# Effect of Bio-Fertilizers on Growth, Yield and Quality of Buckwheat

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## Abstract

*Buckwheat is an important medicinal plant which is used in pharmaceutical industries. A pot experiment was conducted to study the effect of bio-fertilizers on growth, yield and quality of buckwheat (Fagopyrum esculentum Moench) at K.R.C.C.H college of Arabhavi as information available is very meager in this aspect. The design followed was Completely Randomised Design with 11 treatments and 3 replications. There was significant difference among all the treatments. At 45 days after sowing, significantly superior plant height (100.33 cm), number of branches (10.67), number of leaves (71), leaf length (8.57 cm) and leaf breadth (9.01 cm) and herb yield (57.67 q/ha) were observed in the treatment $T_{11}$ (RDF - 50:40:40 kg NPK/ ha, FYM-20 q/ha) however, $T_{10}$ - A. chroococcum + A. brasilense + VAM + P. striata+ Trichoderma harzianum have also shown good result, next to RDF. Maximum bacterial population (139 x $10^6$), fungi (111.00 x $10^3$), actinomycetes (81.33 x $10^4$) were obtained in the treatment $T_{10}$ (A. chroococcum + A. brasilense + VAM + P. striata + Trichoderma harzianum). Higher population of Azotobacter chroococcum (184.33 x $10^3$) was found in the treatment $T_1$ (Azotobacter chroococcum -375 g/ ha, Seed treatment). Higher number of Azospirillum brasilense (214.66 x $10^3$) was observed in $T_2$ (Azospirillum brasilense -375 g/ ha, seed treatment). Maximum population of Pseudomonas striata (204.00 x $10^3$) was obtained in the treatment $T_5$ (Pseudomonas striata-375 g/ ha, seed treatment), Trichoderma harzianum (43.33 x $10^3$) was found in $T_4$ (Trichoderma harzianum-1.5% soil drench). Higher root colonization (95.33%) is observed in $T_3$ (VAM-25kg/ha, soil application). Maximum number of chlamydospores (1308.66) was recorded in $T_3$. As bio-fertilizers are eco-friendly and helps in maintaining the harmony with the nature, at the same time helps to obtain higher yields with higher productivity.*

## *Introduction*

Buckwheat (*Fagopyrum esculentum,* Moench, 2n=16) belongs to the Polygonaceae family, in Hindi, it is called as "Kutu". Temperate Central Asia is reported to be the origin of this plant. Buckwheat is a herbaceous annual plant of 50-55 days crop duration that grows to a height of 80-160 cm. In Europe, Russia, USA and France it constitutes one of the main food crops. In India, it is grown as a grain crop in the higher altitudes (600-3650 m) of the Himalayas and in Nilgiris (Bhairab, 1999).

Buckwheat contains rutin, it occurs in 3-6% of its dry weight. It is a flavonol present in the seeds, cotyledon, leaf, stem and flower (Dipak and Ranbir, 2002). Buckwheat is used for medical reasons in gluten free-diet for celiac diseased patients, and in alleviation of some specific diseases. The rutin is reported to be beneficial in treating conditions characterized by capillary bleeding and increased capillary fragility, in preventing haemorrhagic diseases. With the growing importance of rutin as a medicine to treat the harmful effects of X-rays, it is used for persons exposed to dangerous atomic radiations (Farooqi and Sreeramu, 2004).

## *Material and Methods*

The pot experiment was carried out in the division of plantation, Spices, Medicinal and Aromatic Crops, K. R. C. College of horticulture, Arabhavi during 2013-2014. The experiment was laid out in Complete Randomised Design with 11 treatments and 3 replications.

**Sowing of Seeds**

The earthen pots were selected for the experiment and they were filled with the potting mixture containing 1:1:1 proportion of sand, soil and Farm Yard Manure before 15 days of sowing. Five seeds were sown in individual pots, where three pots were maintained for individual treatments. They were sown on 4$^{th}$ December, 2014.

**Seed Treatment with Bio-Fertlizers**

Culture of *Azospirillum brasilense, Azotobacter chroococcum, Pseudomonas striata* were applied as seed treatment. Bio-fertlizer culture suspension was prepared by using 375 g/ha of *azotobacter chroococcum, Azospirillum brasilense, Pseudomonas striata* and mixed in water at a ratio of 1:2 and with adding jaggary which acts as sticker. Then the seeds were shade dried overnight and then were used for sowing.

