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Effect of Different Levels of Calcium & Magnesium on Production and Quality of Banana (*Musa paradisiaca* L.) cv. Grand Naine

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present experiment was conducted out during the 2022-2023 at the Horticulture Research Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Science Prayagraj. The banana tissue culture cv. Grand Naine G-9 (Cavendish Subgroup, AAA) was brought from government tissues culture, unit Lucknow. Tissue culture plants were left in shade nets condition for 2 weeks due to transportation and environmental stress. Light and frequent irrigation with watering can was done accordingly with respect to moisture levels in the soil. The field experiment was set up in RBD with 9 treatments and three replications. The different levels of Magnesium viz., (75g and 150g /plant) and Calcium viz., (150g and 300 g/plant).Based on

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the findings of the experiment, it is concluded that RDN + Calcium (150g /plant) showed the highest plant height (3.29 m), plant girth (72.14 cm), number of leaves/plant (27.11), number of sucker at harvest (9.13), leaf area (10.19 m^2), length of inflorescence (122.62 cm), days taken to flowering (281.77), days to taken fruit harvest (83.12), bunch weight (27.28 kg), no. of hands/bunch (10.80), No. of finger per hand (17.33),total number finger of bunch (187.31), finger weight (136.33 g), finger length (22.87 cm), finger girth (15.20 cm), fruit yield per plant (25.52 kg), TSS (23.48 °Brix), Vitamin C (13.48 mg/100g), carbohydrates (25.44 g/100g), calcium (10.38 mg/100g) and magnesium (40.38 mg/100g).

Keywords: RDN; calcium; magnesium; production; quality; banana; grand naine (G-9).

1. INTRODUCTION

Banana is a rich source of carbohydrate and is rich in vitamins particularly vitamin B. It is also a good source of potassium, phosphorus, calcium, and magnesium. The fruit is easy to digest, free from fat and cholesterol. Banana powder is used as the first baby food. It helps in reducing risk of heart diseases when used regularly and is recommended for patients suffering from high blood pressure, arthritis, ulcer, gastroenteritis, and kidney disorders (NHB). Banana evolved in the humid tropical regions of S.E. Asia with India as one of its centres of origin. Modern edible varieties have evolved from the two species – *Musa acuminata* and *Musa balbisiana* and their natural hybrids, originally found in the rain forests of S.E. Asia. Grand Naine is popular variety grown mostly in all export-oriented countries of Asia, South America, and Africa. Due to many desirable traits like excellent fruit quality, immunity to Fusarium wilt it has proved better variety [1]. Very little information is available on effect of biofertilizers on Grand Naine banana Gaikwad et al. (2010). Calcium is an important secondary macro nutrient [2], which may be deficient in plants either due to low calcium in soil, low calcium availability due to high soil pH, and low mobility in the plants especially to the fruits [2]. Therefore, a continuous supply of calcium is required for leaf development, plant canopy, and vigorous root growth [3]. Thus, it's an important task to maintain the quantity of Mg in agricultural products within enough. Nitrogen and magnesium are considered important nutrients for growth, production, and fruit quality [4] and therefore needed in adequate amounts, especially at critical crop growth stages, and development [5]. Magnesium (Mg) is recognized as an essential nutrient for various living organisms including, plant species, and animals and as well as human beings and thereby its deficiency may cause the reduction in productivity and quality in agriculture (Hermans *et al.* 2004) and forestry (Mitchell *et al.* 1999). Magnesium is integral part of chlorophyll, photosynthesis, enzymes activator, building of nucleic acids, carbohydrate metabolism and stimulates phosphorus uptake and transport [4]. Magnesium deficiency proved negative effects on mulberry plants in an experiment performed by Tewari et al. [6].

