

COPY RIGHT



ELSEVIER
SSRN

2020 IJEMR. Personal use of this material is permitted. Permission from IJEMR must be obtained for all other uses, in any current or future media, including reprinting/republishing this material for advertising or promotional purposes, creating new collective works, for resale or redistribution to servers or lists, or reuse of any copyrighted component of this work in other works. No Reprint should be done to this paper, all copy right is authenticated to Paper Authors

IJEMR Transactions, online available on 27th Nov 2020. Link

[:http://www.ijiemr.org/downloads.php?vol=Volume-09&issue=ISSUE-12](http://www.ijiemr.org/downloads.php?vol=Volume-09&issue=ISSUE-12)

DOI: 10.48047/IJEMR/V09/I12/91

Title: **Efficiency of Endophytic bacterial culture on yield and yield attributes of groundnut**

Volume 09, Issue 12, Pages: 514-518

Paper Authors

Kumar Naik, A. H. Umesha S, Basavaraj Naik, T.



USE THIS BARCODE TO ACCESS YOUR ONLINE PAPER

To Secure Your Paper As Per **UGC Guidelines** We Are Providing A Electronic Bar Code

Efficiency of Endophytic bacterial culture on yield and yield attributes of groundnut

¹Kumar Naik, A. H. ²Umesha S and ³Basavaraj Naik T.

¹Assistant Professor, Department of Agronomy, ZAHRS, Babbur farm, Hiriya-577598

²Research Associate, Natural Farming Project, ZAHRS, Babbur farm, Hiriya-577598

³Senior Farm Superintendent, ZARS, CoA, Navile Shivamogga-577225

umesayadav.s@gmail.com

Abstract— Field experiments were carried out for three consecutive years conducted during 2016, 2018 and 2019 during kharif season at Zonal Agricultural and Horticultural Research Station, Babbur farm, Hiriya, Karnataka, India to study the alleviation of moisture-deficit stress in groundnut by application of endophytic bacteria under rainfed conditions. The experiment was laid out in randomized block design with three replication and eight treatments. The pooled results of three years revealed that treatment having DGREB-3 culture with intercultural operations significantly recorded higher pod yield (1022 kg ha^{-1}) as compared to control (693 kg ha^{-1}) and it is on par with any DGREB culture (T_2) with two intercultural operations (909 kg ha^{-1}). Any DGREB culture with two intercultural operations significantly recorded highest nodulations at 30 and 60 days (50.2 and 57.8) as compared to control (20.6 and 33.7). In case of higher gross returns (Rs. 46,565), net returns (Rs. 16,997) were recorded with DGREB-3 culture with intercultural operations. Whereas highest B:C (1.66) was recorded with any DGREB culture with two intercultural operations.

Key words: Endophytic bacteria, DGREB culture, Groundnut

Introduction

Now a day's agriculture has been largely achieved through the use of farm equipment, high-yielding crop varieties, intensive tillage, irrigation, fertilizers, pesticides and other manufactured inputs (Foley *et al.*, 2005). However, detrimental effects of the agricultural practices on soil ecology, high irrigation needs as well as effect on human health have been recognized. Therefore new environmentally

benign approaches have to be employed to maintain sustainable agricultural production through endophytic bacteria and to overcome threats that lead to loss of crop yield, including plant stresses associated with unfavourable environmental conditions, such as drought, extreme temperatures and soil salinity as well as biotic stress induced by plant pathogens and pests.

