Response of nitrogen and bio-fertilizers on growth and yield of banana cv. Grand Nain

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Abstract
Banana (Musa spp.) is one of the important fruit crops of the tropics. Higher productivity in banana is possible through improved planting material and nutritional management. The objective of experiment includes studying the response of various level of nitrogen and bio fertilizer on growth and yield parameters of banana. The experiment contains fifteen (15) treatment combinations with three replications laid out in a randomized block design with factorial concept. The treatment consists as three levels of nitrogen (100%, 80% and 60%) and five levels of bio-fertilizers (Azotobacter, Azospirillum, Rhizobium, 50% of Bi + 50% of B+ 50% of B and No bio-fertilizer (Control)). The treatment received 100% recommended dose of nitrogen (RDN) along with Azotobacter (20ml two times) noted positive reaction towards all growth parameters also significantly positive response to yield parameters i.e. weight of bunch (kg) number of hands per bunch, number of fingers per bunch, weight of third hand (kg), yield (t/ha).

Keywords: Banana, nitrogen, bio-fertilizer, growth and yield parameters

Introduction
Banana (Musa sp.) is an important fruit crop of the tropics. Banana, an antique fruit crop of the world is known as ‘Apple of the Paradise’ and botanically named as Musa spp. Banana is widely grown in many countries like India, Mexico, Philippines, Thailand, Kenya, Colombia, Brazil, China, Venezuela, Israel, South Africa, Bangladesh, Fiji, Hawaii, Indonesia, Taiwan, Sri Lanka, Cuba, Panama, Jamaica, Malaysia, West Indies and Australia. Banana is a heavy feeder of nutrients and thus need balanced nutrition for optimum growth and fruit production, and in turn potential yields. A deficiency or excess of nutrients can cause substantial damage to the plant. Studies have clearly demonstrated that, application of recommended dose of essential nutrients at appropriate growth stage is necessary for high productivity of banana (Pandey et al., 2005 and Thangaselvabai et al., 2009) [6, 9]. Bio-fertilizers play a very significant role in improving soil fertility by fixing atmospheric nitrogen both in association with and without plant roots. The use of bio-fertilizer is increasing day by day due to increase in the price of chemical fertilizers, its beneficial effect on soil health and increase in production of crop. However, information on the combined use of inorganic fertilizers and bio-fertilizers is limited. Generation of such information is of immense importance for switching over better fertilizer technology and to produce export quality bananas. In view of the paucity of information pertaining to the integrated nutrient management in banana under high density plantation, the present study on “Response of nitrogen and bio-fertilizers on growth, yield and quality of banana cv. Grand Nain” was planned.

Material and Methods
A field experiments was conducted during the year 2018-19 at Regional Horticulture Research Station, ASPEE College of Horticulture and Forestry, NAU, Navsari, Gujarat to study Response of nitrogen and bio-fertilizers on growth and yield of banana cv. Grand Nain. There were totally fifteen treatments in three replications which were laid out in randomized block design with factorial concepts. Each plot consisted rows of 2.4 m length with spacing of 1.8 m between rows. Recommended cultural practices were adopted for the cultivation of banana crop. Observations on growth parameters viz., pseudostem height (cm), pseudostem girth (cm), number of functional leaves per plant, leaf area (cm²), number of days to flowering, number of fingers per bunch, number of hands per bunch, weight of third hand (kg), yield (t/ha) and quality parameters such as color, firmness, size and texture of fruit were recorded.
days to harvest and total crop duration. While yield parameters viz., weight of bunch (kg) number of hands per bunch, number of fingers per bunch, weight of third hand (kg), yield (t/ha), finger length (cm) and finger girth (cm) were recorded at different stages of the crop.

