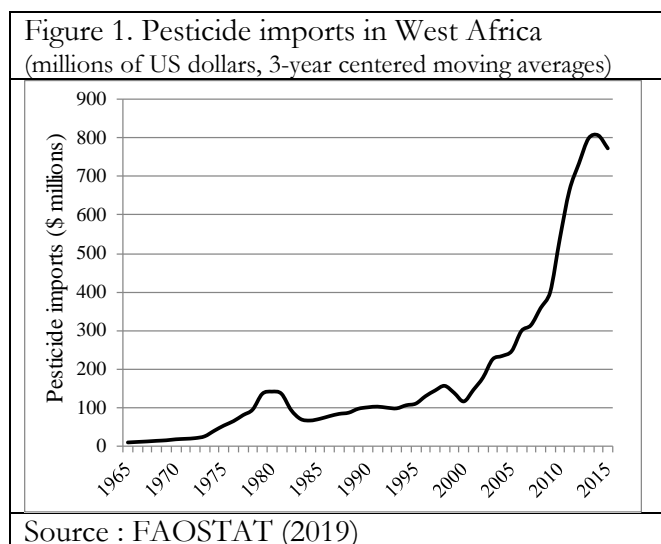


Quality Comparison of Fraudulent and Registered Pesticides in Mali

Steven Haggblade, Amadou Diarra, Wayne Jiang,
Amidou Assima, Naman Keita, Abdramane Traoré and Mamadou Traoré

Objectives

Pesticide markets have grown rapidly in West Africa over the past decade and a half (Figure 1). Sales of the herbicide glyphosate, the most widely sold pesticide in West Africa, have led this rapid growth, driven by rising farm wage rates and falling prices of the growing number of generic glyphosate brands (Figure 2).



Because regulatory capacity has not kept pace with this rapid market growth, sales of fraudulent pesticides have increased as well (Figure 3). On average, a study of the eight largest West African pesticide markets suggests that fraudulent products account for roughly 34% of pesticide sales, 27% unregistered and 7% counterfeits (Mir Plus 2012).

In the face of widespread fraud, Malian farmers complain frequently about low and variable input quality (Assima et al. 2017). This policy brief responds to their regular requests for guidance on how to identify good quality pesticides.

Key Findings

- Pesticide markets have grown rapidly in West Africa over the past decade and a half, far faster than regulatory monitoring capacity.
- As a result, fraudulent pesticides (unregistered and counterfeit) are widely sold throughout Mali.
- Purchase of 100 glyphosate samples from 50 different retailers across Mali indicate that that 45% were fraudulent products.
- Laboratory testing indicates that fraudulent glyphosate products contain 8-10% less active ingredient than registered products.
- Farmers can protect themselves by purchasing only pesticides duly registered by the Comité Sahélien des Pesticides (CSP).

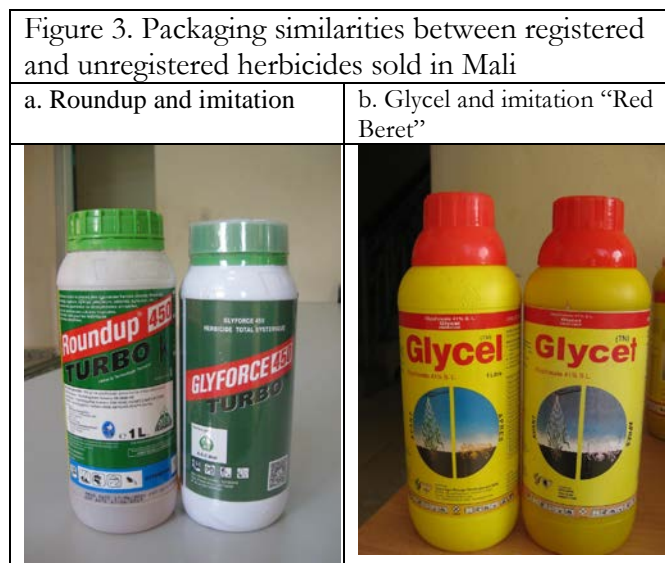
Figure 2. A partial display of glyphosate brands sold in Mali



a. Roundup and its imitators (above)



b. The « Red Berets », Glycel and imitators (above)



