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# The Role of Bio Fertilizer in Canola Growth, Yield and Stress Condition : A Review

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## ABSTRACT

The oil extracted from canola (Brassica napusL.) has high industrial and economic value, since it is used as edible oil and feedstock for biodiesel production. It is also the third most produced oilseed in the world. Canola has the lowest saturated fat content among vegetable oils and thus presents an increasing demand for diet-conscious consumers. Oilseed rape has a relatively high requirement of nitrogen where the content of this nutrient in seeds and plant tissues is greater than in most grain crops. 6 Nitrogen different levels and biofertilizers effects were studied on growth and yield of canola Canola represents its highest yield in proper and desirable soil conditions. However its growth, yield and oil yield can be reduced significantly by environmental stresses such as drought, salinity and water logging. Therefore, canola yield may reduce under saline soils. The use of Plant growth promoting rhizobacteria (PGPR) for reducing chemical inputs in agriculture is a potentially important and interesting issue for increasing international concern in food and environmental quality. It is necessary for developing strategies of integrated fertilization for crops to maximize production of crops and reducing the risk of pollution from chemical fertilizers. Therefore, the objectives of this study to evaluate the impact of bio-organic, chemical nitrogen on seed quality of canola.

**Keywords:** Canola (Brassica Napus L.), Oilseed, Plant Growth Promoting Rhizobacteria (PGPR), Environmental Stresses

## I. INTRODUCTION

Rapeseed, which originates the canola (Brassica napus L. var. oleifera Moench.) species of the genus Brassicaand belongs to the Brassicaceae family, is indigenous to the Mediterranean region and Southwest Asia (Judd et al., 2009). The oil extracted from canola has high industrial and economic value, since it is used as edible oil and feedstock for biodiesel production, being the third most produced oilseed in the world (USDA, 2013). Oilseeds are considered as a secondary source of energy in human nutrition after cereals. On the other hand, the meal of canola is used as an important protein-rich food for cattle, poultry and marines (Shahidi and Furouzan, 1997). Canola (Brassica napus L.) is one of the main oil crops in many countries especially in Canada, European Union and USA. oilseed rape has a relatively high requirement of nitrogen where the content of this nutrient in seeds and plant tissues is greater than in most grain crops. Research on N efficiency in oilseed rape was initiated by Grami and La Croix (1977) in Canada. However, the higher application of mineral nitrogen fertilizers may lead to environmental pollution especially to groundwater, and soil acidification as well as increased denitrification resulting in higher emission of $N_2O$ to the atmosphere which may impact global warming (Sharma et al., 1997; Khalid et al., 2004; Rodriguez et al., 2004; Ebrahimi et al., 2007, Yasari et al., 2008 and Yasari et al., 2009). Positive reports of application of biofertilizers (Azotobacter and Azospirillum and other bacteria) on yield are available on crops like: Indian mustard, cotton, corn, sorghum, wheat, tobacco and barley, which is attributed to the enhancement of factors like N fixation nitrate reductase activity, intake of $NO_3$ , $NH_4$ , $H_2$ $PO_4$ , K, Fe, plant water status and production of phytohormones such as Indol acetic acid (Bashan et al., 2004). These microorganisms not only fix atmospheric nitrogen but also produce certain plant growth promoting hormones (Yasmin et al., 2007), Application of bacterial inoculants as biofertilizers has improved growth and yield of cereal crops (Saharan and Nehra, 2011). They play a significant role both under stressed and normal conditions for improving plant growth and developmental processes (Zahir et al., 2004). The mechanisms that promote plant growth comprises nitrogen fixation, phosphorus solubilization, production of siderophores, plant growth regulators and organic acids as well as protection by enzymes like ACC-deaminase, chitinaseand glucanase (Berg, 2009; Lutgtenberg and Kamilova, 2009; Hayat, 2010). Altering vital plant physiological processes by bacterially produced plant growth regulators and hormones, enhanced nutrient availability by improved uptake of nutrients and nutrient solubilization, minimization of negative impacts of ethylene produced in response of various stresses, excretion of exopolysaccharides are some important mechanisms through which PGPR boost crop production (Sandhya et al., 2009; Saravanakumar et al., 2007; Upadhyay et al., 2011). During the last two decades, various bacteria (i.e., Azotobactersp., Azospirillum sp., Acetobacter sp., Bacillus, Pseudomonas sp.) are used for plant growth promotion under various prevailing biotic and abiotic stresses (turan et al., 2006).

