Using oxygen-releasing fertilizers to improve crop plant growth

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Lack of oxygen in soil, or hypoxia, is an environmental challenge to crop productions because shortage of oxygen bioavailability in soil can adversely impact seed germination and seedling growth. Over irrigation, flooding, and waterlogging can all cause hypoxic and anoxic problems often leading acute oxygen deprivation of plant roots by saturating pores in the soil. Additionally, big size seeds and fatty seeds such as corn and peanut seeds commonly suffer from hypoxia during germination. Specially, over one-year-old seeds often germinate poorly due to the shortage of bioavailable oxygen. Currently, there is no product available that can be used to alleviate the problems for crop productions even though there is 21% gaseous oxygen available in air because this gaseous oxygen is not applicable.

However, our recent discovery provides a new means to infuse the soil with an available oxygen source that promotes seed germination and seedling growth. The oxygen-releasing fertilizers are inert and stable in soil when there is no water. They will release bioavailable oxygen gradually as long as six months if the soil is flooded or over-irrigated. The fertilizers are environment-friendly.

The oxygen fertilizers improved markedly germination rate of corn seeds. The effects of oxygen fertilizers were significant as showed in the picture below (Figure 1). The germination rate for three-year old corn seeds was improved from 30% without oxygen fertilizer to 80% with oxygen fertilizer applied.

The oxygen fertilizers favor restoration of ecosystems in the wetland seawater intrudes. Our research showed that the fertilizers promoted survival rate and growth of bald cypress in the floodplain in the Loxahatchee River Watershed (Figures 2 and 3). Bald cypress is tolerant to flooding and also some extent tolerant to salinity but the species can not stand both stresses at the same time. Our research indicated that the stressed bald
cypress seedlings could survive and grow when oxygen fertilizer is applied. The field study proved that application of oxygen fertilizers significantly improved growth of the seedlings.

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Figure 1. Effects of bioavailability of oxygen on germination of corn seeds. The top pair: one day after treatment. The bottom pair: three days after treatment.
Figure 2. Effects of oxygen fertilizer (OF) of seedlings with 100% of roots submerged in H₂O and exposed to either 0 ppt NaCl or 8 ppt NaCl. Flooded plants exposed to 8 ppt NaCl and treated with OF grew better than flooded plants.

Figure 3. Effects of solid oxygen fertilizer (SOF) on growth of bald cypress seedlings in floodplain of the Loxahatchee River Watershed. CK = control. Different letters indicate significant difference (P ≤ 0.05).