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EFFECT OF BIOFERTILIZER AND CHEMICAL FERTILIZER ON WHEAT CROPS

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ABSTRACT

Bio-fertilizer has increased the yield element of wheat significantly. Results from the present study indicated that the yield and growth of wheat; have been affected by inoculation with *Azotobacter*; as these Bio-fertilizers can fix soil nitrogen. Seed invested with *Azotobacter* has salutary goods in the soil and also increases the growth and yield of wheat by 5.30%. As a result, Bio-fertilizers can be recommended for the sake of achieving the loftiest quality product. The traits plant height, plant weight could be used for selection of Better yield. The compared result indicated that in the combination of Bio-fertilizer + Chemical fertilizer treatment, good yield was recorded.

In Modern Agriculture chemical fertilizers degrade the fertility of soil making it infelicitous for raising crop plants. In addition the intensive use of these inputs led to severe health and environment hazards similar as soil erosion, water impurity and fungicide poisoning. Bio-fertilizers naturally spark the microorganism set up in the soil, being cheaper, effective and environment friendly. The biofertilizers are gaining importance for their use in crop production, restoring the soil's fertility and protection against soil condition and therefore stimulate plant growth.

In this study it was found that the combined operation or the single use of Bio-fertilizers can considered as beneficial for the growth and yield of wheat.

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INTRODUCTION

Wheat (*Triticum aestivum* L) is the alternate most important cereal crop of India and plays a vital part in food and nutritive security of the country. Nearly 55 Percent of world's population depends on wheat for about 20% of calories input.
Wheat is an periodic lawn growing to between ½ and 1 ¼ meter in height, with a long stalk that terminates in tightly formed cluster of rotund kernels. It is grown all over the world for its largely nutritious value. Wheat grain is one of the three top most produced crop along with corn and rice. It is used in production of chuck, biscuit, feeds, confectionary etc. This crop has been cultivated for over 10,000 years presumably, originates in Fertile Crescent, along with other staple crops.

Types of Wheat

Wheat are classified on the basis of species, marketable types, growth habits. Grounded on these, there are sixteen species, two marketable type: bread (*Triticum aestivum*) and macaroni or Durum wheat (*Triticum Durum*) and three growth habits (Winter habit, Winter spring, downtime facultative Wheat).
Scientific Names of wheat: *Triticum* Spp.
Major cultivated species of wheat

1. Common Wheat (T. *aestivum*):- a hexaploid species that is most extensively cultivated in .the whorls.
2. Durum *(T. Durum*):- The only tetraploid form of wheat extensively use today and the second most cultivated wheat.
3. Einkorn (*T. monococcum*):- A diploid species with wild and cultivated variant some cultivated at the same time.
4. Emmer *(T. Dicoccum*):- A tetraploid species cultivated in ancient times but no longer in wide spread use.
5. Spelt (*T. Spelta*):- Another hexaploid species cultivated in limited quantities.

Origin and History

Wheat is being cultivated since pre major times from all possible record, it seems that its centre of origin is south Western in Asia. It is believed that Aryans brought wheat grains to India. According to be condole the wheat was began in the Eupharated and Valilov (1950). After expansive studies came to the conclusion that the origin of the whole group of *durum* (kathiya) wheat probably in the region of Abyssina where as the whole group of soft wheat which includes bread wheat, presumably began in the region of Pakistan, South Western Afganistan and the Southern part of mountainous Bokhara.

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Significance of wheat:

Wheat is one of the chief foods of north India population. Wheat grain are ground in to flour and consumed substantially in the form of Chapatti or leavened Bread. Soft Wheat is used for making Chapatti bread, Cutlet, Biscuits, Pastry and other Bakery product.

Whereas hard wheat is used for manufacturing rawa, Suji and sewaya. In areas where rice is a staple food grain , wheat is also eaten in the form of puri etc. It is also used for making cakes and sweet refection. Wheat grain is used for manufacturing starch. When straw is used as fodder and padding material.

India's Global position Crop species

Presently, India is the second largest patron of wheat in the world after china with about 15 % share in total world's wheat production. presently India is superior in wheat production and in a position to export. Three species of wheat named

(i) T. Aestivum

(ii) T. Durum

(iii) T. Diococcum

Nutrition Value

Wheat is used by human in form of making Chapatti, Semolina and Pasta product etc. Wheat contains about 70% carbohydrates, 12% Proteins 1.7% fats, 2.7% fiber and 12% humidity.

Quality Parameter

The parameters considered important for determining wheat quality are the Grain, Protein content, B-Carotene content, Hectoliter weight, Sedimentation value, humidity Content, Gluten (Wet, Dry and Gluten, index), Grain Hardeners

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index/appearance, Test weight, Alkaline water retention capacity and yellow berry prevalence.

