The Critical Role of Mancozeb in Global Agricultural Sustainability and Food Security

Prepared for Policymakers
By the Center of Excellence in Regulatory Science in Agriculture (CERSA), NC State University, in partnership with UPL, and our Mancozeb Summit stakeholders (June 3-4, 2025, in the U.K.)

Introduction

The ongoing court process regarding the renewal of approval of the broad-spectrum fungicide mancozeb in the European Union (EU) comes at a critical juncture for global agriculture. Recent breakout sessions organized by the Center of Excellence in Regulatory Science in Agriculture (CERSA) at NC State University, in collaboration with UPL, convened international experts on potato, banana, soybean, and citrus production to discuss the significance of mancozeb for production of their respective crops. These sessions underscored the multifaceted importance of mancozeb across diverse crops, geographies, and socio-economic contexts. This paper summarizes the key findings and urges policymakers to consider the scientific, economic, and social implications of restricting access to this vital fungicide.

Potato: Quantifiable Losses and Evidence-Based Advocacy

Mancozeb is a widely used fungicide essential for managing destructive plant diseases, including *Phytophthora infestans*, the causal agent of late blight in potatoes. This disease remains one of the most significant threats to potato production worldwide. Its multi-site mode of action has been a cornerstone of resistance management strategies for decades, preventing the development of resistance to other, often single-site, fungicides.

The European Union's potato sector is a substantial contributor to its agricultural economy. In 2023, the value of raw potato production (including seed potatoes) within the EU was estimated at €19.4 billion, representing 3.8% of the total value of the EU's agricultural output. The broader EU potato market was valued at $18.9 billion in 2024, encompassing the revenues of producers and importers. Intra-EU trade in potatoes alone amounted to approximately 9.0 million tonnes with a market value of €3.0 billion in 2023, underscoring the interconnectedness and economic significance of the sector. In the European Union (EU), the area of land harvested for potatoes has shown a marked decline - dropping from 3.0 million hectares in 2000 to just 1.3 million hectares in 2023. Over the same period, total EU potato production fell by nearly one-third, from over 72 million tons in 2000 to 48.3 million tons in 2023.

Since the EU's withdrawal of mancozeb approval in 2021, growers have completed three seasons adapting to alternative disease management strategies. Early observations and reports from these seasons suggest severe consequences. EuroBlight, the European network for potato late and early

blight research, has historically highlighted mancozeb's consistent and reliable efficacy, even utilizing it as a reference standard in numerous fungicide trials for decades due to its broad-spectrum, multi-site protective action and remarkable lack of confirmed resistance development over 50 years of use.

The absence of this critical tool has profoundly impacted growers. Reports from 2022 and 2023 indicate widespread devastation in regions like the Netherlands, Northern Germany, and Denmark, where strains resistant to alternative fungicides (e.g., carboxylic acid amide and oxathiapiprolin fungicides) caused significant crop losses. French farmers, for instance, reported losing "whole crops to potato blight in 2024," with anecdotal evidence suggesting that without mancozeb, farmers are applying "2–3 times more fungicides, significantly increasing costs." This directly translates to higher input costs for farmers, diminishing their profitability and contributing to an upward pressure on consumer prices.

This situation underscores the critical importance of maintaining access to a diverse set of fungicide tools. The current portfolio of plant protection products, while featuring some robust options, has become less resilient without the foundational multi-site protection offered by mancozeb. This creates a greater susceptibility to the development of more aggressive blight strains, particularly as single-site fungicides face increased pressure, accelerating resistance.

As the sector continues to adjust, these experiences offer valuable insight into the role that multi-site fungicides like mancozeb have historically played in supporting stable production and safeguarding the significant economic value of the EU potato industry.

