

Research Article



Soaking-Derived Pesticide from Bintaro Fruits (*Cerbera manghas*): A Potential Repellent for Rice-Eating Birds

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ABSTRACT

Bird pests represent a major constraint in rice cultivation, often causing significant yield losses due to their increasing population and feeding activity. Conventional control methods are limited, prompting exploration of plant-derived repellents as sustainable alternatives. This study investigated the effectiveness of pesticide formulations derived from *Cerbera manghas* (Bintaro) fruit extract in repelling rice-eating birds. The research was conducted in Tonasa Village, Takalar Regency, South Sulawesi, using a field-based spraying approach. Observations were recorded across morning, midday, and afternoon periods, comparing bird attack frequencies before and after treatment. Results demonstrated a marked reduction in pest activity: morning attacks decreased from 20-35 to 9-16, midday from 9-15 to 3-6, and afternoon from 22-33 to 9-15. These findings indicate that *C. manghas* fruit extract exhibits promising repellent properties, contributing to improved rice protection and potentially enhancing sustainable pest management strategies.



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1. INTRODUCTION

Rice (*Oryza sativa* L.), Indonesia's primary staple, is more than a caloric necessity; it is a pillar of national economic resilience and social balance. In recent years, fluctuations in rice availability have served as an indicator for

political stability, making food security a permanent component of government policies (Baharsyah et al., 1998; Amang & Sawit, 2001). While Indonesia has hit significant production milestones 74.99 million tons in 2015, the path to the Ministry of Agriculture's "2045 Global

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Food Barn" vision is fraught with uncertainty. El Niño and persistent biotic pressures contribute to a gap between production targets and actual yields (BPS, 2018).

Among these biotic constraints, bird pests pose a disproportionately destructive but undermanaged threat. Granivorous birds, particularly sparrows (*Passer* spp.), peking birds, and bondol birds, cause the most damage during the "milk stage" of grain development, which occurs around 70 days after planting. These attacks are not unintentional; the flocking behavior and aligned feeding patterns of these species can cause yield losses ranging from 30% to 50% (Ziyadah, 2011; Modjo, 2012). Despite the severity of these losses, traditional mitigation methods, such as manual field guarding and fundamental scarecrows, remain labor-intensive and largely ineffective for modern, large-scale cultivation (Syahminan, 2017). The economic strain on smallholder farmers highlights the critical need for a transition from passive deterrence to active, scalable protection.

In this framework, phytochemical pesticides arise as a refined, environmentally sustainable substitute for synthetic substances and ineffective conventional techniques. *Cerbera manghas* (Bintaro), a perennial arboreal species endemic to the Indonesian archipelago, harbors a formidable biochemical composition distinguished by toxic alkaloids and cardiac glycosides. Fundamental to its defensive strategy is cerberrin, a compound that exerts considerable repellent and antifeedant properties on vertebrate nuisances (Kartimi, 2015). In addition to its direct toxicity, the volatile aromatic constituents of the Bintaro fruit have been

demonstrated to elicit behavioral aversion in both rodents and bird nuisances (Shafna, 2016). The synergy of saponins, polyphenols, and tannins within the extract disrupts feeding patterns, providing a multi-faceted defense against infestation (Tarmadi et al., 2007).

This study aims to determine the effect of providing vegetable pesticides from Bintaro fruit extract in repelling rice-eating bird pests. By elucidating the influence of this phytochemical pesticide on pest prevalence and agricultural damage, this inquiry aspires to furnish a sustainable, economically viable remedy for Indonesian cultivators. Ultimately, the incorporation of such biobased strategies into integrated pest management (IPM) paradigms is imperative for preserving yield consistency and achieving the nation's enduring food security ambitions.

2. MATERIALS AND METHODS

Study site and period

This research was conducted in the agricultural fields of Paddinging, Tonasa Village, Sanrobone District, Takalar Regency, South Sulawesi, Indonesia. The study was carried out over a 30-day duration during the rice generative phase.

Materials and instrumentation

The primary botanical material consisted of mature, desiccated fruits of *Cerbera manghas* (Bintaro), characterized by a dark brown to blackish pericarp (Figure 1). Field equipment included a 15-liter knapsack sprayer equipped with a polyjet nozzle (1.5-inch spray width), precision scales, graduated measuring cylinders, and standard

processing tools (machetes, hammers, and filtration mesh).

