

Pre-emergence herbicides for maize crops

Solution Holder is **Jonga Munyaradzi** and can be contacted through **j.munyaradzi@aatf-africa.org**

Summary

The level of weed encroachment in farmlands across Sub-Saharan Africa is generally high and causes vast amounts of water and nutrients in soils to be drawn away from food crops, which reduces grain yields and returns on agro-input investments. It is critical to keep a low number of common weeds in maize crops, especially during its germination and initial growth stages, up to 10 weeks after planting. Without proper control of weed encroachment during the first five weeks of the season the potential grain yield of maize crops is brought down by 50% on average, and if no measures are taken by farmers the yield losses are ranging from 57 to 80%. Removing weeds that have sprouted by hand or machine is labor-intensive and expensive as it has to be repeated 2-3 times for effectively reducing weed encroachment and increasing maize grain yields, this because agitation of soils by shallow hoeing and harrowing promotes other weeds to germinate. Pre-emergence herbicides that prevent weeds from developing roots after seed budding make it possible to keep farmlands free of weeds during the critical stages of early crop development, and minimizes weed encroachment later in the growing season. This kind of herbicides is applied shortly before or at the time of planting maize after the soil has been tilled which keeps weed seedlings from coming up and has proven to render major increases of grain productivity, fertilizer efficiency and resilience to drought.

Technical Description

Maize is most sensitive to weed encroachment between the stage of emergence up to the time when six leaves are unfurled during which period the root system of the staple crop is being developed and its shoots may get outcompeted by fast-growing weeds. Pre-emergence herbicides give crops a head start by eliminating competition for light, nutrients and moisture when it is most vulnerable during its early growth stage, and thereby accelerate the development of roots and shoots. Major advantages are offered by use of pre-emergence herbicides in comparison to other weed control strategies such as manual and mechanical removal or chemical-assisted killing of weeds that have sprouted. For one, the solution virtually eliminates seed dispersal from weeds that gives rise to long-term reductions in encroachment, and recurrent savings in herbicide use and labor; this because one year of seed dispersal by weeds requires seven years of removal or chemical control. In maize cropping systems with a high degree of weed encroachment there is need for multiple herbicide applications throughout the growing season, and in such cases the early-stage control that is achieved through the pre-

emergence approach has shown to increase the effectiveness of post-emergence herbicides. Also, preventing weeds from damaging maize in the initial growth stages alleviates the time pressure on further pest control measures during the season, which are required in many African farming systems.

Uses

The application of pre-emergence herbicides is suitable for weed management in all maize growing areas of Sub-Saharan Africa, especially in farmer communities where availability of labor for manual removal is limited. Studies across the continent have shown that application of pre-emergence herbicides is effective on farmer fields with high to low levels of weed encroachment under humid to semi-arid climates, creating short and long term benefits under these varying conditions. The sort of weeds in farmlands, seasonal weather patterns and timing of other management practices are dictating the exact formulation of chemical agents and moment of application that is necessary for pre-emergence weed killing. Use of the chemical control technology has to be combined with the appropriate input of inorganic fertilizers and organic resources to farmlands for the intervention to increase grain production and food security, especially on degraded fields with low soil fertility status. Pre-emergence weed control strategies have proven to be more effective than post-emergence approaches which are most often used by farmers in Sub-Saharan Africa, thus providing a direct entry point for improving agriculture.

Composition

Agro-input companies in Sub-Saharan Africa market a range of pre-emergence herbicides that contain different chemical agents and are designed for eradicating specific kinds of weeds occurring in maize crops. Herbicides for broadleaf weeds such as Blackjack, Thorn Apple, Oxalis and Spiderwort are usually made of atrazine, phenoxy (MCPA) or terbutryn compounds, whereas for grass weeds like Bermuda grass, Guinea Fowl grass, Star grass, Wild oats and Nutsedge the most common herbicides are made of metolachlor, acetochlor or alachlor compounds. Further to this, adjuvants are added to pre-made formulations or spray tanks for enhancing herbicidal activity or application characteristics, such as better mixing and handling, greater droplet coverage, spray retention and droplet drying, improved herbicide cuticle penetration and cellular accumulation which minimize leaching of the chemical agents through the soil profile. Depending on the prevalent sorts of weed and type of maize cultivation, i.e., monocrop, rotation or intercrop, the formulation of pre-emergence herbicide needs to be adjusted.

