

Significant Role of Radio Chemistry in Agricultural Development

Suryanarayana Raju Sivangi, Sreerama Murthy Chalumuri

Department of Chemistry, GIET Engineering College, Andhra Pradesh, India

Abstract:-Radio isotopes are having significant importance in various fields which includes several life processes. Sustainable maintain of nutrient supply to the plants is so vital in growth of the plant kingdom. Several methods are under practice for the supplement of nutrients and the corresponding activity during crop maintaining period. Traditional methods of studying nutrient uptake and absorption by agricultural plants and their translocation in various parts of the plant and root system at different soil depths, were replaced by the sophisticated method of application of radio isotopes by which the activity at any subsequent process or location can be identified and determined. The mechanism of foliar application of the tagged (ratio active) nutrients involve by spraying the same on the leaves, stems, fruits and its translocation to different plant parts will be traced by the path way of the nutrients to various plant parts. The rates of absorption and transport of nutrients in sprays and their contribution in plant metabolism are well discussed.

Key Words - Agricultural Plants, Life Processes, Nutrients, Plant metabolism, Radio Isotopes

I. INTRODUCTION

Advanced methods of investigation in agricultural research are very much needed globally along with growing population for better living and survival of animal, plant and human folk in the world scenario. However, several methods are under utilization for sustainable development of crop growth. Traditional methods of finding out the nutrient uptake and its translocation in different parts of the agricultural crops are being replaced by the application of radio-isotopes as the activity at any condition and any particular location can be identified and further determined. Since the procedure is found as a well substitute for critical chemical analysis, more precise and sensitive than any traditional methods of analysis, it can be adopted for betterment of agriculture related activities.

II. DISCUSSION

About Radio Isotopes

The atoms of the same element, but of different atomic weights or mass numbers are called isotopes. Radio isotopes differ from stable isotopes in which the protons and neutrons of the nuclei are in an unstable arrangement and undergo spontaneous disintegration. They are chemically identical with their non-radioactive counter parts and pass through the same physical, chemical and biological processes

as the stable isotopes. Their special characteristics are of special interest in applying the same for different applications which includes agriculture.

III. APPLICATIONS

Studies on Nutrient Uptake and translocation in Plants

Micronutrient elements are required in very small quantities by plants for normal growth and reproduction. The required concentration is well below 1 ppm. The common elements are Iron, Boron, Copper, Manganese, Zinc and Molybdenum. The problems are primarily metabolic ones. Others involve the study of factors affecting their solubility, absorption and translocation of the elements by higher elements. Radio isotopes have been used in the usual way to trace the path and rates of translocation and identified by the areas of concentration of elements in plant tissues. These techniques often represent savings in labour and time [1], [3].

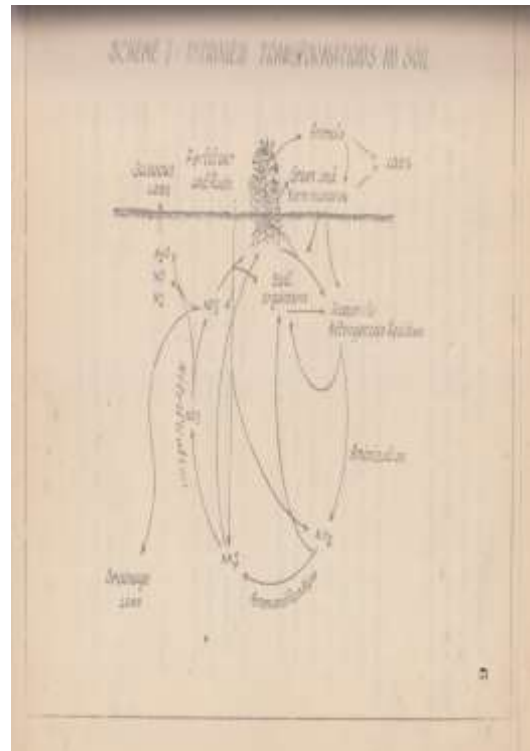


Fig. 1 Nitrogen transformations in soil

It has been observed that deficiency of Iron occurs when the plants are grown in soils containing excess of soluble manganese. Manganese has been found to interfere with the movement of Iron from roots to leaves by establishing a redox potential that oxidise Iron to the insoluble Ferric salts. Excess of copper also effects Iron translocation in a similar way.

Studies on Root Development of Plants

Radio tracer techniques have been successfully applied in the investigations of growth of roots of higher plants besides furnishing anchorage. Roots absorb and conduct the water and nutrients essential for their life to the other parts of the plants. In some plants they serve the function of reproduction and food storage [3].

Conventional methods of studying the distribution of plant roots under a given environment are based on trenching around the plant and removing the soil from the roots. The soil moisture depletion method of root study is also laborious and ineffective in regions of high rain fall [5].

Tracer methods using certain dyes in specific sites in the soil to indicate when roots absorb from the point of placement are now replaced by the substitution of P^{32} in pre determined pattern. Measurement of activity of plants and P^{32} uptake at regular intervals gives knowledge about the progressive development of the root system. This in turn helps to determine the appropriate timings and placement of fertilizers. Rate distance and direction of root penetration can be studied by radio tracer method with moderate ease and accuracy [6].

The degree to which root attacking insects and diseases impair the absorption and translocation functions of plant roots can also be studied by careful placement of radioactive tracer and measurement of radio activity of the above ground growth.

Study of Rooting Pattern

It is important to have knowledge of the extent and activity of the root systems of crop plant so as to gain an idea of the volume of soil from which the plant can obtain the nutrients and water that it requires.

Such information is most helpful in the determination of the placement of fertilizer for optimum utilization by the growing plant. A simple method for the study of the rooting system and habits utilizing radio phosphorus has been described by HALL. In essence, the procedure consists in injecting radio phosphorus in to the soil at specific locations relative to the plant and then determining the amount taken up by the plant at different times by the analysis of leaf and root tissue. By this the efficiency of root system of a given species in utilizing the added fertilizer under given conditions can be very well known [2],[4].



Fig. 2 Uprooted tobacco plant from experimental field (Light soil)

Nutrient uptake by Foliar Absorption

Radio isotopes permit tracing the path of nutrients in plants when they are applied as sprays to leaves, stems and fruits. The rates of absorption and transport of nutrients in sprays and their contributions in plant metabolism can be resolved by labeling the foliar applied nutrients and then distinguishing them in the plant from there which are absorbed by the roots.

$P-32$, $K-42$, $S-35$ and stable isotope $N-15$ are rapidly taken up by all arial plant tissues if there is active growth, within a few hours, and significant contribution to the nutritional needs of distant plant organs may be made after a single spray [8].

Environmental and other factors which effect the foliar absorption and transport are high humidity, temperature, incident radiation and vigorous growth. Chemical and physical properties of spray solution influence greatly the absorption. It has been further observed that radioactive, mineral absorbed by roots may be lost from leaves during rain fall [5]

It is probable that the mechanism of foliar absorption involves the passage of nutrients through intermittent parallel layers of pectinacious substances interspersed with the cutinised areas. The isotope is generally injected in to the leaf or the leaf is momentarily dipped into a solution under question. The different parts of the plant are examined for the transported radioactive substance by the technique of auto radiography [9].

IV. CONCLUSION

Conventional methods of perfect nutrient supply to the plants has been cumbersome due to climatic variations and resulting

to poor yields. Isotopes due to higher versatile nature can be adopted as the best source for supply of nutrients in particular commercial crops.

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