Key points include:

- **Data-Driven Insights**: EuroBlight's historical efficacy data unequivocally demonstrated mancozeb's consistent performance as a protective fungicide, acting as a critical resistance management tool due to its multi-site action. The post-withdrawal period has provided empirical evidence of its absence leading to increased blight incidence, productivity declines, and higher input costs for farmers across Europe.
- **Economic Stability**: The loss of this cost-effective fungicide reduces production efficiency, significantly increases farm-level input costs (with farmers needing to apply more expensive alternatives, often at higher frequencies), and contributes to upward pressure on consumer prices, with potential implications for food security and market stability. Indeed, as potato growers in the UK and Europe are increasingly subject to risks without any convincing means of dealing with them, they are turning away from the sector, threatening future supply.
- **Resistance Management**: Mancozeb's multi-site nature was pivotal in prolonging the efficacy of single-site fungicides by reducing selection pressure for resistance. Its reintroduction would provide a crucial "resistance breaker" in rotation-based disease management strategies, not just in potato but other important crops as well (e.g., grapes, onions, apples, pears, citrus, olives, bananas, and soybeans).

- **Reintroduction Potential:** The ongoing EU Court case represents a real possibility for mancozeb to be reintroduced to European markets. The reintroduction of such a highly reliable multi-site fungicide would significantly enhance the ability of growers to guarantee the yield and quality desired by the European potato industry. Driven by increasing demand for potatoes in the European Union, the market is expected to continue an upward consumption trend over the next decade.

Banana: Social, Economic, and Security Consequences in Latin America and Beyond

Mancozeb is a crucial tool for sustainable disease management in banana cultivation. It is particularly effective in controlling black Sigatoka (*Pseudocercospora fijiensis*), which is the most destructive foliar fungal disease affecting banana production. This disease can lead to yield losses of up to 50%, resulting in significant economic damage. Many growers would be forced out of business completely. One of the key advantages of mancozeb is that black Sigatoka has not developed resistance to it, making this multi-site fungicide an essential protectant and a vital component of resistance management strategies.

The banana industry is not simply an agricultural sector—it is a socioeconomic lifeline for millions of people across Latin America. It provides direct and indirect employment through farming, transport, packing, and logistics, especially in countries like Ecuador, Costa Rica, Colombia, and Guatemala. Any disruption caused by the removal of mancozeb would lead to widespread job losses, deepen rural poverty, and increase migration and social instability in already fragile communities. Banana production underpins livelihoods, regional stability, and national economies heavily reliant on exports for GDP.

The EU's steady banana supply from Latin America is not merely a trade convenience but a cornerstone of its food supply chain and a major source of affordable, nutritious fruit for consumers. In 2021, approximately 76% of the EU's banana supply originated from Latin America, with countries like Ecuador, Costa Rica, and Colombia leading those global exports. For example, in 2024, Ecuador sent 28% of its total banana exports to the EU. For Colombia, the EU represented 70% of its market's exports, and bananas are the 3rd largest agricultural export for the Colombian economy. It is nearly a billion-dollar export with over 100 million boxes of bananas sent to the EU annually. In Costa Rica, the EU comprised nearly a third of its banana exports. Any disruption to this supply chain would likely raise prices for European consumers and limit the availability of this dietary staple.

Key insights from the breakout session include:

- **Economic Disruption and Job Loss**: In Ecuador, the banana industry supports around 250,000 direct jobs, with 70% of producers being smallholders. For Colombia, the banana industry generates more than 200,000 direct and indirect jobs across the country with some regions, namely Urabá and Magdalena, employing over 50,000 workers. In the banana producing Caribbean region of Costa Rica, the banana industry provides

approximately 150,000 jobs. Without mancozeb, banana yields could fall by 30–50%, threatening a billion-dollar export sector. In addition, the absence of an effective alternative to mancozeb could escalate costs and drive small and medium-sized producers out of the market.

- **Social Stability and Migration Pressures**: Reduced employment could increase vulnerability to organized crime and drug trafficking in rural areas, being that drug trafficking is a transnational problem directly correlated to demand growth of EU consumers. Organized crime poses a reputational and economic threat to the Latin-American banana sector, affecting the livelihoods of producers and workers, as well as the smooth functioning of the banana trade to the EU. In many South and Central American countries including Colombia, Costa Rica, Ecuador, and Guatemala, the banana sector plays a stabilizing role in communities already facing economic fragility.
- **MRLs**: EU Maximum Residue Limit (MRL) policies are often misunderstood. MRLs are legal limits established by each country reflecting the Good Agriculture Practice (GAP) approved in the setting country. They are set well within acceptable levels of protection with wide safety margins applied. Proper handling and processing practices ensure that fruit residues remain below established MRLs. Educational efforts are needed to clarify the distinction between MRLs and actual consumer risk. For bananas, EFSA's evaluation did not include data on this specific crop, which is peeled before consumption—this omission raises questions about the scientific consistency of the decision-making process. The European Court of Justice partially overturned the Commission's decision on banning mancozeb, citing outdated scientific evidence and failure to consider newer assessments, underscoring the need for up-to-date, crop-specific scientific evaluations.
- **Public Health and Environmental Concerns**: Without mancozeb, less effective fungicides would require more frequent applications. This could have the opposite effect from intended, actually increasing negative environmental impact while compromising disease control.

