2025 Potassium Citrate IPM Foliar Combination Wash Study - WhitePaper Summary
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Evaluation of a Potassium Citrate-Based Foliar Feed for Cannabis Cultivation - White Paper Summary

1. Executive Summary

This whitepaper details the development and evaluation of a novel foliar spray solution for cannabis cultivation, derived from a mixture of **potassium bicarbonate** and **citric acid**. The primary objective was to create an effective, non-toxic, and affordable alternative to commercially available products for controlling powdery mildew (PM) and other pests.

Initial commercial products proved insufficient, showing rapid PM reemergence and negatively impacting the final product's taste. This led to the development of a proprietary formula based on a simple mixture of potassium bicarbonate and citric acid, which chemically react to form potassium citrate, CO2 and Water.

Through a series of field tests, It was observed that this foliar feed effectively suppressed and eliminated powdery mildew while also strengthening plants. The final formulation was proven safe for use on cannabis, passing all testing requirements for medical cannabis in South Dakota.

Key Findings:

Effective Pathogen Control: The solution successfully eliminated powdery mildew from the facility.

Optimal Formulation: A ratio of 2.5:1 potassium bicarbonate to citric acid was most effective for emergency PM control.

Plant Health: The solution acted as a foliar feed, providing essential potassium and strengthening plant cellular structures.

Phytotoxicity: Damage to plants was minimal and avoidable. It was primarily observed in very young plants, specific strains, or when using an improperly balanced or overly strong solution.

Cost and Safety: The solution is more affordable than all commercial alternatives and is safe for growers, with no irritating effects on skin or eyes. The final product passed all required testing with no taste or residue issues.

2. Introduction

Foliar feeding is a critical practice in modern cannabis cultivation, offering a method for near-immediate nutrient delivery directly to plant cells. This not only supports robust growth but also strengthens cellular structures, making plants more resilient to stress. In an industry where plant health is directly tied to the quality of the final product, an integrated approach to nutrition and pest management is essential.

This study investigates the potential of a simple, potassium citrate-based foliar spray to provide a more effective and affordable solution for both plant nutrition and pathogen control. The foliar feed is created by mixing potassium bicarbonate ($KHCO_3$) with citric acid ($C_6H_8O_7$) in solution, which reacts to form potassium citrate ($K_3C_6H_5O_7$). Potassium is a vital macronutrient for plant growth and is known to be a key component in many commercial pest and mildew control products.

The primary goal of this study was to demonstrate that this simple, on-site formulation could provide superior results to commercial alternatives, specifically in terms of preventing powdery mildew reemergence and maintaining overall plant health.

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3. Chemical Basis and Formulation

The foliar feed is created through a chemical reaction between potassium bicarbonate and citric acid.

3.1 Reaction Chemistry

The balanced chemical reaction is as follows:

$$3KHCO_3 + C_6H_8O_7 \rightarrow K_3C_6H_5O_7 + 3CO_2 + 3H_2O$$

Potassium Bicarbonate ($KHCO_3$): A common, soluble salt.

Citric Acid ($C_6H_8O_7$): A acid found in citrus fruits.

Potassium Citrate ($K_3C_6H_5O_7$): The desired, highly bioavailable foliar feed component.

Byproducts: The reaction produces carbon dioxide (CO_2) gas and water (H_2O).

The effervescence from the CO_2 gas release is believed to be a key element in the solution's efficacy, potentially aiding in the mechanical removal of powdery mildew spores.

3.2 Mixture Parameters

Initial testing began with a dilution of 20g potassium bicarbonate per gallon and 37g citric acid per gallon. The ratio of potassium bicarbonate to citric acid is a critical factor influencing the solution's effectiveness and safety.

Ratios for Foliar Feed (Nutritional): Ratios between **1:1 and 2:1** (potassium bicarbonate:citric acid) were found to be best for general foliar feeding, providing plant-strengthening benefits with minimal risk of damage.

Ratios for Pathogen Control: Ratios between **2.5:1 and 5:1** were most effective for addressing existing mildew outbreaks.

