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Editorial

Crop Nutrient Requirements and Advanced Fertilizer Management Strategies

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1. Introduction

From an estimated 7.6 billion people worldwide in 2021, projections of the United Nations (UN) indicate global population growth to around 8.6 billion by 2030, 9.8 billion by 2050, and more than 11.0 billion in 2100 [1]. As a consequence, the global total demand for all agricultural products is expected to increase by 1.1% per year until 2050. Therefore, challenge for the coming decades will be to ensure long-term food security of the ever-growing world population by increasing crop productivity using sustainable agricultural practices while, at the same time, maintaining soil health and preserving the quality of the environment [2,3]. This must be accomplished in the context of the shrinking availability of arable land and shortage of fossil fuels since many of the resources needed for crop production are limited (mainly agricultural land, water, and nutrients), making it indispensable that must be used responsibly [4,5]. The UN has set ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture among the 17 Sustainable Development Goals (SDGs) by the year 2030. Improving nutrient-use efficiency (NUE) and crop yield through improved nutrient management practices also ensures SDG 1 (no poverty), SDG 3 (good health and wellbeing), and SDG 15 (life on land). However, crop production depends on several interrelated agronomic factors, such as soil (e.g., pH, texture, organic matter content, water holding capacity, mineral composition, and nutrient availability, etc.), plant genetic material, crop management, and several other biotic and abiotic factors. Apart from soil testing and nutrient removal by harvestable products that are traditionally used to derive the amounts of nutrients required by the crop [6], the role of roots, which has often been neglected, should also be taken into consideration for better resource acquisition [7]. Crop nutrition and balanced fertilization (both from inorganic and organic sources) are considered among the primary actions towards satisfactory crop growth and production while decreasing production costs. Nutrient elements are essential resources for food, feed, and biofuel production, next to energy, water, carbon dioxide (CO_2), biodiversity, labor, capital, and management.

Sustainable nutrient management is critical to increase or maintain crop yields, and soil fertility must be consistently high in order to meet crop needs throughout a growing season [5]. To increase crop yields, elevated levels of nitrogen (N), potassium (K), and phosphorus (P)-containing fertilizers as well as other macro and micronutrients have been applied in croplands since the end of World War II, have prevented soil nutrient depletion, and, in some cases, have even built-up soil fertility (maintenance fertility) [8]. However, fertilizer recommendations are regularly at the fore of production and environmental concerns related to agriculture. At the same time, worldwide fertilizer use is forecasted to decline up to 7% (in a pessimistic scenario) before partial recovery, with food security implications a reflection of significant uncertainty in market conditions due to the war in Ukraine [9]. Balanced fertilization refers to the application of plant nutrients in optimum quantities and in the right proportions through appropriate methods and at the right times for a specific crop's needs and agroclimatic conditions [10–12]. In this context, the development of novel and sophisticated fertilization practices is the challenge for future nutrient management that helps to improve crop NUE, maintain adequate levels of soil nutrients, and prevent deficiencies or the imbalance or overuse of fertilizers, leading to economic and environmental benefits [13]. However, crop-specific information on nutrient management, including diverse nutrient sources as part of an integrated nutrient management as well as improving NUE by developing novel and practical fertilizer recommendations for farmers, needs to be further explored under diverse pedoclimatic environments. The role of plant roots should also be taken into account as key parameters for improving NUE, which is central but still under debate. It will provide a better understanding of how crop plants acquire water and nutrients through their roots and maintain growth and performance under diverse pedoclimatic conditions.

This Special Issue (SI) provides a base for revealing the principal mechanisms of enhanced NUE-related parameters in cropping systems, from the agronomic perspective to environmental considerations. Moreover, it focuses on the physiological basis of genotypic differences in the uptake and utilization of key nutrients, including the primary macronutrients nitrogen (N), phosphorus (P), and potassium (K); the secondary macronutrients calcium (Ca), magnesium (Mg), and sulfur (S); and the micronutrients iron (Fe), copper (Cu), manganese (Mn), zinc (Zn), boron (B), and silicon (Si) and provide demonstrated experimental data in order to optimize fertilizer management. It tries to identify the barriers that exist to the improvement of nutrient management and which interventions can lead farmers along pathways towards the adoption of novel and more profitable and sustainable fertilization strategies.

