Original Research Article

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

ABSTRACT

The present experimentwasconducted out during the 2022 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., (75 and 150g /plant) and Calcium viz., (150g and 300 g/plant).Based on the findings of the experiment, it is concluded that RDN + Calcium (150g /plant) showed the highest plant height (3.29), plant girth (cm) (72.14), number of leaves/plant (27.11), number of sucker at harvest (9.13), leaf area (cm^2) (10.19), length of inflorescence (cm) (122.62), days taken to flowering (281.77), days to taken fruit harvest (83.12), bunch weight (kg) (27.28), no. of hands/bunch (10.80), No. finger per hand (17.33),total number finger bunch (187.31), finger weight (g) (136.33), finger length (cm) (22.87), finger girth (cm) (15.20), fruit yield per plant (kg) (25.52), TSS (°Brix) (23.48), Vitamin C (13.48), carbohydrates (g /100g) (25.44), calcium (mg/100g) (10.38) and magnesium (mg/100g) (40.38).

Key words: RDN, Calcium, Magnesium, Production, Quality, Banana and Grand Naine (G-9)

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 (Singh and Chundawat, 2002). Very little information is available on effect of biofertilizers on Grand Naine banana Gaikwad *et al*. (2010). Calcium is an important secondary macro nutrient (Kadir, 2005), 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 (Kadir, 2005). Therefore, a continuous supply of calcium is required for leaf development, plant canopy, and vigorous root growth (Del-Amor and Marcelis, 2006). Magnesium deficiency proved negative effects on mulberry plants in an experiment performed by Tewari*et al*. (2006). 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 (Nguyen *et al.* 2016) and therefore needed in adequate amounts, especially at critical crop growth stages, and development (Alva *et al*. 2006).Magnesium(Mg)isrecognizedasanessentialnutrientforvariouslivingorganisms including, plant species, and animals and as well as human beings andtherebyitsdeficiencymaycausethereductioninproductivityandqualityinagriculture (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 stimulatesphosphorusuptakeandtransport(Nguyen*et al*, .2016). Magnesium deficiency proved negative effects on mulberryplants in an experiment performed by Tewari*et al.* (2006).

MATERIALAND METHODS

The present investigation was done to understand the effect of magnesium, calcium and different RDN doseson 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.Thedifferent combination doses of RDN and calcium and magnesiumcomprised 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 (cm); 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**.**

Table 1Influence of different treatment combinations of calcium and magnesiumon growth parametersof banana.

Treatment symbol	Treatment Details	Plant height (m) 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 2Influence 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 3Influence 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

RESULTS AND DISCUSSION

A) Growth Parameters

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

1. Plant height (cm)and Plant grith (cm)

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 plant height (m) as compared to control (T0). The maximum increased plant height (3.29) 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) 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 plant girth (cm)as compared to control (T_0). The maximum increased plant girth (cm) (72.14) was foundin 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)wasrecorded 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*. (2020). 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).

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 (150 and 300g /plant) and magnesium (75 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 onleaf area (cm2)as compared to control (T_0). Themaximum increased leaf area (m^2) (10.19) was found intreatment 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_0Control. 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 (Ragupathi*et al.*, 2002). 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. 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)andmagnesium(75and150g/plant)havesignificanteffectonlengthofinflorescence(cm)asc omparedtocontrol(T_0).Themaximumincreasedlengthofinflorescence(cm)(122.62)wasfoundintreatm entRDN+Calcium (150g /plant)which was at par with followed by T8 RDN + Magnesium (150g /plant) +Calcium(150g/plant),T6RDN+Magnesium(75g/plant)+Calcium(150g/plant),T9RDN + Magnesium (150g /plant) + Calcium (300g /plant) and T3 RDN + Magnesium (150g/plant). Whereas the minimum length of inflorescence (cm) (90.18) was recorded in T0Control. 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 toflowering as compared to control (T_0). Theminimum 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_8RDN+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 T0Control. The data shown that soil application of different levels of calcium (150 and 300g/plant) and magnesium(75 and 150g /plant) have significanteffect ondaysto takenfruitharvestas compared tocontrol (T_0). The minimum days to taken fruitharvest(83.12) was found in treatment RDN + Calcium (150g /plant) which was at par withT_8RDN + Magnesium (150g /plant) + Calcium (150g /plant). Whereas the maximumdaysto taken fruit harvestincreased(120.00)wasrecordedin T_0Control. AccordingtoPrema(1992)inbananathemagnesiumtreatmentsfailedtoinfluence the vegetative characters as well as yield and yield characteristics. Significanteffects 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(Martinez*et al.*, 2002).