Phytotoxicity: Ratios higher than 5:1, or improperly balanced solutions, showed increased risk of phytotoxicity, particularly on young plants or mature pistils.

3.3 Solution Characteristics

The final solution is a clear, nearly odorless liquid with a white, tasteless residue upon drying. The pH range of the mixed solution is controllable between 4.0 and 6.5, with an electrical conductivity (EC) range of 1.0 to 3.9.

Solution Preparation Protocol: Solutions were prepared immediately before application to ensure the reaction was ongoing and the mixture was at its peak efficacy.

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4. Experimental Design and Application

The study was conducted in a commercial indoor cultivation facility without a formal control group. All observations were made on an "in-field necessity" basis, comparing results from various solution ratios and application protocols.

4.1 Application Protocol

Frequency: For emergency control of powdery mildew, the solution was applied every 5 days.

Timing: Applications were conducted in the late morning to midday, with lights off. The solution was allowed to dry slowly to maximize contact time.

Method: The solution was applied using a garden hose with a center spray nozzle and a small pump to ensure thorough coverage, including the undersides of leaves.

Coverage: Approximately 13-17 gallons were used for six 4x8 ft tables with small plants, increasing to 30 gallons for large plants in late flower.

4.2 Monitoring Parameters

Pathogen Pressure: Powdery mildew reemergence was the primary metric. Incomplete coverage or weak solutions (e.g., 1.5:1 ratio) led to reemergence, while stronger ratios (2.5:1 or higher) effectively eliminated it.

Plant Health: Plant health was monitored visually. High-ratio solutions caused leaves to feel "papery," while lower ratios resulted in soft, healthy-feeling leaves. No significant stunt in growth or flower development was observed with appropriate application rates.

Phytotoxicity: Phytotoxicity was initially observed in early trials with overly strong, high-pH solutions and was also noted when sulfur applications were combined with the foliar feed. This was not an issue once the optimal application rates were established.

Residue and Safety: The final product passed all state-mandated testing for medical cannabis, with no taste found on the final product. Microscopic analysis suggests three modes of action for the solution: mechanical dislocation, cellular oxidative stress, and hypotonic lysis.

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5. Results and Discussion

The potassium citrate foliar feed successfully addressed the problem of persistent powdery mildew in the cultivation facility. The solution eliminated powdery mildew and significantly reduced the need for repeated applications. The application interval was successfully extended from daily to once per week after an initial six-week period of 5-day intervals.

The solution's efficacy as a dual-purpose foliar feed and pathogen control agent has been clearly demonstrated. The ability to control the solution's pH and EC by adjusting the ratio of potassium bicarbonate to citric acid allows for a high degree of customization based on specific environmental and plant needs.

While a formal control group was not used, the in-field results were highly conclusive, demonstrating superior performance to the commercial 25b-labeled products previously used, which were both less effective and caused noticeable off-tastes in the final product.

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6. Conclusion and Future Recommendations

This study successfully demonstrated that a simple, in-house foliar spray derived from potassium bicarbonate and citric acid is a viable, safe, and highly effective tool for cannabis cultivation. The solution not only eliminated powdery mildew but also contributed to overall plant health without compromising the final product's quality.

The key benefits of this approach are:

High Efficacy: It provided superior control over powdery mildew compared to commercial alternatives.

Cost-Effectiveness: It is more affordable than many commercial solutions.

Multi-Purpose Use: It functions as both a nutritional foliar feed and a pathogen suppressant.

Safety and Compliance: It is safe for both growers and consumers, and the final product consistently passed state-required testing.

Recommendations for Further Research:

Nutrient Assimilation: Conduct a formal study to quantify the rate and efficiency of potassium uptake through foliar application.

Shelf Stability: Investigate the solution's efficacy and stability over time.

Pest Control: Conduct a controlled study to specifically evaluate the solution's effectiveness against common cannabis pests like spider mites and thrips.

Residue Analysis: Perform a detailed analysis of residue persistence on plant surfaces and final product.