Soybean: Irreplaceable Tool for Disease Management and Global Food Stability

Brazil is the world's leading exporter of soybeans, with exports reaching a record 101.9 million metric tons in 2023. Of those, 11.8% (9.77 Mt) soybean exports were to the EU (approximately 40% of EU total soy imports) in that same period. Approximately 77% of Brazilian soybeans (~16.3 million tons) are processed into soybean meal for animal feed (primarily for poultry, swine, and cattle).

Given the scale and global importance of Brazil's soybean production—particularly its role in supplying animal feed and edible oil—effective disease management is essential for maintaining national yields and international market stability. In Brazil, mancozeb plays a critical role in controlling aggressive foliar diseases such as Asian soybean rust and target spot. As a multi-site

fungicide, it not only provides broad-spectrum control but also functions as a safener when tank-mixed with potentially phytotoxic Demethylation Inhibitors (DMI) chemistries like triazoles. Many single-site fungicides available in Brazil are constrained by resistance development, limited pathogen targets, or higher cost, making them less practical for long-term, widespread use.

Key points include:

- **Importance in Disease Management**: Mancozeb is one of the few remaining effective tools against foliar pathogens in soybeans. Its role in integrated disease management cannot be easily substituted.
- **Economic and Trade Impacts**: Maintaining access to mancozeb helps support consistent yields and cost-effective soybean production. Its continued availability contributes to stable global prices for soy products such as oil and animal feed, benefiting international supply chains and consumers in key import-dependent countries such as China, Argentina, Mexico, the EU, and the United Kingdom (UK).
- **Agronomic Benefits**: Mancozeb contains the micronutrients zinc (Zn) and manganese (Mn), which are essential for key physiological processes in plants, such as photosynthesis and the synthesis of antioxidant enzymes. The presence of these elements helps mitigate the phytotoxic effects commonly observed with triazole applications, such as tebuconazole and prothioconazole. Mancozeb contributes to more effective pathogen control and, consequently, to increased crop productivity. In addition to soybeans, the agronomic benefits of mancozeb extend to other economically important crops, including rice, cotton, common beans, corn, and wheat.
- **Regulatory and Residue Profile**: While unlikely to have any use restriction in Brazil, mancozeb faces regulatory scrutiny in the EU. Understanding how mancozeb behaves in processing and is not fat-soluble is important for clear and accurate risk communication and helps inform balanced regulatory evaluations.

Citrus: Compliance with EU Phytosanitary Regulations with Limited Tools for non-EU producers

The recent implementation of EU Regulation 2022/632, aimed at preventing the introduction and spread of pests like *Phyllosticta citricarpa* (Citrus Black Spot), presents significant challenges for citrus producers outside the EU. While the regulation seeks to protect European agricultural health through the prescription of treatment programs, the EU Commission has limited or not authorized the use of critically needed fungicides such as mancozeb, placing an undue burden on many non-EU countries. Mancozeb has historically been a crucial tool in integrated pest management programs for citrus, offering broad-spectrum control against various fungal diseases. The lack of authorized alternatives with comparable efficacy, coupled with the often prohibitive costs and regulatory hurdles associated with adopting new treatments, severely compromises the ability of

these producers to meet the EU's phytosanitary standards without jeopardizing their livelihoods and the quality of their exports. This disparity in approved crop protection tools creates an uneven playing field and threatens established trade relationships.