Treatment details
The experiment was portrayed in Randomized blocked design with factorial concept along with two factors which are given in detail below

Factor-A Nitrogen level Factor-B Bio-fertilizers
D1: 100% RDN B1: Azotobacter (20 ml/plant)
D2: 80% RDN B2: Azospirillum (20 ml/plant)
D3: 60% RDN B3: Rhizobium (20 ml/plant)
D4: 40% RDN B4: 50% of B1 + 50% of B2 + 50% of B3
D5: No bio-fertilizer (Control)

Result and Discussion
Three levels of nitrogen (100% RDN, 80% RDN and 60% RDN) and Five different bio fertilizers 20 ml each (Azotobacter, Azospirillum, Rhizobium, 50% of B1 + 50% of B2+ 50% of B3 and No bio-fertilizer (Control)) were used. The interaction effect between nitrogen levels and biofertilizer were non-significant in all the growth characters observed during experiment and the best result was found in 100% RDN with Azotobacter (D1B1) treatment.

Effect of nitrogen levels and biofertilizers on Growth parameters
Data presented in Table-1 showed that application of different levels nitrogen along with biofertilizer influence on all the growth characters. It was noted that treatment combination D1B1 i.e. 100% RDN application along with 20 ml Azotobacter twice during the growth period of banana found better for all the parameters. Treatment combination D3B1 was noted non-significant result in all the growth characters i.e. pseudostem height, pseudostem girth, number of functional leaves per plant, leaf area and days to flowering, days to harvest and crop duration but higher value of growing characters (pseudostem height, pseudostem girth, number of functional leaves per plant, leaf area) and minimum days (days to flowering, days to harvest and crop duration) was registered in the same treatment. It may be due to we all known that banana is heavy feeder crop requiring large amount of nutrient. In this regard, banana plant treated with judicial application of 100% RDN i.e., 300 g N/plant utilized efficiently by plant and significantly influenced the pseudostem girth and number of leaf at 7 month after planting. Both are the important factors, because leaves are the structural size bearing photosynthetic machinery which assimilating maximum sunlight through leaf lamina and may utilized maximum efficiency of CO2 assimilation with primary productivity of C4H2O6. (El-Monlem and Radwan, 2003) [1]. Azotobacter has the capacity to accumulation of polyhydroxybutyric acid which gave rise to vegetative cell. Moreover, pigment production and activated enzymes are important characteristics of Azotobacter, which involves in protein synthesis and has direct effect on vegetative characters which were accordance with Kumar et al. (2009) [3], and Kumar et al. (2013) [4], in banana as well as Ram and Rajput (2000) [8], in guava.

Effect of nitrogen levels and bio fertilizers on Yield parameters
Data presented in Table-2 about effect of nitrogen levels and biofertilizers on yield parameters of banana i.e. weight of bunch, number of hands per bunch, number of fingers per bunch, weight of third hand, yield, finger length and finger girth were found significant when banana plants treated with different levels of nitrogen and biofertilizers yield parameters like weight of bunch, no of hand per bunch, weight of third hand and yield per hectare were noted significantly higher in 100% RDN along with twice application of Azotobacter (D1B1) as compare to other combination of nitrogen levels and biofertilizers. No. of finger per bunch, finger length and finger girth was found non-significant but maximum value of all these parameters recorded in D1B1: 100% RDN with Azotobacter (D1B1) treatment.

| Treatment | Pseudo stem height (cm) | Pseudo stem girth (cm) | No. functional leaves per plant | leaf area (cm²) | Days to flowering | Days to harvest | Crop duration |
|-----------|-------------------------|------------------------|-------------------------------|----------------|------------------|----------------|--------------|
| D1B1      | 118.23                  | 43.01                  | 14.42                         | 11.25          | 258.10           | 98.65          | 345.95       |
| D1B2      | 111.98                  | 39.35                  | 13.55                         | 10.95          | 270.43           | 104.33         | 357.25       |
| D1B3      | 110.42                  | 38.43                  | 13.00                         | 10.83          | 273.51           | 105.75         | 360.07       |
| D1B4      | 115.10                  | 41.18                  | 13.67                         | 11.08          | 264.26           | 101.49         | 351.60       |
| D1B5      | 99.48                   | 32.03                  | 12.00                         | 10.23          | 295.09           | 115.68         | 379.84       |
| D2B1      | 116.67                  | 42.10                  | 14.33                         | 11.17          | 261.18           | 100.07         | 348.77       |
| D2B2      | 108.85                  | 37.52                  | 13.09                         | 10.74          | 276.59           | 107.16         | 362.90       |
| D2B3      | 105.73                  | 35.69                  | 14.38                         | 10.57          | 282.76           | 110.01         | 368.54       |
| D2B4      | 113.54                  | 40.26                  | 12.92                         | 11.00          | 267.35           | 102.91         | 354.42       |
| D2B5      | 97.91                   | 31.12                  | 12.17                         | 10.14          | 298.17           | 117.10         | 382.66       |
| D3B1      | 107.29                  | 36.60                  | 13.08                         | 10.65          | 279.67           | 108.58         | 365.72       |
| D3B2      | 102.60                  | 33.86                  | 11.75                         | 10.40          | 288.92           | 112.84         | 374.19       |
| D3B3      | 101.04                  | 32.94                  | 12.25                         | 10.31          | 292.00           | 114.26         | 377.02       |
| D3B4      | 104.16                  | 34.78                  | 12.91                         | 10.48          | 285.84           | 111.42         | 371.37       |
Table 2: Effect of nitrogen levels and bio fertilizers on yield parameters banana

