



Feed the Future Tanzania Kilimo Tija Activity

Technical Bulletin: Effective and Safe Use of Agrochemicals

INTRODUCTION

Agrochemicals, if used properly, can enhance crop yields, mitigate pest-related losses, and lead to greater farm productivity and food security. However, if misapplied, agrochemicals can pose severe risks to the environment, users, and the crops themselves. The effective and safe use of agrochemicals is determined by the care and attention given to precautionary measures before, during, and after application, as well as selecting the proper agrochemical that will act effectively while posing the least risk to people, livestock, wildlife, and the environment. This bulletin aims to equip Tanzanian smallholder farmers with essential knowledge on the safe and effective application of agrochemicals, focusing on locally available inputs and common horticulture crops such as tomato, sweet pepper, carrots, onion, watermelon, and papaya.



Figure 1: KTA farmers in Njombe receive training on agricultural inputs, agrochemicals, and technologies.
Photo: Fintrac Global Inc.

DIAGNOSING THE PROBLEM

Applying agrochemicals depends on the problem that a farmer is trying to solve. The first step is to accurately diagnose the pest, disease or nutrient deficiency through farm surveys and field scouting. This allows you to:

- Identify the specific problem (fungal, bacterial, insect pest)
- Gauge severity and extent of infestation
- Determine if agrochemical intervention is necessary.

For minor or localized issues, an agrochemical may not be warranted. Consider preventative and cultural methods first and weigh the cost-benefit of spraying.

SELECTING THE RIGHT PRODUCT





If agrochemical treatment is needed, choose a product specifically registered and recommended for the diagnosed problem. Selectivity and mode of action are key considerations and be sure to adhere to label directions for dosage, timing, and preharvest intervals.

For prophylactic treatments like fungicides:

- Follow a 7–10-day protective spray schedule.
- Rotate chemical modes of action to avoid resistance.

For curative treatments like insecticides:

- Apply only when pest density crosses economic threshold levels based on scouting.
- Target life stages for maximum impact.

TIMING AGROCHEMICAL APPLICATION

Timing is critical. Agrochemicals should be applied at the recommended stages of crop development and under suitable environmental conditions to avoid adverse effects. Additionally, farmers should consult local agricultural experts and adhere to predetermined spraying programs suited to specific crops and regions.

Typically, a predetermined weekly spraying program using foliar fertilizers are applied to address fungal problems. Whereas pests and bacterial problems are addressed on a case-by-case basis according to the methodology above.

DEVELOPING PROFICIENCY

Knowing what type of information to collect to make an informed decision and how to effectively apply that decision takes experience. Work closely with extension agents and agrodealers to correctly diagnose issues, select suitable chemicals, determine need and proper application timing. Be sure to keep records of the chosen course of action in order to refine usage based on effectiveness.

The above course of action can be summarized in the five following steps:

1. **Assessment:** Understand the farm's current condition and determine whether there is a real threat to the crops.
2. **Exploration:** Explore the available options and alternative solutions before resorting to chemical intervention.
3. **Decision:** Decide the correct intervention considering the growth stages of the crops and the severity of the problem.
4. **Execution:** If chemical application is unavoidable, select the most suitable product and ensure its proper and safe application, adhering to the recommended doses and procedures.
5. **Understanding:** Record your methodology and course of action in a logbook so that you can refine your approach based on its effectiveness and can refer back to your experience in case pests or disease recur on future plantings.

SELECTION AND USE OF SPRAYING EQUIPMENT

The spraying equipment used depends on the crop stage, farm scale, target pest or disease, and product type. The following are the most applicable equipment for smallholders:

Backpack Sprayers

- Capacity ranging from 2-20 liters.
- Ideal for small nurseries, gardens, and ground spraying.



- Different nozzles for varied coverage needs.
- Enable targeted application on affected parts.

Mist Blowers

- Higher pressure of 30-50 psi.
- Generate smaller droplets for better foliar coverage.
- Useful for taller crops like fruit trees.
- Risk of drift to nearby crops.

