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Effect of biofertilizers in increasing sunflower crop productivity: A review

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Abstract

Biofertilizers are organic fertilizers that include microorganisms that fix nitrogen organically, soluble phosphate, or produce hormones, vitamins, and other growth regulators required for plant growth. The use of biofertilizers, which are highly effective and ecologically benign fertilizers substituted for traditional fertilizers, is an excellent way to boost crop output while reducing nutrient loss during fertilization. Pollination of crop plants with it is a promising technique in crop production, including sunflowers. To produce bacterial biofertilizers, strains that are appropriate for a given crop in a specific agroclimatic zone must be chosen. Since soil properties and agroclimatic conditions differ greatly, it is essential to isolate a variety of strains of each biofertilizer for every area. This makes increasing the supply of nutrients both economically and environmentally appealing. When applied to seeds, seedlings, plants, or soil, it aids in mobilization of plant nutrients for crop growth by providing any other plant nutrient needed for crop growth, such as phosphorus solubilization or nitrogen biological fixation. In order to control a variety of root-borne infections, several biofertilizers also function as efficient biocontrol agents. It is known to available micronutrients such as iron, copper, zinc, molybdenum, manganese, etc. to plants and helps in collecting water from distant areas of the crop root zone through the process of root branching. It was found that adding biofertilizers (Azotobacter, Azospirillum, phosphate solubilizing bacteria, Sulphur-oxidizing bacteria) to the sunflower crop led to stimulating and accelerating growth and increasing seed productivity of this crop, besides the fact that biofertilizers are easy to apply to plants and can lower production expenses.

Keywords: Biofertilizers, Azotobacter, Azospirillum, Phosphate solubilizing bacteria, Sunflower.

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Introduction

Physical and chemical characteristics of soil are adversely affected by the excessive use of chemical fertilizers in agriculture, which is also expensive. As a result, Various organic fertilizers that serve as organic growth and development stimulants have been introduced in recent years (Khan et al., 2009).

Through the natural processes of fixing nitrogen, solubilizing phosphorus, and producing growth-promoting compounds, biofertilizers supply nutrients to the soil. Use of chemical fertilizers and pesticides will decline as biofertilizers become more widely available. The microorganisms found in biofertilizers help the soil's organic matter and nutrient cycle return to normal.

The purpose of this article is to describe how certain biofertilizers help to boost sunflower crop output.

Biofertilizers:

They contain microorganisms that can be either symbiotic or non-symbiotic, such as bacteria, fungi, or even a particular kind of algae. They can be sprayed straight onto seeds, plants, or soil. After being treated, they proliferate and carry out several vital functions that enhance soil fertility and plant growth. Smitha (2005).

Both integrated soil nutrient management and soil sustainability and productivity are greatly enhanced by these biofertilizers. Biofertilizers have gradually supplanted chemical fertilizers as a cost-effective, sustainable, and eco-friendly source of plant nutrition.

Role of biofertilizers:

Biofertilizers are an inexpensive, a renewable resource that is vital for boosting atmospheric nitrogen fixation through biological processes and increasing availability of nitrogen and phosphorus for agriculture. The growth of certain agricultural plants can be more effectively stimulated by co-inoculation of worms and probiotic bacteria.

Biofertilizers are products that contain life microorganisms of different kinds. Applying these microbes to seed, plant surfaces, or soil causes them to colonize the root zone or inside the plant. By using biological processes like phosphate rock dissolution and nitrogen fixation to change nutritionally significant components (phosphorus and nitrogen) from an inaccessible form to an available form, this method aids in the growth of the plant (Adesemoye and Kloepper, 2009).

One advantage of biofertilizers is that they:

1. increase soil nitrogen levels.
2. Use fewer artificial fertilizers.
3. Biocontrol, which involves making plants resistant to antibiotics so they can fend off illnesses.
4. Enhance the structure and pH of the soil.

The drawbacks of biofertilizers:

1. Their functioning may be impacted by biotic factors that influence the existence of other species.
2. Abiotic factors are aspects of the immediate environment, like the soil's quality and the local climate in the agricultural region. Therefore, it's critical to select those that are most environmentally friendly.
3. It's crucial to keep an eye on the fertilizers' expiration date because they cannot last very long.
4. Since these creatures are living things, it is important to adopt the right storage methods to prevent their demise.
5. The right fertilizers must be selected for the grown plants to achieve the greatest results.
6. Farmers may find it challenging to apply biofertilizers because some techniques differ from those used with chemical fertilizers, therefore they need to be instructed on how to apply them correctly to ensure their efficacy.

