Implications of Zinc Deficiency for Ameliorating Toxicity (Lathyrism) in Grasspea

John Ryan and Ali M. Abd El-Moneim

International Center for Agricultural Research in the Dry Areas (ICARDA), P.O. 5466, Aleppo, SYRIA (j.ryan@cgiar.org)

INTRODUCTION

In many areas of the world, agricultural production is constrained by drought, often to the point of causing severe food shortages and, in many cases, famine. The broad Middle East and North Africa region as well as parts of Asia typify such environments. In an effort to alleviate the adverse effects of drought, research has to consider staple food and forage crops. Invariably crop and animal production are interrelated in most dry-land farming systems. The International Center for Agricultural Research in the Dry Areas (ICARDA) has interest in East Africa, where the drought-tolerant forage crop grasspea (*Lathyrus sativus*) can be used as a food source in times of food scarcity because it survives and produces seeds when other crops fail.

Lathyrus belongs to the *Vicia* genus, which includes common Mediterranean legumes such as pea, faba bean and lentil. The genus contains 160 species and 45 sub-species, embracing food, forage and ornamental crops. Grasspea is related to dwarf chickling (*L. cicera*) and Cyprus vetch (*L. ochrus*).

Seeds of *Lathyrus* have been used for human and animal consumption since Neolithic times. Remains of seeds have been found on sites from the 4^{th}-3^{rd} Century BC. Currently, it is used as a "famine" food of last resort for at least 100 million people in countries such as Ethiopia, India and Bangladesh.

In addition to being drought tolerant, grasspea is suitable for low-fertility soils, resistant to insects and diseases, and easily cultivated. As a nitrogen-fixing legume, it is highly nutritious, having about 30% protein.

However, the major drawback with the crop is associated with a neurological disorder causing irreversible paralysis of the lower limbs if consumed in large quantities, e.g., over 25% of the diet. The causal agent is believed to be a toxin, a non-protein amino acid –N-oxalyl-L-a-b-diaminoproprionic acid (beta-odap). Animals are generally unaffected. The condition is frequently observed in soils that are depleted in Zn often due to leaching after flooding. Apparently, the problem of toxicity arises when the toxin exceeds 0.2% in the seeds. Neurolathyrism has also been associated with low levels of Zn in the brains of affected people. However, the precise role of Zn in neurolathyrism is unclear**.**

METHODS

We assessed the effect of soil applied Zn on the concentration of beta-odap in two *Lathyrus* lines (high, low) in two greenhouse trials and two field trials in a typical soil from the Mediterranean region (Calcixerollic Xerochrept) at the main ICARDA station of Tel Hadya in Northern Syria.

RESULTS AND DISCUSSION

While Zn increased weight of seeds and plants, it also decreased the toxin concentration in the seeds, an effect that was only partly attributed to a dilution affect.

CONCLUSIONS

Despite the importance of the toxic factor as a detriment to the safe use of grasspea seeds for human consumption, the problem can be solved by breeding for eliminated or reduced toxin contents. While Zn is required for the production of this hardy legume, it has a beneficial effect of reducing the level of the toxin, and thus mitigating the problem of neurolathyrism, especially where cultivars with low toxin concentrations are not available. In essence, the solution to the problem is selection and breeding combined with appropriate soil management.