2. Overview of This SI

The Special Issue (SI) comprises 18 original research articles and one communication on various topics of rational crop nutrient management, reporting novel scientific finding updates and recent developments on fertilization strategies of crops with quite diverse utilizations: from primary arable crops used for both food and fodder, like wheat (*Triticum aestivum* L.), maize (*Zea mays* L.), and faba beans (*Vicia faba* L.), to forage crops, such as marandu grass (*Urochloa brizantha* cv. Marandu), to oil crops with food or non-food usage, like soybean (*Glycine max* L.), olives (*Olea europaea* L.), oil palm (*Elaeis guineensis* Jacq.), and oilseed rape (*Brassica napus* L.). It also includes crops for the brewing industry (malting barley, *Hordeum vulgare* L.) and the perfume and pastry industry (Rose scented geranium, *Pelargonium graveolens* L.). Moreover, dual-purpose crops such as cotton (*Gossypium spp.* L.) grown for fiber and oil purposes or multipurpose crops are also included in this SI, like hemp (*Cannabis sativa* L.), which is cultivated worldwide for fiber, oil, and cannabinoids for medical purposes; flax (linseed) (*Linum usitatissimum* L.) for human nutrition, cosmetics, and the pharmaceutical industry; and sugarcane (*Saccharum officinarum* L.) for agro-industrial uses and the pharmaceutical and the chemical energy sectors. The studies have been carried out under both field and laboratory conditions, as well as modelling studies, and a wide range of geographic regions are also covered: six studies originated from China; three from Egypt and Brazil; two from Poland, the Czech Republic, and the United States; and one from Tailand.

The aim of the study by Yang et al. [14] was to investigate N accumulation, assimilation, and utilization in four commercial domestic hemp cultivars, as well as the growth and physiological response of hemp to N concentrations in a pot experiment conducted in a greenhouse. Those aims were well covered by the results and provide more precise answers about hemp responses to N in controlled conditions, which could serve for field recommendations of N for hemp production in the future. The study suggests that N application up to 6.0 mmol/L (NO_3-N in the nutrient solution) is sufficient to regulate morpho-physiological attributes, antioxidant capacities, and N accumulation to achieve the optimal growth of hemp. The study also investigated root parameters (root weight, root to shoot ratio, root N) exploring the role of roots as key parameters for improving NUE.

Even though the use of imaging and Near-Infrared (NIR) applications to detect N status in cereal crops is not all that new, the main objective by Klem et al. [15] in their study was to improve prediction of N status in malting barley using multiple spectral reflectance wavelengths, by selecting vegetation indices, using N status indicators, and employing artificial neural networks. The employment of artificial neural networks in remote sensing provides a number of advantages in comparison to regression models. Increasing the accuracy of N status estimation in barley aboveground biomass by combining indirect N status indicators, such as N nutrition index (NNI) or N uptake, and an artificial neural network is expected to advance the potential impact to improve N nutrition of malting barley and avoid over fertilization. Combining NNI or N uptake and a neural network increased the accuracy of N status estimation to up 94%, compared to less than 60% for N concentration.

Sulfur (S) is an essential secondary macronutrient involved in the growth and development of plants. After N, P, and K, it is increasingly seen as the fourth major nutrient in plants. The role of sulfur (S) in plant growth and development, the functions of which include both being a structural component of macrobiomolecules and modulating several physiological processes and tolerating abiotic stresses, is still under debate. The topic of the article by Stepaniuk et al. [16] covers the dose and method of S application for winter oilseed rape, which is an important crop for edible oil and biofuel. Moreover, the optimization of mineral S fertilization is considered to be particularly important among agricultural practices to boost oilseed rape yields grown in a monoculture. In this respect, soil fertilization must be supplemented with foliar fertilizers, and their doses and dates should be defined correctly. The impact of S on winter oilseed rape yield depended significantly on both the dose and the application method. Even at the lowest dose (20 kg·ha^{-1}), S increased seed yield, regardless of the application method. Fertilization with S increased the mineral composition of rapeseeds, whereas the contents of macroelements in the straw were more variable than in the seeds. Each of the S fertilization treatments reduced the S harvest index. The findings of this study seem to be interesting since a fertilization scheme of winter oilseed rape plants growing in a monoculture could be suggested.