**3.4.1.7 Application of Trichoderma Harzianum**

*Trichoderma harzianum* was applied @ 1.5 per cent as drench.

**3.4.1.8 Inoculation with AM Fungus**

AM fungus, *Acaulophora laevis* was used. Five grams of inoculum was applied per seed before sowing.

## *Results and Discussions*

Growth and yield parameters (Table-1) differed significantly at all the stages of crop growth. Plant height (100.33 cm), number of branches per plant (10.67), number of leaves per plant (71), leaf length (8.53 cm), leaf breadth (9.01 cm), herb yield (57.67 g/pot) recorded maximum with the application of RDF - 50:40:40 kg NPK/ ha, FYM-20 q/ha ($T_{11}$), however, $T_{10}$ - *A. chroococcum* + *A. brasilense* + VAM + *P. striata*+ *Trichoderma harzianum* have also shown good result, next to RDF.

This increasing trend in morphological parameters might be due to recommended dose of fertilizer , could be attributed to the quick and readily availability of major nutrients like N, P and K to plants at earlier stages of plant growth. The results obtained in the present investigation are in agreement with earlier findings of Rana *et al*. (2005), Campbell and Gubbels (1978) in buckwheat, Snezana *et al.*, 2012 in buckwheat. However the organic treatment (VAM + Panchagavya + Amritpani-3% Drench and Spray) has also shown better result, this might be due to the reason that, their built up beneficial soil microbial population in the rhizosphere, increased plant residue decomposition and mineralization with the help of mulching, regular addition of bio-formulations especially by the synergetic effect both drench and spray of panchagavya and amritpani have lead to the effective supply of nutrients. The results obtained in the present investigation are in agreement with earlier findings of Rajamani *et al.* (2007) in turmeric, Das *et al.*, 2007 in stevia and Bassanagowda, 2005 in Mango.

**Table 1: Growth and Yield of Buckwheat at 45 Days after Sowing**

| **Treatments** | Plant height (cm**)** | Number of branches | Number of leaves | leaf length (cm) | leaf breadth (cm) | Herb yield (q/ha) |
|---|---|---|---|---|---|---|
| $T_1$ - *Azotobacter chroococcum* (375 g/ ha, Seed treatment) | 77.66 | 6.67 | 28.00 | 6.46 | 6.55 | 32.67 |
| $T_2$ - *Azospirillum brasilense* (375 g/ ha, Seed treatment) | 76.00 | 6.00 | 36.00 | 7.00 | 6.55 | 34.33 |
| $T_3$ -Vescicular Arbuscular Mycorrhiza (VAM-25kg/ha, soil application) | 82.69 | 8.33 | 59.00 | 6.83 | 7.20 | 42.67 |
| $T_4$ - *Trichoderma harzianum* (1.5% Soil drench) | 86.34 | 7.67 | 53.33 | 6.43 | 7.13 | 46.00 |
| $T_5$ - *Pseudomonas striata* (375 g/ ha, Seed treatment) | 79.30 | 8.00 | 34.33 | 7.06 | 6.73 | 40.00 |
| $T_6$ - *Azotobacter chroococcum* + *Azospirillum brasilense* | 81.15 | 8.00 | 43.33 | 6.96 | 7.55 | 46.00 |
| $T_7$ - *A. chroococcum* + *A. brasilense* + *P. striata* | 84.41 | 7.67 | 54.00 | 7.06 | 6.97 | 47.33 |
| $T_8$ - VAM + *P. striata* | 91.22 | 10 | 64.67 | 7.73 | 8.05 | 48.00 |
| $T_9$ - *A. chroococcum* + *A. brasilense* + VAM + *P. striata* | 92.26 | 10.33 | 68.67 | 7.33 | 8.64 | 47.33 |
| $T_{10}$ - *A. chroococcum* + *A. brasilense* + VAM + *P. striata* + *Trichoderma harzianum* | 93.00 | 10.67 | 70.00 | 7.93 | 8.97 | 51.00 |
| $T_{11}$ - RDF (50:40:40 kg NPK/ ha, FYM-20q/ha) | 100.33 | 10.67 | 71.00 | 8.53 | 9.01 | 57.67 |
| Mean | 85.85 | 8.55 | 52.94 | 7.22 | 7.58 | 44.82 |
| S.Em± | 0.90 | 0.43 | 0.91 | 0.11 | 0.15 | 1.65 |
| CD @ 1% | 3.59 | 1.74 | 3.65 | 0.43 | 0.63 | 6.58 |