Irrigation Systems

- Allow application of soluble systemics and soil nutrients.
- Drip irrigation enables direct root zone delivery.
- Saves labor but limited to specific products.
- Reduce exposure risks for applicators.

Manual Application

- Direct baiting onto affected parts.
- Very labor intensive and exposure risks.
- Not recommended; avoid for toxin-based products.



Figure 2: KTA farmers receive training on the use of a backpack sprayer.

Photo: Fintrac Global Inc.

Consider cost, labor needs, safety, equipment maintenance, and environmental impacts when selecting spray machinery and be sure to match equipment capacity and features to intended use. Investing in quality equipment that will last a long time is highly recommended.

APPLICATION STEPS

Each step of the application process requires care to ensure the effective and safe use of agrochemicals:

Pre-application

- 1) Read and understand labeled instructions and any other information provided with the agrochemical, application equipment, and protective clothing.
- 2) Assess the risks of application to the people, animals and environment and take action to minimize those risks.
- 3) Ensure the user has been thoroughly trained on application techniques and the product being used.
- 4) Mix only the amount of agrochemicals required for a particular task – do not overmix.
- 5) Check application equipment for signs of leaks or other damage.
- 6) Ensure that all personal protective equipment (PPE) is in good condition.
- 7) Confirm that weather conditions are favorable for spraying.

During application

- 1) Wear PPE properly at all times.
- 2) Avoid blowback from granules or powdered materials while mixing product.
- 3) Handle containers carefully to avoid spilling and overagitating the product.
- 4) When mixing two or more agrochemicals, ensure the compatibility of the two products together. Dangerous chemical reactions can occur if incompatible chemicals are mixed.
- 5) Do not eat, drink, or smoke while applying.

Post-application



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- 1) Thoroughly wash hands, face, neck, and any other body parts which may have come in contact with the agrochemicals.
- 2) Return unused agrochemicals to a safe storage area, and safely dispose of empty containers and any surplus application equipment.
- 3) Decontaminate application equipment and PPE by thoroughly washing it in the designated bio-bed area.
- 4) Bathe or wash again thoroughly after completing the steps above.

KEY FACTORS FOR EFFECTIVE APPLICATION

Good application is essential for the products to work properly and to avoid risks to the crops and the applicator. The following are important factors that affect how well agrochemicals are applied:

Applicator's Knowledge and Proficiency

- Diagnosing problems and knowing crop physiology.
- Understanding product compositions and label directions.
- Calculating proper dilutions, dosages and water volumes.
- Recognizing the influence of weather and crop stage.
- Skilled in using spray equipment and troubleshooting issues.
- Proper training in safe handling, use and disposal.

Optimal Mixing and Water Quality

- Use clean water with proper pH (5-6) and low mineral content.
- Avoid excessive temperatures that degrade chemicals.
- Ensure compatibility of products when tank mixing.

Fine-tuning Water Volumes

- Higher volumes are needed for larger, mature plants vs. seedlings.
- Adjust volume based on canopy size, not land area.
- Modify volume based on pest or disease distribution.

Precision Application Parameters

- Nozzle type and size determine discharge rate.
- Speed of applicator influences coverage.
- Pressure impacts droplet size and penetration.

Weather Conditions

- Avoid windy conditions that cause drift.
- Consider application timing based on pest biology and photodegradation.
- Do not spray just before or during rain.

Well-Maintained Equipment

- Inspect for leaks, clogs, and worn parts regularly.
- Clean equipment thoroughly after each use.
- Replace defective nozzles affecting discharge rate.
- Ensure proper calibration and output.

CALIBRATING EQUIPMENT

Proper calibration ensures the sprayer is delivering the required amount of product per area. Follow these key steps:

I. Determine appropriate water volume

- Consult crop-specific guidelines and label rates.





