

The Effects of Carboxin-thiram on Associative Relationships between *Azospirillum* Species and Wheat (Chamran Cultivar)

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Introduction: Biofertilizers have been identified as alternative to chemical fertilizers to increase soil fertility and crop production in sustainable farming systems. One of the most useful kind of biofertilizers include plant growth promoting rhizobacteria (PGPR). *Azospirillum* is an associative rhizobacteria which can be very useful for plants such as wheat. It can help plant by fixing nitrogen through biological way, causing root development, plant strength improvement in primary phases, causing germination percent increment, improving plant tolerance in stress situations (drought, salinity, soil compaction and pathogens), secreting plant promoting hormones like cytokinin, Oxin and finally yield increment will be observable. Modern agriculture largely relies on the extensive application of agrochemicals, including inorganic fertilizers and pesticides. Although pesticides are important, their effects on nontarget organisms are of great concern because this poses a risk to the entire ecological system. The fungicides may also adversely affect the soil microflora, especially the types of microorganisms that can be applied to seeds as bacterial inoculants. Considering useful effects of plant growth promoting rhizobacteria especially *Azospirillum* on Wheat, this study was done in order to survey interaction effects between fungicide and available biofertilizers in Iran market.

Materials and Methods: Effect of carboxin tiram in 2 levels (applied, non-applied) as fungicide, on efficacy of wheat plant (Chamran Cultivar) and final crop yields under association conditions with 5 *Azospirillum* species (*A.brasilense*, *A.lipoferum*, *A.halopraeferense*, *A.irakense*, *A.sp*) using powdery and liquid formulation were studied in a greenhouse test for four months in Soil and Water Research Institute. At first some properties of used soil, including soil texture, pH, EC, organic carbon and available soil K, P, Fe, Zn, Mn and Cu were measured by laboratory methods. Nutrient Broth medium were used for bacterial inoculum production with 10^8 bacterial count per ml in final suspension. Using factorial experiment in a Completely Randomized Design (CRD), 2 bacterial inoculants factors (5 inoculation level and a non-inoculation level), CarboxinThiram fungicide levels (applied, non-applied) and two inoculants formulations (liquid and powdery) with four replicates per treatment and a total of 96 experimental units (pots), the most effective contribution of different species of *Azospirillum* bacteria with Chamran wheat varieties were evaluated in the presence of the fungicide. Studied Parameters included number of tillers, node interface, flag length, number of grains per spike, grain weight per spike, shoots wet weight, 1000 grain weight and shoot dry weight of wheat plant. Data were analyzed with SASS and Excel softwares. The comparison was done by Tukey test.

Results and Discussion: Regarding ANOVA table (table 2), liquid and powdery formulations of *Azospirillum* with different species had significant effect on 8 of 11 studied traits including number of tillers, plant height, spike length, node interface, flag length, number of spikes per square meter, grain weight in spike, shoot wet weight, shoot dry weight. Fungicide had effect on 2 traits such as number of grain per spike and grain weight spike independently. Bacteria and fungicide interaction had significant effect on number of tillers, node interface, flag length, number of grain per spike, shoot dry weight ($p < 0.01$) and shoot wet weight ($p < 0.05$).

Numeric comparison between similar treatments in presence and absence of fungicide, it can be concluded that although fungicide presence had no significant positive effects on studied traits, it did not have any negative effects either. Even it could increase traits quantity by affecting on bacteria. Also, regarding to Table 5, comparing fungicide effect on bacteria with studied trait in two formulations, it can be concluded that fungicide presence with bacteria was effective on quantity of some trait in powdery formulation and some in liquid formulation. These findings may be the result of fungicide effects in controlling soil born pathogens in compatible treatments with used bacterial inoculums.

Conclusion: As final result, using *A.lipoferum* with both formulations and *A.halopraeferense* with powdery formulation, because of high compatibility with carboxin thiram fungicide can be advised in case of fungicide

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application. This advice can have good effects on functional traits such as number of tillers, grain weight in spike and shoot dry weight. To consider the effects of environmental conditions on the final results we propose to do this experiment in field scale in some Iranian provinces with different climatic conditions. The use of different concentrations of carboxin thiram and also different kinds of PGPR and other fungicides must be considered in future experiments.

Keywords: *Azospirillum*, Carboxin-thiram, Inoculant formulation, Wheat

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