Preparation of *C. manghas* extract

The botanical pesticide repellent was prepared through a cold maceration process: (1) Selection and Mechanical Processing: Fully ripened, sun-dried Bintaro fruits were selected. Due to the high lignocellulosic fiber content, 2 kg of fruit was mechanically fragmented using a hammer and machete to increase the surface area for extraction.



Figure 1. Bintaro Fruit Used

(2) Maceration: The fragmented fruit was submerged in 15 liters of water (a ratio of approximately 1:7.5 w/v) and allowed to undergo extraction for seven days. This duration was selected to ensure the optimal release of bioactive

volatile compounds and alkaloids, evidenced by the development of a dark brown coloration and a pungent, characteristic aroma. (3) Filtration: Following the 7-day period, the crude extract was filtered to remove particulate matter and spent pulp (Figure 2), ensuring the resulting liquid was suitable for nozzle-based application.



Figure 2. Preparation of Bintaro fruit extract, including weighing of the fruit and filtration of the soaked solution.

Application method and calibration process

The extract was applied to a 0.5-hectare (5,000 m²) rice paddy using a calibrated knapsack sprayer to ensure uniform coverage. Calibration involved measuring the flow rate and walking speed to determine the volume required for the treatment area.

Pressure management: The tank was manually pressurized (10-15 pumps) to maintain a consistent discharge rate.

Timing of application: Spraying was initiated during the "milk ripening" stage (approximately 65-100 days after planting), as this phenological stage is most vulnerable to bird herbivory.



Figure 3. Knapsack sprayer equipped with a nozzle used for field application of the Bintaro fruit extract pesticide.

Experimental design and observation parameters

A longitudinal comparative observation method was employed to evaluate the repellent's efficacy against the Scaly-breasted Munia (*Lonchura punctulata*), commonly known as the bondol bird. (1) Baseline (Pre-treatment) Observations: Initial data were collected over four consecutive days to establish the average frequency of bird flock attacks under natural conditions (without botanical intervention). To account for the diurnal rhythms of the pests, observations were conducted during three peak feeding intervals: Morning (06:00-08:00), Midday (11:00-13:00), and Afternoon (15:00-17:00). The primary parameter recorded was the "Average Attack Frequency," defined as the number of bird groups entering the 0.5-hectare plot per two-hour interval. Data were recorded using standardized field instruments and photographic documentation to ensure accuracy. (2) Post-treatment Observations. Following the baseline period, the *C. manghas* extract was applied. The frequency of bird attacks was then recorded for another four-day period using the same time intervals (morning, mid-day, and

afternoon). The effectiveness was determined by comparing the mean number of bird groups observed in the 0.5-hectare plot before and after the application of the botanical repellent.

3. RESULTS AND DISCUSSION

Observations in this experiment were executed over two successive days. The initial day functioned as the baseline (absent pesticide application), whereas the subsequent day encompassed the application of *C. manghas* fruit extract to rice plants. This brief interval was selected to apprehend the optimum growth phase of rice, which is most susceptible to bird pest incursions and to guarantee comparability between untreated and treated states. A comparative methodology was utilized to quantify the frequency of bird groups engaging in attacks prior to and following pesticide application. The outcomes indicated a significant diminution in bird pest activity subsequent to treatment.

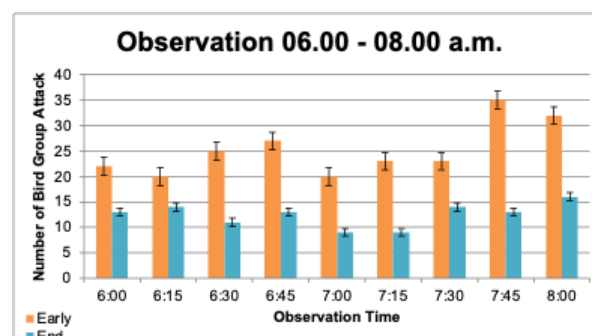


Figure 4. Comparison of bird pest attacks before and after application of Bintaro fruit extract pesticide during morning observations.

