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INTRODUCTION

Although national losses are unknown, bird damage is a chronic problem for many Filipino rice farmers and is sometimes a severe problem within localized areas. Three species of Philippine weavers (*Lonchura malacca*, *L. leucogaster*, and *L. punctulata*) are common pests; and other birds such as sparrows, parrots, and even ducks contribute to crop losses. Post seedling damage by Philippine weavers, the focus of this study, usually occurs from the milky to the early maturing stages of rice growth. At this time, the birds arrive in flocks, alight within the fields, and squeeze "milk" from the developing seeds or hull the doughy grains directly from panicles (Benigno et al., 1975). Although some studies (Manuel, 1930, 1934; Alviola et al. 1973; Benigno et al., 1975) have been conducted on the biology, feeding habits, and damage of Philippine weavers, little attention has been given to methods for reducing crop losses.

Farmers in most countries employ combinations of favorite devices and methods in attempts to frighten birds from their fields and to reduce crop losses. In the Philippines, such combinations usually include; (1) "bird boys" who make noises to frighten the birds; (2) networks of strings, tin cans, and stones that are stretched over the fields and that rattle with the wind or when a cord is pulled; (3) "scarecrows"; (4) white flags flown several meters above the fields; and (5) wooden or bamboo, wind-driven propellers. In countries where farming practices are more mechanized, such devices are supplemented or replaced by firecrackers, exploders, or other noisemaking devices; nets to protect crops of high value; and chemical repellents. Two repellents, methiocarb (which causes conditioned food aversion; Rogers, 1974) and 4-aminopyridine (a frightening agent; De Grazio et al., 1972), have received limited study in the Philippines but appear too costly for practical use in maturing rice at this time.

In the present study, we considered the possibility of using perches coated with glue to frighten birds from a farmer's field. This method would take advantage of the Philippine weaver's habit of alighting on tall weeds (e.g., *Echinocloa* sp.) or other vegetation within the field to feed on rice. If a few of the birds adhered to the perches, we hypothesized that the "glued" birds would emit distress calls and that the remaining birds would learn to avoid the treated fields. Such a treatment would be somewhat analogous to the repellent effect of 4-aminopyridine but could be contrived by Filipino farmers using inexpensive, local materials.

MATERIALS AND METHODS

We selected four contiguous plots, 0.25 hectares each, within 6 hectares of ricefields near Namanparan, Diadi, Nueva Vizcaya, an area in which two species of Philippine weavers are common. Rice plants within the plots were local varieties at the early maturing stages, whereas surrounding fields had plants from booting to the early maturing stages. The greatest numbers of birds (*L. malacca* and *L leucogaster*) concurrently visiting each plot were estimated for each 10-minute interval from sunrise (0600) to early evening (1700) for 4 consecutive days (total of 66 counts per plot per day). These estimates were rounded to the nearest five when more than 10 birds were seen, and will be referred to as bird counts. The counts were made from surrounding hillsides that gave us clear views of each of the plots. Bird damage was then estimated for each plot by counting the total and bird-damaged tillers on five adjacent hills of rice plants (1 sample), 20 samples per plot (5 from each quarter plot, locations selected randomly). Locations of the samples were marked so that subsequent appraisals could be repeated on the same samples.

With pretreatment counts completed, 240 perches were made from twigs of local shrubs, and coated on one end with a "bird glue." The glue had been prepared, according to directions provided by local farmers who use the formulation to collect birds, by mixing the saps of two species of trees (*Artocarpus* spp.) and boiling with low heat over an open fire until very sticky. Perches were placed in two plots (randomly selected; 120 perches per plot) so that the coated ends extended 15-20 cm above the rice plants. The remaining two plots (designated as reference plots) received no sticks. The 4-day bird counts and damage surveys, as described above, were repeated twice for all four plots.

Data from the bird counts were transformed $\left(\sqrt{X+0.5}\right)$ and analyzed (ANOVA) as a mixed, three-factor design. Factors were plots (random) nested within treatments (fixed) and time of day (fixed). Hourly means of the bird counts were used as individual observations, with days serving as repeated measures of the observations. Each period (pretreatment, Days 1-4 of treatment, and Days 5-8 of treatment) was analyzed separately.