The group of endophytes and their existence have been traced in the fossil records suggesting that endophyte-host association may have evolved from the time of emergence of first higher plants on earth (Rodriguez & Redman 1997, Strobel 2003). Endophytic bacteria are a class of endosymbiotic microorganisms that live in internal plant tissues of apparently healthy host plants (Schulz, Boyle, 2006). Unlike phytopathogens, such bacteria do not normally cause any substantial disease symptoms. The endophytes aid nutrient availability and uptake enhance stress tolerance and provide disease resistance (Hamilton *et al.*, 2012). Plant growth promoting capability of endophytes could be directly established through production of plant growth hormones, interactions that alter endogenous plant hormone production or activity that increases accessibility of nutrients, such as nitrogen and phosphorus (Glick, 2012). Plant disease resistance promoting properties are associated with the ability of endophytic bacteria to produce a wide range of compounds such as antibiotics or chitinase enzyme, which can inhibit growth of plant pathogens and thus act as biocontrol agents (Brader *et al.*, 2014, Wang *et al.*, 2014). Endophytes were also shown to stimulate a latent disease defense mechanism, termed as induced systemic resistance (ISR), that confers an enhanced level of protection to a broad spectrum of pathogens (Pieterse *et al.*, 2014). In this context, there is a strong case for using endophytic bacterial

cultures can provide beneficial effects on groundnut, directly by enhancing crop nutrition or indirectly by reducing damage caused by environmental stress like drought.

Materials and Methods

The proposed field study was conducted at Zonal Agricultural and Horticultural Research Station, Babbur farm, Hiriyur, Karnataka, India during *kharif* seasons of 2016, 2018 and 2019. The experimental site was situated between 13° 57' 32" North latitude and 70° 37' 38" East longitude at an altitude of 606 metre above mean sea level and comes under agro climatic zone-IV (Central dry zone of Karnataka). The soil of the experimental plot was block in texture and alkaline in reaction. The soil has an organic carbon content of 0.41 per cent and was low in available nitrogen 205 kg/ha, high in phosphorus 23.0 kg/ha and potash 321 kg/ha. The experiment was laid out in randomized block design with three replications. The experiment consisted of eight treatment combinations of seed treatment with different DGREB series cultures. The cultures obtained from National Research Centre for Groundnut (NRCG), Junagadh. Seed treatment with DGREB series culture @ 20g/kg of groundnut was done by sticking solution (jaggary solution @ 125g/liter water) on seeds and it was mixed thoroughly. Seeds were air dried in shade after treatment and then used for sowing. A recommended dose of nitrogen, phosphorus, potash and at 45 days after sowing gypsum was applied. The crops were sown under rainy

season but after cessation of monsoon five irrigations each of 50 mm depth were given to groundnut crop at an interval of 15 days. Pest and disease control measures were taken as and when required. The total rainfall received during 2016, 2018 and 2019 was 312.2 mm, 490.4 mm and 788.4 mm, respectively.

Result and discussion

Growth and yield attributes

The growth and yield attributes of crops differed significantly during first (2016), second (2018) and third (2019) year of experiments and the pattern of response to endophytic bacterial cultures application was similar in all the three years. Therefore, only pooled data of the three years are used to highlight the results and discussed in this chapter (Table 1, 2 & 3).

There is no statistically difference between the plant populations among the treatments. The highest number of branches per plant (3.9), nodule count at 30 and 60 days after sowing (50.2 and 57.8, respectively) were recorded by any DGREB culture with two intercultural operations (T_2). Whereas, significantly higher number of pods per plant (29.7) and 100 kernel weight (40.7 g) were recorded in treatment receiving DGREB-3 culture with intercultural operations (T_3). They may confer benefits to their host plants *via* multiple mechanisms including biological nitrogen fixation (Doty, *et al.*, 2016) enhancing the bioavailability of phosphorous (P), iron (Fe) and other mineral nutrients (Bulgarelli, *et al.*, 2013), production of phytohormones including

indole acetic acid (IAA), abscisic acid (ABA), gibberellic acid (GA), brassinosteroids (BR), jasmonates (JA) and salicylic acid (SA) (Fahad, *et al.*, 2015), generation of antioxidants for increased plant productivity and tolerance to biotic or abiotic stresses.