2. MATERIALS AND METHODS

The present investigation was done to understand the effect of magnesium, calcium and different RDN doses on yield and quality of banana variety Grand Naine. The experiment was carried out at Horticultural Research Farm (HRF), Department of Horticulture, Naini Agricultural Institute SHUATS, Prayagraj, U.P., during 2022-23. The different combination doses of RDN and calcium and magnesium comprised of T_0 (Control); T_1 (RDN-NPK 100g+50g+225g /plant); T_2 (RDN + Magnesium 75 g/plant); T_3 (RDN + Magnesium 150 g/plant); T_4 (RDN + Calcium 150 g/plant); T_5 (RDN + Calcium 300 g/plant); T_6 (RDN + Magnesium 75 g/plant + Calcium 150 g/plant); T_7 (RDN + Magnesium 75 g/plant + Calcium 300 g/plant); T_8 (RDN + Magnesium 150 g/plant + Calcium 150 g/plant) and T_9 (RDN + Magnesium 150 g/plant + Calcium 300 g/plant); and replicated thrice. Observations were recorded at different stages of growth periods for characters like plant height (m); plant girth (cm); number of leaves per plant; number of suckers per plant; days taken to fruit harvest and many more. The data were statistically analysed by the method suggested by Fisher and Yates, 1963.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

Data from the Table 1 depicts the growth parameters observed for banana.

3.1.1 Plant height (m) and plant grith (cm)

The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75g and 150g /plant) have significant effect on plant height (m) as compared to control (T0). The maximum increased plant height (3.29 m) was found in treatment RDN + Calcium (150g /plant) which was at par withT3 RDN + Magnesium (150g /plant), T6 RDN + Magnesium (75g /plant) + Calcium (150g /plant), T8 RDN + Magnesium (150g /plant) + Calcium (150g /plant) and T9 RDN + Magnesium (150g /plant) + Calcium (300g /plant). Whereas the minimum plant height increased (2.16 m) was recorded in T0 Control. The data shown that soil application of different levels of calcium (150g and 300g /plant) and magnesium (75g and 150g /plant) have significant effect on plant girth (cm) as compared to control (T_0). The maximum increased plant girth (cm) (72.14) was found in treatment RDN + Calcium (150g /plant) which was at par with T_8 RDN + Magnesium (150g /plant) + Calcium (150g /plant). Whereas the minimum plant girth (cm) (48.43) was recorded in T0 Control. Manganese also plays an important role in synthesis of chlorophyll molecules which increases the photosynthesis and consequently plant growth Vikas et al. [7]. Sarkar et al. (2005) also found limited Ca translocation rates in potato plants in an *in vitro* culture. Since the transport of Ca in the xylem is dependent on plant transpiration, high air humidity in the in vitro environment can induce Ca deficiency in the aerial parts of micro propagated plants. It is probable that, among all macronutrients, Ca is most sensitive to problems in translocation, thereby impacting plant growth (White; Broadley, 2003). In our study, chlorosis was observed in mature leaves. This supports the rapid translocation of Mg from mature to younger plant parts; the visual symptoms of Mg deficiency therefore first appear in more mature leaves (Epstein; Bloom, 2005), in contrast to Ca, which accumulates in older organs due to its low mobility in the phloem (Malavolta, 2006). Stimulation of vegetative growth at higher rates of applied N has been reported earlier in banana Cv. Palayankodan in “Nendran” (Geetha and Nair, 2000). Adequate supply of N and K might have ensured optimal functioning of sucrose synthatase and suppression of hydrolytic enzymes leading to build up of greater quantity of sugars in proplastids. Calcium is an important nutrient that performs important role in the cell walls and cell membrane structure, fruit growth, development as well as general fruit quality. It enhances resistance to bacterial and viral diseases. Magnesium plays a key role in the growth and improvement of new cells and thus with the application of magnesium more growth is occur. These results are close to that of who stated that plant height increased with the foliar application of magnesium Chapagain & Menzies (2003).

