Research Article

Effects of enhancers with biofertilizer on the better Wheat (*Triticum aestivum)* growth

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ABSTRACT:

Pot experiments were conducted with the objective to evaluate the effect of different fertilizers and fertilizer amendments on growth of wheat plant and soil properties. Seeds were treated in different combinations of biofertilizer with urea and neem-coated urea. Combined application of biofertilizer with urea gave highest results for growth properties such as shoot and root fresh weight, dry weight, yield and yield attributes. For soil phosphorus and potassium content combined application was most beneficial while for Nitrogen content application of urea and neem coated urea was most effective. Application of biofertilizer in combination with urea increased the efficiency of applied nitrogen fertilizer as it shows increase in NPK content of soil. Amendment of biofertilizer with urea could compensate for nutrient deficiency and higher rates of chemical N fertilization.

Key words: Biofertilizer; neem; urea; wheat.

1. INTRODUCTION

India, being an agronomic country, exerts continuous pressure on the crop production and soil fertility. One of the major essential nutrients for the growth of plants is Nitrogen and is required in large quantities. Nitrogen is provided in the form of chemical fertilizers [1]**.** Increased use of chemical fertilizers and agrochemicals cause adverse effects on soil as well as on human health. Biofertilizers will be cost-effective and environment friendly alternative for the same and can help to reduce the use harmful chemicals and improve the soil quality [2]**.**

Biofertilizer as a substance containing living microorganisms which, when applied to seed, plant surfaces, or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant [2]**.** *Azotobacter* being a diazotroph is able to fix atmospheric nitrogen in the soil and will serve as means for enhanced plant growth and grain yields of cereals. Yasari et al [3] revealed that *Azotobacter* can be used successfully for cultivation of most crops.

Wheat (*Triticum spp.*) is a cereal grain and is second most produced cereal after rice in India. About 10-11% of the world wheat area and production is in India [2]**.**Sundstøl et al [4] exhibited the use of chemical fertilizer (urea) on the increased yield and nutritive content of wheat. Globally use of chemical fertilizers especially urea has been on rise. International fertilizer demand for urea is said to be increasing from 149.1 metric tonnes in 2014 to 155.53 metric tonnes in 2016 with annual increase of almost 3% every year [5]. Neem has been traditionally used as an active bio-pesticide in India since the vedic times [6] and has

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been proven [7]. It has also been shown to act as an effective antimicrobial agent by Rajasekaran et al. [8].

Here we studied the comparative effects of different fertilizers and fertilizer combinations on growth, yield and yield components of Wheat. The impact of applied fertilizer on soil quality, its contribution in plant growth and development will be determined using different quantitative microbial and chemical analysis methods.

2. MATERIALS AND METHODS

2.1. Experimental procedure and treatments

Pot experiments were conducted at the research farm of biofertilizer plant of Krishak Bharti Cooperative Limited (KRIBHCO), Surat, India. The site is situated at 21˚18' N latitude, 72˚69' E longitude, and has a semi arid environment.

Wheat (*Triticum aestivum*) variety "Bhaliya" was used as a test crop to investigate the effects of fertilizers supplemented with Urea, Biofertilizer, Urea+ Biofertilizer, Neem coated urea and Neem coated urea+Biofertilizer. Untreated pot is kept as a control, Six treatments are as follows: T1-Control, T2-Urea, T3-Urea+Biofertilizer, T4-Biofertilizer, T5- Neem coated urea + Biofertilizer, T6-Neem coated urea. Pots were filled with 12 kg of soil (incorporated with Vermicompost) obtained from a fallow field nearby the research farm.

2.1.1. Seed sterilization

Uniform-sized seeds were surface sterilized in ethyl alcohol 70% (for 3min), sodium hypochlorite 3% (for 3min) with subsequent rinsing (six times) with sterile water and air dried [9].

2.1.2. Fertilizer application

Azotobacter biofertilizer was obtained from Krishak Bharti Cooperative Limited (KRIBHCO), Hazira, Surat. Surface sterilized seeds were soaked in biofertilizer solution (1h) [9], air dried and sown immediately (n=8) in pots. The pots were regularly irrigated to maintain a proper moisture level of approximately 60% water holding capacity of the soil. Each pot was supplemented with manufacture directed amount of urea (3g/pot) and equal volume of neem coated urea after 15 days of germination (to protect seedlings).

2.2. Plant growth analysis

After 50 days of sowing, two plants from each pot were uprooted, with minimal damage to the root system, washed gently under running water and separated from the shoots, oven dried for three days at 70˚C. Total root and shoot lengths, and their fresh and dry weight were recorded[10]. Chlorophyll content of leaves were determined (Sadasivam and Manickam 1996)**, s**pikelet length and grain yield/plant were also recorded before final harvest.

