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}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}Cs , ^{210}Pb and ^{7}Be , have proven to be very powerful tracers of soil movements and soil erosion measurements . Much of this work involves ^{137}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}O and ^{2}H labeled) method is for estimating of energy expenditures of grazing animals , body composition , basal metabolic rate , and milk output . $NaH^{14}CO^{3}$ / $NaH^{14}CO^{3}$ 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 . 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 .

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