

Effect of bio-fertilizers on growth and yield of chilli (*Capsicum annuum* L.) cv Byadagi Dabba at different levels of nitrogen and phosphorus

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Abstract

Investigations were carried out to study the effect of nitrogenous and phosphatic bio-fertilizers along with different levels of nitrogen and phosphorus on growth and yield of chillies (*Capsicum annuum*) cv Byadagi Dabba. The maximum plant height, leaf area per plant and dry matter production per plant were in the treatment supplied with 75 % N, P plus 100 % K in addition to the inoculation of *Azotobacter*, *Azospirillum*, phosphate solubilizing bacteria (PSB) and vesicular arbuscular mycorrhiza (VAM). The plants inoculated with *Azotobacter*, *Azospirillum*, PSB and VAM along with 75 % N, P plus 100 % K produced more number of fruits per plant and higher yield of dry chillies. Application of bio-fertilizers along with reduced level of chemical fertilizers has beneficial effect compared to application of chemical fertilizers or bio-fertilizers alone.

Key words: *Azospirillum*, *Azotobacter*, *Capsicum annuum*, fertilizers, phosphate solubilizing bacteria, vesicular arbuscular mycorrhiza.

Chilli is one of the important spice crops of India earning annually over Rs. 250 crore foreign exchange (Balasubramaniam 2001). In India, it is grown over an area of 8.92 lakh hectares with a production of 8.8 lakh tonnes (Anon. 2000). Chilli fruits are rich in ascorbic acid and known for two important quality parameters, the biting pungency attributed to capsaicin and captivating red colour due to the pigment, capsanthin.

Vegetables inoculated with vesicular arbuscular mycorrhizal (VAM) fungi showed considerable increase in the growth and yield, because of improved uptake of phosphorus and other mineral nutrients particularly in phosphorus deficient soils (Bagyaraj & Sreeramulu 1982). Sriharibabu *et al.* (1988) recorded the highest green fruit yield (10.15 t ha⁻¹) in chillies with

combined application of VAM along with 50 per cent of phosphorus. *Azotobacter* and *Azospirillum* are also known to increase growth and yield of vegetable crops (Bashan *et al.* 1989; Hamedunnisa & Begum 1998). However, information on synergistic effect of various bio-fertilizers at different levels of chemical fertilizers is lacking. The present investigations were therefore undertaken to study the effect of bio-fertilizers at different levels of nitrogen and phosphorus on growth and yield of chilli variety Byadagi Dabba.

A field experiment was conducted on chilli cv Byadagi Dabba during *kharif* season of 1999 at University of Agricultural Sciences, Bangalore on red sandy loam soil, which was slightly acidic (pH 6.5), low in electrical conductivity (0.07 dsm⁻¹) and low in organic carbon content

(0.35%). The available nitrogen ($190.50 \text{ kg ha}^{-1}$), P_2O_5 (20.12 kg ha^{-1}) and K_2O ($108.32 \text{ kg ha}^{-1}$) were low. Fifteen nursery beds of 6 m length, 1 m width and 15 cm height were prepared. To each bed, 6 kg of FYM was evenly applied and mixed well and 100 g each of *Azotobacter*, *Azospirillum*, phosphate solubilizing bacteria (PSB) and 200 g of VAM were mixed with about 1 kg of FYM and applied to the beds (soil application) as per the treatment. Chilli seeds were sown in rows at 30 cm apart, covered with a layer of soil and watered regularly. Healthy and uniform seedlings (six weeks old) were transplanted in beds of 3 m x 2.75 m with a spacing of 60 cm between rows and 45 cm between plants. One seedling was planted per hill, resulting in 30 plants per plot. At the time of transplanting, 5 g each of *Azotobacter*, *Azospirillum* and PSB were applied to the soil in each plot as per the treatment combinations. Chemical fertilizers as per the treatment combinations were also applied at the time of transplanting. The fertilizer dose prescribed for chilli crop for Karnataka region is 100 : 50 : 50

kg N : P_2O_5 : K_2O per hectare. Nitrogen, phosphorus and potassium were applied in the form of urea, single super phosphate (SSP) and muriate of potash (MOP), respectively. The experiment consisted of 15 treatment combinations (Table 1 & 2) laid out in a Randomized Complete Block Design (RCBD) with three replications. The plots were irrigated as and when required and plant protection measures were undertaken as per the recommended package of practices (Anon. 1990).