- Factor growth stage, canopy size, pest distribution.
- 2. Measure applicator speed**
 - Time a test run over measured distance (e.g. 100 m).
 - Conduct under typical field operating conditions.
 - 3. Measure output volume**
 - Operate sprayer for fixed duration (e.g. 5 minutes).
 - Collect and measure discharge from nozzles.
 - 4. Adjust parameters to achieve target output**
 - Change nozzle type or size if needed.
 - Modify pressure; higher pressure increases output.
 - Adjust walking speed; slower speed increases deposition.
 - 5. Assign designated sprayers to each applicator**
 - Consistent use of one sprayer improves precision.
 - Simplifies calibration and aids troubleshooting.
 - 6. Retest regularly for changes**
 - Nozzle wear enlarges aperture over time.
 - Re-calibrate if output volume declines.

AGROCHEMICAL MIXING AND HANDLING AREA

For safety and environmental conservation, it is important to have a designated area for agrochemical handling and mixing, referred to as a bio-bed. This area should be close to the farm, but as far away as possible from the water source, and should be well-equipped with the following components:

1. Clean water source: necessary for preparing solutions and for cleaning equipment post-application.
2. Sturdy table/bench: to prepare and mix agrochemicals.
3. Trash bag: for the proper disposal of agrochemical containers and other waste materials.
4. Pit filter: essential for trapping any chemicals that may originate from equipment washing or disposing of unused spray mix, thus mitigating the risk of soil and water contamination.

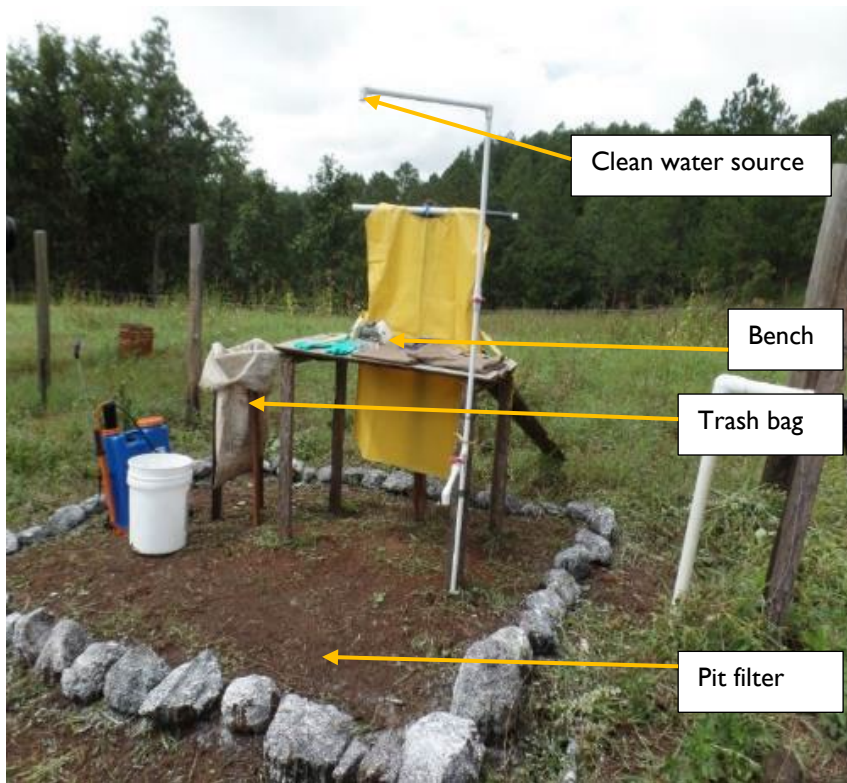


Figure 3: An example of a bio-bed for the safe mixing of agrochemicals.
Photo: Fintrac Global Inc.

