

The Effects of Inoculation and N Fertilization on Soybean (*Glycine max* (L.) Merr.) Seed Yield and Protein Concentration under Drought Stress

Abstract— Using mineral fertilization is increasing worldwide, as it is claimed to be majorly responsible for achieving high yields; however, the negative impacts of mineral fertilization on soil and environment are becoming more obvious, with alternative methods being more necessary and applicable, especially with the current climatic changes which has imposed serious abiotic stresses, such as drought.

An experiment was made during 2017 growing season in Debrecen, Hungary to investigate the effects of inoculation and N fertilization on the seed yield and protein concentration of the soybean (*Glycine max* (L.) Merr.) cultivar (*Panonia Kincse*) under three different irrigation regimes: severe drought stress (SD), moderate drought stress (MD) and control with no drought stress (ND). Three N fertilizer rates were applied: no N fertilizer (0 N), 35 kg ha⁻¹ of N fertilizer (35 N) and 105 kg ha⁻¹ of N fertilizer (105 N). Half of the seeds in each treatment was inoculated with *Bradyrhizobium japonicum* inoculant, and the other half was not inoculated.

The results showed significant differences in the seed yield associated with inoculation, irrigation and the interaction between them, whereas there were no significant differences in the seed yield associated with fertilization alone or in interaction with inoculation or irrigation or both. When seeds were inoculated, yield was increased when (35 N) was applied compared to (0 N) but not significantly; however, the high rate of N fertilizer (105 N) reduced the yield to a level even less than (0 N). When seeds were not inoculated, the highest rate of N increased the yield the most compared to the other two N fertilizer rates whenever the drought was present (moderate or severe). Under severe drought stress, inoculation was positively and significantly correlated with yield; however, adding N fertilizer increased the yield of uninoculated plants compared to the inoculated ones, regardless of the rate of N fertilizer.

Protein concentration in the seeds was significantly affected by irrigation and by fertilization, but not by inoculation. Protein concentration increased as the N fertilization rate increased, regardless of the inoculation or irrigation treatments; moreover, increasing the N rate reduced the correlation coefficient of protein concentration with the irrigation.

It was concluded that adding N fertilizer is not always recommended, especially when seeds are inoculated before being sown; however, it is very important under severe drought stress to sustain yield. Enhanced protein concentrations could be achieved by applying N fertilization, whether the seeds were pre-inoculated or not.

Keywords—Drought stress, N fertilization, protein concentration, soybean.