Data from the damage surveys were also transformed (arc sine $\sqrt{\text{percentage}}$) and analyzed (ANOVA) as a mixed, three-factor design. Factors were plots (random) nested within treatments (fixed) and periods (fixed). Samples were used as individual observations with repeated measures of the observations for each period.

Newman-Keul's Test ($\alpha = 0.05$) was used to compare means for both the data on bird counts and damage when more than two means were being tested.

RESULTS

The perches lost their adhesive qualities within three days. While the perches were sticky, a total of 13 Philippine weavers (9 *L. malacca* and 4 *L. leucogaster)* and 18 other birds representing three common ricefield species became stuck in the glue and emitted distress calls. Some were still entangled at sunset and were removed from the perches.

Based on hourly means of bird counts for all plots. *Lonchura* were most active during early morning and afternoon and least active around midday. These differences were significant ($p<0.05$) between 0600 to 0800 and 1100 to 1300 during each period. During Days 1-4 of treatment, birds were significantly ($p<0.05$) more active from 0600 to 0700 than during any other hours of daylight (Figure 1).

Before the perches were installed, similar ($p>0.10$) numbers of birds visited the treated and the reference plots. During the periods of treatment, however, bird counts were significantly ($p<0.01$ and $p<0.005$, respectively) greater within the reference than within the treated plots. In fact, bird counts within the treated plots dropped below the pretreatment levels. During treatment, bird counts averaged 2.4 and 0.2 (Days 1-4 and Days 5-8, respectively) for the treated plots, but 17.1 and 16.3 (Days 1-4 and Days 5-8, respectively) for the reference plots (Figure 1).

Amounts of bird damage were also similar ($p>0.10$) in all plots before the glued perches were used. After treatment, damage increased only slightly (and not significantly) within the treated plots. In contrast, damage increased greatly within the reference plots, and by Day 4 of treatment exceeded ($p<0.05$) damage within the treated plots as well as the pretreatment levels of damage for all plots (Figure 2).

DISCUSSION AND CONCLUSIONS

The study serves as a clear demonstration that an understanding of bird behavior can contribute to the management of birds as pests of tropical crops. The perches, coated with glue, effectively protected the treated plots from significant damage during the early maturing stage of plant growth when damage was expected to be heaviest. *Lonchura* quickly learned to avoid plots that had the perches and continued to avoid these plots for at least 5 days after the glue had lost its adhesive qualities.

Other factors, however, should be considered before such a practice is recommended for general use. Factors influencing economic benefit were set arbitrarily in our study. For example, studies are needed to determine the optimal number of perches for best economic benefit, a number that will probably be far below the 480 perches per hectare that we used. A variety of glues might be tested that are more convenient and effective for the farmers and inexpensive. A detailed economic analysis, including such factors as the net increase in labor (this method could be used at the expense of some other, less effective practices), should be conducted.

Factors that influence environmental hazard were also set arbitrarily in our study. Eighteen (or 58%) of the birds that we caught in 0.5 hectare of treated plots were nontarget birds. These were common species in rice fields, and we expect that the small numbers removed by our study had few effects on the respective population of the birds; but we paid little attention to the interspecific effects of distress calls. By restricting the use of perches to the stages of rice growth during which Philippine weavers are a serious threat, and perhaps by designing perches (e.g., using wires that simulate *Enchinocloa)* that are preferred by the Philippine weavers, impact on nontarget species could be reduced.

