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The Efficiency of Nutrient use by Crops for Low Input Agro-Environments

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Mini Review

The development of high yield varieties (HYVs) occurred during the "Green Revolution", increasing agricultural yield. At this time, the paradigm of agriculture was based on the response of plants to the use of energy and fertilizers (considered at the time as inexhaustible sources), with intense mechanization and use of irrigation [1]. However, with the oil crisis in 1970, the new emerging paradigm for agriculture was based on adapting the plant to the environment, developing sustainable agricultural production systems (Symbiotic Nitrogen Fixation [SNF], no tillering system, green manure, etc.), with the stability of advanced but inexpensive crop production and its essential technologies [2].

Specially, in areas considered marginal for agriculture, because of its low fertility and frequent environmental stresses, the population grown faster, as stated by FAO [3], and thus, the use of more adapted varieties to low fertility and environmental stresses is essential [4]. The agriculture of the future, especially for human feed, needs to cultivates plants with greater efficiency in the use nutrients (NUE), using the so-called varieties with low-cost cultivation (LYVs), associated with the dissemination of sustainable cultural practices for these varieties [3]. The morphological characteristics of the LYVs is very distinct from HYVs with theirs small root volume and few organs harvested. Hen improved volume and depth of the root system, with yield stability, greater efficiency in the acquisition and use of nutrients, associated with the tolerance of the environmental stresses, must be characters used for the selection of LYVs, with satisfactory yield, but with lower cost of the crop [1].

The first approach to management strategies for nutrient stress is fertilizer use and organic matter management [5]. Adequate fertilizer application and simultaneous additions of organic materials and nitrogen fertilizers can increase nitrogen availability [4]. However, the SNF and inoculation of growth promoting bacteria and mycorrhiza plant associations for crops' nitrogen, phosphorus, and water acquisition, is an essential high technology with low input, needs to be enhanced [5]. SNF is an important source of plant nitrogen obtained from N2 in the air. This process must be better studied to improve its efficiency in supplying all nitrogen required by the crop or the green manure, improving nitrogen input in the agro-environment. The enhancement of SNF can be achieved by a better understanding of the plant genes and messengers involved in the process, which is less studied than the SNF bacteria, and the selection of efficient plants and bacterial strains [4].

In addition, management strategies for soil organic matter conservation and its incorporation, by green manure or other practices, are important for global changes because of soil carbon sequestration [2]. Pearl millet is now cultivated before the principal crop to produce biomass used to cover the soil in the minimal tillering system or for rotation during the low rainfall winter, recycling nutrients leached from the principal crop used in the rainy season [4]. Intercropping, especially grass with a legume such as pearl millet and cowpea, improved the pearl millet grain yield by 15 to 103% in semiarid West Africa [6]. Agroforestry, especially using leguminous trees native to marginal environments such as *Acacias spp*, *Prosopis spp*, *Faidherbia albida*, can be used for animal feeding and improve nitrogen addition in the soil by SNF [5]. This practice can reduce water and wind erosion, improving nitrogen supply for the intercropped culture [5].

Conclusion

Therefore, the future agriculture will continue to use HYVs, but it is important to select new LYVs and introduce them in marginal areas for agriculture to feed the growing population of the world..

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