Data and methods

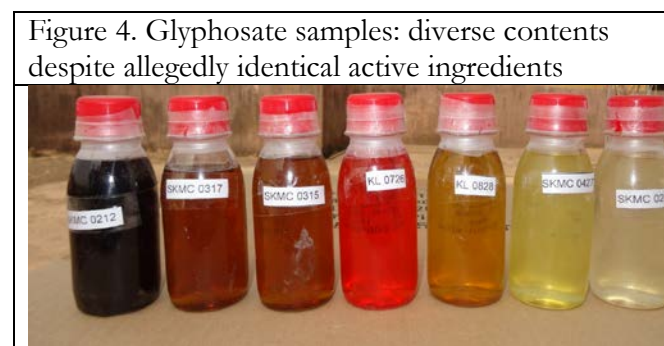
To assess glyphosate quality across a range of different agro-ecological zones, this study collected samples from agricultural input suppliers operating in four major market centers: Bamako (central market, Bozola and Kati), Niono, Koutiala and Sikasso. In each location, the team obtained a listing of all registered farm input retailers. From this listing, the team selected 10 distributors at random. One team member then visited each shop, posing as a farmer, and asked the shop owner to recommend two glyphosate products -- the best quality product as well as the cheapest. The buyer then purchased two one-liter bottles from each supplier. In this way, the team aimed to obtain a range of glyphosate brands and qualities. These purchases took place in December 2016.

The resulting distribution of glyphosate samples included 40 from Bamako, 30 from Niono, 16 from Sikasso and 14 from Koutiala. The selection included 31 different brands of glyphosate (Figure 2). Among the 100 glyphosate samples, 63 came from China, 18 from Europe, 2 from India, 1 from Ghana, and 1 from Mexico while 15 failed to indicate provenance. Prices ranged considerably, from 2,500 to 8,000 CFAF/liter (\$4.30 to \$13.80). The oldest product listed a fabrication date of February 2009, compared to the most recent in December 2016. Out of 100 products purchased 45% were fraudulent, 6 of them registered elsewhere

and smuggled into Mali and 39 unregistered anywhere.

From each bottle, a senior chemist from Mali’s Central Veterinary Laboratory pulled two 100 ml. samples. The team then gave each sample a unique code number and shipped a set of 100 samples to testing laboratories in West Africa and in the USA.

The laboratories conducted their analysis blind, with no knowledge of the individual product names, locations of purchase, price, registration status or manufacturing location. The wide range of colors found among the 100 glyphosate samples suggests clear differences in the various glyphosate formulations sold (Figure 4).



The potency of any given glyphosate product depends on the quantity of glyphosate acid supplied. Typically, manufacturers measure dosage in grams of glyphosate acid-equivalents (ae) per liter of formulation (g/L ae). In addition to glyphosate acid, most formulations include salts as co-formulants to improve product adherence to plant foliage. The classic original Roundup formulation included 360 g/L of glyphosate acid plus an additional 120 g/L of isopropylamine (IPA) salts. In terms of acid-equivalents, this results in a dosage of 360 g/L ae. Some suppliers advertise this same formulation as containing 480 g/L of active ingredients (glyphosate acid plus salt).

Glyphosate products sold in Mali fall into four different groups (Table 1). Groups 1 and 2 both contain the standard Roundup dosage of 360/g/L ae. However, their labeling differs, with Group 1 reporting 480 g/L of active ingredients (glyphosate acid plus the IPA salts) while Group 2 markets the same formulation as containing 360 g/L glyphosate acid-equivalents (ae). Group 3 contains 450 g/L ae,

while Group 4 contain 489 g/L ae in a potassium (K) salt formulation.