**Table 2: Enumeration of Total Count of Bacteria, Fungi and Actinomycetes from the Buckwheat Soil after Crop Harvest**

| **Treatment** | **Bacteria No. X $10^6$ CFU/ g of soil** | **Fungi No. X $10^3$ CFU/ g of soil** | **Actinomycete No. X $10^4$ CFU/ g of soil** |
|---|---|---|---|
| $T_1$ - *Azotobacter chroococcum* (375 g/ ha, Seed treatment) | 73.50 | 61.33 | 38.33 |
| $T_2$ – *Azospirillum brasilense* (375 g/ ha, Seed treatment) | 65.33 | 65.33 | 32.00 |
| $T_3$- Vescicular Arbuscular Mycorrhiza (VAM-25kg/ha, soil application) | 53.50 | 67.33 | 25.66 |
| $T_4$ - *Trichoderma harzianum* (1.5% Soil drench) | 76.50 | 70.00 | 20.66 |
| $T_5$ - *Pseudomonas striata* (375 g/ ha, Seed treatment) | 65.00 | 36.00 | 43.66 |
| $T_6$ - *Azotobacter chroococcum* + *Azospirillum brasilense* | 70.00 | 98.00 | 54.66 |
| $T_7$ - *A. chroococcum* + *A. brasilense* + *P. striata* | 101.00 | 82.00 | 52.00 |
| $T_8$ - VAM + *P. striata* | 105.33 | 106.33 | 70.33 |
| $T_9$ - *A. chroococcum* + *A. brasilense* + VAM + *P. striata* | 122.33 | 105.00 | 75.33 |
| $T_{10}$ - *A. chroococcum* + *A. brasilense* + VAM + *P. striata*+ *Trichoderma harzianum* | 139.00 | 111.00 | 81.33 |
| $T_{11}$- RDF (50:40:40 kg NPK/ha, FYM-20q/ha) | 48.00 | 78.00 | 36.66 |
| Mean | 83.59 | 80.03 | 48.23 |
| S.Em± | 1.84 | 1.18 | 0.62 |
| CD @ 1% | 7.33 | 4.72 | 2.50 |

**Table-3: Isolation of Inoculated Microorganisms from the pots of Buckwheat (Fagopyrum Esculentum Moench)**

| **Treatment** | ***Azotobacter Chroococcum* No. X $10^4$ CFU/ g of soil** | ***Azospirillum Brasilense* No. X $10^4$ CFU/ g of soil** | ***Pseudomonas striata* No. X $10^4$ CFU/ g of soil** | ***Trichoderma harzianum* No. X $10^4$ CFU/ g of soil** |
|---|---|---|---|---|
| $T_1$ - *Azotobacter chroococcum* (375 g/ ha, Seed treatment) | 184.33 | 14.66 | 13.33 | 6.66 |
| $T_2$ - *Azospirillum brasilense* (375 g/ ha, Seed treatment) | 16.00 | 214.66 | 13.66 | 6.00 |
| $T_3$ -Vescicular Arbuscular Mycorrhiza (VAM- 25 kg / ha, soil application) | 19.00 | 16.66 | 15.00 | 6.00 |
| $T_4$ - *Trichoderma harzianum* (1.5% Soil drench) | 19.33 | 14.00 | 16.33 | 43.33 |
| $T_5$ - *Pseudomonas striata* (375 g/ ha, Seed treatment) | 20.33 | 15.33 | 206.00 | 4.33 |
| $T_6$ - *Azotobacter chroococcum* + *Azospirillum brasilense* | 172.6 | 147.00 | 15.66 | 7.33 |
| $T_7$ - *A. chroococcum* + *A. brasilense* + *P. striata* | 142.66 | 131.00 | 14.00 | 5.66 |
| $T_8$ - VAM + *P. striata* | 13.66 | 17.33 | 173.33 | 7.00 |
| $T_9$ - *A. chroococcum* + *A. brasilense* + VAM + *P. striata* | 123.66 | 116.66 | 136.66 | 5.66 |
| $T_{10}$ - *A. chroococcum* + *A. brasilense* + VAM + *P. striata* + *Trichoderma harzianum* | 104.00 | 90.66 | 99.00 | 26.66 |
| $T_{11}$ - RDF (50:40:40 kg NPK/ ha, FYM- 20q/ha) | 16.33 | 17.33 | 17.00 | 5.33 |
| Mean | 75.62 | 72.29 | 65.45 | 11.26 |
| S.Em± | 3.28 | 2.77 | 2.41 | 0.94 |
| CD @ 1% | 13.08 | 11.07 | 9.61 | 3.77 |

