Pre-plant blended fertilizers and nitrogen topdressing for maize

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Summary

For maize to achieve high grain yields there is need of applying the right fertilizers at the right rate and at the right time following best agronomic practices. Shortages of nutrients like nitrogen (N), phosphorus (P) and potassium (K) result in a weaker root system, crop stunting, disease vulnerability, low photosynthetic activity and efficiency, fewer numbers of cobs and kernel row, and incomplete grain filling. Many farmers in Sub-Saharan Africa do not use appropriate formulations, dosages and schedules of mineral fertilizer input which causes unsatisfactory grain yields, low profitability and undesired losses to the environment. Specialty mixes of common fertilizers that contain N, P, K and other nutrients like sulfur have been developed for basal application to maize crops at planting that create balanced availability of nutrients. N fertilizer inputs represent one of the largest investments for maize farmers, and get severely undermined by drought or excessive rainfall that occur ever more frequently in SSA. It is widely recommended that N fertilizers are applied in two splits, with a top-dress later in the growing season. This practice ensures adequate supply of N for crops throughout the growth cycle and mitigates financial risks for farmers.

Technical Description

Use of “single” fertilizers with N, P, K and other nutrients causes farmers to apply suboptimal and inconsistent balances that undermine the uptake and production gain of maize crops, and give rise to unsatisfactory returns on investments. Blended fertilizers are easy to make by mixing two or more single fertilizers using carefully measured formulas that address nutrient deficiencies, ensure no wastage and reduce costs of application to croplands. Agro-input suppliers and manufacturers offer specially designed pre-plant fertilizer blends for maize which promote early crop development, stress resilience and grain production by efficiently supplying nutrients throughout the growing season. Top dressing N fertilizer ensures the availability in soils is well aligned with the demand of maize crops unlike is the case when applying the input all at once. Usually, the optimum time for top dressing N fertilizer is at the stage when maize crops have 8 to 10 fully developed leaves. It is widely demonstrated that African farmers can obtain higher maize yields with lower rates of nutrient inputs when using blended fertilizers at planting instead of single fertilizers, and splitting applications of nitrogen instead of a one-time input (even with slow release products). To maximize efficiency and profitability

of pre-plant and top-dress fertilizer application it is necessary to account for residual nutrient stocks in soils and deficiencies in crops through visual inspection of stands.

Uses

Pre-plant fertilizers with specialty nutrient blends and split application of nitrogen by topdressing are recommended for maize production in all types of growing areas from SSA, this includes regions with a dry sub-humid or humid climate and soils with a high clay or high sand content. These fertilizer technologies offer particularly large benefits for smallholder farming systems where low amounts of mineral nutrients are applied, and degraded croplands where availabilities in soils are very low and imbalanced. Commercial maize farmers stand to reduce fertilizer spends and enhance profit margins owing to the high levels of fertilizer use efficiency that are achieved by pre-plant fertilizer blends and N top-dressing. The use of balanced fertilization for maize works in conjunction with legume intercropping and rotation since the mineral nutrient inputs also benefit the accompanying crop.

Composition

Specific nutrient formulas that fulfil requirements of maize can be made by blending a wide range of solid granular types of fertilizers like urea, calcium ammonium nitrate, potassium chloride, single or triple super phosphate and sulphate. Micronutrients like zinc, boron and cupper, amongst others can be added in solid form or impregnated as liquid. Readily accessible types of fertilizers and manufacturing facilities across Sub-Saharan Africa can be used to prepare appropriate blends of nutrients for maize crops. The rates of nutrients applied by pre-plant fertilizer blends and N top-dressing is based on specific yield targets and recommendations aligned with local conditions.

Means of application

Formulations of specialty pre-plant blended fertilizers for maize crops are developed on the basis of information about the nutrient deficiency and imbalance in specific growing areas contained within soil maps and past agronomic trials. A dry rotary system available in medium to large sizes is used for mixing single fertilizers that are sourced locally subject to availability. It is best for blended pre-plant fertilizers to be place at the bottom of sowing holes by hand or planting equipment, but they can also be broadcast shortly before or after planting. For N topdressing the most common fertilizers are urea or calcium ammonium nitrate, and there is a recent trend of using supergranules or slow release agents to improve uptake. Applications of the fertilizer on top of soils can be done at the base of maize plants by manual placement and using side dressers, or can also be broadcast by hand or using spinners. Foliar spraying of liquid N fertilizer can also be used which is fast and has very low losses through leaching and volatilization, but is prone to scorch and leaf damage if not properly applied. The timing for applying the second dose of N depends on nutrient availabilities in soils and rainfall conditions, for dry granules this has to be done before a rain event to move the nitrogen into the soil.