Group	Label information		Acid-equivalent dosage*
	dosage	formulation	
Group 1	480	IPA salt	356
Group 2	360	IPA salt	360
Group 3	450	IPA salt	450
Group 4	500	K salt	489
total			376

* Glyphosate acid-equivalent (ae) dosage (g/L ae).

Sources: Haggblade et al. (2019).

Results

The laboratory testing results enable comparison of actual glyphosate dosage (in acid-equivalents) with the expected dosage as reported on the product labels. A dosage rating of 1.00 means that the laboratory measured exactly the same dosage of glyphosate acid as promised on the product label, while a dosage rating of 0.75 indicates that the product contained only 75% of the promised dose of glyphosate acid.

Quality varied substantially among the various glyphosate products tested. On average, the test results measured glyphosate dosage at 87% of the manufacturers' stated value. Fully 18% of the samples tested contained extremely low dosages, below 75% of expectations (Table 2).

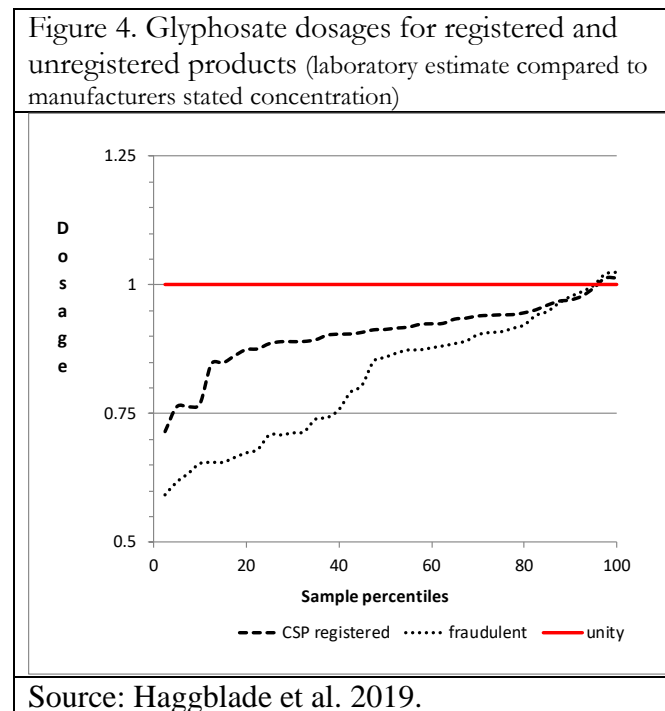
Registration status	Laboratory dosage / stated dosage			
	average	distribution		
		<75%	75-89%	90-110%
Fraudulent*	0.82	38	30	32
Registered by CSP	0.91	4	32	64
total	0.87	18	32	50

* Fraudulent products include the 39% unregistered anywhere and the 6% registered in neighboring countries and then illegally smuggled into Mali.

Source: Haggblade et al. (2019).

Statistical analysis indicates that registration status proves to be the strongest determinant of dosage levels (Haggblade et al. 2019). Other potential quality indicators -- price, manufacturing date and location -- do not significantly affect dosage rates. Overall, products properly registered by Mali's regulatory authority (the CILSS-managed Comité Sahélien des Pesticides, or CSP) have significantly

higher dosage of active ingredient than the fraudulent products (Figure 4). On average, the fraudulent products contain 9% less active ingredient than the CSP-registered brands (Table 2). Even more striking, over one-third of the unregistered products contain less than 75% of the promised glyphosate acid-equivalent dosage. This suggests that the easiest quality control measure farmers can apply is to simply purchase one of the 38 generic glyphosate products registered by the CSP.



Since registration status provides the clearest quality signal for farmers, Table 3 explores the characteristics of registered products. International agro-chemical firms registered 95% of their products. The remaining 5% are likely counterfeits, according to industry sources whom we showed the unregistered labels. Local trading firms, in contrast, registered only about one-third of their products, with two-thirds of them unregistered anywhere. Among the four groups of glyphosate products, suppliers of Groups 2, 3 and 4 register over 80% of their products. In contrast, only 10% of Group 1 products are registered for sale in Mali by the CSP. Another 10% are registered elsewhere and smuggled into Mali, while fully 80% are not registered anywhere (Table 3).