The inhibitors of nitrification and urease play an important role in sustainable fertilization strategies and the influence of nitrification inhibitors (NIs) on soil N losses are widely known. However, there is no solid information on the fate of fertilizers containing N-transformation inhibitors (NIs) in soil. It is still not clear how long the effectiveness of the NIs can last and what factors can affect their efficiency. More studies are required about factors that affect NI efficiency, which can help growers to use NIs in fields correctly. These issues were well addressed by three original articles [17–19] and one communication [20] in this SI and contribute to our better understanding on N management affecting the economic and environmental aspects of fertilization.

The study by Školníková et al. [17] compared the effect of conventional N fertilizers with those containing N-transformation inhibitors and evaluated the timings of their applications on the wheat-grain yield and quality. A single application of urea with NI and/or urease inhibitors resulted in a relatively average increase in the wheat grain yield, whereas grain protein content, and the Zeleny test values were significantly increased compared to the split N application. Significant increases in the grain yield (by 6.3%) and the Zeleny test value (by 16.5%) were observed after inhibited urea applications compared to the control treatment (without inhibitors).

The study by Torabian et al. [18] evaluated the impact of two different types of "nitrate stabilizers" (NSs), in combination with urea and urea ammonium nitrate as N fertilizer sources under two N application methods and rates (single and split applications; 100 and 85% of fertilizers) on grain yield, SPAD (flag leaf greenness), protein concentrations of wheat, and mineral soil N contents. The results demonstrated that selecting effective NSs, suitable N sources, reducing N rates, and splitting N fertilizers during the growing season could be regarded as practical strategies to reduce NO_3^--N leaching while not compromising the wheat yield. However, they highlighted the importance to carrying out trials based on multiple years and locations to draw solid conclusions on the effects of NSs and N management on potential yield benefits and the N dynamics of soils.

The objective of the study by Cassimiro et al. [19] was to evaluate ammonia volatilization and dry matter production of *Urochloa brizantha* cv. Marandu (a pasture crop) in response to rates (100 and 200 kg ha^{-1} year) and four N sources of enhanced-efficiency N fertilizers (Urea—UrConv; Ammonium nitrate—AN; Urea+NBPT—UrNBPT; Urea+Duromide—UrDuromide). When urea or UAN are applied to a soil, several factors, such as soil moisture content, high temperature, soil acidity, soil organic C and N, and high crop residues, can contribute to N loss (mainly by ammonia volatilization). These losses can reduce N availability, and, therefore, crop dry matter yield and quality. The findings of the study would inform N management strategies by incorporating urease inhibitors and reducing N losses by volatilization and contribute to the advancement of the knowledge of pasture production and quality.

NIs were originally intended to improve N retention in soil by blocking the microbial oxidation of ammonium (NH_4^+) to nitrate (NO_3^-). However, NIs also have the potential to alter other components of the N cycle, such as denitrification. The outcome of the communication by Li et al. [20] could provide information as to how improved N use efficiency through the use of NIs promotes crop growth and decreases N losses in soil and the atmosphere. They studied the effects of the inhibitors on denitrification rates, which remain largely unclarified. The study monitored the dynamics in annual denitrification rates affected by NIs from a maize field. Their results showed that the denitrification rates and denitrifying enzyme activities were highly variable in different growing periods but were not affected by the applications of inhibitors. Partial inhibition of the nitrification process was observed in the inhibitor treatments compared with the urea- or manure-only treatments. The formation of NO_3^--N and the nitrification rates could be markedly reduced by DMPP (3,4-dimethylpyrazole phosphate), whereas NO_3^--N availability did not affect the denitrification rates. To provide insightful information for our understanding of the achievement of inhibitors on the mitigation of N losses in arable soil under field conditions, more studies are needed under different sites to explore additional mechanisms driving changes over longer time periods.

