	9.96	8.86
S_3xF_3	17.44	0.62	5.22	11.47	6.25	9.84	8.25
Factor A (SE m ±)	0.74	0.009	0.07	0.06	0.064	0.26	0.42
Factor A (CD 5%)	NS	0.027	0.22	0.19	0.20	NS	NS
Factor B (SE m ±)	0.74	0.009	0.07	0.06	0.064	0.26	0.42
Factor B (CD 5%)	NS	NS	NS	0.19	0.20	NS	NS
Factor Ax B(SE m ±)	1.29	0.015	0.13	0.109	0.11	0.45	0.73
Factor AxB (CD 5%)	NS	0.047	NS	0.330	0.33	NS	NS

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