Effects of Spraying Effective Microorganisms (EM) on Senescence in the Flag Leaf of Spring Wheat (*Triticum aestivum*)

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Abstract : *Senescence, especially early senescence, is one of the important limiting factors to grain yield in wheat cultivation. As the senescence progressed, photosynthesis, chlorophyll content and soluble protein concentration declined, and oxy-free radicals accumulated in leaves. Usually, delaying leaf senescence is beneficial to grain yield. A microbial inoculant containing many kinds of naturally occurring beneficial microbes known as Effective Microorganisms (EM) was introduced to crop and vegetable cultivation in recent years. Studies have shown that the inoculant has been effective in promoting growth, enhancing metabolic activity, increasing yield and improving quality. However, we know little about whether the inoculant affects leaf senescence. Therefore, a study was conducted to determine the effects of spraying EM on flag leaf senescence and grain growth process in spring wheat.*

The plants were grown in tile pots (0.30m tall by 0.20m diameter). Each pot was filled with 16 kg soil taken from surface of experiment field. Twenty-five plants were retained in each pot after thinning at 3-leaf stage. Three treatments were designed: Spraying water (CK), Spraying EM solution diluted at 1:1000(0.1% EM), and spraying EM solution diluted at 1:500 (0.5% EM) on the 2nd and 12th days after anthesis. Photosynthesis of the flag leaf was measured using a LI-6200 Potable Photosynthesis System (Li-COR Inc NE USA). Chlorophyll content was measured according to Arnon (1949). Soluble protein concentration was measured according to Lorry (1953). Malondialdehyde (MDA) concentration was measured using the thiobarbituric acid (TBA) method. Wheat ears were sampled every 5 days from anthesis to harvest, and dried at 80 . Dry matter accumulation of kernel was analyzed with Logistic equation, i.e, Y = K/(1+A e Bx), where Y is kernel weight; X is day after anthesis; and K is the maximum potential weight of kernel. Kernel growth rate was obtained by derivation of the equation.

Photosynthesis was much higher ($p<0.05$) at the stages of 14, 20 and 27 days after anthesis in 0.1% EM and 0.5% EM than in CK. Total protein concentrations were significantly higher at the stages of 9 days ($p<0.05$), 16 days ($p<0.01$) and 24 days ($p<0.05$) after anthesis in 0.1% EM and 0.5% EM than in CK. Plants treated with EM showed higher leaf chlorophyll content. The difference between EM treatments and CK was significant ($p<0.05$) at 16 days after anthesis, and very significant difference ($p<0.01\%$) was observed at 22 days after anthesis. Compared with CK, MDA concentration in 0.1% EM and 0.5% EM was significantly lower ($p<0.05$) at initial grain-filling stage (10 days after anthesis) and at fast grain-filling stage (20 days after anthesis). The analysis in kernel growth process and yield components showed that kernel weight was lower in EM treatments at earlier growth period and surpassed that of CK later; growth rate of kernel was higher in 0.1% EM and 0.5% EM than in CK; plants treated with EM developed more kernels per spike, bigger grain size and greater yield per pot than that treated with water (CK). It is concluded that, treatments of spraying diluted EM solution diminished decreases in concentrations of leaf chlorophyll, soluble protein and increases in MDA concentration during leaf senescence. This might be attributed to decreased membrane peroxidation in the same period with photosynthesis maintained to a relatively high level and as a consequence more dry matter accumulation was high shown by large kernel size and higher grain yield.