FOOD PREFERENCES AND DAMAGE LEVELS OF SOME AVIAN RICE FIELD PESTS IN MALAYSIA

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INTRODUCTION

As in many other countries throughout the world, rice is a staple food item in Malaysia. Through the development of improved varieties, irrigation systems, and agronomic practices, rice production there has increased substantially in recent years and the country is now 80-85% self-sufficient in rice. The main limitation to obtaining full self-sufficiency is the lack of additional land area suitable for raising two rice crops annually (Samy 1977). Another factor limiting production is rice crop pests, particularly rats and insects. Birds also are generally acknowledged as pests in rice fieids of this region (FAO 1973, De Grazio 1978), but in Malaysia little effort has been directed toward understanding the nature or extent of the problem.

From April 1975 through March 1977, I conducted an investigation of bird damage to rice at a site in northwestern peninsular Malaysia. In this paper, I report the results of experimental caged-and field-feeding trials and present rough estimates of the level of damage caused by birds in rice fields of the area. Various aspects of this work have been presented elsewhere (Avery 1978, 1980).

In Malaysia, there are several bird species that potentially are pests to rice. These include the European tree sparrow, *Passer montanus;* baya weaver, *Ploceus philippinus*; pin-tailed parrotfinch, *Erythrura prasina;* Java sparrow, *Padda oryzivora;* sharp-tailed munia, *Lonchura striata*; white-bellied munia, *L. leucogastra*; spotted munia, *L. punctulata;* chestnut munia, *L. malacca;* and white-headed munia, *L. mala.* On my study area only the sharp-tailed and spotted munias, and baya weaver were numerous enough to consider. The experiments described in this paper concern primarily the sharp-tailed munia, although some comparisons with the spotted munia are made. These two species are easily maintained in captivity and are ideal subjects for this type of work. Both are small (10-12 g), sexually monomorphic, and abundant in lowland rice-growing areas where they nest in palms, ornamental shrubs, and fruit trees, usually in close association with humans. Although they have been studied previously in captivity, little attention has been paid to their natural history, and information on their relation to the rice crop is largely anecdotal.

STUDY AREA AND METHODS

This study was conducted at the Rice Research Center of the Malaysian Agricultural Research and Development Institute at Bumbong Lima, Province Wellesley. The center is located in one of the most productive rice growing regions of the country. Research in the Center's 15 ha of experimental rice fields includes varietal improvement trials, agronomy, plant physiology, and crop protection.

To obtain data on bird movements and population levels, I initiated a banding program that continued throughout the two years of the study. Population-size estimates were obtained from the recapture data by using Lincoln index and frequency of recapture methods (Overton 1971).

Two series of experiments were carried out to determine food preferences of the two munia species. Birds caught at Bumbong Lima were put singly or in pairs into large (2.5m x 2.0m x 1.8m) outdoor cages. Into each cage were placed two food items. In the first series of trials, the food items were ripe rice *and Echinochloa crusgalli,* a common grass; while in the second series, rice at differing stages of development was used. Entire plants were taken from the field, placed in ceramic pots and all but the ten tallest panicles were clipped to standardize the trials. Pots were placed into the cages between 0800 and 0900. The food items were put on opposite sides of the cage and placement was random. From one to four experimental cages were operated simultaneously, and one control cage (no birds) was always used. After 24 hours, the plants were removed and replaced with new ones. Panicles of the old plants were clipped, dried for 72 hours at 70° C, and then weighed. Dry weights of the food items from each day's experimental cages were expressed as fractions of the respective dry weights from the day's control cage. Each trial lasted five or six days after which the birds were released. In each cage, the fraction of food item A was compared with that of B; and if the differences were in the same direction on each of the five or six days of the trial, a preference was assumed to exist, according to the sign test (Sokal and Rohlf 1969).