Azotobacter and Azospirillum:

The most prevalent and significant are Azotobacter and Azospirillum. Both are known to increase fruit yield and quality, produce growth-promoting compounds, and supply nitrogen (20–30 kg N/ha). It was discovered that nitrogen application and Azotobacter inoculation increased seed production, which in turn improved pea growth, leaf chemical composition, and yield. In addition to being free nitrogen fixers, Azotobacter also contributes to plant growth and yield in the root zone by supplying a range of beneficial carbon compounds (Gomare et al., 2013).

The two most significant non-symbiotic nitrogen-fixing bacteria in non-legume crops like sunflowers are Azotobacter and Azospirillum. Under the correct circumstances, Azotobacter and Azospirillum can increase plant growth and yields of numerous major crops in a range of soil types and climatic zones. Their capacity to stimulate root growth, improve nutrient and water intake through the roots, and displace detrimental bacteria and fungi that injure plants are the primary causes of Azotobacter and Azospirillum's positive effects on plants (Stephens and Rask, 2000).

Phosphate Solubilizing Bacteria:

The high cost of making phosphate fertilizers would be reduced and insoluble components of fertilizers and the soils they are applied to would be facilitated by employment of phosphate-solubilizing bacteria in agricultural activities. Phosphate-solubilizing fungi (PSF) make up only 0.1-0.5% of phosphate fertilizers, whereas phosphate-solubilizing bacteria (PSB) make up 1-50% of the entire microbial community in soil (Arun, 2007).

Sulfur-oxidizing bacteria:

Sulfur fertilization lowers the alkalinity of alkaline soils and raises the sulfate content required for plant nourishment. Mineral sulfur, an insoluble powder in water, is transformed into sulfuric acid by chemolithotrophic sulfur bacteria in well-aerated soils (El-Halfawi et al., 2010).

Some studies on the effect of biofertilizers on sunflower crop productivity:

Sunflower is one of the most significant crops in the world. Because the oils are an element in many commercial products and are used in human nutrition, their scarcity makes them even more significant. Because sunflower oil contains unsaturated fatty acids, such as omega-3, it is one of the best oils for cooking (Nasralla, 2014).

The results reached by Keshta et al. (2008) when studying several levels of minerals, organic, and biological fertilizer (45 Kg N/fad, 1/2 N +30 m^3/fad of organic fertilizer, bio fertilizer + 22.5 Kg N/fad, bio fertilizer + 30 m^3/fad organic fertilizer + 22.5 Kg N/fad), bio fertilizer + 30 m^3/fad organic fertilizer + 11.25 Kg N/fad, 30 m^3/fad of organic fertilizer + 22.5 Kg N/fad and bio fertilizer + 30 m^3/fad organic fertilizer) showed that the fourth treatment (bio fertilizer + 30 m^3/fad organic fertilizer + 22.5 Kg N/fad) was significantly superior to the seed yield (60.6 g/plant).

Mostafa and Abo-Baker (2010) found, during their study, that several levels of biological and mineral fertilizers significantly exceeded the last treatment (phosphorus-fixing bacteria + nitrogen-fixing bacteria + 100% of recommended dose of phosphorus and nitrogen) in seed yield (2265.93 kg/ha).

According to the findings of Akbari et al. (2011), who employed two different biofertilizer treatments (no biofertilizer (control) and biofertilizer (Inoculation with Azospirillum and Azotobacter), the addition of biofertilizer increased seed yield (2401.3 kg/ha).

Namvar et al. (2012) found in their study of two biofertilizer treatments (without inoculation, inoculation with Azospirillum and Azotobacter) that inoculation with Azospirillum and Azotobacter resulted in a significant increase in seed yield (3372.57 kg/ha).

The results of Pramanik and Bera (2013) in their study they used four treatments of biofertilizer showed that the fourth treatment (phosphate solubilizing bacteria + vesicular arbuscular mycorrhiza + Azotobacter) was significantly superior in the seed yield trait (2401.3 kg/ha).

The results of Radwan et al. (2013) in their study of four treatments of biofertilizer showed that the treatment mixture of Phosphorein with Mycorrhizae+37.2 kg P_2O_5/ ha. was significantly superior in seed yield (3.89 tons/ha).

Patra et al. (2013) in their study of three treatments of biofertilizer showed that the third treatment (Phosphate Solubilizing Bacteria+Vesicular Arbuscular Mycorrhizae+Azotobacter) significantly increased seed yield (23.75 q/ha).