Means of application

Concentrated solutions of pre-mixed or single herbicides are diluted in water to activate the chemical agents following the prescribed ratio and safety precautions. This is then applied to farmer fields using a backpack systems with one or two spraying nozzles or tractor-mounted systems with many spraying nozzles, which is substantially benefiting herbicide placement, effectiveness of weed control and labour requirements for application to croplands. Protective clothing should be worn by workers that apply the herbicides to avoid contact with chemical agents. Soils should be moist, not too wet or

too dry, when fields are sprayed thus requiring the time of application to be synchronized with rainfall, being carried out one week after tillage of croplands and latest before maize is 10 cm tall. Chemical weed control management technologies should be prioritized on fields with the highest level of weed encroachment and most difficult to control weeds to maximize yield and income gain, allowing to steadily build down infestations on farms.

Agroecologies	All Agroecologies.
Regions	Africa.
Developed in Countries	Cameroon, Ethiopia, Ghana, Kenya, Malawi, Nigeria, Rwanda, South Africa, Tanzania, Uganda, Zambia.
Available in	Cameroon, Ethiopia, Ghana, Kenya, Malawi, Nigeria, Rwanda, South Africa, Tanzania, Uganda, Zambia.
Solution Forms	Input Supply.
Solution Applications	Weed control.
Agricultural Commodities	Maize.
Target Beneficiaries	Small-scale farmers, Commercial farmers.

Commercialization

Commercialization Category

Commercially available

Startup Requirements

1) Agro-input dealers need to market pre-emergence herbicides in growing areas that are appropriate for common weeds, 2) Awareness-raising with farmers about benefits of chemical control strategy on food production and risk mitigation, and 3) Provide financial support for local suppliers and smallholder farmers that catalyzes investments on pre-emergence herbicides.

Production Costs

Spraying of pre-emergence herbicides to avoid that weed encroachment diminishes grain yield levels of maize crops is requiring dispensable cash from farmers to buy pre-made formulations or single chemical agents, and purchase or rent spraying systems. A pilot program in maize growing areas of Nigeria has shown that use of pre-emergence herbicide and the labor to apply these is costing USD 27 per hectare for mixes of pendimethalin and atrazine, and USD 25 per hectare for mix of metolachlor and atrazine at a rate of 1 kilogram active ingredient per hectare.

Customer Segmentation

Agro-input suppliers, Commercial and subsistence maize growers

Potential Profitability

Use of pre-emergent herbicides is making maize crops less prone to drought and disease and higher yielding which can substantially enhance the returns on investments for seed material, fertilizer, irrigation and other management by farmers that rely on crops for food and income. A study in maize growing areas of Nigeria showed that low application rates of commercially available pre-emergence herbicides, i.e., pendimethalin or metochalor with atrazine at 1 kilogram active ingredient per hectare, was reducing the number of weeds per square meter by 61% to 80% as compared to a non-treated weedy scenario. Maize crops that were protected with pre-emergent herbicides showed a grain yield increase of 0.7 and 1.6 ton per hectare as compared to unprotected weed-infested stands, and this translated into an added net revenue of USD 404 to USD 515 per hectare. The control of weeds with pre-emergence herbicides in fertilized maize crops raised the gross margins by USD 84 to USD 433 per hectare. P