Based on experience with other repellents the long-term effectiveness of the method also warrants consideration, especially if the method were to be used over wide areas. Pest birds become accustomed to most noisemaking and other frightening devices if they are used repeatedly. We would be unrealistically optimistic to assume that birds could not adapt to the presence of glued perches. Further research could define how this adaptation will occur and how rapidly and, perhaps, tell how the useful life of the method could be extended. Another question with this and other repellent methods is whether they affect the actual amount of damage or just the distribution of damage within an area (reducing damage on one farm and increasing it on the next). Some data supporting the latter hypothesis come from our study where the total number of birds for the four plots remained relatively constant (21.3 birds, mean for all pretreatment counts; 17.4 birds, mean for counts on Days 1-4 of treatment; 18.7 birds, mean for counts on Days 5-8 of treatment) throughout the study. But our study was conducted on small plots, and the key to this question probably depends greatly on the intrinsic responses of the pest population to a greatly reduced carrying capacity over a large area. To our knowledge, the question has not been answered satisfactorily, even where chemical repellents have been used extensively over wide areas.

We conclude that perches coated with glue effectively protected rice field plots in our trial. More studies are required to determine under what conditions the method will be useful to Filipino farmers.

ACKNOWLEDGEMENTS

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DISCUSSION

Q: Did you notice any raptors going around picking off the birds?

A: This would have been a possibility. There are several raptor species that are common in the Philippines. We were not observing the raptors in this particular study.