Hard wheat (*T. aestivum)* with high gluten content are the main quality demand for bread making, for biscuit products. Low protein with weak gluten content found in *diococcum* variety of wheat or soft wheat used for Chapatti making. Medium to high protein and medium gluten is needed for hard type of wheat (*T. Durum*), High protein with high B-carotene content are required for Pasta and traditional product making.

The Indian bread or aestivum wheat & pasta or durum wheat types posses low amount of grain iron (27-55 ppm) & Zinc (25-50ppm) thus there is a demand of enhancing the iron Zinc and micronutrient content in wheat through bio-fertification with an aim of developing bio-fortified wheat. Numerous cultivators or genotype have been linked or developed for cultivation through the implementation of appropriate parentage strategies, some promising cultivators lately recognized for best quality and nutritive parameters as given table below –

Climatic condition

Wheat is substantially grown during Rabi season and has wide rigidity. It can grown not only in the tropical and sub-tropical zone but also in the temperate and cold tracts. Wheat can tolerate severe cold & snow and resume growth in warm weather. It can be cultivated from sea level to an attitude of 3300 measures.

The most favorable climate condition for wheat cultivation is cool & wettest weather during the regenerative growth and bear warm weather for grain to mature and grow. The optimum temperature for ideal germination of wheat seed is 20-25 °C. Warm and damp climatic condition are not suitable for wheat growth.

During the title and flowering stages, excessively high or low temperature may be dangerous to wheat. Cloudy weather with Brazil has a long history of research with inoculants and it is impossible not to mention the fundamental role that great researchers such as Johanna Döbereiner and João Ruy Jardim Freire played in this scenario. According to Döbereiner, the soybean crop has become a highlight in the Brazilian agricultural panorama, with the use of nitrogen fertilization being entirely dispensed, due to the joint work of microbiologists and breeder moisture and low temperature cause rust attack. Wheat plant require about 25-30 °C optimum temperature at the time of grain stuffing and development. Temperature above 25 ° C during this period tend to depress grain weight. The congential Temperature for different growth stages of wheat crop.

Bio-fertilizer: salutary bacteria are *Azotobacter, Azspirillium, Mycorrhiza* which are essential in crop production. And gaining more importance for utilization in crop production or restoring the soil fertility. Keeping in the view of dangerous effects of chemicals like DAP on agriculture production following objective is taken for this study:

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Objectives:-

- To exploit the microbial diversity in various agro-ecologies for biofertilizer application in diversified systems.
- To study the impact of soil operation practices on microbial functions and soilhealth.
- To improve biofertilizer technology to ensure high quality and better delivery.
- To diversify biofertilizer exploration and application in drylands, degraded soilsand ethnical areas.

REVIEW OF LITERATURE

History:

The history on the study of bio fertilizers started in 1895, when Nobbe and Hiltner in laboratory made a culture of Rhizobia and launched it with the name of ‒Nitagrin‖ (Singh et al. 2019). Likewise *Rhizobia*, *Azotobacter*, Blue-green Algae and *Azospirillum* were also discovered. In India N.V Joshi began to study about Rhizobium symbiotic relationship with legume plants as bio fertilizer, In India during the ninth five-year plan, Ministry of agriculture set up National Project on Development and usage of Bio-fertilizers and spread the idea of Bio-fertilizer in India. In India most generally used biofertilizer are *Rhizobium*, *Azotobactor*, Blue-green Algae and *Azolla*, phosphate solubilizing biofertilizer (Javorekova et al. 2015, Rao et al. 2015).

The first studies in Brazil with rhizobia of agricultural interest took place in the state of Rio Grande do Sul to select strains for clover (*Trifolium* spp.) and alfalfa (*Medicago sativa*) crops intended for livestock production. In the early 1960s, when soybean (*Glycine max* (L.) Merr) production started its expansion in Brazil, the industry of rhizobia-based products also followed the same trend (Santosh et al. 2019). Brazil has a long history of research with inoculants and it is impossible not to mention the fundamental role that great researchers such as Johanna Döbereiner and João Ruy Jardim Freire played in this scenario. According to Döbereiner, the soybean crop has become a highlight in the Brazilian agricultural panorama, with the use of nitrogen fertilization being entirely dispensed, due to the joint work of microbiologists and breeder (Etesami et al. 2018, Maheswari et al. 2018).

With agriculture becoming increasingly more intense and technological, pesticide use has increased significantly over the last two decades. This increase in the amount of agrochemicals has also caused an increase in residues, which have been identified in various environments (Kumar et al. 2014, Maurya et al. 2014). Pesticide and fertilizer contamination of soil and water has become a large concern at local, regional, and global scales.