3.1.2 Number of leaves per plant, number of suckers per plant and leaf area (m^2)

The data shown that soil application of different levels of calcium (150g and 300g /plant) and magnesium (75g and 150 g/plant) have significant effect on number of leaves /plant as compared to control (T0). The maximum increased number of leaves /plant (27.11) was found in treatment RDN + Calcium (150 g/plant) which was at par withT8 RDN + Magnesium (150 g/plant) + Calcium (150 g/plant). Whereas the minimum number of leaves/plant (14.22) was recorded in T0 Control. The data shown that soil application of different levels of calcium (150 and 300 g/plant) and magnesium (75 and 150 g/plant) have significant effect on number of suckers at harvest as compared to control (T0). The maximum increased number of sucker at harvest (9.13) was found in treatment RDN + Calcium (150 g/plant) which was at par with T3 RDN + Magnesium (150 g/plant), T6 RDN + Magnesium (75 g/plant) + Calcium (150 g/plant) and T8 RDN + Magnesium (150 g/plant) + Calcium (150 g/plant). Whereas the minimum number of suckers at harvest (4.20) was recorded in T0 Control. The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant effect on leaf area (cm2) as compared to control (T_0). The maximum increased leaf area (m^2) (10.19) was found in treatment RDN + Calcium (150g /plant) which was at par with T_8 RDN + Magnesium (150g /plant) + Calcium (150g /plant) and T_9 RDN + Magnesium (150g /plant) + Calcium (300g /plant). Whereas the minimum leaf area (m^2) (6.07) was recorded in T_0 Control. The uptake of calcium and magnesium increase at all stages of growth. Higher levels of nitrogen increased the uptake of Ca & Mg. The greatest respositories of calcium and magnesium were leaves, pseudo stem and corm. Upto shooting these two elements continued to enter every part of the plant [8]. The critical nutrient concentration of Ca in the leaf lamina of the third youngest leaf of banana as reported by Stover and Simmonds (1987) is 0.45%.

3.1.3 Length of inflorescence, days taken to flowering and days taken to first fruit harvest

The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant effect on length of inflorescence (cm) as compared to control (T_0). The maximum increased length of inflorescence (cm) (122.62) was found in treatment RDN + Calcium (150g /plant) which was at par with followed by T8 RDN + Magnesium (150g /plant) + Calcium (150g /plant), T6 RDN + Magnesium (75g /plant) + Calcium (150g /plant), T9 RDN + Magnesium (150g /plant) + Calcium (300g /plant) and T3 RDN + Magnesium (150g /plant). Whereas the minimum length of inflorescence (cm) (90.18) was recorded in T0 Control. The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant effect on days taken to flowering as compared to control (T_0). The minimum days taken to flowering (281.77) was found in treatment RDN + Calcium (150g /plant) which was at par with T_6RDN + Magnesium (75g /plant) + Calcium (150g /plant), T_8 RDN + Magnesium (150g /plant) + Calcium (150g /plant) and T_9 RDN + Magnesium (150g /plant) + Calcium (300g /plant). Whereas the maximum days taken to flowering (324.63) was recorded in T0 Control. The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant effect on days to taken fruit harvest as compared to control (T_0). The minimum days to taken fruit harvest (83.12) was found in treatment RDN + Calcium (150g /plant) which was at par with T_8RDN + Magnesium (150g /plant) + Calcium (150g /plant). Whereas the maximum days to taken fruit harvest increased (120.00) was recorded in T_0 Control. According to Prema [9] in banana the magnesium treatments failed to influence the vegetative characters as well as yield and yield characteristics. Significant effects were observed on days to flowering, plant height, number of leaves at flowering, leaf magnesium content, and yield in the highly weathered Puerto Rica soils and 25% yield increase was observed at the lowest magnesium increment relative to the control [10].

3.2 Yield Characters

Data from the Table 2 depicts the yield characters observed for banana.