Abd El-Gwad and Salem (2013) observed in their experiment in which they used three treatments of biofertilizer (Azotobacter chroococcum, Bacillus megatherium (PDB) and mixture of two isolates) that the last treatment (mixture of two isolates) was significantly superior in seed yield (899.5 kg/acre).

Elham et al. (2013) in their study of two treatments of biofertilizer (seed uninoculaton and inoculated) showed that the inoculation treatment significantly increased seed yield (1846.40 kg/ha).

Pujar et al. (2014) concluded during their study of several treatments of biofertilizer (Control (Uninoculated), Sulphur Oxidizing Biofertilizer, Sulphur 10 kg/ha, Sulphur 10 kg/ha+ Sulphur Oxidizing Biofertilizer, Sulphur 20 kg/ha, Sulphur 20 kg/ha+ Sulphur Oxidizing Biofertilizer, Sulphur 30 kg/ha, Sulphur 30 kg/ha+ Sulphur Oxidizing Biofertilizer) that the treatment of the last was significantly superior in giving highest seed yield (2007 kg/ha).

The results obtained by Mahrous and others (2014) during their study of several biofertilizer treatments showed that sixth treatment (Compost (8.75 tons/ fed) +350 kg/ fed natural mineral rocks+NPK - Bio fertilizers mixtures) was significantly superior in seed yield (3485.99 kg/ha).

Ahmed et al. (2015) observed during their study of two treatments of biofertilizer (Without bio, Bio fertilizer) that adding Bio fertilizer led to an increase in seed yield (2063.94 kg/ha).

The results obtained by Farnia and Moayedi (2015) during their study of four treatments of biofertilizer (Supernitroplas, Nitrokara, Nitroxin and control) showed that adding Nitroxin gave the highest seed yield (6900 kg/ha).

In their study of four biofertilizer treatments (without biofertilization, Azotobacter inoculation, Azospirillum inoculation, and Bacillus megaterium inoculation), Abdel-Salam et al. (2015) demonstrated that the Azotobacter inoculation treatment significantly increased seed yield (3490.9 kg/ha).

In their experiment using several biofertilizer treatments, Khan and colleagues (2016) found that the first treatment (organic fertilizer with biofertilizers 247 kg/ha + mycorrhizal fungi 12 kg/ha + sulfur 12 kg/ha) considerably surpassed the seed yield (3666.8 kg/ha).

Sarwar et al. (2016) in their experiment in which they used several treatments of biofertilizer treatment 100 % of recommended P+ (Bacillus+Pseudomonas) seed inoculation was significantly superior in giving the highest seed yield (3027 kg/ha).

In their investigation of three different biofertilizer concentrations (0, 2, and 4 L/ha), Fakirah et al. (2017) observed that the concentration of 4 L/ha considerably raised seed output (1579.6 kg/ha).

Choudhary et al. (2017) found during their study of several treatments of biofertilizer that the last treatment (45 kg/ ha Sulphur+Sulphur oxidizing bio fertilizer) was significantly superior to the seed yield (2372.66 kg/ha).

In their investigation of several biofertilizer treatments, Khandekar et al. (2018-a) found that The last treatment (100% N + Azospirillum + Azotobacter seed treatment) produced the highest seed yield (1848.0 kg/ha).

Khandekar et al. (2018-b) found in their study of several treatments of biofertilizer that the ninth treatment (100% N + Azospirillum + Azotobacter seed treatment) was significantly superior in seed yield (1848.0 kg/ha).

Alamery and Ahmed (2020) found in their experiment in which they used four treatments of biofertilizer (Control, Azotovit, Phosphatovit, and Azotovit+ Phosphotavit), the Azotovit treatment significantly outperformed the seed yield (4.39 tons/ha).

In their investigation of several biofertilizer treatments(20 kg/ha of Sulphur through SSP + Azospirillum, 20 kg/ha of Sulphur through SSP + Azotobacter, 20kg/ha of Sulphur through gypsum + Azospirillum, 20kg/ha of Sulphur through gypsum + Azotobacter, 30kg/ha of Sulphur through SSP + Azospirillum, 30kg/ha of Sulphur through SSP + Azotobacter, 30kg/ha of Sulphur through gypsum + Azospirillum, 30kg/ha of Sulphur through gypsum + Azotobacter, Control), Sandhya et al. (2021) found that the sixth treatment (30 kg/ha of sulfur through SSP + Azotobacter) greatly outperformed the seed yield (1495.67 kg/ha).

When comparing three different amounts of biophosphorus fertilizer (0, 0.5, and 1 L/ha), Zamanian and Yazdandoost (2021) found that adding 1 L/ha of biophosphorus fertilizer increased seed yield (5.88 tons/ha).