2.3. Soil chemical analysis

Soil samples were collected from each pot and oven dried at 72˚C for 24 hrs.Organic carbon content was determined by Walkley and Black method [11]. Soil sample (1g) was added to 1N $K_2Cr_2O_7$ (10 ml) and mixed with concentrated H_2SO_4 (20 ml). Mixture was allowed to react for 30 min, 200 ml of demineralised water was added with corresponding controls. 10ml of concentrated orthophosphoric acid was added followed by 0.5ml of diphenylamine sulphonate indicator solution and titration was carried out by rapidly adding 0.5N $FeSO_4$ until the colour flashes from blue to green.

Total nitrogen content was determined by Kjeldahl method (Pisces, KJELPRO series). (The Fertilizer Control Order 1985, as amended upto November 2013). 10 g soil sample was added with 3.0 g K_2SO_4 and 0.3g $CuSO_4$, 15 ml concentrated H_2SO_4 was digested at 420˚C for 20 min. Distillation was then performed, cool the sample and titrated against 0.02N HCl until the colour change.

Orthophosphate was determined colorimetrically by the molybdophosphate method. [18]. 100 ml sample was added with 1 ml of 30% H_2SO_4 and 4 ml $(NH_4)_2MoO_4$ solution; 5 ml of 1-amino-2-naphthol-4-sulphonic acid (Amino solution) was

added and then it was kept for 30 min along with respective blank using 100 ml demineralised water. Absorbance was determined at 650 nm.

Potassium content was determined by Flame photometric analysis [19]. Using Flame Photometer (Systronic, 1986) and 10ppm standard potassium solution, controls were set. Then samples were diluted and aspirated into flame photometer and readings were recorded.

3. RESULTS

3.1. Growth characteristics

Different Nitrogen (N) treatments, applied alone or in combination with biofertilizer, increased shoot length, shoot fresh weight and shoot dry weight (Figure 1). Root characteristics, i.e. length, fresh weight and dry weight, as well as leaf surface area and chlorophyll content exhibited a higher response to N application compared to control. Treatments T3 and T6 exhibited maximum increase while T5 showed moderate increase in shoot length while treatment T5 showed decreased root length than all the treatments in comparison to control T1. Treatment T3 exhibited highest increase in shoot and root fresh and dry weight while treatment T5 showed average increase in fresh weight in comparison to T1 (Figure 1). Treatments T4 showed highest increase while T2 and T6 exhibited medium content of chlorophyll (Figure 1); treatment T3 showed highest while T5 showed medium increase in leaf surface area (Figure 1).

3.2. Yield and yield attributes

Grain yield and spikelet length were significantly affected by the use of biofertilizer combined with chemical fertilizers (Figure 1d). Highest yield and yield components are observed in plants treated with biofertilizer with urea compared to the sole application of chemical or biofertilizer.

3.3. Changes in soil properties

Soil analysis showed that the highest carbon content was present in soil treated with biofertilizer alone (T4).

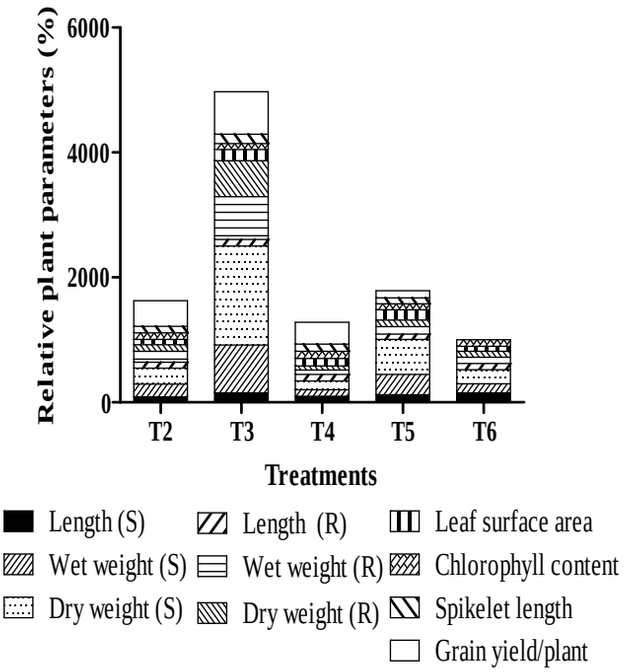

Figure 1: Relative plant parameters (in percentage with respect to control). Length, Dry and wet weight of the plant shoot and root, Spikelet length and Grain yield, and Leaf characteristics (surface and cholophyll) in the treatment systems – T2-Urea, T3-Urea+Biofertilizer, T4-Biofertilizer, T5- Neem coated urea + Biofertilizer, T6-Neem coated urea.