3.2.1 Bunch weight (g), number of bunches per plant, number of fingers per hand, total number of fingers and finger weight of banana

The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant effect on bunch weight (kg) as compared to control (T_0). The maximum bunch weight (kg) (27.28) was found in treatment RDN + Calcium (150g /plant) which was at par with T_8 RDN + Magnesium (150g /plant) + Calcium (150g /plant). Whereas the minimum bunch weight (kg) (19.87) was recorded in T_0 Control. The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant effect on no. of hands bunch -1 as compared to control (T_0). The maximum no. of hands bunch -1 (10.80) was found in treatment RDN + Calcium (150g /plant)which was at par withT_3 RDN + Magnesium (150g /plant), T_5 RDN + Calcium (300g /plant), T_7 RDN + Magnesium (75g /plant)+ Calcium (300g /plant), T_8 RDN + Magnesium (150g /plant)+ Calcium (150g /plant), T_6 RDN + Magnesium (75g /plant)+ Calcium (150g /plant) and T_9 RDN + Magnesium (150g /plant)+ Calcium (300g /plant). Whereas the minimum no. of hands bunch -1 (9.06) was recorded in T_0 Control. The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant effect on No. finger per hand as compared to control (T_0). The maximum No. finger per hand (17.33) was found in treatment RDN + Calcium (150g /plant) which was at par withT_3RDN + Magnesium (150g /plant) andT_6RDN + Magnesium (75g /plant) + Calcium (150g /plant) . Whereas the minimum No. finger per hand (10.86) was recorded in T_0 Control. The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant effect on total number finger bunch as compared to control (T_0). The maximum total number finger bunch (187.31) was found in treatment RDN + Calcium (150g /plant) followed by T8 RDN + Magnesium (150g /plant) + Calcium (150g /plant), T6 RDN + Magnesium (75g /plant)+ Calcium (150g /plant), T9 RDN + Magnesium (150g /plant)+ Calcium (300g /plant) and T3 RDN + Magnesium (150g /plant). Whereas the minimum total number finger bunch (98.36) was recorded in T_0 Control. The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant

effect on finger weight (g) as compared to control (T_0). The maximum finger weight (g) (136.33) was found in treatment RDN + Calcium (150g /plant) followed by T8 RDN + Magnesium (150g /plant) + Calcium (150g /plant), T6 RDN + Magnesium (75g /plant) + Calcium (150g /plant), T9 RDN + Magnesium (150g /plant) + Calcium (300g /plant) and T3 RDN + Magnesium (150g /plant). Whereas the minimum finger weight (g) (102.52) was recorded in T_0 Control. Silva et al. [11] reported that there were no significant effects of Ca treatments on plant growth, fruit weight, fruit size distribution or most indices of fruit quality of pineapple. There was also a significant negative correlation between translucency index and extractable soil calcium, basal white and green D-leaf calcium, and fruit calcium. Fertilization with calcium increased fruit calcium levels and improved fruit storage life by reducing the incidence of internal browning associated with refrigerated storage [12].

3.2.2 Finger length, finger girth and fruit yield per plant

The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant effect on finger length (cm) as compared to control (T_0). The maximum finger length (cm) (22.87) was found in treatment RDN + Calcium (150g /plant) which was at par with T_8RDN + Magnesium (150g /plant) + Calcium (150g /plant). Whereas the minimum finger length (cm) (19.05) was recorded in T_0 Control. The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant effect on finger girth (cm) as compared to control (T_0). The maximum finger girth (cm) (15.20) was found in treatment RDN + Calcium (150g /plant) which was at par withT_3 RDN + Magnesium (150g /plant), T_6 RDN + Magnesium (75g /plant) + Calcium (150g /plant) and T_9 RDN + Magnesium (150g /plant) + Calcium (300g /plant). Whereas the minimum finger girth (cm) (13.06) was recorded in T_0 Control. The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant effect on fruit yield per plant (kg) as compared to control (T_0). The maximum fruit yield per plant (kg) (25.52) was found in treatment RDN + Calcium (150g /plant) which was at par with T_8RDN + Magnesium (150g /plant) + Calcium (150g /plant). Whereas the minimum finger girth (cm) (10.08) was recorded in T_0 Control. Plants growing with adequate Ca in their natural habitats have shoot Ca concentrations between 0.1 and 0.5% of dry weight. Ca is required for structural roles in the cell wall and membranes, as a counter-cation for inorganic and organic anions in the vacuole, and as an intracellular messenger in the cytosol. Calcium is required for cell elongation and cell division and plays a major role in the maintenance of membrane permeability [13]. Cleland et al. [14] reported that cell extension requires loosening of the cell wall, a process in which auxin induced acidification of the apoplast plays a role by replacing Ca2+ from the cross links of the peptic chain of the cell wall.

