

## Application of nuclear techniques in improving pasture/range management

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**Introduction** Nuclear techniques play an increasingly valuable and often unique role in agricultural research and development. They are one of the tools to solve problems for agriculture or natural resources which cannot be solved using conventional techniques. In this paper, the research activities carried out and the achievements so far obtained in the agricultural specialties with particular reference to pasture/range management—all by using nuclear techniques—will be given.

**Soil** Nuclear techniques are used to trace fertilizers to determine the best form, timing, and placement to avoid waste and to reduce its movement into the environment. Others are used to detect, measure, and track fertilizer-supplied nutrients in soil and plants; determine the availability of soil moisture; promote the natural process of nitrogen fixation. Nitrogen-15 ( $^{15}\text{N}$ ) and the soil-moisture neutron probe are nuclear techniques to determine the fate of applied N, to follow water and nitrate movement in the soil. Nuclear techniques like using fallout radionuclide to measure soil erosion are fully documented. Fallout radionuclides (FRNs), such as  $^{137}\text{Cs}$ ,  $^{210}\text{Pb}$  and  $^7\text{Be}$ , have proven to be very powerful tracers of soil movements and soil erosion measurements. Much of this work involves  $^{137}\text{Cs}$  to quantify soil loss risks at the watershed scale. Isotopic analysis (particularly of chlorine) is being used to monitor the movement of saline water and to assess the suitability of the salt-tolerant plants.

**Livestock** Doubly labeled water ( $^{18}\text{O}$  and  $^2\text{H}$  labeled) method is for estimating of energy expenditures of grazing animals, body composition, basal metabolic rate, and milk output.  $\text{NaH}^{14}\text{CO}_3 / \text{NaH}^{14}\text{CO}_3$  infusion is for estimating of the carbon dioxide production which in turn is used to estimate energy expenditure in free-ranging animals. ELISA (*Enzyme Linked Immuno Sorbent Assay*) is a specific kit which can be used to diagnose low levels of disease at laboratory level. It is well known for its use in the campaign to eradicate rinderpest (infectious bacterial disease of cattle and sheep) in Africa. Adding radioactive and stable isotopes in producing of feed supplement as markers to determine how feed material is digested, how the different nutrients are utilized and to discover any deficiency or imbalance in nutrients.

**Plant, pest and weed management** Improved plant varieties can be produced by mutation breeding e.g. gamma irradiation. It has produced varieties with ability to withstand flooding and tolerance of drought stress. In West Africa, *sorghum*, is undergoing irradiation treatment and, in field trials, some of the new mutant varieties produced have demonstrated increases yield of 30-50%, higher protein content and earlier maturation compared to local cultivars.

Sterile Insect Technique (SIT) is one of the well-known nuclear-based methods to eradicate dangerous insects and pests. The males are irradiated with gamma radiation, which renders them sterile. Then the large numbers of sterile males released out and no offspring result from these sterile mating. Nuclear Polyhedrosis Virus (NPV) is a lower cost and new solution instead of chemical sprays to control the pest. The herbicide, N-phosphonomethyl glycine (glyphosate), is a non-selective foliage-applied herbicide used extensively for the control of many types of perennial weeds.

**Conclusions** Isotopes and nuclear techniques are very crucial in understanding how various factors influence water-soil-plant-livestock interrelationship in pasture and rangeland ecosystems. Nuclear techniques provide particularly strong tools to understand the mechanisms by which nutrients and water interact. There has been little development of this technique applications in range and pasture management directly. Until now, most attempts have been done to apply the technique to improve agricultural products supply for human demand in developing countries.

### References

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