	Registration status			total
	CILSS	none	other	
Supplying firm type				
International R&D	93%	5%	2%	100%
Local trading	28%	64%	9%	100%
Manufacturing location				
Europe	83%	11%	6%	100%
other	47%	37%	16%	100%
China	49%	48%	3%	100%
Formulation				
Group 1. 356 g/L	10%	80%	10%	100%
Group 2. 360 g/L	84%	12%	5%	100%
Group 3. 450 g/L	83%	17%	0%	100%
Group 4. 489 g/L	100%	0%	0%	100%
All samples	55%	39%	6%	100%

Given the predominance of unregistered products in Group 1, these products not surprisingly provided the lowest average dose of any product group, only 82% of the acid-equivalent glyphosate concentration promised on the label. 40% of all samples from Group 1 provided less than 75% of the promised dosage (Table 4).

Group	Laboratory dosage / stated dosage			
	average	distribution		
		<75%	75-89%	90-110%
Group 1	0.82	40	30	30
Group 2	0.92	2	26	72
Group 3	0.86	17	41	42
Group 4	0.86	0	80	20
total	0.87	18	32	50
* Glyphosate acid equivalent (ae) dosage (g/L ae).				
Source: Haggblade et al. (2019).				

This evidence suggests that farmers should be wary of Group 1 products. Their labels advertise the number 480 in large font, evidently hoping that farmers will mistakenly conclude that these products offer higher potency than the standard 360 g/L formulations. In reality, Group 1 products promise only 356 g/L of glyphosate acid. Even more disconcerting, they deliver only 82% of the promised dosage, the lowest of any of the four product groups (Table 4). Use of the 480 on the label appears to identify firms that aim to fool farmers with big-but-misleading numbers that include the weight of the co-formulant salts.

Policy Implications

For farmers, these results suggest a simple decision rule for ensuring the quality of glyphosate they purchase for use on their fields. The prudent farmer would purchase only products duly registered by Mali's regulator, the Comité Sahélien des Pesticides (CSP). Currently, the CSP has approved 38 generic glyphosate brands registered for sale, resulting in a wide array of good choices. Since 90% of the glyphosate products in Group 1 are fraudulent (unregistered or smuggled), farmers would also be well advised to avoid any product with a 480 g/L on its label.

For regulators, the widespread prevalence of fraudulent glyphosate products in Mali raises serious concerns. Fully 45% of the glyphosate samples purchased were fraudulent. Of these, over two-thirds were under-dosed; one-third of them contained less than 90% of the promised glyphosate acid while a further one-third contained less than 75% of the promised dosage. The widespread prevalence of low-quality, fraudulent products suggests a clear need for more aggressive monitoring of markets and product quality.

References

- Assima, Keita and Kergna. 2017. Restitution des résultats de recherche aux producteurs. *FTF Document de travail 39*. East Lansing : MSU.
- Haggblade et al. 2019. Quality comparison of fraudulent and registered glyphosate products sold in Mali. *FTF Research Paper 125*. East Lansing : MSU.
- MIR Plus. 2012. *Evaluation de la qualité des pesticides commercialisés dans huit pays de l'espace CEDEAO*. Abuja and Abidjan : ECOWAS and UEMOA.

This research is made possible by the generous support of the American people through the United States Agency for International Development (USAID) under the Feed the Future initiative. The contents are the responsibility of study authors and do not necessarily reflect the views of USAID or the United States Government.

Copyright © 2019, Michigan State University. All rights reserved. This material may be reproduced for personal and not-for-profit use without permission from but with acknowledgement to MSU.

Published by the Department of Agricultural, Food, and Resource Economics, Michigan State University, Justin S. Morrill Hall of Agriculture, 446 West Circle Dr., Room 202, East Lansing, Michigan 48824