

Effect of bio-fertilizers on bio-chemical and macronutrients of barley seeds

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ABSTRACT

A study was conducted with seeds of barley, *Hordeum vulgare* to elucidate the effect of bio-fertilizers, applied individually and in conjunction on bio-chemical parameters such as total nitrogen, total protein, total soluble carbohydrates and total lipid contents and macronutrients like calcium, iron and phosphorus under pot culture conditions. A Positive and significant results were obtained by different biofertilizer treatments as compared to their respective controls. Application of *Azotobacter* showed significant increase in total nitrogen, crude protein, carbohydrate and lipid contents of seeds, whereas *Azospirillum* significantly increased calcium and iron contents of barley seeds. Combined treatment (*Azotobacter*+ *Azospirillum*+ *Phosphate Solubilizing Bacteria*) also increased seed's total nitrogen, crude protein, iron, calcium and phosphorus contents as compared to the control.

Key words : *Azospirillum*, *Azotobacter*, *Phosphate Solubilizing Bacteria*, *PSB*, *Barley*, Bio-fertilizers, Macronutrient, *Hordeum vulgare*.

INTRODUCTION

Barley, (*Hordeum vulgare*) is one of the only vegetation on the earth that can supply sole nutritional support from birth to old age. Barley has served as a staple food in most cultures. The use of barley for food and medicinal purposes dates to antiquity. Agronomists place this ancient cereal grass as being cultivated as early as 7000 BC. Roman gladiators ate barley for strength and stamina. Outstanding amounts of vitamins and minerals are found in green barley leaves. When barley leaves are 12-14 inches high, they contain many vitamins, minerals, and proteins necessary for the human diet, along with chlorophyll. These are easily assimilated throughout the digestive tract, giving our bodies instant access to vital nutrients. These include potassium, calcium, magnesium, iron, copper, phosphorus, manganese, zinc, beta-carotene, vitamin B₁, B₂, B₆, C, along with folic acid, and pantothenic acid. Escalation of fertilizer prices, leads to integrated nutrient supply approach, more remunerating for getting high returns with

considerable fertilizer economy and better health. Biofertilizers have attracted greater attention particularly in developing countries like India as a substitute for costly chemical fertilizers. Biofertilizers like *Azotobacter*, *Azospirillum*, *Phosphate Solubilizing Bacteria* (i.e. *PSB*) are known to improve nutrient status of plants either by way of fixation or by making fixed nutrient available to plants. But up till now, precise role of biofertilizers in supplementing nutritional requirement of barley seeds has not been documented. Therefore, an attempt has been made to study various nutrients and chemical entities in barley seeds as affected by the treatment of different biofertilizers.

MATERIALS AND METHODS:

Only 100 gm of soaked barley (*Hordeum vulgare*) seeds were mixed with 1mg/gm of selected bio-fertilizers (manufactured by *International Panacea Ltd.* New Delhi) and the effect of following treatments were studied in triplicates.

T₀- Uninoculated (control)
 T₁- Treatment with *Azotobacter*
 T₂- Treatment with *Azospirillum*
 T₃- Treatment with *PSB*
 T₄- Combined treatment with all the above three bio-fertilizers.

The seeds were dried in shades and sown in pots having sandy loam garden soil. The representative soil sample was analyzed in Regional Soil Testing Laboratory, Bilwa, Bareilly (U.P) and was found to contain: -

Available Nitrogen - 60kg/ha
 Available Phosphorus - 197.50kg/ha
 Available potassium in kg/ha - very low
 Organic matter - 0.23 %
 Soil had the pH - 7.36

Only 15 seeds were sown in each pot and after emergence of seedlings thinning was done by allowing only 10 plants per pot to grow. Seeds obtained after ripening were subjected to chemical analysis. Following methods were employed for

analysing chemical parameters.

- Total nitrogen by conventional micro-Kjeldahl method.
- Protein by multiplying N-values with 6.25 (Sadasivam and Manickam, 1992).
- Ether extractable lipid content by Soxhlet extraction procedure using petroleum ether.
- Magnesium by Atomic Absorption Spectrometer (AS-4139).
- Calcium and Phosphorus content was estimated as calcium and ammonium phosphomolybdate respectively.
- Data thus obtained were subjected to statistical analysis as per procedure outlined by Panse and Sukhatme (1976).