| Treatment | Weight of bunch (kg) | No. of fingers per bunch | No. of hands per bunch | Finger length (cm) | Finger girth (cm) | Weight of 3rd hand (kg) | Yield (t/ha) |
|-----------|---------------------|--------------------------|------------------------|-------------------|-----------------|-----------------------|-------------|
| D1B1      | 40.74               | 243.97                   | 14.04                  | 20.89             | 13.56           | 4.25                  | 111.81      |
| D1B2      | 37.89               | 236.99                   | 13.59                  | 20.22             | 12.94           | 4.09                  | 99.73       |
| D1B3      | 34.94               | 207.59                   | 13.27                  | 20.05             | 12.79           | 3.58                  | 98.51       |
| D1B4      | 38.45               | 225.85                   | 14.38                  | 20.56             | 13.25           | 3.75                  | 105.59      |
| D1B5      | 26.01               | 161.76                   | 10.06                  | 18.87             | 11.71           | 2.22                  | 73.64       |
| D2B1      | 40.75               | 239.25                   | 13.29                  | 20.72             | 13.41           | 4.43                  | 114.65      |
| D2B2      | 38.85               | 214.38                   | 12.75                  | 19.88             | 12.63           | 3.41                  | 108.86      |
| D2B3      | 30.75               | 214.16                   | 11.81                  | 19.55             | 12.33           | 3.07                  | 85.76       |
| D2B4      | 35.59               | 221.56                   | 14.16                  | 20.39             | 13.10           | 3.92                  | 99.47       |
| D2B5      | 24.94               | 162.21                   | 9.84                   | 18.71             | 11.56           | 2.06                  | 69.44       |
| D3B1      | 31.93               | 211.95                   | 12.42                  | 19.71             | 12.48           | 3.24                  | 88.88       |
| D3B2      | 28.22               | 180.71                   | 11.02                  | 19.21             | 12.02           | 2.73                  | 78.75       |
| D3B3      | 27.97               | 192.42                   | 10.70                  | 19.04             | 11.86           | 2.56                  | 76.32       |
| D3B4      | 29.91               | 213.09                   | 11.18                  | 19.38             | 12.17           | 2.90                  | 79.90       |
| D3B5      | 25.28               | 165.62                   | 9.97                   | 18.54             | 11.40           | 2.39                  | 68.62       |
| SEm±      | 1.63                | 11.82                    | 0.47                   | 0.83              | 0.64            | 0.16                  | 4.52        |
| CD@5%     | 4.72                | NS                       | 1.36                   | NS                | NS              | 0.46                  | 13.09       |
| CV%       | 8.60                | 9.93                     | 6.68                   | 7.25              | 8.85            | 8.77                  | 8.84        |

Conclusion
From foregoing research data base, banana plants treated with 100% recommended dose of nitrogen (RDN) along with Azotobacter (20ml per plant two times) noted positive response to growth parameters and yield like weight of bunch (kg) number of hands per bunch, number of fingers per bunch, weight of third hand (kg), yield (t/ha).

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