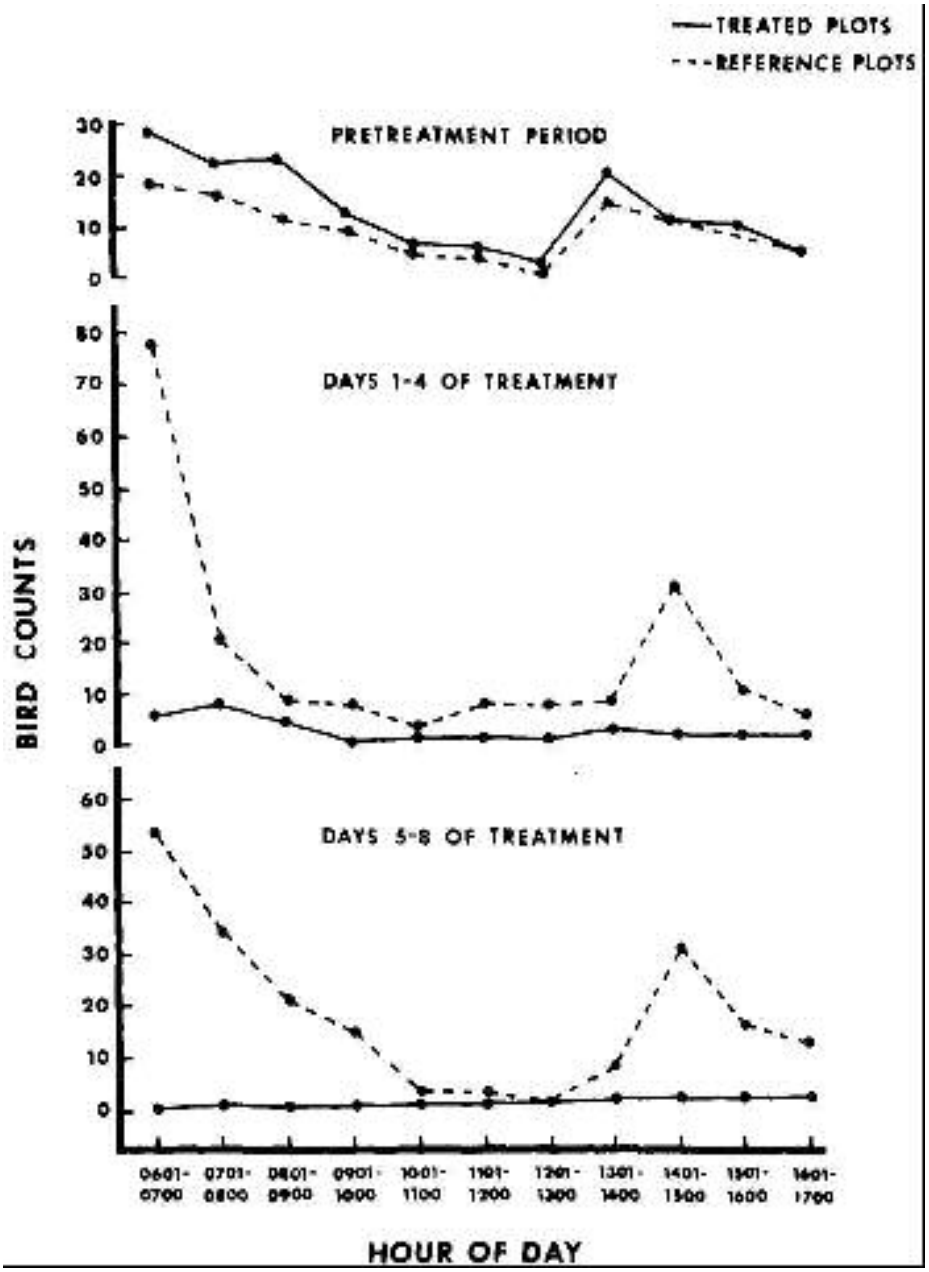

FIGURE 1. **Counts of *Lonchura malacca* and *L. leucogaster* alighting within two treated and two reference plots. Each point represents the mean of 48 observations; i.e., two plots x 4 consecutive days x six observations per plot per hour. Plots were 0.25 hectare each, contained local varieties of rice at the early maturing stage of growth, and were located near Diadi, Nueva Vizcaya. For treatment, perches (120 per plot) coated with a sticky substance were placed within the plots.**

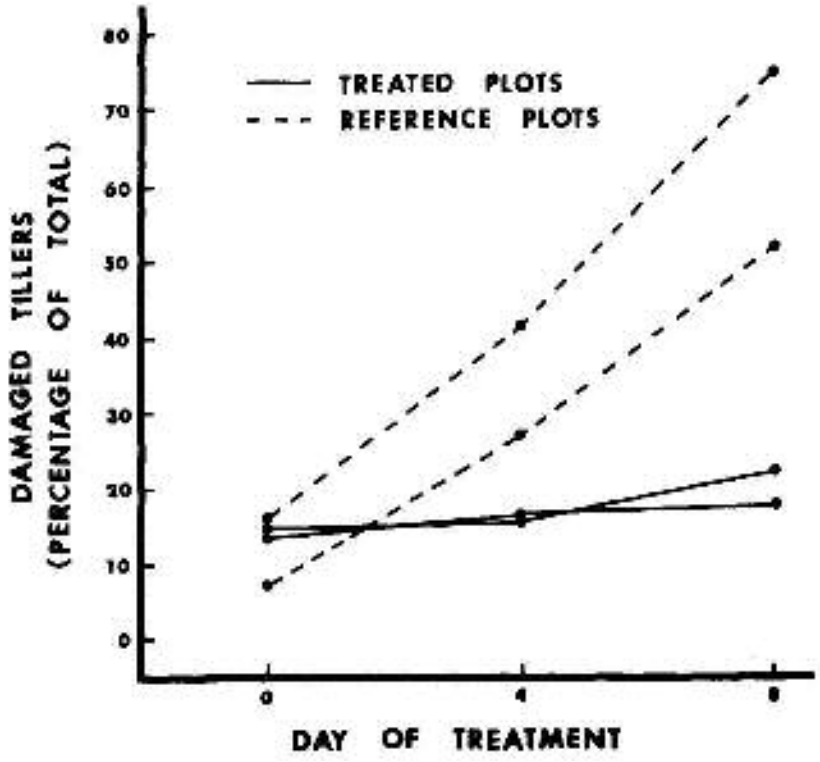

FIGURE 2. Percentage of tillers having *Lonchura malacca* and *L. leucogaster* damage within two treated and two reference plots. Each point represents the mean of 40 measurements, I.e., two plots x 20 samples per plot (5 hills per sample). Plots were 0.25 hectare each, contained local varieties of rice at the early maturing stage of growth, and were located near Dladl, Nueva Vlzcaya. For treatment, perches (120 per plot) coated with a sticky substance were placed within the plots.