Morning observations (06:00-08:00) revealed that prior to the application, bird groups attacked at a frequency of 20-35 per observation period. Following the application of Bintaro extract, the

frequency of attacks decreased markedly to 9-16 groups (Figure 4). This reduction is congruent with the critical feeding periods of birds, which typically transpire during the morning and evening (Syahminan, 2017; Duttenhefner et al. 2024; Hardiansyah et al., 2023). The decline in attacks can be ascribed to the repellent characteristics of secondary metabolites inherent in Bintaro extract, encompassing flavonoids, terpenoids, and alkaloids. These compounds emit a potent aroma that is deleterious to birds, thus dissuading them from foraging. Both seed and pulp extracts contributed to this effect, with seeds generally containing elevated concentrations of active compounds.

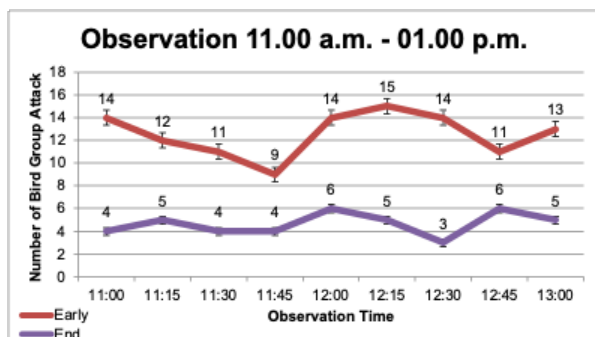


Figure 5. Comparison of bird pest attacks before and after application of Bintaro fruit extract pesticide during midday observations.

Midday observations (11:00-13:00) indicated a diminished frequency of attacks overall in comparison to morning hours. Prior to treatment, bird groups attacked at a frequency of 9-15, which diminished to 3-6 groups following spraying (Figure 5). The reduced baseline activity reflects bird behavior during midday, wherein elevated temperatures inhibit active foraging. Instead, birds typically perch in adjacent trees, seeking shade rather than sustenance (Ziyadah, 2011; Werner et al. 2007; Hardiansyah, 2020). Nevertheless, the additional

reduction post-spraying underscores the efficacy of Bintaro extract even under conditions of inherently lower pest pressure. Seed extracts appeared particularly efficacious, likely due to heightened concentrations of bioactive compounds in comparison to pulp extracts (Utami, 2010; Hardiansyah et al., 2020; DeLiberto & Werner, 2024).

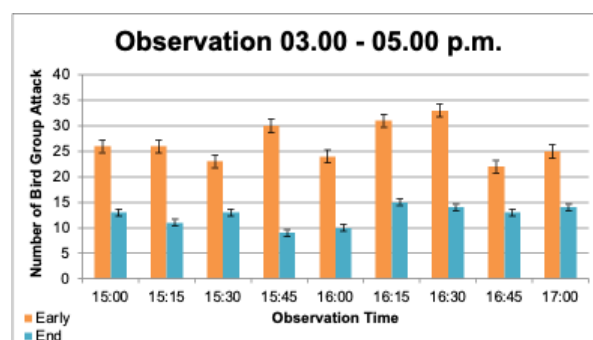


Figure 6. Comparison of bird pest attacks before and after application of Bintaro fruit extract pesticide during afternoon observations.

Afternoon observations (15:00-17:00) disclosed that bird attacks were once more more frequent, ranging from 22-33 groups prior to treatment. Subsequent to spraying, attacks decreased to 9-15 groups (Figure 6). Although afternoon attacks were less intense than those in the morning, this period remains critical for pest activity, as birds recommence foraging prior to roosting. The persistence of the repellent effect during evening hours illustrates the effectiveness of Bintaro extract in mitigating bird pest pressure across multiple feeding intervals. The applied liquid adheres to leaves, grains, and panicles, releasing volatile compounds that repel birds. The aroma typically endures for 2-3 hours under overcast conditions and 1-2 hours under bright sunlight, with wind further facilitating dispersal. Given birds' highly developed olfactory and auditory senses

(Rudiansyah & Radhi, 2019; Hardiansyah et al., 2020), the presence of these compounds effectively dissuades them from approaching treated rice fields.

4. CONCLUSION

Bird pest attacks on rice plants were most frequent during morning and evening feeding periods. Application of Bintaro fruit extract pesticide significantly reduced attack frequencies, with morning groups declining from 20-35 to 9-16, midday from 9-15 to 3-6, and evening from 22-33 to 9-15. These results demonstrate that Bintaro fruit extract is an effective botanical repellent, offering a sustainable approach to reducing bird pest pressure and supporting more stable rice production.

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