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Biofertilizer:

Bio-fertilizers are the sum of everything like plant extract, manure and dead remain of plant etc. Bio-fertilizer is a substance that usually contain different micro organism, which fixes the nitrogen or substantially solubilize phosphors and potassium present in the upper sub caste of soil which also called as rhizosphere, these micro organisms increase the introductory nutrient in the soil and stimulate the growth of plant. They increase the productivity of crop without harming the environment. Their phosphate solubilizing and nitrogen fixing capacity can fix upto 40Kg nitrogen per acre (Jha and Subramanian et al. 2016, Kumar et al. 2016). Bio-fertilizer may also be defined as microbial innoculant which is made instinctively to divide the natural micro organism present in the soil to improve the fertility and productivity of the soil. Different microorganism like bacteria, algae and fungus help as a Bio-fertilizer and fix or solubilize different element present in soil. Bio fertilizers approach pose lots of such benefits from an profitable, social & environmental points of view (Dotaniya et al. 2016).

Types of Biofertilizers:

(1) Bacteria as Bio-fertilizer:

Azotobacter is used as Bio-fertilizer since greater than 100 years in 1901. Martine Beijernick explained that *Azotobactor* belongs to *Azotobacteraceae* family and its class is Gamma-Proteabacterin which generally can be found in ormal soil across the world. It is the most delved species of *Azotobacter*. These are generally big in size & have a oval shape (about 3um wide & 10 um long) This bacteria is gram –ve in Nature and produce pigment of various colour like reddish violet, yellowish green & brownish black. *Azotobacter* can fix atmosphere nitrogen in the free-living state without symbiotic association with any other plant (Mazid et al. 2011).

Azotobacter releases auxin or indol -3 acetic acid (IAA) on the addition of tryptophan into the medium. Some of the other hormones like Gibberellins and cytokinnin are also produced by bacteria. These hormones help the plant root to expand in width which eventually helps in plant growth. Use of *Azotobacter* as bio-fertilizer revealed that the dry weight of some plant increased upto great extent (Garcha and Maan et al. 2017).

Nitrogen fixation is a veritably important biological or natural activity and it maintains the nitrogen balance in the atmosphere. Eventually, it reclaim the nitrogen on earth surface. Nitrogen fixation help in enhancement of soil fertility and crop product. Azotobacter can convert the Nitrogen present in atmosphere into ammonia which is taken up by plants. Azotobacter can fix up to 20KgN/ha/Yr (Franche et al. 2008). Siderophore are a group of iron (Fe) chelating molecules that help the plant

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from pathogen attack and help the plant to grow faster.

(2) *Azospirilum* as Bio-fertilizer:

Azospirillum as a Bio-fertilizer is used since more than 43 years. In 1978 Johanna Dobereiner discovered it with his fellows. *Azospirillum* belong to *Azospirillanceae* family and it belongs to the class Alpha Proteo bacteria. It is a gram –ve bacteria which is twisted and rod in shape (Kennedy et al. 2004). It is a chemo organotroph in nature. It is substantially set up in roots of corn, Sugarcane rice, wheat etc. Rearmost two species were discovered are *A. thiphilum* and *A.picis.*

Azospirillum is a very good plant growth enhancing rhizobacteria because it has the capability to fix the nitrogen and also release phytochemicals which help in plant growth. It has capability to solubilize the phosphate and it produces siderophore (Rroco et al. 2003). *Azospirillum* like other bacteria also release physiochemicals which are necessary for plant growth. It release some phyto-hormone like auxin, gibberellin, cytokinnin, abscise acid, ethylene and Nitrogen dioxide. It also solubilize the insoluble phosphate present in the soil with the help of enzyme like phosphatases. *Azospirillium* produces many different types of organic acid which helps to solubilizing further phosphate in soil.

(3) Fungi as Bio-fertilizer:

Mycorrhiza as Bio-fertilizer – *Mycorrhiza* fungi play a crucial part in the growth and development of plant. It can enhance the quality of plant to a higher extent in stress condition. *Arbuscular Mycorrhizas fungi* (AMF) make collective symbiotic relation with 80% of plant. AMF also give protection against flood, drought, high saltiness etc. Some metals are veritably important like Iron (Fe), Zinc (Zn), and Copper (Cu) (Smith et al. 2008). If used in high concentration it become poisonous, the AMF decrease toxic effect and help the plant to utilize metal in proper concentration for growth. A Zinc transporter is known as one species of AMF i.e. *Glamous intraradices* (GinZNT1).

AMF has high affinity phosphate transporter which help to transport the phosphate from the soil to the plant root. *Arbuscular Mycorrhizas* fungi also help to lowers the green house gas. There are several challenges when AMF is considered to be used as a bio-fertilizer in large scale but the need is very critical. The Production at large scale is delicate because AMF is a obligate symbiotic organism and it can't be produced in pure cultures so one of the general way to extract and multiply the organism is that it should be transferred to a new plant to divide(Glyanko et al 2009, Thilakarantha et al. 2017). Several attempts are being made so that it can be produced on large scale and be used as a natural fertilizer.