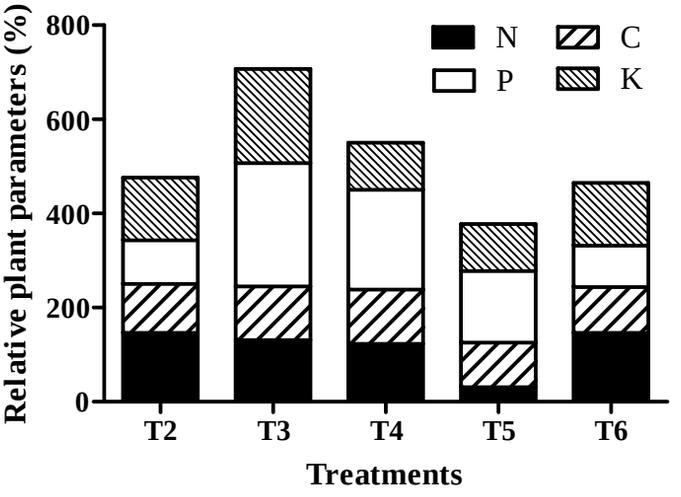

Figure 2: Soil nutritiveness. Total Nitrogen (N), Carbon (C), Phosphorus (P), and Potassium (K) content in the treatment systems T2-Urea, T3-Urea+Biofertilizer, T4-Biofertilizer, T5- Neem coated urea + Biofertilizer, T6-Neem coated urea with respect to the Control system (T1)

The total Kjeldahl nitrogen was found to be highest in soil treated with urea (T2) and neem coated urea (T6) (Figure 2). Soil K content showed a similar response to different amendments, but results suggests that not marked but some difference exist in K content of soil treated with biofertilizer with urea (T3) (Figure 2). The soil used in this experiment was fairly poor in available P but higher P content was observed in soil treated with biofertilizer with urea when compared with control (Figure 2).

4. DISCUSSION

Crop management decisions require the knowledge of stage of development of the crop. In particular, spring fertilizers applications, herbicides, fungicides, growth regulators are typically applied at specific stages of plant development. Knowledge of stages is also interesting to identify periods of higher risk, in terms of climate. Several systems exist to identify crop stages, with the Feekes and Zadoks [12] scales being the most widely used. Each scale is a standard system which describes successive stages reached by the crop during the agricultural season. Tummaramatti and Hegde [13] stated that *Azotobacter* produce variety of growth promoting substances & vitamins similar to PGPR.

Application of Biofertilizer alone (T4) did not result in a significant growth increase when compared with control (T1). However, plants treated with biofertilizer in combination with urea (T3) exhibit comparatively higher growth rates. Similarly application of urea and neem coated urea in T2 and T6 treatments respectively increase growth characters when compared with control. But application of neem coated urea to plants grown from biofertilizer treated seeds shows decreased growth characters (T5). Using biofertilizer *Azospirillum brasilense* [14], showed the increased growth of wheat varieties.

Use of Livestock manure has been reported previously [15] for increased grain yield and plant length. Iruthayaraj [16] reported the excellent plant growth promotion activities by *Azotobacter* resulting in increase in cotton yield (15-28%) attributing to the N_2 fixation, antibacterial and antifungal activity, production of growth regulators and siderophore. The use of urea with biofertilizer in our studies and studies using 1:1 amount of urea and poultry manure reported by Abbasi & Yousra [9] increased the yield and plant length significantly. Different biofertilizers have been reported with 2-6% increase in yield when applied in combination with 50% NPK.

The biofertilizer-microbial activities can be attributed to the increased carbon and least nitrogen content in the respective soils. Abbasi & Yousra [9] showed that highest total N content was obtained after treatment with poultry manure & biofertilizer. Increased phosphate solubilisation was seen in soils treated with biofertilizer with urea. Eleiwa et al., [17] revealed that effective microorganisms can be used as biofertilizers to prevent environmental pollution and to ensure public health & sustainable agriculture.

Above results clearly indicate that improved growth characteristics were obtained for plants treated with fertilizers but higher growth rate will be achieved when biofertilizer was applied in combination with urea.

5. CONCLUSION

Addition of enhancers like urea, neem coated urea and their combination increased the biofertilizer's capability with respect to control. Addition of biofertilizer increased soil nutritiveness comparatively higher than most of treatments suggesting the ability of biofertilizers in influencing the crop cycles along with the plant growth. The integrated approach for plant growth promotion with the use of herbal extracts is environmentally safe and can be used in future for encapsulation of potential biofertilizers with chemical enhancers.

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