ROLE OF BIOFERTILIZERS IN FLAX FOR ECOFRIENDLY AGRICULTURE

(Review)

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ABSTRACT: A considerable number of bacterial species have been reported which have beneficial effects on plant growth. Normally, these bacteria are associated within the rhizosphere, so they are called rhizobacteria. These rhizobacteria have great tendency to produce certain growth promoting substances like Auxins, Gibbralins, Cytokinins etc. so they are called Plant Growth Promoting Rhizobacteria (PGPR). Numerous bacterial species have found as PGPR mainly Azotobactor, Azosprillium, Bacillus, Pseudomonas etc. The application of these bacterial species as biofertilizers could be the alternate source of synthetic fertilizers because these bacterial species (Azotobactor, Azosprillum) have great potential to fix atmospheric nitrogen as well as to solubilize the phosphorus in the soil. Bio-fertilizers have no environmental hazards, so these could be the possible substitution of synthetic fertilizers without compromising on flax yield and it will also solve the issue of environmental pollution which is being caused by the use of synthetic fertilizes and ultimately it will be helpful in the restoration of environment.

Keywords: Azotobactor, Azosprillum, Bio-fertilizer, Bacillus, Flax, Pseudomonas, Plant Growth Promoting Rhizobacteria (PGPR).

INTRODUCTION

Flax is also called linseed which belongs to Linaceae family and considered as an important oil seed crop. It has great economic and agronomic values [1]. It is an annual plant with a height of 60 cm having slender and fibrous stems [2]. It is widely used in Asian countries for edible purposes as well as pharmaceutical purposes. It is also used for poultry diets [3]. It is oldest plant used for fiber and oil production [4, 5]. Linseed is an important industrial crop which contains 30–48% oil contents. Its oil is used importantly in dye industry [6, 7, 8].

PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPR)

In sub-tropical countries like Pakistan, high temperature and continuous application of synthetic fertilizers increase soil pH continuously. That's why most of the soils in Pakistan are saline, pH more than seven. Due to this increase in soil pH there is need of application of bio-fertilizers because they reduce the soil pH and environmental friendly. The bacteria grows in the roots of the plant and they provide them food, shelter and energy. In recent years, N_2 – fixing bacteria as a bio-fertilizer become more popular in non-leguminous crops. Inoculations have great influence on the plant growth and which ultimately increase the yield of crop. Some bacteria which are called Plant Growth Promoting Rhizobacteria (PGPR) are used to increase the plant growth [9]. In Azospirillum genera, Diazotrophic bacteria are a focus for a lot of importance because of their ability to promote plant growth, mineral and water nutrition improvement [10, 11, 12]. Use of bio-fertilizer supplies successful implementation of biological mechanisms of plant nutrition, growth promotion and safety [13, 10, 11, 12]. Application of bio-fertilizers can prevent the reduction of the soil organic matter [14]. The positive effects of PGPR have also been observed in both greenhouse and field conditions [15, 16a, 16b]. Those bacteria which are settle in rhizosphere and roots of the plants, and boost plant growth by some mechanisms are refer as plant growth promoting rhizobacteria (PGPR). PGPR have been applied to a variety of crops to improve plant growth, emergence of seed and crop yield [17, 18, 19]. Under salt conditions, PGPR have shown optimistic effect on plants in the parameters such as germination rate, drought tolerance, weight of shoots and root, yield and growth of plant [20, 21]. Azospirillum and Azotobacter increase the nodulation process and which ultimately increase the yield of different legumes species [22, 23, 24, 25, 26]. Bio-fertilizers increase the growth and productivity of commercial crops which include rice, wheat, cucumber, maize, cotton, black pepper and banana, these results were also found by [27, 28, 29, 30, 31, 32,33].

(PGPR) AS ORGANIC CONTROL

An additional main advantage of PGPR is to generate antibacterial compounds that are useful in opposition to specific plant pathogens and pests [17, 18, 19]. In recent times, there is a rising concentration in PGPR suitable to their effectiveness as organic control and growth promoting agents in several crops [34].

NITROGEN FIXER'S

Azotobacter, free living nitrogen fixing bacteria is considered as economical, low cost bio-fertilizer in agricultural productions. Experiments with strains of Azotobacter chroococcum has resulted the potential of the bacteria to promote plant growth and enhance the yield of crops in different soils and in different climatological conditions [35]. Production of plant growth hormones, improved nutrient uptake and antagonistic effect on plant pathogens [36] are few beneficial effects of Azotobacter. Atmospheric nitrogen and fixation in soil is assimilated by Azospirillum, it also helps to save nitrogen. Phytohormones in the plant roots region turn enhance the root growth are

secreted by Azospirillum. Literature cited clearly revealed that Azospirillum can be used as potential bio-fertilizer in both extensive and intensive agriculture [37, 38, 39]. Bio-fertilizers application is an important key for maximizing the yield of crop, Azotobacter and Azospirillum are potential bio-fertilizers which are capable to contribute nitrogen to a number of non-leguminous crops. Increasing height, dry mater, protein percentage, grain weight, grain yield, leaf area index, roots extension are associated with the contamination with Azetobacter and Azespirilium [40, 41, 42], these effects could be affecting reasons of PGPRs syntheses of the N fixation process or the plant protection role of these bacteria by synthesis some kind of antibiotics [43, 44, 45].

