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CHASING THE MAIN PLEIOTROPIC EFFECTS IN LOW PHYTIC ACID1-1 MUTANT: A SUSTAINABLE SOLUTION TO NON-RENEWABLE PHOSPHORUS

COLOMBO F.*, BERTAGNON G.*, SANGIORGIO S.*, SINGH S.**, PILU R.*

*) Department of Agricultural and Environmental Sciences-Production, Landscape, Agroenergy, University of Milan, Italy
**) DBT- North East Centre for Agricultural Biotechnology, Assam Agriculture University, Jorhat, 785013, Assam, India

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Phosphorus (P) is an essential component of fertilizers and feed and in recent decades has become one of the main sustainability issues as a non-renewable resource. In plant seeds, the main reserve of phosphorus is phytic acid (PA), a strong anti-nutritional factor. In fact, only ruminants can degrade PA due to the presence of phytases in the digestive tract, while monogastric animals assimilate only 10% of phytate in feed and 90% is excreted, contributing to P pollution and water eutrophication. In this context, the reduction of PA in cereal seeds has become a major challenge in breeding programs to increase the nutritional quality of foods and feeds and to improve the environmental P sustainability in agriculture. Many low phytic acid (lpa) mutants have been isolated in all major crops and lpa1-1 is the most promising in maize, showing a 66% reduction in PA, followed by a proportional increase in free P. Unfortunately, the reduction of PA leads to many adverse pleiotropic effects on the seed and in general on plant performance. Aim of the present work is to study the two main pleiotropic effects in lpa1-1, i.e. the seed weight reduction and the susceptibility to drought stress.

First, we set up a two-year field experiment conducted on two different genetic backgrounds, B73 and B73xMo17. From the agronomic parameters collected, it emerged that under high-input conditions, in both the backgrounds lpa1-1 surprisingly showed equal or superior single seed weight and seed weight/ear than the controls, limiting the problem of the mutant

to the reduced field emergence.

Also, the greater susceptibility of lpa1-1 to drought stress was investigated: a dedicated field experiment was set up and measurements were carried out in two moments, under optimal water conditions and moderate drought stress. It was found that the sensitivity to drought in the mutant is mainly caused by an altered stomatal regulation, but not by a less developed root system, as previously reported. In fact, when water stress occurs, the parameters measured with CIRAS-2 did not significantly change in the wild-type, while dropped dramatically in lpa1-1: the net photosynthesis decreased by 58%, the transpiration rate by 63% and the stomatal conductance of the 67%.

Further breeding work on these mutants will be needed before the development of a commercial variety, which always remains the main goal to exploit the nutritional benefits of low phytic acid mutants.