TANK MIXING PROCEDURE

1. Check water pH; adjust to 5-6 if required (unless otherwise stated).
2. Add 1/3 of required water volume to the empty tank.
3. Use a measuring cup to determine the required amount of pesticide and add the required amount for one tank load as recommended from the pesticide label.
4. Add the remaining amount of clean water needed to reach target volume.
5. Add a sticker/label to identify the product, if available.
6. Seal and agitate tank thoroughly to dissolve and disperse the product throughout the water.

Use the tank mix within 2 hours of preparation as prolonged storage can cause chemical degradation.

MIXING ORDER

It is important to mix chemicals in the proper order, otherwise you can end up with an insoluble mix that cannot be sprayed. The recommended mixing order is:

1. Water soluble packs.
2. Dry formulations.
3. Water-based liquid flowables and suspension concentrates.
4. Emulsifiable concentrates.
5. Surfactants.
6. Water based solutions and water liquids, liquid fertilizers, and micronutrients.



PROTECTIVE EQUIPMENT FOR AGROCHEMICAL APPLICATION

To minimize the risks associated with handling and applying agrochemicals, users must ensure that they are adequately protected by wearing suitable Personal Protective Equipment (PPE). This equipment acts as a barrier between the agrochemicals and the user, reducing the risk of exposure and contamination. Below are the recommended PPEs that should be used during the application of agrochemicals:

Protective Clothing:

- Coveralls: Wear chemical-resistant coveralls to protect the skin from exposure to chemicals.
- Aprons: Chemical-resistant aprons are essential when mixing and loading agrochemicals.

Hand & Foot Protection:

- Gloves: Use chemical-resistant gloves to protect the hands from direct contact with agrochemicals.
- Boots: Wear chemical-resistant boots to prevent any spillage from coming into contact with the feet.

Eye & Face Protection:

- Safety Goggles: Protect the eyes from splashes with a pair of safety goggles.
- Face Shield: A full-face shield provides additional protection, especially when mixing and applying highly corrosive agrochemicals.

Respiratory Protection:

- Masks: Use appropriate masks or respirators to avoid dust.
- Respirators: For highly toxic chemicals, a full-face respirator provides protection against inhalation of chemical mists, vapors, and dust.

Hygiene and Cleanliness:

- Wash Stations: Have easily accessible and adequate wash stations for immediate decontamination in case of spills or splashes.
- Clothing Change: Change out of contaminated clothing immediately and wash separately from other laundry.

Proper Disposal:

- Discard any contaminated or damaged PPE properly to avoid any secondary exposure and contamination.

Recommended Practice:

- Training on PPE Use: Regular training and demonstrations on the correct use, maintenance, and disposal of PPE should be conducted.
- Regular Inspection: All protective equipment should be inspected regularly for any damages, and damaged equipment should be replaced immediately.
- Label Compliance: Always adhere to the PPE recommendations provided on the agrochemical product labels.



Figure 4: A sprayer wearing PPE
Photo: Fintrac Global Inc



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SPECIFIC RECOMMENDATIONS FOR HORTICULTURE CROPS

Tomatoes and Peppers

Regular monitoring for pests and diseases such as aphids and blight is essential. Appropriate agrochemicals should be applied promptly upon detection of any threats.

Carrots and Onions

The emphasis should be on soil health and moisture levels. Pest and disease management should focus on soil-borne pathogens and pests.

Watermelons and Papayas

Monitoring for pests like melon flies and diseases like powdery mildew is crucial. Timely application of suitable agrochemicals is essential to manage these threats.

CONCLUSION

The judicious and accurate application of agrochemicals is important to help Tanzanian smallholder farmers achieve maximum productivity potential. This bulletin has outlined crucial steps, from problem identification to the resolution, emphasizing the importance of knowledge, precision, safety, and environmental stewardship in utilizing agrochemicals. Adherence to recommended procedures, regular equipment checks, proper calibration, and the use of Personal Protective Equipment are essential to mitigating risks and ensuring the effectiveness of the applications. By implementing the guidelines and best practices provided in this bulletin, farmers will have a better understanding of how to effectively and safely use agrochemicals on their farms.