Statistically superior bacterial population (139 x $10^6$), fungi (111.00 x $10^3$), actinomycetes (81.33 x $10^4$) (Table -2) were obtained in the treatment $T_{10}$ *(A. chroococcum* + *A. brasilense* + VAM + *P. striata* + *Trichoderma harzianum*). *Azotobacter chroococcum* (184.33 x $10^3$) was found statistically superior in the treatment $T_1$ - *Azotobacter chroococcum* -375 g/ha, Seed treatment). Higher number of *Azospirillum brasilense* (214.66 x $10^3$) was observed in $T_2$ *(Azospirillum brasilense* -375 g/ ha, seed treatment). Maximum population of *Pseudomonas striata* (204.00 x $10^3$) was obtained in the treatment $T_5$ *(Pseudomonas striata*-375 g/ ha, seed treatment), *Trichoderma harzianum* (43.33 x $10^3$) was found in $T_4$ *(Trichoderma harzianum* -1.5% soil drench). These findings are in agreement with, Maragatham and James, 2010, the population of *Azospirillum*, Phosphobacteria, *Pseudomonas* and VAM were higher because of the increase in microbial load due to application of bio-inoculants and Srivatsava and Gobind, 2007 in gladiolus.

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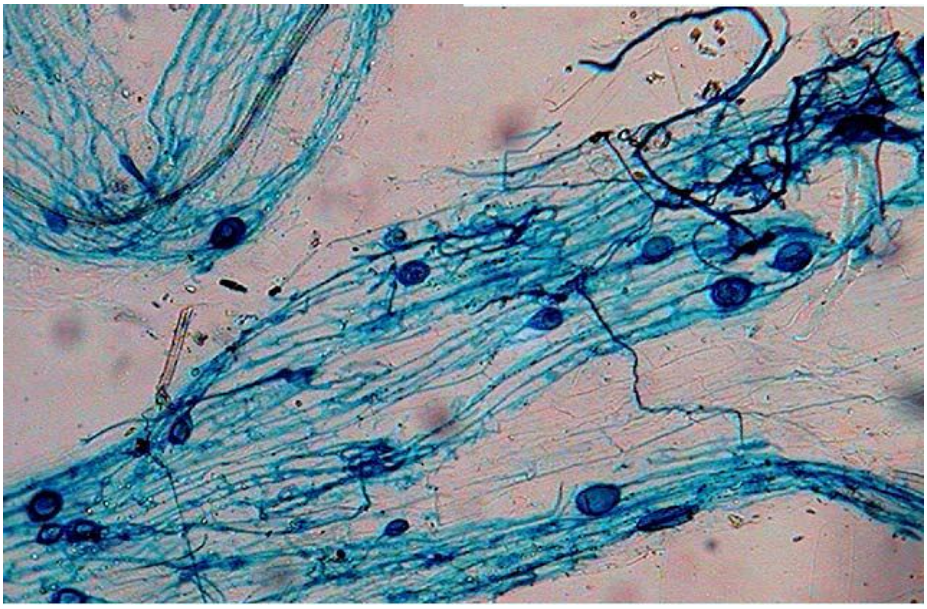
**General View of the Experimental Site**


**$T_{11}$ = RDF (50:40:40 kg NPK/ ha, FYM-20q/ha)**


**$T_{10}$ = (VAM + Panchagavya + Amrit pani-3% Drench and Spray), on par with the RDF**



**Buckwheat Root colonization by VA mycorrhizal fungus *Acaulophora laevis***