In their investigation of many biofertilizer treatments(Control (N:P:K-80:60:40), 60 kg/ha Nitrogen + Azospirillum, 60 kg/ha Nitrogen + Azotobacter, 60 kg/ha Nitrogen + Azospirillum + Azotobacter, 70 kg/ha Nitrogen + Azospirillum, 70 kg/ha Nitrogen + Azotobactor, 70 kg/ha Nitrogen + Azospirillum + Azotobactor, 80 kg/ha Nitrogen + Azospirillum), Jonnagorla et al. (2021) discovered that the tenth treatment (80 kg/ha N + Azospirillum + Azotobacter) considerably raised seed output (1351.15 kg/ha).

During their investigation of three levels of biofertilizer (nitrogen fixing bacteria, phosphate dissolving bacteria, and potassium edit facilitator), Hafez et al. (2021) observed that the third level (potassium edit facilitator) considerably exceeded the seed yield (4.40 tons/ha).

In his experiment, Abdelaziz (2022) used four different treatments of biofertilizer (Control, Bio, Diatoms, and Bio+Diatoms). He found that the fourth treatment, Bio+Diatoms, produced a significantly higher seed yield (2689.92 kg/ha).

Conclusion

Biofertilizers (Azotobacter, Azospirillum, Phosphate-dissolving bacteria, and Sulfur-oxidizing bacteria) have improved sunflower crop yields, improved soil quality, and are sustainable over the long run. Furthermore, it is safe for the environment and can be used in place of mineral fertilizers.

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مجلة جامعة كركوك للعلوم الزراعية

تأثير الاسمدة الحيوية في زيادة انتاجية محصول زهرة الشمس: مقال مراجعة

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الخلاصة

الأسمدة الحيوية هي أسمدة عضوية تحتوي على كائنات دقيقة تعمل على تثبيت النيتروجين عضوياً، او الفوسفات القابل للذوبان، او إنتاج الهرمونات والفيتامينات ومنظمات النمو الأخرى المطلوبة لنمو النبات. إن استخدام الأسمدة الحيوية، وهي أسمدة فعالة للغاية وصديقة للبيئة تحل محل الأسمدة التقليدية، يعد وسيلة ممتازة لتعزيز إنتاج المحاصيل مع تقليل فقدان العناصر الغذائية اثناء التسميد. إن تلقيح نباتات المحاصيل بها يعد تقنية واعدة في إنتاج المحاصيل، بما في ذلك زهرة الشمس. لإنتاج الأسمدة الحيوية البكتيرية، يجب اختيار السلالات المناسبة لمحصول معين في منطقة مناخية زراعية محددة. نظراً لأن خصائص التربة والظروف المناخية الزراعية تختلف اختلافاً كبيراً، فمن الضروري عزل مجموعة متنوعة من سلالات كل سماد حيوي لكل منطقة. وهذا يجعل زيادة إمدادات العناصر الغذائية جذابة اقتصادياً وبيئياً. عند تطبيقه على البذور او الشتلات او النباتات او التربة، فإنه يساعد في تعبئة العناصر الغذائية النباتية لنمو المحاصيل من خلال توفير أي عنصر غذائي نباتي آخر مطلوب لنمو المحاصيل، مثل إذابة الفوسفور أو التثبيت البيولوجي للنيتروجين. من أجل السيطرة على مجموعة متنوعة من الإصابات التي تنتقل عن طريق الجذور، تعمل العديد من الأسمدة الحيوية ايضاً كعوامل فعالة للمكافحة الحيوية. ومن المعروف أن العناصر الغذائية الدقيقة مثل الحديد والنحاس والزنك والموليبدينوم والمنغنيز وغيرها متوفرة للنباتات وتساعد في جمع المياه من مناطق بعيدة من منطقة جذر المحصول من خلال عملية تفرع الجذور. وقد وجد أن إضافة الأسمدة الحيوية (الازوتوباكتر والازوسبيريلوم والبكتيريا المذيبة للفوسفات والبكتيريا المؤكسدة للكبريت) الى محصول زهرة الشمس أدى إلى تحفيز وتسريع النمو وزيادة إنتاجية بذور هذا المحصول، إلى جانب حقيقة أن الأسمدة الحيوية سهلة التطبيق على النباتات ويمكن أن تخفض تكاليف الإنتاج.

الكلمات المفتاحية: الاسمدة الحيوية، الازوتوباكتر، الازوسبيريلوم، البكتيريا المذيبة للفوسفات، زهرة الشمس.