

Effects of soil pH and Fe²⁺ content on growth and physiology of alfalfa

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Introduction Soils in the wet tropics contain high levels of iron that are toxic to alfalfa plants . The soils affected by iron toxicity are characterized by high iron concentration in the soil solution and low pH (Pathirana , 2002) . High concentration of water-soluble Fe²⁺ results in growth retardation or even death of alfalfa plants . In addition to high levels of iron , these soils also have a low pH which leads to damages of root growth and rhizobium development , as well as deficiencies of other nutrients such as P and Ca , which results in severe yield losses .

Materials and methods Seeds of WL525 were sown in 40 plastic pots with the size of 20 cm-diameter and 20 cm-height for each pot . The medium for seedling in the pots were the mixture of sand and FeSO₄ . The contents of FeSO₄ in the mediums were five levels , which were 10mg/kg , 50mg/kg , 100mg/kg , 150mg/kg and 200mg/kg . Each FeSO₄ level had eight pots . The pH of the mediums were adjusted to two levels of pH4 .5 and pH6 .0 by the way of placing each pot into plates containing modified 1/4Hogland nutrient with pH=4 .5 and pH=6 .0 until the Hogland nutrient over 3~5mm of soil surface in each pot . The adjusted pH work did one time every week . Each treatment has four repeats .

Results The rhizobium number , seedling number , shoot weight , root weight and shoot height were higher in pH6 .0 than pH4 .5 under the treatments of Fe²⁺ contents between 100 mg/kg and 150 mg/kg after 40d growth . But they were lower in pH6 .0 than pH4 .5 among Fe²⁺ treatments of 10 mg/kg , 50 mg/kg and 200 mg/kg , except for rhizobium number . With the increase of Fe²⁺ content in medium , the rhizobium number , seedling number , and shoot weight significantly decreased (p < 0 .05) in pH4 .5 , but the root weight and shoot height increased to highest value at Fe²⁺ content of 100 mg/kg and 50 mg/kg , respectively . There were no significantly difference (p > 0 .05) about seedling number , shoot weight and shoot height among the Fe²⁺ contents of 10 mg/kg to 100 mg/kg in pH6 .0 , but were significantly higher (p > 0 .05) than 150 mg/kg and 200 mg/kg . The rhizobium number significantly decreased (p > 0 .05) with the increase of Fe²⁺ contents in pH6 .0 , while shoot weight significantly increased (p > 0 .05) to highest value until Fe²⁺ content of 100 mg/kg , then significantly decreased (p > 0 .05) .

Conclusions When the Fe²⁺ content of soil were less than 50 mg/kg , the growth of alfalfa did not restricted by Fe²⁺ and lower pH , but the growth of alfalfa were significantly restricted when the Fe²⁺ content was over 100 mg/kg in pH4 .5 , and over 150 mg/kg in pH6 .0 . The significantly decreased rhizobium number in pH4 .5 may contribute to the yield losses of alfalfa in lower pH of native soil .

Reference

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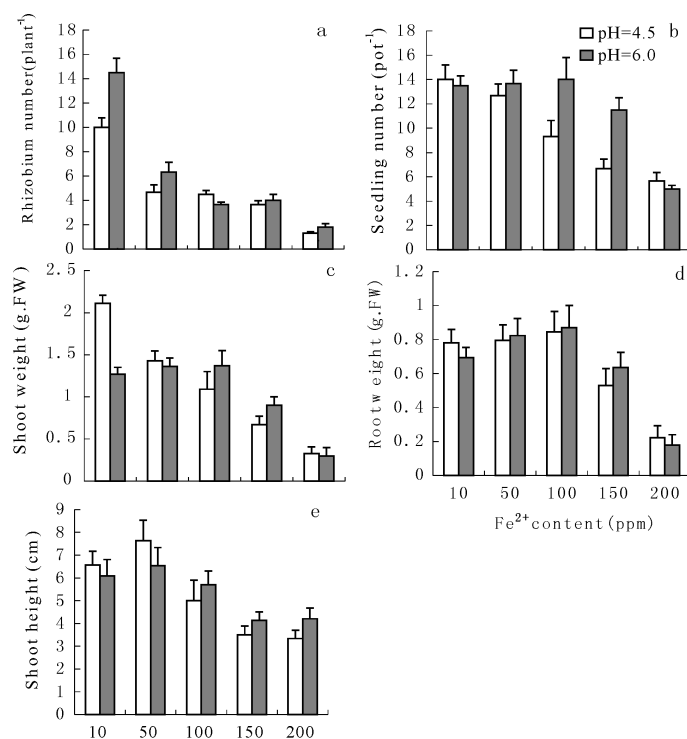


Figure 1 Changes of rhizobium number , seedling number , shoot weight , root weight and shoot height on different pH and Fe²⁺ contents .