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(4) *Azolla* and *Anbaena* as Bio-fertilizer:

Anabaena Azollae is an endophytic blue green algae which lives in symbiotic association with small water fern *Azolla lans* to fix the Nitrogen present in soil for itself and host plant. *Anabaena Azollae* fixes the nitrogen for *Azolla lans* and *Azolla lans* give protection, the better environment and fix carbon for the algae. The production of agriculture is rely on the Quantity of nitrogen being given to 21kg Nt. It is observed to produce the grain and it is constant (Meena et al. 2013, Srivastava et al. 2016).

When chemical fertilizer (NPK) is used in field, the agro ecosystem is interrupted and pollution is increased in the environment. This disturbed ecosystem can be treated using Bio-fertilizer. The most compatible crop which is growth in Azolla-anabaena Bio-fertilizer is rice and it can be apply on rice crop and mono or intercrop both.

CHEMICAL FERTILIZER:

Chemical fertilizer have been extensively used to achieve maximum productivity in conventional agriculture system (Lin et al. 2019).

A chemical Fertilizer is described as any inorganic material of wholly or incompletely synthetic origin that is added to soil to sustain plant growth. Chemical fertilizers are made synthetically from inorganic matter.. Since they are formed artificially they may have some dangerous acids. Microbes found in soil are helpful for plant growth naturally. They are rich in 3 essential nutrient required for plant growth some examples of chemical fertilizer are ammonium sulphate, ammonium phosphate, ammonium nitrate, urea etc.(Azizi et al. 2016).

(1). Nitrogenous fertilizer:

It provide nutrition of nitrogen to plants and are of three types :-

- Nitrate Fertilizer – e.g. Sodium Nitrate.
- Ammonium Fertilizer- e.g. Ammonium sulphate
- Nitrate and ammonium fertilizer – e.g. ammonium

sulphate • Amide fertilizer-e.g. Urea

(2) Phosphate fertilizer:

For utilization of phosphorus in plants with some phosphate fertilizer. Calcium dihydrogen phosphate, ammonium phosphate and ammonium hydrogen phosphate are the example.

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(3) Potassium Fertilizer:

They supply the nutrition of potassium to the plant

- Potassium Chloride
- Potassium Sulphate
- Potassium Nitrate

Urea (H_2NCONH_2)

It is the most important nitrogenous fertilizer because of its high nitrogen concentration (46%N). This is the most concentrated soil nitrogen fertilizer. It is occasionally used for upstanding top –dressing. In the soil urea convert to ammonium carbonate which may results in the very harmful pH (Glibert et al. 2006). Nitrogen, as ammonia may be lost from surface of chalk or limestone soil or light sandy soil. If applied as a top dressing during a period of warm weather. When it applied into the soil, It is as effective as any other nitrogen fertilizer and most efficiently utilized on soil with proper humidity content, so that the gaseous ammonia go rapidly into solution. If applied very close to seeds it may reduce germination.

DAP (Di- Ammonium Phosphate)[$(NH_4)_3PO_4$]

Di-Ammonium phosphate popularly known as DAP is a favored fertilizer in India because it consist of both Nitrogen and Phosphorus which are primary macro-nutrient and part of essential plant nutrients.

It can be supplied in autumn for tilling and sowing. During sowing dissolving in soil, it give temporary alkalization to soil and regulate he better uptake of phosphate from the fertilizer. It also contribute to better input of nitrogen and phosphorus by plant (Iqbal et al. 2020).

A field trail was conduct at Indore, India from 2000 to 2002 in gault texture. The aim was to estimate the effect of nitrogen –fixing bacteria, phosphorus solubilizing bacteria, vericular, asbuscular mycroohizae (VAM) (*Glunuis fasciculam*) and chemical fertilizer on yield performance and quality parameter of durum wheat (Triticum fungi dunvar-durum desi) (A. R. Sharma et al. 2007). The grain (15664Kgha-1) and strains yield under recommended fertilizer dose (100%NPK) then under 50% NPK (4676Kgna-1) compared to 50% NPK , bio fertilizer +50% NPK increased grain yield hardly (2-6%) and could not reach to position of significance, still straw yield were advanced under after treatment (Uma Kanta Behera et al. 2009).

A relative estimation of various Bio-fertilizer and chemical fertilizer on growth and yield of wheat was conducted in year 2020 by experimenters. From that study it may concluded that Bio-fertilizer along with Chemical fertilizer (DAP) brought out significant enhancement in morphology and yield contributing character of wheat.