**Benefit of Biofertilizers**

1-Cheap source of nutrients; 2-Suppliers of microelements,3- Suppliers of micro nutrients, 4-Suppliers of organic matter,5-Counteracting negative impact of chemical fertilizers,6-Secretion of growth hormones (Gaur, 2010).

**biofertilizers effect on growth and yield of Brassica napus L.**

Canola (Brassica napusL.) production after soybean and palm is the third largest oilseed crop, producing as much as 14.7%of total vegetable edible oil in the world (Yasari et al., 2008). PGPRs have gained worldwide importance and acceptance for agricultural benefits. These microorganisms are potential tools for sustainable agriculture and a trend for the future (podileet al., 2006). The use of rhizosphere-associated microorganisms as biofertilizers is now considered as having potential for improving plant productivity (Vessey, 2003). Vessey (2003) defined biofertilizers as substances which contain living microorganisms and when applied to seed, plant surfaces or soil colonize the plant and promote its growth by increasing the nutrient availability. The results showed that nitrogen had significant effect on the seed number per silques, number of silques per plant, seed yield , 1000 seed weight, seed yield and Plant height. So that with the increased use of nitrogen fertilizer, all of these traits increased.and the combined use of was also increased on Seed yield. Interaction of nitrogen and biofertilizer affected on seed yield, significantly.(Naderifar and Daneshian, 2012).

**Effect of Azospiillum Under Water Deficit Conditions**

Abiotic stresses are the main cause of crop failure Worldwide, dipping average yields for most major crops by more than 50% .The average annual yield loss due to drought was estimated between 17 to over 70 percent in the world (Nasri et al., 2007). Rapeseed is more resistant to water stress in properties such as high ratio of root: shoot and higher efficiency for material transport to the grains. Under drought condition, the secondary root system of canola change to a short glandular form and will be elongated only after providing moisture, but basically is susceptible to drought during germination and pod growth stage (Khajehpour, 2005). In an experiment, the effect of inoculation with Azospirillum brasilense on growth and yield of Sorghum bicolorin hydroponic systems was a significant enhancement of dry matter content, leaf area development and grain yield. At later stages of growth, leaf senescence was delayed in inoculated plants, thus favoring dry matter accumulation and grain filling. In addition studies showed that Azospirillum promote the growth of tomato, eggplant, pepper, cotton and mustard (Bashan and Holguin, 1997). Okon and Kapulnik (1986) observed improvements in root development and function with Azospirillum which lead in many cases to higher crop yield. In order to investigate the effect of Azospirillum on quantitative and qualitative traits of canola (Brassica napus L.) under water deficit condition, The results showed that the simple effect of water deficiency was significant on seed yield, biological yield and 1000 seeds weight in probability of $1_{\%,}$ on number of pods per m in probability of 1% and no significant was observed on other traits. the interaction effect of stress and bacteria was significant on number of sub-sub shoot per plant, length of pod per sub shoot and number of pods per m in probability of 5%. (Azam Sakar, 2012).

## Plant growth promoting rhizobacteria effects on yield

Canola represents its highest yield in proper and desirable soil conditions. However its growth, yield and oil yield can be reduced significantly by environmental stresses such as drought, salinity and water logging. Therefore, canola yield may reduce under saline soils (Ashraf and Neilly, 2004). The use of Plant growth promoting rhizobacteria (PGPR) for reducing chemical inputs in agriculture is a potentially important and interesting issue for increasing international concern in food and environmental quality. Under salt stress, PGPR have shown positive effects in plants on such parameters as germination rate, tolerance to drought, weight of shoots and roots, yield, and plant growth (Kloepper et al., 2004; Kokalis-Burelle et al., 2006). In addition to improvement of plant growth, PGPR are directly involved in increased uptake of nitrogen, synthesis of phytohormones, solubilization of minerals such as phosphorus, and production of siderophores that chelate iron and make it available to the plant root (Glick, 1995; Bowen and Rovira, 1999). It has also been reported that PGPR is able to solubilize inorganic and/or organic phosphates in soil (Liu et al., 1992). Recently, there is a growing interest in PGPR due to their efficacy as biological control and growth promoting agents in crops (Thakuria et al., 2004). An experiment was conducted to investigate the effect of seed biopriming (consist of unprimed as control, priming by inoculation with nitrogen fixing bacteria, phosphate solubilizing bacteria) on yield and yield components of rapeseed cultivars. Results showed that the pot trials revealed that inoculation with selected PGPR increased plant height, pod number per plant, 1000-grain weight and grain yield compared to un inoculated control (Saber et al., 2013).