Yield characters

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

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). Themaximum bunch weight (kg) (27.28) was foundin treatment RDN + Calcium (150g /plant) which was at par with T_8 RDN + Magnesium(150g/plant) +Calcium(150g/plant).Whereastheminimumbunchweight(kg)(19.87)was recorded inT_0Control. The data shown that soil application of different levels of calcium (150 and 300g/plant) and magnesium (75 and150g /plant) have significant effect on no. of handsbunch -1as compared tocontrol (T_0). Themaximum no. of hands bunch -1 (10.80) wasfound in treatment RDN + Calcium (150g /plant)which wasat 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_9RDN + Magnesium (150g /plant)+ Calcium (300g /plant). Whereas the minimum no.ofhands bunch -1(9.06)was recorded in T_0Control. 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 perhandascomparedtocontrol(T_0).ThemaximumNo.fingerperhand(17.33)wasfoundin treatment RDN + Calcium (150g /plant) which was at par withT_3RDN + Magnesium(150g /plant) andT_6RDN + Magnesium (75g /plant) +Calcium (150g /plant) . Whereastheminimum No. fingerperhand (10.86) wasrecordedin T_0Control. 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 numberfinger bunch as compared to control (T_0). Themaximum total numberfinger bunch(187.31) was found in treatment RDN + Calcium (150g /plant) followed byT8 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 totalnumberfinger bunch (98.36) was recorded in T_0Control. 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 intreatment 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).Whereastheminimumfingerweight(g)(102.52)wasrecordedin T_0Control. Silva *et al.* (2006) reported that there were no significant effects of Ca treatmentson plant growth, fruit weight, fruit size distribution or most indices of fruit quality ofpineapple. There was also a

significant negative correlation between translucency indexand extractable soil calcium, basal white and green D-leaf calcium, and fruit calcium.Fertilization with calcium increasedfruit calcium levels and improved fruit storage lifebyreducingtheincidenceofinternalbrowningassociatedwithrefrigeratedstorage(Herath*et al.,* 2000).

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 intreatment 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)wasrecorded in T_0Control. 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)ascomparedtocontrol(T_0). The maximumfingergirth(cm)(15.20)wasfoundintreatment 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_9RDN + Magnesium(150g /plant) + Calcium(300g /plant). Whereasthe minimumfinger girth (cm)(13.06)was recorded inT_0Control. 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 perplant (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 inT_0Control. PlantsgrowingwithadequateCaintheirnaturalhabitatshaveshootCaconcentrations between 0.1 and 0.5% of dry weight. Ca is required for structural roles inthe cell wall and membranes, as a counter-cation for inorganic and organic anions in thevacuole, and as an intracellular messenger in the cytosol. Calcium isrequired for cell elongation and cell division and plays a major role in the maintenance ofmembrane permeability (Fageria*et al.,* 1997). Cleland *et al.* (1990) reported that cellextensionrequireslooseningofthecellwall,aprocessinwhichauxininducedacidification of the apoplast plays a role by replacing Ca2+ from the cross links of thepepticchain of thecell wall.

Quality parameter

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

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) ascompared to control (T_0). The maximum TSS (23.48°Brix) was found in treatmentRDN + 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)andT_8 RDN+Magnesium(150g/plant)+Calcium(150g/plant).Whereasthe minimum TSS (20.31°Brix)wasrecorded in T_0Control. 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 ascomparedtocontrol(T_0).ThemaximumVitaminC(13.48)wasfoundin treatmentRDN + 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)andT_8 RDN+Magnesium (150g /plant) +Calcium (150g /plant). Whereas the minimum TSS (Brix0)(9.18)was recorded inT_0Control. Tripathi and Shukla (2011) reported that in gooseberry the foliar application ofcalcium nitrate at 1.5% increased the TSS total sugar, ascorbic acid and reduced titratableacidity content offruits as compared to thecontrol. The data shown that soil application of different levels of calcium (150 and 300g/plant)andmagnesium(75and150g/plant)havesignificanteffectoncarbohydrates(g/100g) as compared to control (T_0). Themaximum carbohydrates (g /100g)(25.44) wasfoundintreatmentRDN+Calcium(150g/plant)WhichwasatparwithT$_2$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). Whereastheminimum carbohydrates (g/100g)(22.24)wererecorded in T_0Control. The data shown that soil application of different levels of calcium (150 and 300g/plant)andmagnesium(75and150g/plant)havesignificanteffectoncalcium(mg/100g) as compared to control (T_0). The maximum calcium (mg/100g) (10.38) wasfound in treatment RDN + Calcium (150g /plant) which was at par withT_1RDN (NPK100g+50g+225g /plant), T_2 RDN +Magnesium (75g /plant), T_5 RDN + Calcium (300g/plant).Whereasthe minimumcalcium (mg/100g) (9.51)wasrecorded inT_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). Themaximum magnesium (mg/100g) (40.38)wasfoundintreatmentRDN+Calcium(150g/plant) whichwasatparwithT$_2$ 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)andT_9(RDN+Magnesium(150g/plant)+Calcium(300g/plant).Whereasthe minimummagnesium (mg/100g)(38.43)was recorded inT_0Control. Gerendas and Fuhrs (2013) reviewed that increasing Mg supply on Mg deficientsites tends to increase the quality of agricultural crops, particularly when the formation ofqualitytraitsisdependentonMg-drivenphotosynthesisandassimilatetranslocationwithin the plant. They also pointed that Mg doses beyond those required for maximumyield rarelyinduceafurther improvement ofproducequality.

Conclusion

Based on the findings of the experiment, it is concluded that RDN + Calcium(150g /plant) showed the highestplant 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), daysto taken fruit harvest (83.12), bunch weight (kg)(27.28), no. of hands/bunch (10.80),No.fingerperhand(17.33),totalnumberfingerbunch(187.31),fingerweight (136.33 g), finger length (22.87 cm), finger girth (15.20 cm), fruit yieldperplant(25.52 kg),TSS(23.48°Brix),VitaminC(13.48 mg/100g),carbohydrates(25.44 g/100g),calcium (10.38 mg/100g)

andmagnesium (40.38 mg/100g). Themaximum benefit cost ratio (3.56) was found in treatment RDN + Calcium (150g/plant).

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