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Also application of DAP + Bio-fertilizer significantly increase productive tillers on plant height , protein content, biomass, yield by 33.59% over control and 15.91% over chemical fertilizer (Fukami J et al. 2016; Nougueria et al. 2016). Similarly on application of Bio-fertilizer also increase the plant yield significantly. It indicate that the use of Bio-fertilizer has increase the plant height but the issues associated with the use of chemical fertilizer is that they cause environment problems including soil physical destruction and nutrient imbalance.

MATERIAL AND METHODS

Microbial strains/ biofertilizers:

The Bio-fertilizer (Azotobacter Mac27 and PSB3) was collected from HABITAT GENOME, CCS HAU Hisar, chemical fertilizer (Urea and DAP) was collected from fertilizer shop. The seeds of wheat (*Triticum aestivum*) were collected from super seeds and nursery, Hisar. *In vitro* assay was performed in pertiplates under lab conditions in a incubator.

Plant material:

Wheat grain (*Triticum aestivum L*) was taken to study the effect of Bio-fertilizer and Chemical fertilizer on it. Chemical fertilizer in this work used in form of urea (46%N) and was applied 0,50 and 100 % nitrogen of the recommended dose as decided by the Ministry of Agriculture (224KG fed). The nutritional value of wheat is given in the below table 1.

Table 1: Nutritive value of wheat crop

Component	**% in grain**	**% in floor**
Moisture	9-18	13-15
Protein	8-15	8-13
Cellulose	2.25	0.2
Oil and fat	1.5	0.8-1.5
Mineral matter	1.5-2	0.3-0.5
Carbohydrates	62-72	65-70

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Seed Sterilization:

Uniformly sized seeds were surface sterilized in ethyl alcohol 70% (for 3min) sodium hypochlorite 3% (for 3 min) with posterior rising (16 times) with sterile water and air dried.

DAP:

Di-ammonium phosphate prominently in the experiment to check their effect on the wheat plant. DAP Fertilizer is shown in below figure no. 1.

Fig. 1: DAP Fertilizer

Composition of DAP is provided in the table 2.

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Table 2: Composition of DAP

Parameters (by weight)	**%**
Moisture	2.5 (max.)
Total Nitrogen	18.0 (max.)
Ammonical Nitrogen	15.5 (max.)
Total Nitrogen as urea	2.5 (max.)
Water soluble (P2O5)	46.0 (max.)

Uses:

(i) DAP gives very good combination with urea fertilizer.

(ii) DAP is also the best fertilizer for pulse where lesser nitrogen and higher phosphorus is n as starter dose.

(iii) Give full phosphorus nutrition throughout crop yield and development as well as a starter dose of nitrogen and low sulphur.

(iv) It can be applied in autumn for tilling and in spring during sowing as well as pre-sowing cultivation.

Urea: An experiment was conducted to estimate the effect of urea fertilizer for nitrogen use efficiency and yield of wheat (*Triticum aestivum*). Urea is a white crystal. It is not only a simple organic compound but it is a nitrogen fertilizer. Urea has little damage to soil.

Fig. 2: Urea fertilizer

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As shown in above figure no. 6, Urea fertilizer can not be scattered on the ground because large amount of urea can cause soil damage and result in tree death, with serious consequences. High level of urea in soil decrease the accessibility of urea as nutrient for growth of plant and effect the germination of seed.

Microbial Strain:

Bacterial strain *Azotobactor Mac 27* and PSB was taken from Habitat and Genome, CCS HAU, Hisar . The yield of wheat increase when it was applied on wheat seeds. N (36%) *Azotobactor* suggersively increase the spikes, no. of tillers, grain weight, grain size and harpoons per plant accordingly. The use of 70% mineral nitrogen and bio-fertilizer with *Azotobactor* and *Azospirilum* enhance the growth character in wheat. Bio-fertilizer companies are IFFCO, Shri Ram Fertilizer, Kribcho etc.

Incubator:

Incubator provides on enclose environment for growth of bacteria and plants.

- Not only the temperature but it also maintain moisture, oxygen and carbon dioxide.
- It provides a desirable temperature range for growth.
- Mostly bacteria grow best at temperature according to the need for germination ofwheat seeds.

Fig. 3: Incubator

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Method:

For each treatment Petri plates were covered with whatman paper than wet with water and were treated with different combination of *Azotobactor* (Bio-fertilizer) and DAP.

Layout of Experiment

Surplus use of chemical fertilizer negatively affect the domain and natural microbial diversity in soil and thereby decline soil fertility and crop quality.

The implementation of biofertilizer containing a combination of advantageous microorganism in a formulation with a reduce amount of chemical fertilizer was believed to be effective compared to the application of only chemical fertilizer.