RESULTS AND DISCUSSION

The results of the effect of different biofertilizers on various metabolites and macronutrients composition of barley seeds along with their controls are presented in Table 1.

Table - 1: Effect of different biofertilizers on various biochemical and macronutrients composition of barley seeds {% on dry matter basis}

| Treatment | Total Nitrogen | Crude Protein | Total Carbo. | Total Lipid | Ca* | Fe* | P |
|-------------------|----------------|---------------|--------------|-------------|---------|---------|---------|
| T ₀ | 1.526 | 9.512 | 86.532 | 1.838 | 0.359 | 2.669 | 0.206 |
| T ₁ | 1.658** | 10.362** | 86.987 | 1.668 | 0.399** | 3.154** | 0.299** |
| T ₂ | 1.529 | 9.454 | 87.328** | 1.471 | 0.305 | 2.764 | 0.225 |
| T ₃ | 1.532 | 9.079 | 86.904** | 2.443** | 0.316 | 3.012 | 0.265 |
| T ₄ | 1.663** | 10.393** | 86.864 | 1.521 | 0.389** | 3.311** | 0.298** |
| CD at 5% (P=0.05) | 0.1244 | 3.6605 | 1.0076 | N.S | 0.982 | 1.3860 | 0.1651 |

* Values in mg/100gm; remaining parameters values in percentage on dry matter basis.

** Significant values

Total nitrogen and crude protein content

They showed similar variations against all treatments. The values of total nitrogen / crude protein in combined and *Azotobacter* treatment were significantly higher than that of control. However, *Azospirillum* and *PSB* did not produced favourable results. Biochemical and macronutrient attribute showed enhancement due to single and

combined inoculations. This was also supported by the work of Arthur and Kowlis, 1993 and Nath *et al.*, 2002. The increased N-uptake by plant may be due to increased P-uptake which might in turn enhanced the activity of NAD dependent enzyme which contribute to nitrate reductase activity (Trappe and Fogel, 1977).

Lipid content:

The oil content of barley seeds showed no regular response to different biofertilizer applications. However the application of PSB increased the oil content of barley grains and the value 2.443 % obtained was significantly higher than control. The results are in close conformity with findings of Sharma and Namdeo (1999) and Kumar *et al.* (2000) on soybean.

Carbohydrate content

Carbohydrate content was found to be significantly higher in Azospirillum and PSB treatments with respect to control in barley seeds, recording highest 87.328% in Azospirillum treatment. The result stands corroborated by findings of Shafeek *et al.* (2004) and Baktash *et al.* (2003).

Calcium content

Barley seeds treated with different bio-fertilizers had irregular effect on its calcium content. Azotobacter treatment recorded maximum value (0.399%) of calcium content, whereas Azospirillum treatment gave lowest value (0.305%). Azotobacter and PSB treatment showed a significant positive response. The better uptake of calcium in the said treatment can be attributed to higher nodulation and symbiotic nitrogen fixation, thus, making plant roots more efficient to absorb nutrients and ultimately improved uptake. The results are in concordance with findings of Rajendran and Devaraj (2004).

Iron content

The combined and Azotobacter biofertilizer treatments showed significantly higher values

against their respective controls. Although other biofertilizer treatments recorded higher values on the basis of means but statistically these values were non- significant. It seems that the combined treatment leads to changes in iron content when compared with the plants inoculated with any single biofertilizer. Similar findings were also reported by Rodelas *et al.* (1999).

Phosphorus content

The results clearly indicated that all the treatments of biofertilizer increased the phosphorus content of barley seeds. Azotobacter and combined treatments showed maximum and significantly higher values at 5% critical level. Similar findings were also reported by Rajendran and Devaraj (2004).

It is evident from foregoing discussion that the selected bio-fertilizers produced positive effect on the chemical spectrum (macro-nutrient) of seeds of barley. Single treatment of Azotobacter resulted in significant increase in total nitrogen, crude protein, calcium, iron and phosphorus contents; Azospirillum significantly increased total carbohydrate content only, PSB treatment increased seed's lipid profile and total carbohydrate contents and combined treatment showed significant increase in total nitrogen, crude protein, calcium, iron and phosphorus as compared to their respective control. Best response was achieved by combined treatment < Azotobacter < Azospirillum < PSB < control. Therefore it can be inferred from the said trial that a balanced and judicious use of these bio-fertilizers had a favourable effect on the nutritive value of barley seeds.

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