Pod yield and Economics

The pooled analysis of the data indicated that, DGREB-3 culture with intercultural operations (T_6) recorded significantly higher pod yield, kernel yield and haulm yield (1022, 619.3 and 1369 kg/ha, respectively) (Table 4 and Fig.1). However, higher gross returns (Rs. 46,565), net returns (Rs. 16,997) was recorded with DGREB-3 with intercultural operations (T_6) and B:C ratio (1.66) was recorded with any DGREB culture with two intercultural operations (T_2) (Table 5 and Fig.1).

Pod Yield: In 2016, Pod yield differed significantly due to different DGRB cultures. The treatment DGREB-3 culture with intercultural operations (T_6) recorded significantly higher pod yield (929 kg/ha) and it was on par with (T_2) any DGREB culture (848 kg/ha), (T_8) DGREB-5 with inter cultivation (802 kg/ha), (T_7) DGREB-4 with inter cultivation (795 kg/ha) and (T_4) DGREB-1 with inter cultivation (770 kg/ha) as compared to other treatments and control. However, in 2018 only DGREB-3 culture with intercultural operations (T_6) recorded significantly higher pod yield (909 kg/ha) compared to other treatments. Whereas, 2019 DGREB-3 culture with intercultural operations (T_6) recorded significantly higher pod yield (1230 kg/ha) over

other treatment except (T₂) any DGREB culture (909 kg/ha).

Kernel Yield: Highest kernel yield noticed in 2016 was DGREB-3 culture with intercultural operations (T₆) recorded significantly higher pod yield (619 kg/ha) and it was on par with (T₂) any DGREB culture (552 kg/ha), (T₈) DGREB-5 with inter cultivation (546 kg/ha), (T₇) DGREB-4 with inter cultivation (532 kg/ha), (T₅) DGREB-2 with inter cultivation (524 kg/ha) and (T₄) DGREB-2 with inter cultivation (508 kg/ha) as compared to other treatments and control. In 2018, DGREB-3 culture with intercultural operations (T₆) recorded significantly higher pod yield (606 kg/ha) and it was on par with (T₂) any DGREB culture (539 kg/ha), (T₈) DGREB-5 with inter cultivation (533 kg/ha) compared to other treatments. However, in 2019 only DGREB-3 culture with intercultural operations (T₆) recorded significantly higher pod yield (632.9 kg/ha) compared to other treatments.

Haulm Yield: In 2019 highest haulm yield was recorded in (T₆) DGREB-3 culture with intercultural operations (1276 kg/ha) and it was on par with (T₂) any DGREB culture (1257 kg/ha) and (T₈) DGREB-5 with inter cultivation (1079 kg/ha) as compared to other treatments and control. Whereas in 2018, DGREB-3 culture with intercultural operations (T₆) recorded significantly higher pod yield (1249 kg/ha) and it was on par with (T₂) any DGREB culture (1230 kg/ha) compared to other treatments. However, in 2019 DGREB-3 culture

with intercultural operations (T₆) recorded significantly higher pod yield (1581 kg/ha) over other treatment except (T₂) any DGREB culture (1532 kg/ha). This is due to endophytic bacteria can help their host plants in getting increased amounts of limiting plant nutrients, which include nitrogen, iron and phosphorus (Glick, 2012). The endophytic bacteria produce an enzyme called 1-aminocyclopropane-1-carboxylate (ACC) deaminase that can hydrolyse ACC, which is a precursor of plant hormone ethylene. ACC degrading bacteria can bind to plant roots and cleave the exuded ACC into α -ketobutyrate and ammonia, and use it as a nitrogen source (Sun *et al.*, 2009). Thus, hydrolysis of ACC can alleviate plant stress, thereby improving plant growth under stress conditions.

Conclusion

Endophytic bacteria are the plant beneficial bacteria that thrive inside plants and can improve plant growth under normal and challenging conditions. They can benefit host plants directly by improving plant nutrient uptake and by modulating growth and stress related phytohormones. Indirectly, endophytic bacteria can improve plant health by targeting pests and pathogens with antibiotics, hydrolytic enzymes, nutrient limitation and by priming plant defences in sustainable agriculture system.