The soybean (*Glycine max* L. Merr.) is an important legume crop and is widely grown as an oilseed crop and a protein source worldwide. Effective fertilization regimes to achieve a balance between grain yield, plant biomass, and quality traits, as well as to contribute to the promotion of the large-scale cultivation of soybeans under drip irrigation in arid areas worldwide, are provided in the work by Li et al. [21]. Such information will help in fine-tuned soybean fertilization management practices to increase yield, resource-use efficiency, and to minimize environmental risk. They confirmed that N fertilizer significantly affects grain yield, whereas P and K fertilizers influence harvest index and biomass, respectively. They have also gone one step further by describing the optimized combination of fertilizers for high yield, as well as biological and quality traits, by a quadratic polynomial regression analysis. They found that a fertilization combination of 411.6–418.4 kg ha^{-1} N, 154.0–251.0 kg ha^{-1} P_2O_5, and 117.8–144.7 kg ha^{-1} K_2O was required in order to obtain a theoretical grain yield and plant biomass of more than 7.21 tons ha^{-1} and 16.38 tons ha^{-1} with 300,000 plants ha^{-1}, respectively. They also proposed an economical fertilizer combination that could promote the use of profitable fertilizer in the future production of soybean.

The study by Duangpan et al. [22] contributed to the enhancement of our knowledge on improved Si fertilization and on the growth and physiological responses of oil palm seedlings and nursery production under non-stress conditions. Oil palm could be considered as an intermediate Si accumulator, and, therefore, Si-improved management is crucial for vigorous oil palm plantations. Overall, Si fertilization provided beneficial effects on growth and physiological responses in oil palm seedlings. Correlation analysis revealed a highly significant and positive association among Si accumulation, chlorophyll *a* content, photosynthetic rate, total fresh weight, total dry weight, and N content of seedlings, indicating that Si fertilization enhanced the performances of these attributes. It is important, however, to notice that Si application can be more effective in particular soil than others since Si solubility is dependent on soil pH, redox potential, particle size, and organic matter; therefore, the soil type should be concerned when applying Si fertilizer.

In view of the cost for the producer, harm to humans, and the environmental use of chemical fertilizers, nanofertilizers are emerging as a promising alternative to conventional fertilizers through their positive roles in slow releases of nutrients into soils and enhanced nutrient use efficiencies. The use of nanofertilizers as new technology fertilizers was addressed by the study by El-Sonbaty et al. [23], who evaluated the effectiveness of innovative iron (Fe) oxide nanoparticle fertilizer formulations (NPs) against traditional Fe compounds (sulfate or chelate) and on rose-scented geranium herbs in terms of plant growth, biochemical attributes, essential oil, and its constituents. The effects of Fe NPs on growth, secondary metabolites, and essential oil components of rose-scented geranium herbs are of great value for the application of nanomaterials in agriculture. Therefore, the manuscript contributes to increasing and improving our knowledge on new technological fertilizers, ways to alleviate Fe deficiency, and increasing Fe-use efficiency, providing a solid confirmation of the high effectiveness of a nanofertilizer on plant productivity and product quality over conventional Fe sources. Iron deficiency is commonly found in sensitive crop species grown in arid and semiarid regions with calcareous soils, which have been estimated to comprise over one-third of the total world's land area. Therefore, the study has impacts on several regions of the world, challenging similar issues and demonstrating the significance of using Fe NPs for commercial purposes while also being environmentally preferred in alkaline soils.

However, despite the fact that nanofertilizers are undoubtedly opening new approaches towards sustainable agriculture, one should consider the potential limitations of the commercial use of these fertilizers (i.e., interaction of nanomaterials with the environment, potential effects on human health, toxicities of different nanoparticles, evaluations of different soil physio-chemical properties before their uses, market considerations, etc.).