The methods for analysis the effect of Bio-fertilizer and chemical fertilizer are as follows:

Treatment (1) Bio-fertilizer 100%with Zero chemical fertilizer

Treatment (2) Chemical fertilizer (DAP) 100%.with Zero Bio-fertilizer

Treatment (3) 50% Bio-fertilizer and 50% of Chemical fertilizer (Urea or DAP) (BF 50%) & (CF 50%)

Treatment (4) Negative control that means there is no involvement of Bio-fertilizer and chemical fertilizer in this.

RESULTS

From the conducted experiment, we observed that bio-fertilizer Azotobacter provide additional nitrogen in an eco friendly manner and play a crucial role in wheat growth. The application of 100% Bio-fertilizer boost growth as compared to use of chemical fertilizer. From current study we found that the use of chemical fertilizer continuously decrease the crop yield and also lead to environment pollution and decrease the soil health thus deterioration of soil physio-chemical properties. Among all treatment there is no significant growth of plant is seen while using chemical fertilizer and negative control. The yield of wheat also increase when the treatment of combined Bio-fertilizer and chemical fertilizer is applied.

Morphological characteristics

Recording of different morphological characters as given in table 3

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Table 3: Morphological characters

	Treatment	**Plant Health**	**Shoot Colour**	**Root Colour**
T1	Biofertilizers (100%)	Thick	Yellow Green	White
T2	DAP (100%)	Thin	,,	Brown
T3	Biofertilizers (50%) +DAP (50%)	Thick	,,	White
T4	Negative Control	Thin	,,	White

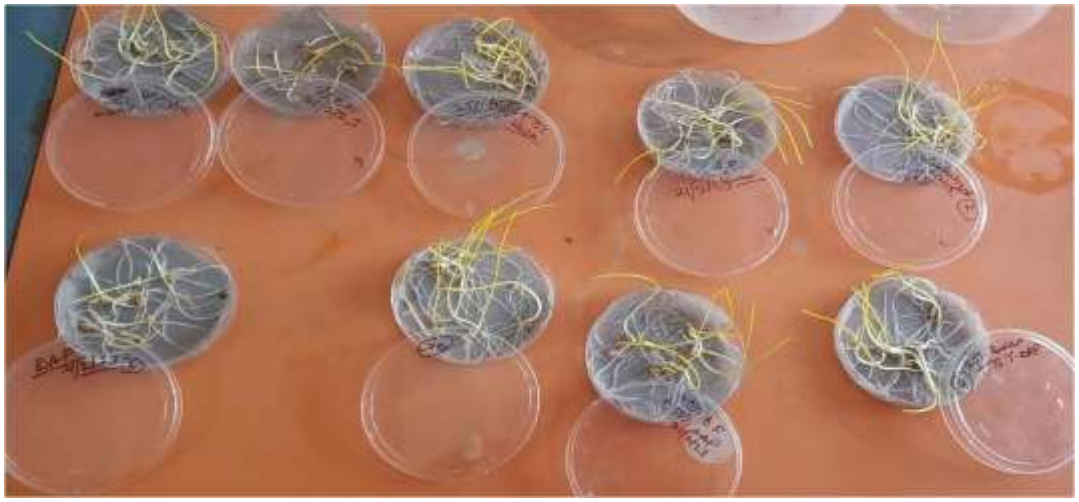

Fig. 4: Growth of wheat seeds after different treatments

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Plant height: As per above experiment it is determined that use of 100% bio-fertilizer in wheat increase the plant height. We observed in (fig. No. 5, 6 and table 4) that their is the maximum growth in height of plant when seeds were treated with Bio-fertilizer. But in case o negative control and 100% chemical fertilizer there is no such significant growth in plant height was observed. Hence we concluded that biofertilizer promote sustainable development.

Fig. 5: Measurements of plant heights from different treatments

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Table 4: Plants height in different experiments

Plant height	**T1 50% B.F. + 50% DAP**	**T2 (100% B.F.)**	**T3 (100% DAP)**	**T4 (-Ve)**
10^{th} Day	11cm	15cm	12 cm	10cm