Assessment of Bacillus subtilis Biofungicide for Control of Clubroot on Canola

Clubroot, caused by the plasmodiophorid pathogen Plasmodiophora brassicae Woronin, is one of the most serious diseases of cruciferous crops worldwide, and an emerging threat to canola (Brassica napusL.) production in western Canada (Howard et al., 2010). Cultivar resistance to clubroot is generally race specific, and historically this type of resistance is not durable because it can be eroded when pathogen race structure changes. In a study by Leboldus et al. (2012), a resistance canola cultivar showed substantially increased clubroot severity after being exposed to the same Pb populationfor two cycles. Host resistance is the key to effective clubroot control on canola. It was not clear if additional measures can help the performance and longevity of resistant Cultivars. The biofungicide a liquid formulation of B. subtilisstrain QST 713, was highly suppressive to clubroot under controlled-environment conditions when applied as a soil drench. It boosted efficacy of a moderately resistant canola line against a heavy load of pathogen inoculum (Peng et al., 2011b).

## Effects of phosphate solubilizing bacteria on yield and yield components of canola

Phosphorous is the second most important plant macronutrient after nitrogen, it is present in soils in organic and mineral forms, and is absorbed from soils as phosphates (Subbarao, 1988). However, phosphorous combines with other soil materials and these combined forms limit phosphorous movement in soils. Therefore, phosphorous becomes unavailable to plant root system, even when soil phosphorous concentration is high. To cope with this situation, plants use various methods to free soil phosphorous so that they can absorb it (Raghothama, 2005; Hammond et al., 2004; Vance et al., 2003). When plants face phosphorous deficiency, they increase carbohydrate entry into roots, which increases the root/shoot ratio (Sezai et al., 2006). Inoculating corn and sorghum with Azospirillum bacteria showed these bacteria increased phosphorous absorption in these plants through expanding their root systems (Fallik and Okon, 1988). The role played by organic acids in solubilizing insoluble phosphates is attributed to reducing pH, chelating cations, and competing with phosphorous for occupying absorption sites in the soil. Moreover, it was reported that organic acids may form soluble complexes with metal ions such as calcium, aluminum, and iron bonded with phosphorous, thereby freeing phosphorous (Omar, 1998). Dehpouri et al. (2015) showed that phosphorous application on canola had significant effects on all characteristics except plant height and cutting height of plants at harvest. Results also revealed that the level of phosphorous application and inoculation, and their interaction effects, had significant effects on number of pods of main stem and per plant.

**Drought mitigation potential of Azospirillum inoculation in canola (Brassica napus)**

Deficiency of water causes injurious effects on plants by reducing growth, decreasing nutrient intake and changing water status of plants (ALi and Ashraf, 2011; Shabaz et al., 2011a). Compared to cereal crops, canola is ranked fifth after wheat, maize, rice and cotton (Cardoza and Stewart, 2003). Canola oil is a premium cooking oil that has less than 2 % erucic acid and is low in saturated fatty acids. It also is rich in mono – poly unsaturated fatty acids which helps to decrease cholesterol level (CarvaLoh et al., 2006; Omidi et al., 2010). Drought is one of the important stress factor which is responsible for reducing production of canola in semi-arid regions of the world. Plant growth-promoting rhizobacteria (PGPR) are able to promote growth and yield of plants under stress conditions. Inoculation of these microorganisms provides higher crop yield without interfering with natural processes in the ecosystem (thakore, 2006). During the last two decades, various bacteria (i.e., Azotobactersp., Azospirillum sp., Acetobacter sp., Bacillus, Pseudomonas sp.) are used for plant growth promotion under various prevailing biotic and abiotic stresses (turan et al., 2006). Azospirillumis one of the very effective Plant Growth Promoting Rhizobacteria (PGPR) which act as a general root colonizer to improve crop growth and yield up to 5 to 30 %. Azospriliumoffer inexpensive and easy application while providing minerals, and phytophormones as well as fixed nitrogen, and reduce the synthesis of ethylene thereby Increasing yield (Yasari et al., 2008). Azospirillum spp inoculation can improve tolerance to water stress, improve the growth of plants in arid and semiarid regions (lIyas and Bano, 2010). Various studies have documented the role of Azospirillum in improving growth and yield of canola (Baniagh Il et al., 2013). The impact of water deficit conditions on plant physiology has been studied for many years. The present study was conducted in order to evaluate the effect of Azospirillum inoculation on growth and yield of canola. Further, physiological and biochemical responses of canola under drought stress and the role of Azospirillumin mitigation of drought stress in canola were also studied.

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