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INORGANIC FERTILISERS VERSUS ORGANIC AMENDMENTS IN A SUMMER MAIZE, WINTER WHEAT ROTATION

Modern crop rotation does not involve the growing of different crops in the same field and in the same sequence in consecutive seasons or years. It requires planning and coordination of limited, balanced changes in crop sequence while emphasising the importance of sustaining soil fertility.

According to research findings, double cropping of winter wheat (*Triticum aestivum* L) and summer maize (*Zea mays* L) requires intensive irrigation and fertilising, which rapidly depletes both aquifers and soil minerals. This leads to salination of underground water, thus threatening the environment.

Research has also shown that crop rotation, crop sequencing and biological diversification forms the basis of sustainable, successful plant production. However, in the recent past, chemical fertilisers have been used intensively, countering and reducing the implementation of these principles.

Different fertilisation strategies, such as the incorporation of plant residues and manure or compost into the soil have proved to increase yield and improve soil fertility. A study conducted by Jiang (2005) on long-term effects of manure in a summer maize – winter wheat system, found that farmyard manure (FYM) increased soil organic matter by 80 %, compared to the 10 % increase affected by NPK fertiliser.

Ploughing in of crop residues improves the microbiological and biochemical activities of micro-organisms in the soil, thus improving its chemical properties and limiting the gradual depletion of organic matter. Heidari (2004) reports that the incorporation of maize residues increases organic carbon, (an indicator of organic matter content of soil) by nearly 25 %, while wheat residues only effected an increase of approximately 16 %. Not only does organic carbon increase the concentration of organic matter in the soil, it also helps to reduce atmospheric CO_2 (a greenhouse gas). The agricultural practice of adding compost and plant residues thus also impacts positively on the global environment (Gibson, Chan, Sharma & Shearman, 2002).

Adding compost has been proven to improve the structural stability of the soil through the stimulation of microbial activity; this stability is dependent on the content and dynamics (changes) of organic matter in the soil. Structural stability prevents physical degradation (breakdown) of soil at risk of rainfall and erosion pressures.

It is a fact that organic fertilisers and the breakdown of plant residues by soil microbes act as cement which binds soil particles into aggregates. The process results in greater soil permeability and aeration, easing crop germination and promoting root growth. The process also leads to improved tillage.

The continuous rotation of maize in summer and wheat in winter is a system that allows the deeper root systems of winter wheat to use soil moisture and plant nutrients that accumulate below the shallow roots of maize after the summer rains and the application of fertilisers. This agronomic practice should, however, be followed by other agronomic rotational practices which ensure that in addition to inorganic fertilisers (NPK), organic fertilisers (FYM, compost, plant residues) are also applied.

During the developmental phases of the Hardap Irrigation Scheme (HIS), lucerne (alfalfa) amounted to at least 25 % of all crops planted (Faul, 2005). This farming practice helped to sustain and build soil fertility. However, Grobler & Theron (2005) found that currently, grain producers continuously plant maize in summer (December to May) and wheat in winter (May to December), burning the plant residues (maize and wheat) to get the next crop in on time while fertilising heavily with chemical fertilisers throughout the season. Such agronomic practices tend to limit soil fertility and the planting or sowing time. They reduce the organic and microbial content of the soil, leading to gradual depletion of fertility and structural stability, and causing environmental pollution. If long-term sustainable production is to be maintained at the HIS, biological strategies need to be incorporated into agronomic practices. These include: the incorporation of maize/wheat plant residues; the use of microbial inoculants, kraal organic matter such as manure or compost; and the rotation of crops including legumes such as cowpeas or lucerne.

Organic fertilisers ensure soil fertility in a cost-effective, alternative way. They increase crop yields, leading to improved livelihoods for farmers. When organic fertilisers are applied in conjunction with inorganic fertilisers, even greater successes are achieved, compared to the use of costly mineral fertilisers alone. Research shows that manure combined with mineral fertilisers gives a higher net present value than mineral fertilisers alone. An experiment conducted elsewhere, evaluating the economic benefit of organic over inorganic resources, showed that manure plus 60 kg of nitrogen per hectare yields a net present value of about USD 633 compared to 100 kg of nitrogen alone, yielding a net present value of USD 532. Organic fertilisers combined with a modest quantity of mineral fertilisers offer the most profitable fertilisation option. They hold the key to enhancement of nutrient budgets, food security and rural livelihoods.

In summation, organic fertilisers have many environmental and economic advantages over chemical fertilisers. When applied in the correct quantities, organic fertilisers provide the nitrogen needed for crop growth, but with much less leaching. The organic compounds in organic fertilisers take longer to break down and they improve the soil structure, which increases its water-holding capacity and protects against erosion.

When used optimally, organic fertilisers increase the organic content of the soil, improving its capacity to exchange nutrients, promoting soil aggregates and buffering the soil against acidity, alkalinity, salinity, pesticides and toxic heavy metals.

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