3.3 Quality Parameter

Data from the Table 3 depicts the quality characters observed for banana.

3.3.1 TSS [°Brix], vitamin C content (mg/100g), carbohydrate content (g/100g) calcium and magnesium content (g/100g)

The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant effect on TSS (°Brix) as compared to control (T_0). The maximum TSS (23.48°Brix) was found in treatment RDN + Calcium (150g /plant) which was at par with T_2 RDN +Magnesium (75g plant^{-1}), T_3 RDN + Magnesium (150g /plant), T_6 RDN + Magnesium (75g /plant) + Calcium (150g /plant) and T_8 RDN + Magnesium (150g /plant) + Calcium (150g /plant). Whereas the minimum TSS (20.31°Brix) was recorded in T_0 Control. The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant effect on Vitamin C as compared to control (T_0). The maximum Vitamin C (13.48) was found in treatment RDN + Calcium (150g /plant) Which was at par with T_1 RDN (NPK 100g+50g+225g /plant), T_6 RDN + Magnesium (75g /plant) + Calcium (150g /plant) and T_8 RDN + Magnesium (150g /plant) + Calcium (150g /plant). Whereas the minimum TSS (Brix0) (9.18) was recorded in T_0 Control. Tripathi and Shukla (2011) reported that in gooseberry the foliar application of calcium nitrate at 1.5% increased the TSS total sugar, ascorbic acid and reduced titratable acidity content of fruits as compared to the control. The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant effect on carbohydrates (g/100g)

Table 1. Influence of different treatment combinations of calcium and magnesium on growth parameters of banana

Treatment symbol	Treatment Details	Plant height (cm) at initial stage	Plant height (m) at harvest	Plant girth (cm) at initial stage	Plant girth (cm) at harvest	Initial number of leaves/ plant	Increased number of leaves/ plants	No of suckers/ plant at harvest	Leaf area (m^2)	Length of inflorescence (cm)
T_0	Control (No fertilizers)	77.14	2.16	20.84	48.43	3.94	14.22	4.20	6.07	90.18
T_1	RDN-NPK 100g+50g+225g /plant	87.18	2.44	28.61	53.33	4.90	16.00	5.78	7.16	91.59
T_2	RDN + Magnesium 75 g/plant	84.87	2.99	34.88	62.30	6.21	19.60	7.37	8.16	103.44
T_3	RDN + Magnesium 150 g/plant	86.57	3.09	36.60	64.59	7.27	22.19	8.02	8.64	109.29
T_4	RDN + Calcium 150 g/plant	103.66	3.29	42.50	72.14	8.85	27.11	9.13	10.19	122.62
T_5	RDN + Calcium 300 g/plant	80.52	2.89	33.91	59.43	5.55	18.35	6.96	7.84	96.24
T_6	RDN + Magnesium 75 g/plant + Calcium 150 g/plant	88.67	3.15	38.43	68.88	7.70	23.39	8.39	8.85	110.11
T_7	RDN + Magnesium 75 g/plant + Calcium 300 g/plant	80.46	2.70	31.75	57.43	5.18	17.25	6.36	7.69	94.01
T_8	RDN + Magnesium 150 g/plant + Calcium 150 g/plant	99.48	3.27	40.27	71.02	8.00	24.85	8.76	9.18	117.74
T_9	RDN + Magnesium 150 g/plant + Calcium 300 g/plant	85.52	3.03	25.55	63.86	7.80	23.10	7.57	8.35	106.26
F-Test		NS	S	NS	S	NS	S	S	S	S
SEd (±)		-	0.046	-	0.731	-	0.764	0.105	0.236	1.385
C.D. (at 5%)		-	0.097	-	1.537	-	1.606	0.221	0.495	2.911
C.V.		-	1.943	-	1.442	-	4.543	1.774	3.512	1.629