Balanced fertilization is the best agronomic practice for soil management in plants grown under stressed conditions. The study by Hussein et al. [24] evaluated the potential performances of two types of highly soluble phosphorus fertilizers (HSPFs), namely, monoammonium phosphate (MAP) and urea phosphate (UP), in comparison to the most widely used phosphate fertilizer, granular calcium super-phosphate (GCSP with a high pH > 7.0), in an attempt to overcome the problem of P fixation and the unavailability of micronutrients under some abiotic stresses in olive trees (*Olea europaea* L.), trees grown under multi-stress conditions (calcareous alkaline soils), which, in turn, affect the growth and productivity characteristics. In short, the application of HSPFs under these conditions might be an alternative surrogate to improve nutrient efficiency and thus improve olive productivity.

Of interest is the extensive work by Korzeniowska and Stanisławska-Glubiak [25], who presented results of micronutrient (B, Cu, Fe, Mn, and Zn) concentsationd in the shoots of 12 wheat, 10 maize, and 12 rape varieties obtained on the bases of plant and soil samples collected from 950 fields in Poland. Such research material is undoubtedly credential of the results obtained, and yet the literature provides little information on the variations in micronutrient concentrations in staple crop cultivars. They tested the hypothesis that the variations in the micronutrient contents in plants between varieties of the same species may be similar or even greater than the differences between species. These varieties may also show significant differences in micronutrient concentrations and thus require different fertilization techniques. This is also more relevant than ever nowadays, where breeders are constantly creating new varieties in search of crops that will have a better yield and be resistant to stresses, with better quality traits for the consumers. Differences were found in micronutrient concentrations between crop species and also between varieties. Even though these observations were not surprising, as different crop species and varieties have unique genetic backgrounds, the study concluded that the cultivar should be taken into account when assessing the need to fertilize wheat, maize, and rape with Cu, Fe, and Mn, whereas the assessment of the need for fertilization of these species with B and Zn could be carried out independently of the cultivar used. When fertilizing certain crops with micronutrients, it would be advisable to take into account not only the nutritional needs of the individual species but also the adaptation of micronutrient doses to the requirements of the cultivars within the species. Such a measure could contribute to a more efficient use of fertilizers in line with sustainable agriculture. Moreover, further research should confirm to what extent the concentrations of micronutrients in the early stage of growth affect the size of the final crop yield.

As an initial step to (i) determine crop nutrient demand corresponding to different target yields, (ii) estimate soil nutrient supply dynamics, and (iii) determine corresponding nutrient application rates and timings, theoretical models are needed for relating plant growth dynamics and crop nutrient uptakes, soil nutrient supplies and climates, and crop nutrient uptakes and yield component formations. Phosphorus, an essential macronutrient for plants, is often available at insufficient levels, limiting crop yield and productivity. The critical dilution curve (CDC) for phosphorus (Pc) was proposed as a suitable analytical tool to assess the flax (*Linum usitatissimum* L.) P nutrition status using four field experiments, with five P applications in the study by Xie et al. [26]. The Pc dilution curve could be useful as a reference curve to assess flax's nutritional status through the P nutrition index (PNI). Although the Pc dilution curve as a simple, accurate, and more rapid tool to diagnose crop P status tools has been used in crop production worldwide, the Pc concentration curve on the capsule dry matter of flax has not been reported. Curves of Pc have been established for a range of crops, such as potato, wheat, timothy, mungbean, urdbean, rapeseed, and maize, defining scenarios of luxury (excess), sufficiency, and deficiency for plant nutrient statuses, but work on the Pc dilution curve for flax for optimizing seed yield, grower profits, P-use efficiencies, and reducing environmental risks is meagre in the literature. Moreover, Pc dilution curves vary among different regions, species, genotypes within species, and practice managements. The results by Xie et al. [26] validated that the capsule Pc dilution curve could be an alternative and more rapid tool to diagnose flax P statuses to support the precise decisions of P fertilization during the reproductive growth of flax in a semi-arid to arid continental climate (Köppen *BSk* or *BWk*).

