Trans-SEC
Innovating Strategies to safeguard Food Security using Technology and Knowledge Transfer

UPS 1b: Fertilizer Micro-dosing for increasing yields under sole and intercropping systems for rural stakeholders

Jörn Germer, Ludger Herrmann, Henry Mahoo, Elirehema Swai, Frieder Graef, Frederik Kahimba, Folkard Asch, Siza Tumbo, Bashir Makoko, Anthony Kimaro, Meike Schäfer, Paul Saidia, Emmanuel Chilagane

Key Objective **To increase and maintain soil nutrient status for sustainable soil fertility management in sub humid and semi-arid areas. Also to improve crop yield with a minimal external input requirement for resource poor farmers in sub humid and semi-arid areas.**

FVC component(s)

Natural Resources, Crop Production

Key constraint addressed

Declining soil fertility due to continuous farming without replenishment of nutrients through fertilizers leads to poor soil fertility and low crop production. Low and erratic rainfall, poor knowledge of soil fertility improvement technologies as well as high cost fertilizers deter small-scale farmers from using recommended amounts of fertilizers to improve soil fertility and sustain crop production. This situation is more critical in dry lands and semiarid areas where the risk of crop failure is high to sporadic and short precipitation.

Description

Micro-dosing involves the addition of small doses of fertilizers to crops during sowing for P fertilizers, such as DAP and TSP, as well as N fertilizers, such as Urea, at fourth to sixth leaf stage (V4 – V6) in cereal crops. This farmer-oriented technology is designed to improve fertilizer use efficiency via localized application. Micro-dosing increases uptake and reduces the investment risk as compared to broadcasting. Farmers can reduce fertilizer costs by more than 50% without adversely affecting crop yields or profitability. When integrated with organic matter and other ISFM practices, like improved seed variety and pest control, the technology holds high potential to intensify farming systems while sustaining soil health and land productivity.

Micro-dose technology can be promoted as an entry point to boost crop yields while using affordable or low risk fertilizer rates, while later farmers may move to a higher rate as they appreciate the need and benefits of applying fertilizers.

Amount of fertilizer applied in maize: A, B, C and D are microdoses at 12.5%, 25%, 50% and 75% of recommended amount, E.

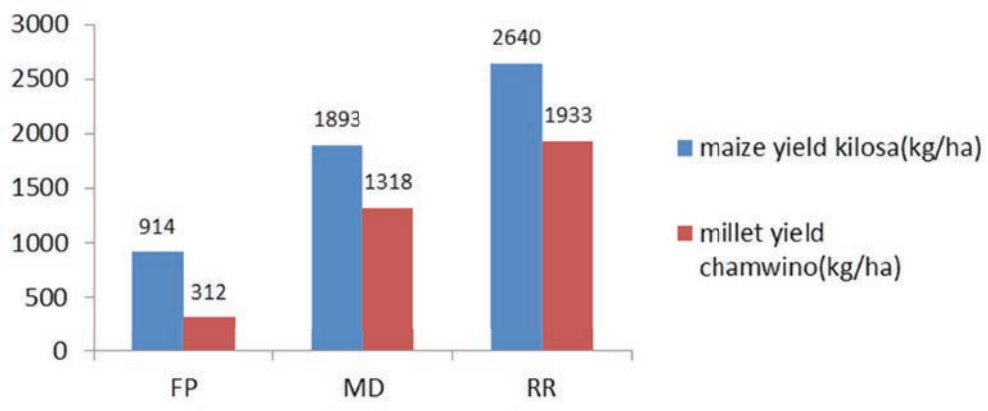
PROVEN SUCCESS IN TZ AND BEYOND

In addressing the problem of low soil fertility, on going projects, such as the Africa RISING in Kongwa and Kiteto and the Soil Health Consortium, are testing micro-dose rates of 7.5 kg P/ha (2 g/hill) and 15 kg P/ha (g/hill) using TSP fertilizer in Dodoma and 20 kg P/ha (5g/hill) in Morogoro for cereal crops. Studies in the sandy soils of the Sahel demonstrated entry microdose rates of 5-6 kg P/ha (2-4g/hill as NPK) with and without organic matter or rainwater harvesting to considerably increase cereal yields (Tabo et al. 2005; Bagayoko et al. 2011; WRI et al. 2013). Camaraet al. (2013) reported that nitrogen and phosphorus fertilizer microdosing at 25% increased sorghum yields by 600 kg/ha in Ethiopia.

TRANS-SEC FINDINGS

The Trans-SEC project carried out research in Kilosa, Morogoro and Chamwino, Dodoma on microdose rates in order to increase the food security of resource poor farmers. Micro-dose rates of 10 kg P/ha (1.2 g DAP /hill) and 7.5 kg P/ha (0.88 g DAP/hill) for maize and pearl millet crops in Kilosa and Chamwino respectively, were used.