Observations on vegetative growth parameters such as plant height, leaf area per plant and dry matter production per plant were recorded at 140 days after transplanting and yield attributes such as number of fruits per plant and dry fruit yield per plant were recorded and fruit yield per hectare were also estimated.

The data on growth and yield of chillies as influenced by bio-fertilizer inoculation and graded levels of chemical fertilizers are presented in Table 1 and 2, respectively. The vegetative as well as yield attributes were

Table 1. Effect of bio-fertilizers and graded levels of nitrogen and phosphorous on vegetative growth parameters in chilli cv Byadagi Dabba

| Treatment | Plant height (cm) | Leaf area plant ¹ (dm ²) | Dry matter production plant ⁻¹ (g) |
|--|----------------------|--|--|
| T ₁ - 100% NPK | 83.62 | 22.66 | 160.16 |
| T ₂ - 75% NP + 100% K | 82.68 | 21.61 | 131.53 |
| T ₃ - 75% N + PK + Azoto. | 85.16 | 23.08 | 160.28 |
| T ₄ - 75% N + PK + Azosp. | 86.40 | 23.46 | 161.79 |
| T ₅ - 75% N + PK + Azoto. + Azosp. | 88.68 | 24.31 | 168.98 |
| T ₆ - 75% P + NK +PSB | 83.80 | 23.36 | 166.44 |
| T ₇ - 75% P + NK + VAM | 84.31 | 23.43 | 167.86 |
| T ₈ - 75% P + NK + PSB + VAM | 84.32 | 24.70 | 169.25 |
| T ₉ - 75% NP + K + Azoto. + PSB | 90.31 | 24.59 | 167.17 |
| T ₁₀ - 75% NP + K + Azosp. + PSB | 91.44 | 25.02 | 167.43 |
| T ₁₁ - 75% NP + K + Azoto. + VAM | 93.70 | 24.66 | 167.82 |
| T ₁₂ - 75% NP + K + Azosp. + VAM | 94.82 | 25.49 | 168.20 |
| T ₁₃ - 75% NP + K + Azoto. + Azosp. + PSB + VAM | 100.03 | 28.79 | 187.36 |
| T ₁₄ - 100% NPK + Azoto. + Azosp. + PSB + VAM | 97.28 | 25.66 | 177.26 |
| T ₁₅ - Azoto. + Azosp. + PSB + VAM | 60.37 | 16.93 | 96.59 |
| F test | * | * | * |
| S. Em± | 0.69 | 0.69 | 5.18 |
| CD at 5% | 2.00 | 2.01 | 15.01 |

* Significant at 5 per cent. Azoto. - *Azotobacter*, Azosp. - *Azospirillum*, PSB - phosphate solubilizing bacteria, VAM - vesicular arbuscular mycorrhiza.

Table 2. Effect of bio-fertilizers and graded levels of nitrogen and phosphorus on yield of chilli cv Byadagi Dabba