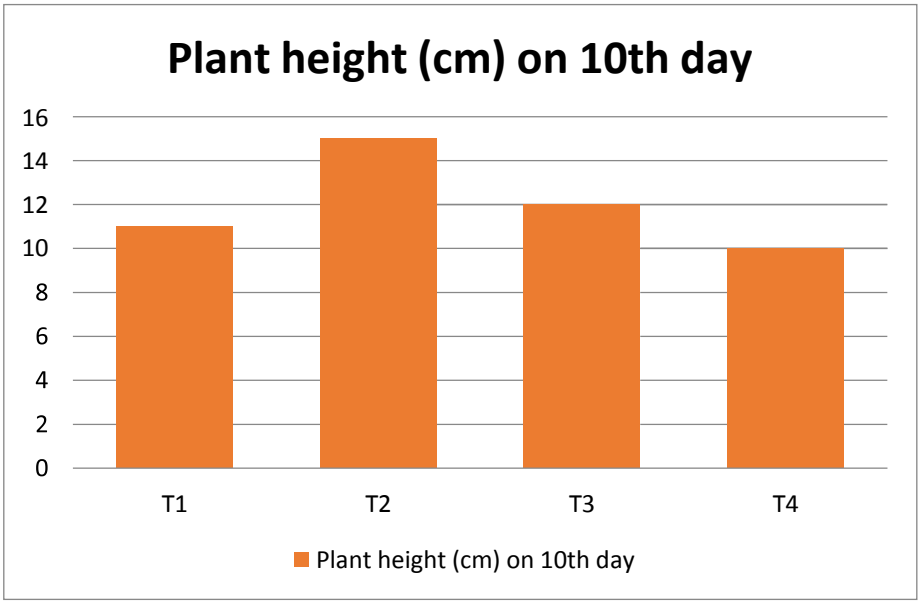

Fig. 6: Plants height in different experiments

Seed germination rate: From Table 5, figure 7 it was observed that Rate of germination of the treatment (Bio fertilizer 100%) was found to be maximum up to 100% followed by treatment 3 (50% DAP + 50% biofertilizers) was 90% than by be treatment T2 (chemical fertilizer 100%) was 80% and least was recorded in negative control experiment.

Table 5: Seed germination rate

	Treatment	**Rate of Germination (%)**
T1	Biofertilizers (100%)	100
T2	DAP (100%)	80

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T3	Biofertilizer (50%) +DAP (50%)	90
T4	Negative Control	70

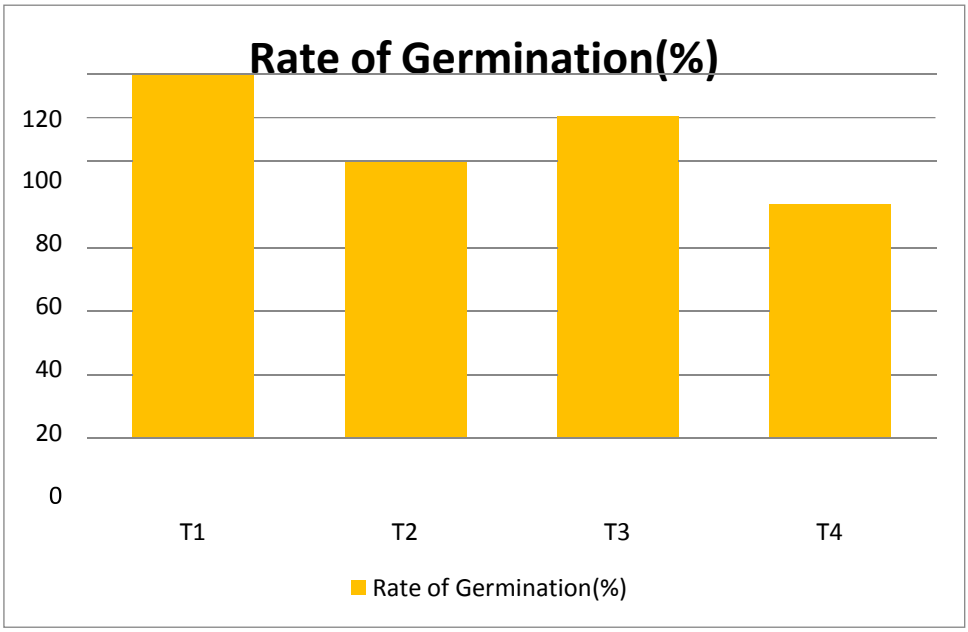

Fig. 7: Seed germination rate

Plant Health: Among the various treatments T1, (100% Bio-fertilizer recorded the best growth of plant i.e. plant is free from any type of disease compared to other treatment. There is no fungal growth is observed in case of Azotobacter treatment. But in case of 100% Chemical fertilizer, fungal growth in roots was observed. Also, plant was disease free in case of combination of Bio-fertilizer. Thus, the application of fertilizer on crops highly influences the better growth of plant.

Also, it was observed (table 3, figure 4) that in case of Bio-fertilizer treatment only, the shoots of wheat plant are thick. But in case of chemical fertilizer (i.e. D.A.P. or Urea), the shoot were thin. Thus, If we use chemical fertilizer regularly on our crops, growth rate of plant will decrease and also the soil health is distorted. Alone use of chemical fertilizer cause environment pollution and has adverse effect on human health also. So, In order to minimize the use of chemical fertilizers that has led to a considerable reduction in soil heath; researchers have emphasized the usage of Bio-fertilizers which are environmental friendly and hold vast potential in plant nutrient requirement, improving soil fertility and plant productivity. The application of

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chemical fertilizer has proved to be 30% more costly than the biofertilizer.