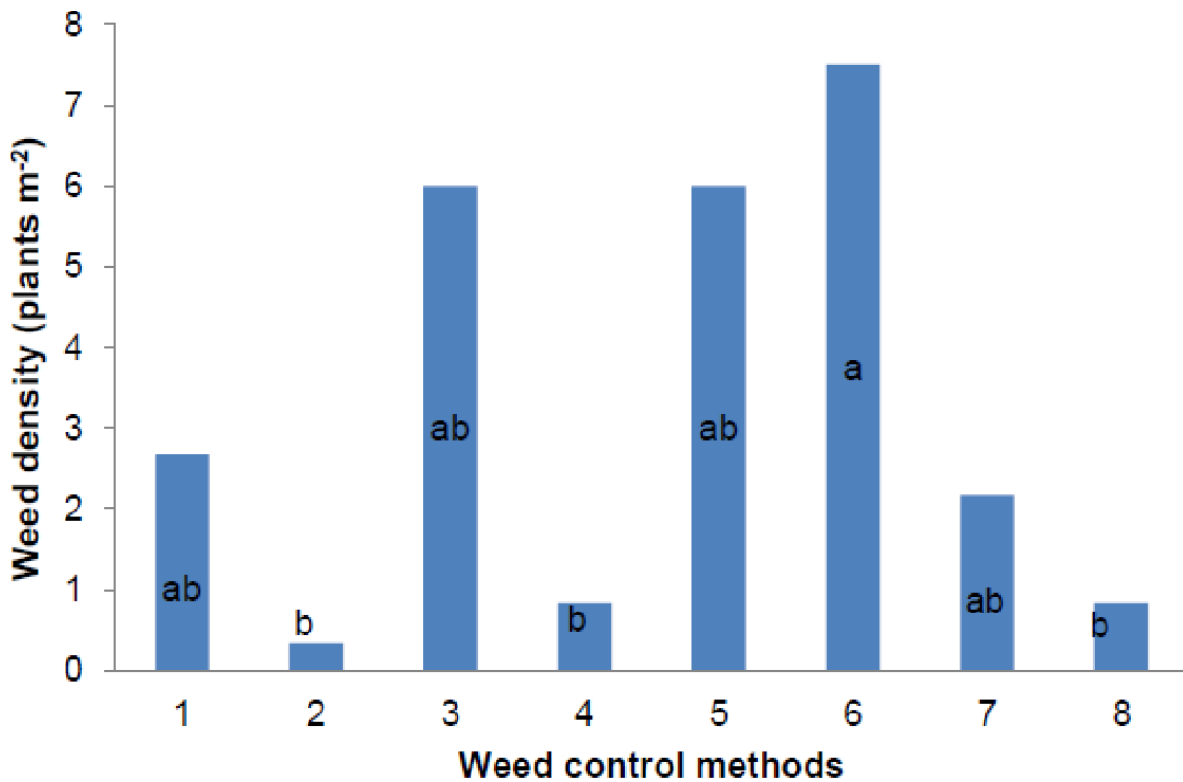
Licensing Requirements

Countries in Sub-Saharan Africa have specific regulations in place for compliance and use of chemical agents to eradicate weeds in croplands which have to be obtained by agro-input companies supplying local markets.

Innovation as Public Good

The development and scaling of pre-emergence herbicides is done primarily by private companies, often in collaboration with independent research institutes.

Solution Images

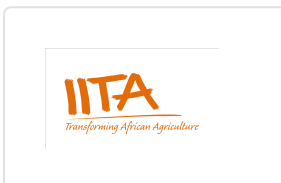


Weed control methods
1. No weeding, 2. Clean field, 3. Hand weeding at 3 & 8 WACE, 4. Pre-emergence herbicides, 5. Mechanical weeding at 3 & 8 WACE, 6. Mechanical weeding at 6 WACE, 7. Pre-emergence herbicides + mechanical weeding at 6 WACE, 8. Pre- + post-emergence herbicides





Institutions



Accompanying Solutions

Drought tolerant varieties (DTMA, WEMA, others), Golden maize varieties (High provitamin A), Specialized pre-plant fertilizer blending and N topdressing, Maize-legume rotation and intercropping, Fall armyworm control in maize production (e.g. FORTENZATM Duo)