Agroecologies	Dryland area, Highlands, Moist savanna.
Regions	Africa South of Sahara.
Developed in Countries	Ethiopia, Kenya, Nigeria, Rwanda, Tanzania, Zambia.
Available in	Ethiopia, Kenya, Nigeria, Rwanda, Tanzania, Zambia.
Solution Forms	Input Supply.
Solution Applications	Soil fertility management.
Agricultural Commodities	Maize.
Target Beneficiaries	Small-scale farmers, Commercial farmers.

Commercialization

Commercialization Category

Commercially available

Startup Requirements

1) Identify appropriate formulations of blended fertilizers base upon balanced nutrient demands and soil fertility conditions for a specific maize growing area, 2) Develop protocols for mixing different single fertilizer and packaging the blend with agro-inputs manufacturers and suppliers, 3) Broker market entries for specialty pre-plant fertilizer mixes and N top-dress fertilizers at affordable prices and monitor sales, and 4) Carry out farmer demonstration and trials to showcase the benefits of pre-plant fertilizer blends and N top-dressing for maize production compared to other management options, and to refine the formulation and branding campaigns over time as necessary.

Production Costs

The initial development of specialty pre-plant fertilizer blends for maize is not expensive as it is based upon desk study from a wealth of secondary information, including the composition of similar products. Refining the formulation of blends is considerably more expensive for this requires agronomic trials and plant and soil analysis. Manufacturing specialty blended fertilizers bears relatively large capital investments for multi-channel dry rotary systems and automated packaging. There is also the cost of assembling or purchasing the primary single fertilizers to be blended. These costs are considerably

reduced for fertilizer companies with existing blending capacity that is seeking to expand their product lines. Smaller, more labour-intensive blending systems are available that can be operated by community-based groups once specific formulations are known.

Customer Segmentation

Large and medium scale fertilizer suppliers, Local agro-input dealers, Subsistence and commercial maize growers

Potential Profitability

Blended fertilizers offer multiple practical advantages for applications to croplands as these are made of homogenous mixes that do not coagulate and thus can be dosed directly from bags, thereby saving time and ensuring crops receive the right formula. Field trials in Ethiopia have shown that application of blended fertilizers with NPKS resulted in a grain yield that is 0.3-0.5 ton/ha higher compared to common NP fertilizer. In the same study, uptake of N and P from blended fertilizers with K and S added was found to be respectively 30% and 57% higher compared to that of applying NP only, because higher grain and stover yields were achieved with lower rates of N and P fertilizer. Split application of N fertilizer via top-dressing drastically increases the cost-effectiveness of input investments as the practice makes sure that nutrient supply is aligned with crop demand, and diffuses risks of fertilizer losses that may arise from fluctuating weather conditions.

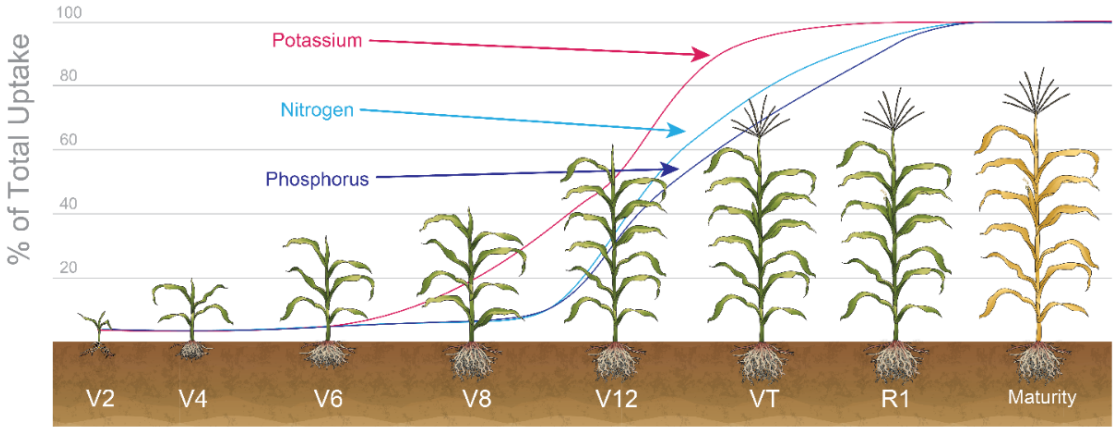
Licensing Requirements

The formulations of pre-plant blended fertilizer for maize crops may be subject to licensing but are more often protected as trade secrets. In cases when the fertilizer composition is publicly known the desired blend proportions can be easily calculate from different primary fertilizer materials.

Innovation as Public Good

Responses to fertilizer application and combination are abundantly available as published information, particular when performed by research institutions as Regional Public Goods. The International Center for Fertilizer Development is responsible for development and dissemination of balanced fertilizer practices for maize in Africa.

Solution Images



Institutions

Accompanying Solutions

Drought tolerant maize varieties (DTMA, WEMA), Imazapyr resistant maize for Striga management (IR), Golden maize varieties (high in provitamin A), Pre-emergence herbicides for weed control