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# Is There Such A Thing As A Seed Inoculant For Wheat And Corn?

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The high price of nitrogen fertilizer this spring has many wishing that wheat and corn were more like soybeans and provide its own nitrogen needs. This leads to the question whether there is such a thing as a seed inoculant for wheat and corn, analogous to the seed inoculants used with soybeans and other legumes. The short answer to the question is 'yes and no', or in other words, 'it depends'.

Sofie Dobbelaere, Jos Vanderleyden of the Catholic University Leuven and a pioneer in this field of research, Yaacov Okon, of the Hebrew University of Jerusalem published an excellent review in 2003 on the subject matter. We have taken the liberty to give you a 'Cliffs Notes' version of the review as a means to answer the posed question.

Bacteria in the genus *Rhizobium* and several closely related genera are well known for their ability to fix atmospheric nitrogen in a symbiotic relationship with the roots of legumes (e.g., soybeans, alfalfa, peas, and clover). In this symbiotic relationship, nodules are formed on the roots of the host and the ammonia produced by the bacteria is used by the plant. There are, however, also free-living and associative $N_2$-fixing, or diatrophic bacteria in the rhizosphere. The first rhizosphere diatroph was identified as early as 1925 and in the 1960s and 1970s researchers were very optimistic about the potential of these associative diazotrophs to provide nitrogen to crops other than legumes.

Conclusive evidence that an associative diazotroph directly provides nitrogen to the host plant has only been found in sugarcane. In other crops, including wheat and corn, the evidence that an associative diazotroph like *Azospirillum brasilense* provides any nitrogen to the crop

directly have been inconclusive. The amount of nitrogen fixed appears to be low and the mechanism to make the N available to the plant appears to rely or death and decay of the bacterial biomass rather than excretion of the accumulated N as is the case with the *Rhizobium* spp.

On the other hand, the research has yielded evidence that rather than $N_2$-fixation, the bacteria may have a direct effect on the growth and development of plants with the production and export of plant growth regulators or phytohormones. Inoculation with *Azospirillum brasilense* causes an increase in the number of lateral roots and root hairs in several crop species, including wheat and corn. Further research has shown that this increase is caused by the production of auxin, cytokine, and gibberellin-like substances. The increased root biomass has been used to explain the observed alleviation of water stress and the improved uptake of nutrients, and eventually plant growth. Furthermore, there is evidence that associated diazotrophs solubilize inorganic as well as mineralize organic phosphate, and ward off pathogenic micro-organisms.

In field research, the observed effect has not yielded consistent improvements in (grain) yield or (grain) quality except for the use of *Acetobacter diazotrophicus* in sugarcane. Inoculation concentration has been shown to be one factor that impacts the response to inoculation with higher inoculum concentrations even having a negative effect on root development. The yield effects appeared to more pronounced in lighter soils, when the organic matter content was low, and when the amount of N fertilization was low. In summary, the authors concluded that, although associative diazotrophs held promise, the practical application were limited until such time that results were more repeatable and predictable.

Sources:

Dobbelaere, S., J. Vanderleyden, and Y. Okon. 2003. Plant growth-promoting effects of diazotrophs in the rhizosphere. *Critical Reviews in Plant Sciences*, 22 (2): 107-149.