| Treatment | No. of fruits plant ⁻¹ | Dry fruit yield plant ⁻¹ (g) | Dry fruit yield ha ⁻¹ (t) |
|--|-----------------------------------|---|--------------------------------------|
| T ₁ - 100% NPK | 81.68 | 70.33 | 1.56 |
| T ₂ - 75% NP + 100% K | 74.40 | 60.42 | 1.22 |
| T ₃ - 75% N + PK + Azoto. | 85.28 | 72.99 | 1.61 |
| T ₄ - 75% N + PK + Azosp. | 88.27 | 75.16 | 1.66 |
| T ₅ - 75% N + PK + Azoto. + Azosp. | 92.55 | 82.20 | 1.67 |
| T ₆ - 75% P + NK +PSB | 87.95 | 74.70 | 1.65 |
| T ₇ - 75% P + NK + VAM | 92.31 | 80.54 | 1.78 |
| T ₈ - 75% P + NK + PSB + VAM | 95.08 | 87.21 | 1.93 |
| T ₉ - 75% NP + K + Azoto. + PSB | 92.93 | 79.87 | 1.77 |
| T ₁₀ - 75% NP + K + Azosp. + PSB | 99.97 | 88.53 | 1.96 |
| T ₁₁ - 75% NP + K + Azoto. + VAM | 98.34 | 85.60 | 1.90 |
| T ₁₂ - 75% NP + K + Azosp. + VAM | 106.49 | 92.44 | 2.05 |
| T ₁₃ - 75% NP + K + Azoto. + Azosp. + PSB + VAM | 111.38 | 102.62 | 2.27 |
| T ₁₄ - 100% NPK + Azoto. + Azosp. + PSB + VAM | 106.50 | 94.86 | 2.10 |
| T ₁₅ - Azoto. + Azosp. + PSB + VAM | 55.28 | 45.71 | 1.06 |
| F test | * | * | * |
| S. Em+ | 1.67 | 1.55 | 0.03 |
| CD at 5% | 4.85 | 4.49 | 0.10 |

* Significant at 5 per cent. Azoto. - *Azotobacter*, Azosp. - *Azospirillum*, PSB - phosphate solubility bacteria, VAM - vesicular arbuscular mycorrhiza.

significantly influenced by the inoculation of various bio-fertilizers at different levels of nitrogen and phosphorus. The plants inoculated with *Azotobacter*, *Azospirillum*, PSB and VAM in combination with 75 per cent NPK plus 100 per cent K (T₁₃) recorded the maximum plant height (100.03 cm), leaf area (28.79 dm² plant⁻¹) and dry matter production (187.36 g plant⁻¹) as compared to the control, supplied with recommended NPK alone (T₁). The plants in the above treatments also produced 36 per cent more fruits per plant (111.38) and 45 per cent more dry fruit yield (2.27 t ha⁻¹) compared to the plants in the control (1.56 t ha⁻¹). However, the inoculation of bio-fertilizers alone (T₁₅) resulted in lesser dry fruit yield (1.06 t ha⁻¹) compared to the control (T₁).

Improved growth and yield parameters in plants treated with bio-fertilizers were due to enhanced uptake of nutrients by the plants (Borea 1991). *Azotobacter* and *Azospirillum* aid in increased plant growth due to their nitrogen

fixing capacity and also they are known to produce growth promoting substances like IAA and GA (Jackson & Brown 1966). VAM fungus increases the plant growth by increasing P uptake and other minor elements like Zn, Cu and Mn (Borea 1991). Further VAM are known to influence the water uptake (Tinker 1975). PSB are able to solubilise the insoluble form of phosphorus and make it easily available to plants.

Combined application of bio-fertilizers had recorded the maximum dry fruit yield than in individual inoculation at different levels of inorganic fertilizers. It may be due to the synergistic interaction effect between all the four bio-fertilizers. The improvement in growth and yield due to the application of bio-fertilizers either singly or in combination has been reported in tomato (Mohandas 1987), chilli (Sreenivasa & Krishnaraj 1992) and bell pepper (Murumkar & Patil 1996). The results of the present investigation are also in agreement with these findings.

Based on the results obtained from the present study, it can be concluded that the application of *Azotobacter*, *Azospirillum*, PSB and VAM along with 75 per cent NP plus 100 per cent K of the recommended dose resulted in better growth and produced the maximum dry fruit yield compared to other combinations. Hence this combination of fertilizers can be recommended for commercial cultivation of chilli cv Byadagi Dabba.

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