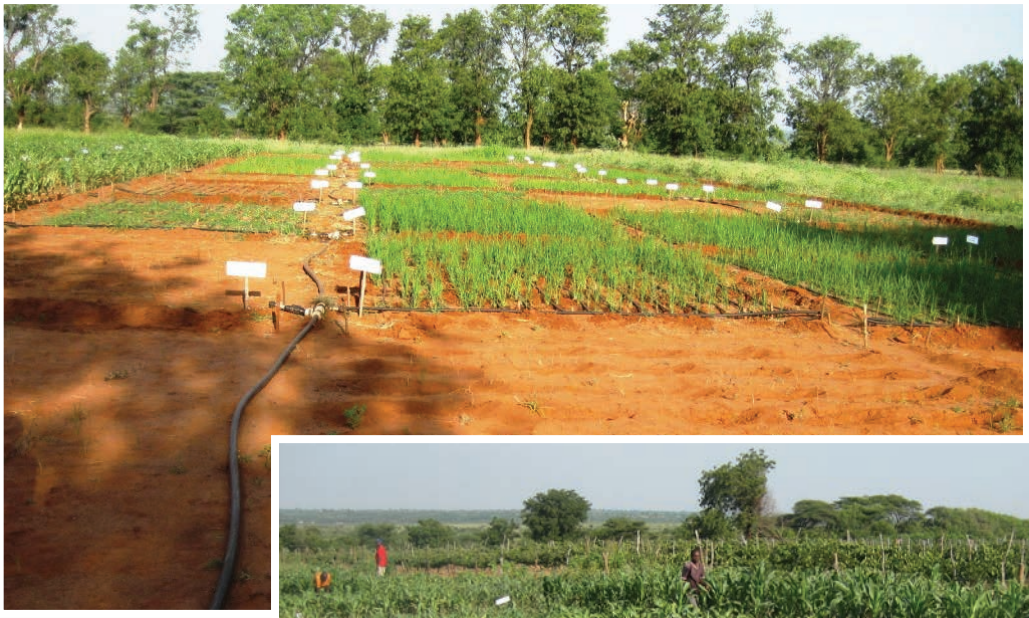
Preliminary results showed that microdose (MD) fertilizer application at 25% of a recommended rate (RR) resulted in doubling the yield of maize and millet crops compared to farmer practices (FP) with no fertilizer application in sub-humid and semi-arid areas. Therefore, resource-poor farmers can use this technology to increase the food security of their households.



Visual crop performance

Fertilized plot

Non fertilized



TECHNICAL SPECIFICS, DIMENSIONS

Microdose at 25% of recommended rate are 10kg P/ha and 7.5 kg P/ha in maize and millet crops grown in Kilosa and Chamwino, respectively. Fertilizer was applied in holes during planting and during vegetative stage (V4 – V6). It requires soil moisture content above 15% by volume. Fertilizer is expensive, for example 1 bag of 50kg DAP in 2015/16 was sold at 75,000 and 80,000 TShs; and urea was sold at 60,000 and 65,000 TShs in Morogoro and Dodoma regions. Fertilizer microdosing works better when integrated with tied ridges under intercropping systems.

TYPE OF FOOD CROPS APPLICABLE

Microdose fertilizers are suitable for all cereal crops grown in semi arid and semi humid areas. This includes maize, rice, millet, and sorghum. It also suits other crops like sunflower, sesame, legumes, and vegetables.

IMPLEMENTATION CONSTRAINTS

Localized application of fertilizer requires more attention and is labour intensive. Myths and misconceptions that mineral fertilizer destroys the soil could deter its adoption and success, especially in Ilolo. Poorly developed input value chains in rural areas may limit access to fertilizer by early adopters. Fertilizer microdosing works in a wide range of soil types, however it performs less well in sandy soils with low organic matter content. This technology is also not suitable to narrow or closely spaced crops, such as sesame, due to higher time and labour demands when compared to wider spaced crops such as maize and pearl millet.

Linkage to other FVC components

Production: fertilizer microdosing improves crop yield, hence higher infrastructure, such as means of transportation, are required. It also results in demand for higher processing capacity and increased storage. Market: increased fertiliser requirements in production areas, need of income to purchase fertilizer, as well as its availability in the market. Consumption: It resulted in increased food availability, lower staple food prices, and increased food security.

Considerations & criteria for UPS outscaling

Training of trainers and farmers' groups on the importance of applying fertilizer in crop roduction, fertilizer types and application rates as well as different method of application. Introduction of special sessions on promoting microdose fertilizer for resource poor farmers. Improving connections between farmers and input suppliers to facilitate the availability of fertilizer in production areas.

Key lessons learned

Using fertilizer micro-doses at 25% of recommended rates increase yields, is economical, and reduces risks of weather variability, especially compared to recommended rate.

Intergration of in-situ rainwater harvesting and fertilizer microdosing is an alternative way to increase the food security of pro-poor farmers in sub-humid and semi-arid areas.

References

Bagayoko, M., Maman, N., Palé, S., Sirifi, S., Taonda, S.J.B., Traore, S., Mason, S.C., 2011. Microdose and N and P fertilizer application rates for pearl millet in West Africa. Afr. J. Agric. Res. 6, 1141–1150.

Camara, B.S., Camara, F., Berthe, A. and Oswald, A. (2013). Micro-dosing of fertilizer- a technology for farmers' needs and resources. International Journal of Agri Science Vol. 3 (5): 387- 399.

Tabo R, Bationo A, Diallo Maimouna K, Hassane O and Koala S. 2005. Fertilizer micro-dosing for the prosperity of small-scale farmers in the Sahel: Final report. International Crops Research Institute for the Semi-arid Tropics, Niamey, Niger. 28 pp.

Winterbottom, R., et al. 2013."Improving Land and Water Management." Working Paper.

Installment 4 of Creating a Sustainable Food Future. Washington, DC: World Resources Institute. Accessible at: http://www.worldresourcesreport.org