Under the same climatic conditions, Xie et al. [27] extended their research and studied the relationship between the increase in soil P fertility and the P and N contents in flax to build the model for critical P concentration in this plant as a function of N concentration in a shoot of flax for diagnostic purposes. This work provided a diagnosis tool that used the relationship between P and N concentrations for the entire growth period to estimate the critical P concentration for quantifying the degree of P deficiency. This tool could be used to adjust P fertilization in the following growing seasons for the species-specific conditions of an approximate soil pH of 8.

The need to increase the efficiencies of phosphate fertilizers in tropical soils, and the lack of information about the issue, motivated the hypothesis by Oliveira et al. [28] that the application of a polymer-coated fertilizer raised phosphate fertilization efficiencies and crop yields. The aim of the study was the evaluation of the effects of phosphate fertilizers with (Policote coating—fixation inhibitors) and without polymer coatings on the productivity and nutritional status of sugarcane ratoon and its effects on soil phosphorus availability for tropical soils with low P agronomic efficiencies. This was in light of the global importance of sugarcane, the crop requirements during the cycle, and low P levels in highly weathered soils. Increasing the longevity of sugarcane ratoons is of utmost importance; however, it is necessary to understand the best way to reapply P fertilizers. This original research paper was interesting because it showed sugarcane ratoon's yield, nutritional status, technological quality, and soil phosphorus availability in response to an enhanced efficiency phosphate fertilizer. Their results indicated that fertilizers with or without a Policote coating induced positive responses in soil P. The P contents varied with the applied doses. The treatments did not influence the concentration of P in the leaf. The technological qualities of cane stalks varied between the studied growing seasons, with better results in the second year. They suggested that further research should be encouraged to understand the dynamics between polymers, the availability of P in soil, and the possible effect on the physiology and production of enzymes that may contribute to nutrient-use efficiency.

Legumes have traditionally been used in cropping systems as part of crop rotations and are also intercropped with other crops (especially cereals). Cereal and legume intercropping for cereal yield and grain protein improvements is common worldwide practice, but the role of intercropping in grain quality has not yet fully understood. The study by Zhu et al. [29] quantified the effect of intercropping (wheat and faba bean intercropping) on wheat grain protein and amino acids under different N input conditions, and they identified the impact of intercropping on the relationship between GY and quality. The research study provided a unique contribution of intercropping technology on grain quality with specific references to proteins and associated amino acids that are essential for human health. Although intercropping has central role in this paper, it also recognizes that intercropping yield advantages can be modified by different N levels. It concludes that N management should be taken into account to achieve both intercropping yield and quality advantages.

Cotton is a dual-purpose crop grown for fiber and oil purposes. Under field conditions, various factors such as environmental conditions and agricultural management practices can significantly influence cotton growth and productivity. Among them, the optimization of crop nutrition by synchronizing nutrient availability with crop demand are key elements for sustainable nutrient management in cotton production. The aim of the study by Amissah et al. [30] was to assess the impact on the productivities and fiber qualities of modern cotton varieties to varying degrees of nutrient stresses (early (E) and late (L) season) under different production conditions. Late stress (30–40% of the full nutrient rates, only at the initial stage of planting) decreased the lint and cotton seed yields by 34.4% and 36.2%, respectively, across all production conditions. Compared to the full nutrient rate, the E-stress (no nutrient application early in the season, but the full rates were split-applied equally at the initiation of squares and the second week of bloom stages) did not adversely impact cotton yield. Significant nutrient stress effects on fiber quality were observed, but the magnitude of the differences was small, and it did not affect the grading class. The minimal impact of E-stress on cotton yield and quality in this study suggested that the rates of nutrients often applied in the early season could be reduced. The study concluded that soil and plant tissue analyses could assist in applying tailored nutrient application rates shortly before the reproductive phase of the crop synchronizing nutrient availability with crop demand.