In recent times many countries have been encouraged to use Bio-fertilizer as a substitute for chemical fertilizer. Healthier soil in needed as it has abundant and diverse population of microbes such as bacteria, fungi and more. They play different function in the soil fertility. Like maintenance of soil structure and laterally helping in sustainable agricultural productivity. *Azotobacter* has synergistic effect on yield generally with the application of *Azotobactor*, the yield of agriculture crops is increased by 10-12 percent. Seed inoculation with *Azotobacter* remarkably increase the growth of wheat. Bio-fertilizer application significantly improved grain yield. The significant increase in N content of grain due to inoculation with *Azotobacter* as compared to negative control.

DISCUSSION

The reduced load of fertilizers into crop fields without causing productivity lost is a feasible but difficult challenge. The results of the experiments confirmed our hypothesis that the combination of *Azotobactor* enriched bio-organic fertilizer with reduced chemical fertilizers could produce wheat yield higher than those obtained using full rates of the chemical fertilizer (CF) (Table 3). However, inoculation with organic fertilizer would cause 6–38% and 9–35% increase in yield over the control (CF) in the presence of 100% chemical fertilizer doses (Majed et al. 2017). Hence, only bio-organic fertilizer could be a viable supplementary strategy to maintain or increase wheat yields. Moreover, some reports showed that bio-organic fertilizers could replace 23–52% of chemical fertilizer without any loss of yield which also indicating the potential role of bio-fertilizer in reducing the amount of chemical fertilizer load to soil.

Therefore, a proper control of the application rate of chemical fertilizers to soil would directly reduce our risks to some nitrate-related health problems

Based on the result, the integration of biofertilizer with low amounts of chemicals promoted a positive effect on improving growth compared with sole application of chemical fertilizer and bio-fertilizers 50% that combined with 50% chemical fertilizer indicated the good plant height, meristem diameter, number of spikes, leaf area and wet and dry weight. From the obtained results, it was revealed that application of compost or sludge with either "*Azotobactor*" or yeast as biofertilizers has superior promoting effect on yield and yield components as well as nutrient content of the grains than chemical fertilizers (Ali et al. 2013, Khandhan et al. 2013). Thus, it can be recommended to substitute chemical fertilization by these organic and biofertilizers to obtain high productivity of wheat. Currently, the use of mycorrhiza fungi as biofertilizer has become more common as there is reduction of the fungi in soil due to the long-term application of chemical fertilizers. This study suggests that the

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integration of biofertilizer with a small rate of chemical fertilizer promised an excellent result compared to the usage of alone 100% chemical fertilizer. The knowledge gained from this study will help to overcome the problems associated with the over-use of chemical fertilizers and environmental problems.

Environmental stresses are becoming a major problem and productivity is declining at an unprecedented rate. Our dependence on chemical fertilisers and pesticides has encouraged the thriving of industries that are producing life-threatening chemicals and which are not only hazardous for human consumption but can also disturb the ecological balance. Biofertilizers can help solve the problem of feeding an increasing global population at a time when agriculture is facing various environmental stresses. It is important to realise the useful aspects of biofertilizers and implement its application to modern agricultural practices.

CONCLUSION

Environmental stresses are becoming a major problem and productivity is declining at an unprecedented rate. Our dependence on chemical fertilizers and pesticides has encouraged the thriving of industries that are producing life-threatening chemicals and which are not only hazardous for human consumption but can also disturb the ecological balance. Biofertilizers can help solve the problem of feeding an increasing global population at a time when agriculture is facing various environmental stresses. It is important to realize the useful aspects of biofertilizers and implement its application to modern agricultural practices. Protract use of chemical fertilizer has negatively affected the atmosphere and environmental microbial organisms in soil and thereby decrease soil fertility and crop quality. The biofertilizers consisting of a formulation with a lesser amount of chemical fertilizer was proved to be more effective with the stand-alone use of biofertilizers or chemicals. In present study, wheat seeds which were treated with biofertilizers with a decreased amount of chemical fertilizer showed better growth, nutrient uptake and higher microbial diversity compared to other treatments. The integration of biofertilizer with small rate of chemical fertilizer also show good growth These results prove that chemical fertilizers could be completely replaced by biofertilizer without any negative effect on vegetative growth and or nutrient contents of plant Government of India has been encouraging use of bio fertilizers instead of chemical fertilizers through State Governments Including in district Gopalganj of Bihar under various schemes/ programmes, viz: Paramparagat Krishi Vikas Yojana (PKVY), Mission Organic Value Chain Development for North Eastern Region (MOVCDNER), National Mission on Oilseeds and Oil Palm (NMOOP), National Food Security Mission (NFSM). ICAR study indicates that biofertilizers can improve crop yield by 10-25%.

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