PHOSPHOROUS SOLUBLIZERS

Phosphate solubilization comes into existence during various microbial processes including organic acid production and proton extrusion [46, 47, 48]. Phosphorus solubilization is occurs by a huge amount of saprophytic bacteria and fungi acting on scarcely soluble soil phosphates [49]. PGPR are considered as an essential because of their plant growth promotional ability and biological control potential in the sustainable agriculture. PGPR containing beneficial soil microbes which are also involved in the control of some plant diseases and pests. In plant growth and soil reaction to P soluble fertilizers and natural phosphate, it is necessary to evaluate and compare the effects of application of sulphur inoculated with Acidithiobacillus, because the sulphuric acid produced in the biological reaction could act in the natural phosphate solubilization and in the soil reaction reducing soil pH, and that could hamper plant growth [50].

MECHANISM OF BIO-FERTILIZERS IN SOILS

Microorganisms will cause two stimulatory effects which are either direct or indirect. Direct effects consist of phytohormones production [51], improvement in the accessibility of some minerals [42], release of phosphates and micronutrients, non-symbiotic nitrogen fixation and motivation of disease-resistance mechanisms [52] while the indirect effects from PGPR are root environment and ecology [53]. It acts as a bio control agent and reduces diseases and release of antibiotic substances that destroy toxic bacteria. The outcome of phosphate dissolving bacteria usage as a bio-fertilizer resulted in reduced soil pH which improves the solubility of some nutrients P, Fe, Zn, Mn, and Cu which resulted in nutrient uptake of the plant. Plant growth promoting bacteria (PGPB) are soil and rhizosphere bacteria that can promote plant growth by various mechanisms [53], and P-solubilization power of the microorganisms is considered to be one of the most important character connected with plant P nutrition.

IMPACT OF BIO-FERTILIZER ON FLAX AND OTHER PLANTS

Comparatively flax needs low level of nitrogen nutrition. If nitrogen fertilizer is used in excess then it will cause negative effect on the yield of flax and quality because excess nitrogen will cause lodging and diseases development [54]. Azospirillum genus is considered very important because these bacteria are found living in close association with roots of several grasses and cereals [55] and fix nitrogen for these plants. Azospirillum inoculation on grain grasses can cause increasing in grain yield [56], can affect root development [57] and of dry matter of vegetative parts of maize [58], wheat [59] and other crops. This bacterium was used as a model and it must be considered that the new carrier could be applied to various nitrogen fixing bacteria that were isolated from various soils [60]. Absorption and fixation of atmospheric nitrogen in root zone and providing 30-50% of nitrogen requirements, production of plant growth hormones (auxins and cytokinins), enhancing the germination efficiency, plant immunity and the yield (25%), assisting in the uptake of mineral nutrients from the soil – extraction of antibiotics, which protect against minor root pathogens are some of their beneficial effects [61, 62].

BIO-FERTILIZERS SUBSTITUTION OF SYNTHETIC FERTILIZERS

By using high yielding cultivars and improved agricultural treatments, we can increase the flax productivity [63, 64]. Use of mineral fertilizers is one of these which are important for vigorous growth and high yield. On the other hand, environmental pollution will caused by frequent application of mineral fertilizers. By reducing high rates of mineral fertilization by using bio-fertilizer, we can reduce the cost of production and safe the environment through pollution [65, 66, 63]. Negative environmental impacts of chemical fertilizers and their rising costs, enhances the application of PGPB which is valuable in the sustainable agricultural practices. Application of bio-fertilizer encouraged plant growth and productivity [67, 68, 69]. Bacterial species associated with the plant rhizosphere are well known to exert a beneficial effect on plant growth, they are called ‘plant growth regulator promoting rhizobacteria (PGPR), and include strains in the genera Bacillus, Pseudomonas, Rhizobium and etc., [70]. Presence of different strain groups such as nitrogen fixer, nutrient mobilization microorganisms which help in increasing the availability of minerals and their forms in composted materials and increase levels of extractable of macro or micronutrients has increased significance effect of bio-fertilizers in different crop plants [71]. Mostly by volatilization or by leaching in drainage of water N-fertilizers are rapidly lost by different ways; sixty percent or more of the applied fertilizers are mainly lost [72]. The problem does not only involve the losing amounts of nitrogen which causes reasonable economic losses, but is also involves under ground water contamination and the other dangerous environmental pollution hazards.

CONCLUSION

We conclude from this study that bio-fertilizers restore soil structure and maintain soil texture and increase its fertility. These bio-fertilizers are recyclable, eco-friendly, less expensive with additional advantages as compare to that of conventional fertilizers. Synthetic fertilizers cause harmful effect on environment as well as they can cause nutrients disorder in soils and affect its pH. Nitrogen fixer’s and phosphorus solubilizers play a vital role in the plant growth. Bio-fertilizer helps in preserving environmental health by reducing the level of pollution. It can also increase the agricultural production and their product market prices in sustainable manner.

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