Soil salinity and alkalinity are among the major challenges that threaten food security globally. Climate change will have a negative impact on agriculture, particularly in arid and semi-arid regions. In semi-arid and arid regions, soil salinity is a major and widespread threat to crop yields, food security, and the environment. Soils in arid and semi-arid regions are commonly alkaline, with high pH values as a result of water scarcity, in addition to low precipitation and high potential evapotranspiration. Therefore, studies related to soil alkalinity modifications are indispensable since alkaline soils cover more than one-fourth of Earth's surface. Soil pH is an important chemical property because it affects plant growth and nutrient availability in many different and complex ways. Soil pH affects plant growth both directly and also indirectly by affecting the availability of essential nutrients, levels of phytotoxic elements, and microbial activities. A pH, either far above neutral (alkaline) or far below neutral (acidic), makes essential plant nutrients less available. For a high soil pH (alkaline soils), limited solutions exist for reducing pH because they are impractical or uneconomical. In this context, the study by Beheiry et al. [31] exhibited particular interest since they investigated the potential impacts of some acidifying agents (acetic acid, citric acid, and sulfuric acid) applied in an attempt to adjust the high soil pH values in olive orchards, which are the main problem with Egyptian soils, whose values vary between neutral and extreme alkaline. The study concluded that significant improvements in total olive yield and their attributes, as well as the olive oil contents, resulted from the positive effect of acidifying agents on reducing soil pH, which, in turn, improved the availability of nutrients in the soil, enhancing their absorption, as mirrored from the leaf nutrient contents. The study also provided an evaluation of the effectiveness of the treatments applied as a valuable practical tool to be used by the farmers to correct soil alkalinity problems, which, in turn, influence physiological and growth parameters, the yield of table and oil olives, and the fruit's physical attributes.

On the other hand, soil acidity significantly decreases the availability of nutrients to plants, such as P and molybdenum (Mo), and increases the availability of aluminum (Al) and manganese (Mn) even to toxic levels. Moreover, other essential plant nutrients can also be leached below the rooting zone. Soil acidity affects approximately 30% of the world's potential food production area. These problems are particularly severe in humid tropical regions that have highly weathered soils. Liming is the most common practice to mitigate soil acidity, but the low solubility of lime and its application on a soil's surface, especially in no-till systems, restrict its reaction on the first soil layers. In this respect, the study by De Souza et al. [32] investigated the effect of the joint application of lime and gypsum to enrich a subsoil with calcium (Ca) and to alleviate Al acidity in an intercropping system with soybean, followed by maize–guinea grass. Their work also investigated the synergistic effects of subsoil Ca associated with N on root growth and yield of maize and soybean. Liming resulted in greater root growth for both crops; however, when lime was associated with gypsum, root growth was further enhanced. Moreover, soil acidity correction and N supply resulted in better distribution of the soybean and maize root systems in the soil's profile, increasing soil exploration, which favored water extraction in periods of scarcity and nutrient absorption in deeper layers of the soil, resulting, eventually, in higher yields. Nitrogen fertilization increased total maize grain yield by 36%, with a more expressive increase when applying 160 kg ha^{-1} or more, and, despite a positive effect on soybean grain yields in the long term, this response seemed not to be a direct effect of the N applied to maize. Overall, benefits resulting from the combination of lime and gypsum include greater plant biomass production, a denser root system, higher crop yield, and, eventually, a positive impact on soil C and N.

3. Conclusions

The collection of these manuscripts presented in this Special Issue (SI) updates and provides a relevant knowledge contribution for the usefulness of improving the fertilizer-use efficiency of crops, thus ensuring enough food for the rising world population of acceptable quality, taking into account environmental considerations. Plant nutrient requirements and nutrition are complex issues, starting from the 17 known and necessary nutrients for plant growth and merging a group of sciences, namely, soil science, plant physiology, chemistry, circular economy, environmental science, etc. Plant nutrition is one of the most important elements on which the yield and the quality of agricultural products depend. For about a century, significant yield increases were the result of the introduced revolutionary method by Nobel Laureate Norman Borlaug on the use of chemical fertilizers by crops who covered the nutritional needs of the world. But, what one should we expect today? The global tendency is to adjust to the actual nutritional needs of the plants, maximizing yields and improving quality, with special attention paid to the environment and the grower, with respect to the consumer. This Special Issue provides nutrient management strategies and advanced knowledge on fertilizer-use efficiency as one of the primary inputs to match the quality and quantity of crops for contributing to the smooth and healthy characteristics of the food chain.

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