Acknowledgement

I would like to express our gratitude to National Research Centre for Groundnut (NRCG), Junagadh for provided endophytic bacterial culture (DGREB culture) in this research.

References

1. Brader, G., Compant, S., Mitter, B., Trognitz, F. and Sessitsch, A., 2014, Metabolic potential of endophytic bacteria. *Curr. Opinion in Biotechnol.*, 27: 30–37.
2. Bulgarelli, D., K. Schlaeppli, S. Spaepen, E.V.L. van Themaat, and P. Schulze-Lefert, 2013, Structure and functions of the bacterial microbiota of plants. *Ann. Rev. Plant Biol.* 64:807–838.
3. Doty, S. L., Sher, A.W., Fleck, N.D., Khorasani, M., Khan, Z., Ko, A.W.K., Kim, S.H. and Deluca, T.H., 2016, Variable nitrogen fixation in wild Populus, PLoS One 11 (5) e0155979, <http://dx.doi.org/10.1371/journal.pone.0155979>.
4. Fahad, S., Hussain, S., Banu, A., Saud, S., Hassan, S., Shaan, D., Khan, F.A., Khan, F., Chen, Y., Wu, C., Tabassum, M.A., Chun, M.X., Afzal, M., Jan A. and Jan, M.T., 2015, Potential role of phytohormones and plant growth-promoting rhizobacteria in abiotic stresses; consequences for changing environment. *Environ. Sci. Pollut. Res.* 22:4907–4921.
5. Foley, J. A., Defries, R., Asner, G. P., Barford, C., Bonan, G., Carpenter, S. R., Chapin, F. S., Coe, M. T., Daily, G. C., Gibbs, H. K., Helkowski, J. H., Holloway, T., Howard, E. A., Kucharik, C. J., Monfreda, C., Patz, J. A., Prentice, I. C., Ramankutty, N. and Snyder, P. K. 2005, Global consequences of land use. *Sci.*, 309 (5734): 570–574.
6. Glick, B. R., 2012, Plant growth-promoting bacteria: mechanisms and applications. *Scientifica* : 1–15
7. Hamilton, C. E., Gundel, P. E., Helander, M. and Saikkonen, K., 2012, Endophytic mediation of reactive oxygen species and antioxidant activity in plants. *Fungal Diversity*, 54 (1): 1–10.
8. Pieterse, C. M., Zamioudis, C., Berendsen, R. L., Weller, D. M., Van Wees, S. C. and Bakker, P. A. 2014, Induced systemic resistance by beneficial microbes. *Ann. Review of Phytopathol.*, 52: 347–375.
9. Rodriguez, R. J. and Redman, R. S., 1997, Fungal life-styles and ecosystem dynamics: Biological aspects of plant pathogens, plant endophytes and saprophytes. *Adv. Bot. Res.* 24:170-193.
10. Schulz, B. and Boyle, C. 2006, What are endophytes? Microbial root endophytes, p. 1–13.
11. Strobel, G. and Daisy, B., 2003, Bioprospecting for microbial endophytes and their natural products. *Microbiol. Mol. Bio. Reviews*, 67(4):491-502.
12. Sun, Y., Cheng, Z. and Glick, B.R., 2009, The presence of a 1-aminocyclopropane-1-carboxylate (ACC) deaminase deletion mutation alters the physiology of the endophytic plant growth-promoting bacterium *Burkholderia phytofirmans*. *FEMS Microbiol. Lett.* 296:131–136.
13. Wang, M., Xing, Y., Wang, J., Xu, Y., Wang, G. 2014, The role of the *chil* gene from the endophytic bacteria *Serratia proteamaculans* 336x in the biological control of wheat take all. *Can. J. Microbiol.* 60 (8): 533–540.