Note: RDN: Recommended doses of nutrients

Table 2. Influence of different treatment combinations of calcium and magnesium on yield parameters of banana

Treatment symbol	Treatment Details	Days taken to flowering	Days taken to fruit harvest	Bunch weight (kg)	No of hands /bunch	No of fingers per hand	Total number finger per bunch	Finger weight (g)	Finger length (cm)
T_0	Control (No fertilizers)	324.63	120.00	19.87	9.06	10.86	98.36	102.52	19.05
T_1	RDN-NPK 100g+50g+225g /plant	315.11	110.22	20.06	9.29	13.19	122.62	106.52	19.19
T_2	RDN + Magnesium 75 g/plant	308.55	97.59	22.10	9.52	15.48	147.32	117.27	20.02
T_3	RDN + Magnesium 150 g/plant	289.07	94.04	22.96	10.51	16.07	168.90	121.83	20.77
T_4	RDN + Calcium 150 g/plant	281.77	83.12	27.28	10.80	17.33	187.31	136.33	22.87
T_5	RDN + Calcium 300 g/plant	304.26	108.26	20.97	10.37	15.05	156.05	112.86	19.66
T_6	RDN + Magnesium 75 g/plant + Calcium 150 g/plant	286.40	91.97	23.83	10.62	16.90	179.53	124.51	20.86
T_7	RDN + Magnesium 75 g/plant + Calcium 300 g/plant	317.66	102.03	20.28	10.42	14.18	147.88	109.63	19.40
T_8	RDN + Magnesium 150 g/plant + Calcium 150 g/plant	285.44	87.07	26.06	10.69	17.14	183.17	130.61	22.08
T_9	RDN + Magnesium 150 g/plant + Calcium 300 g/plant	285.31	81.81	22.37	10.04	15.47	167.10	118.69	20.39
F-Test		S	S	S	S	S	S	S	S
SEd (±)		1.718	1.700	0.433	0.143	0.410	5.791	1.481	0.294
C.D. (at 5%)		3.608	3.572	0.909	0.300	0.862	12.167	3.112	0.617
C.V.		0.702	2.134	2.346	1.729	3.312	4.552	1.537	1.760

Note: RDN: Recommended doses of nutrients

Table 3. Influence of different treatment combinations of calcium and magnesium on quality parameters of banana

Treatment symbol	Treatment Details	Finger girth (cm)	Fruit yield per plant (kg)	TSS [°Brix]	Vitamin C content (mg/100g)	Carbohydrate (g/100g)	Calcium (mg/100g)	Magnesium (mg/100g)
T_0	Control (No fertilizers)	13.06	10.08	20.31	9.18	22.24	9.51	38.43
T_1	RDN-NPK 100g+50g+225g /plant	13.27	13.07	22.19	13.23	24.22	10.03	39.06
T_2	RDN + Magnesium 75 g/plant	13.92	17.28	23.07	12.45	25.12	10.18	40.06
T_3	RDN + Magnesium 150 g/plant	14.16	20.58	23.20	12.60	25.27	10.21	40.21
T_4	RDN + Calcium 150 g/plant	15.20	25.52	23.48	13.48	25.44	10.38	40.38
T_5	RDN + Calcium 300 g/plant	13.54	17.61	22.80	12.52	24.69	10.11	39.50
T_6	RDN + Magnesium 75 g/plant + Calcium 150 g/plant	14.33	22.35	23.26	13.02	25.30	10.30	40.29
T_7	RDN + Magnesium 75 g/plant + Calcium 300 g/plant	13.48	16.22	22.43	12.18	24.39	10.08	39.23
T_8	RDN + Magnesium 150 g/plant + Calcium 150 g/plant	15.08	23.92	23.34	13.17	25.37	10.34	40.34
T_9	RDN + Magnesium 150 g/plant + Calcium 300 g/plant	14.43	21.15	22.76	12.43	25.12	10.23	40.18
F-Test		S	S	S	S	S	S	S
SEd (±)		0.100	0.728	0.155	0.138	0.080	0.101	0.068
C.D. (at 5%)		0.210	1.530	0.325	0.290	0.169	0.213	0.142
C.V.		0.870	4.750	0.834	1.362	0.398	1.226	0.209