- **Limited Approved Alternatives**: Non-EU citrus producers often face a restricted palette of authorized fungicides, with many effective and affordable options, including mancozeb, being prohibited or having significantly lower Maximum Residue Limits (MRLs) in the EU compared to their own domestic regulations.
- **Increased Compliance Costs**: The necessity to adopt alternative, often more expensive, pest management strategies, combined with enhanced testing and certification requirements, substantially increases production and export costs for non-EU growers.
- **Risk of Trade Disruption**: The need to consistently meet the stringent EU phytosanitary demands, driven by the limitations on critically needed fungicides, poses a direct threat to the continuity of citrus exports to the EU market, impacting the economic stability of many producing regions.

Conclusion: A Call for Balanced, Science-Based Decision Making

Mancozeb remains integral to sustainable crop protection across key global commodities, reflecting decades of rigorous scientific scrutiny and practical application. Registered in over 70 countries, mancozeb has been assessed under a wide spectrum of comprehensive regulatory frameworks, consistently demonstrating its safety profile for operators, the environment, and consumers when used according to label instructions.

The primary registrant for mancozeb, UPL, has consistently upheld a steadfast commitment to supporting the scientific data availability that underpins the product's safety record. This dedication is evidenced by mancozeb's recent re-evaluations and approvals in rigorous regulatory environments, such as Canada and South Africa. These re-approvals, often involving updated risk mitigation measures and detailed instructions for safe handling, mixing, and application, reflect the robust nature of the data package provided by the registrant and the efficacy of global regulatory oversight in ensuring responsible product use. These independent regulatory reviews in major agricultural regions serve as compelling evidence of mancozeb's ability to meet contemporary safety standards.

With its long-standing and well-documented safety record, mancozeb is not merely a tool for disease control; it is a foundational component for resistance management and a vital element within Integrated Pest Management (IPM) strategies. Its multi-site mode of action is especially critical, as it significantly reduces the risk of resistance development in target pathogens, thereby prolonging the efficacy of other, often more vulnerable, single-site fungicides. This multifaceted contribution to crop health and resilience plays a significant role in efforts towards global food security, enabling farmers to protect yields and maintain the quality of essential crops.

Decisions regarding plant protection products in the EU have far-reaching consequences that extend beyond European borders. They impact not only European consumers and growers, but also global agricultural supply chains, the livelihoods of smallholder farmers worldwide who depend on effective and affordable crop protection, and the dynamics of international trade. The withdrawal of a product with a proven safety record and critical role in resistance management, such as mancozeb, sends ripples through these interconnected systems, challenging the global agricultural community's ability to sustainably feed a growing population. The ongoing scientific review and the precedent set by positive re-evaluation outcomes in other major agricultural economies continue to reinforce the global perspective on mancozeb's viability and safety as a cornerstone crop protection tool.

We urge policymakers to:

- **Prioritize Evidence-Based Decision-Making**: Integrate comprehensive field data, robust scientific assessments, and direct stakeholder testimony from affected regions into the regulatory review process for crucial crop protection tools like mancozeb. This ensures decisions are grounded in real-world agricultural realities and diverse climatic conditions, moving beyond theoretical concerns to pragmatic, evidence-based outcomes that support sustainable global food systems.
- **Acknowledge and Mitigate Socio-Economic Disruption and Legal Imperatives**: Given the profound socio-economic and environmental consequences of withdrawals of essential fungicides like mancozeb, policymakers must conduct thorough impact assessments. This is especially critical considering the recent ruling by the European Court of Justice which overturned the European Commission's 2021 non-renewal decision for mancozeb, citing reliance on outdated scientific evidence. This judicial precedent underscores the need for regulatory decisions to be based on the most current and comprehensive scientific understanding, ensuring legal soundness and mitigating severe economic dislocations for global agricultural supply chains.
- **Foster a Pragmatic Path Towards Sustainable Solutions**: Advocate for a balanced regulatory approach that allows for the continued, regulated use of proven and effective crop protection solutions like mancozeb, particularly where viable alternatives are unavailable. Concurrently, policymakers should champion and incentivize significant investment in research, development, and adoption of innovative, integrated pest management strategies and genuinely sustainable alternatives, ensuring a smooth transition to future-proof crop protection while maintaining global agricultural productivity and trade stability.

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