Note: RDN: Recommended doses of nutrients

as compared to control (T_0). The maximum carbohydrates (g /100g) (25.44) was found in treatment RDN + Calcium (150g /plant) Which was at par withT_2 RDN + Magnesium (75g /plant), T_3 RDN + Magnesium (150g /plant), T_6 RDN + Magnesium (75g /plant) + Calcium (150g /plant), T_8 (RDN + Magnesium (150g /plant) + Calcium (150g /plant) and T_9RDN + Magnesium (150g /plant)+ Calcium (300g /plant). Whereas the minimum carbohydrates (g /100g) (22.24) were recorded in T_0 Control. The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant effect on calcium (mg/100g) as compared to control (T_0). The maximum calcium (mg/100g) (10.38) was found in treatment RDN + Calcium (150g /plant) which was at par with T_1 RDN (NPK 100g+50g+225g /plant), T_2 RDN +Magnesium (75g /plant), T_5 RDN + Calcium (300g /plant). Whereas the minimum calcium (mg/100g) (9.51) was recorded in T_0 Control. The data shown that soil application of different levels of calcium (150 and 300g /plant) and magnesium (75 and 150g /plant) have significant effect on magnesium (mg/100g) as compared to control (T_0). The maximum magnesium (mg/100g) (40.38) was found in treatment RDN + Calcium (150g /plant) which was at par withT_2 RDN +Magnesium (75g /plant),T_3RDN + Magnesium (150g /plant),T_6RDN + Magnesium (75g /plant)+ Calcium (150g /plant) ,T_8RDN + Magnesium (150g /plant)+ Calcium (150g /plant) and T_9 (RDN + Magnesium (150g /plant)+ Calcium (300g /plant). Whereas the minimum magnesium (mg/100g) (38.43) was recorded in T_0 Control. Gerendas and Fuhrs [15] reviewed that increasing Mg supply on Mg deficient sites tends to increase the quality of agricultural crops, particularly when the formation of quality traits is dependent on Mg-driven photosynthesis and assimilate translocation within the plant. They also pointed that Mg doses beyond those required for maximum yield rarely induce a further improvement of produce quality [16-18].

4. CONCLUSION

Based on the findings of the experiment, it is concluded that RDN + Calcium (150g /plant) showed the highest plant height (3.29 m), plant girth (72.14 cm), number of leaves /plant (27.11), number of sucker at harvest (9.13), leaf area (10.19 m^2), length of inflorescence (122.62 cm), days taken to flowering (281.77), days to taken fruit harvest (83.12), bunch weight (27.28 kg), no. of hands/bunch (10.80), No. of finger per hand (17.33), total number of finger per bunch (187.31), finger weight (136.33 g), finger length (22.87 cm), finger girth (15.20 cm), fruit yield per plant (25.52 kg), TSS (23.48°Brix), Vitamin C (13.48 mg/100g), carbohydrates (25.44 g/100g), calcium (10.38 mg/100g) and magnesium (40.38 mg/100g). The maximum benefit cost ratio (3.56) was found in treatment RDN + Calcium (150g /plant).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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