Trials were conducted to determine if birds displayed preferences for certain morphological characteristics of the rice plant or grain. Six varieties were chosen for their differing physical characteristics and four varieties were tested at a time. A randomized complete block design was used with four replications, one of which was covered with a net just prior to heading to serve as a control. Sowing was timed so that the heading among the four varieties tested was approximately synchronized. No regular observations of bird activity on this trial area were made, so differences between control and experimental plot yields were used as the measure of bird damage. These differences were tested with two-way analysis of variance to determine if differences existed among replicates and varieties.

To assess the damage level to rice by birds, trials were conducted at three sites outside of the Rice Research Center. Four plots, each 5 m square, were used at each trial location. One plot in each trial was covered with a net just prior to grain formation *to* exclude birds; otherwise all plots received the same treatment. Thus, any yield differences between the netted, control plot and the three experimental plots in each trial were attributable to bird damage. The t-test was used to determine whether or not yield differences existed.

RESULTS AND DISCUSSION

Food Preference Trials

Results of the caged feeding trials were consistent with field observations and stomach content analyses (Avery 1980). In the first series of trials, sharp-tailed munias preferred rice to *Echinochloa* 10 of 12 times, whereas spotted munias generally displayed no preference (Table 1). In the second series of trials, the sharp-tailed munias tested tended to prefer young, milky stage rice to rice that was two weeks or more older, although both types of rice were eaten (Table 2). The birds did not distinguish between rice of different ages beyond 115 days after seeding.

Although a preference by sharp-tailed munias for milky rice over ripe rice under caged conditions does not necessarily mean that such a preference exists in the field, similar results have been obtained with two other species of *Lonchura* in the Philippines (Manuel 1934, Benigno et al. 1975). Because the total protein and total free amino acid contents of milky rice are greater than that of ripe rice (Juliano 1966), the apparent preference of munias for milky over ripe rice may be related to reproduction. However, the reproductive state of the birds tested was undetermined and this explanation must remain speculative.

The preference of sharp-tailed munias for rice over *Echinochloa* seeds is perhaps explainable by efficient utilization of resources. The energy content of a rice grain is about 4.1 kcal/g (Juliano 1966). This is similar to other cultivated grains (Robel 1972) and about 300 cal/g greater than that of wild grasses such as *Panicum, Setaria, and Pennisetum* (Jones and Ward 1976). On the study site, both rice and *Echinochloa* (and other wild grasses) were very abundant the major part of the year. However, because a single rice grain weighs roughly 2.5 times as much as an *Echinochloa* seed (40 grains of rice/g equals 100 *Echinochloa* seeds/g, personal observation), it is much easier for a munia to obtain its daily caloric requirement by eating rice instead of *Echinochloa* or one of the other, smaller grasses.

In view of this, it is somewhat surprising that the spotted munias at the Rice Research Center (Avery, unpubl. data), and munias elsewhere (Alviola et al. 1973) have not adopted a virtually exclusive rice diet as have the sharp-tailed munias on my study area. The other munias are apparently able to meet their caloric requirements on a mixed diet of rice and grass seeds, and perhaps prefer some variety.

The results of the varietal preference trials are presented in Table 3. Plot yields in trial

1 were rather low, perhaps due to inefficient field management. However, in all 3 experimental replicates, yields of Bahagia and Sri Malaysia I (SMI) were considerably below that of the control plots. Yields of Mahsuri and Pulut Malaysia I (PMI) were similar to their controls. Similar results were obtained in the second trial when yields were much higher overall. Again Bahagia and SMI experimental plot yields were considerably lower than those of the control plots, while the two remaining varieties, MRI and Sri Malaysia II (SMII), reflected little difference between the experimental and the control plots (Table 3).

Despite the statistically significant ($p<.01$) trend for varieties Bahagia and SMI to give less yield relative to the control plot than the other varieties, it will require additional trials with more refined means of detecting bird damage before a preference can be said to exist. Grain size may be an important factor as both Bahagia and SMI have relatively wide grains (Table 4). Plant height and flag leaf angle were apparently of lesser importance, although it should be noted that none of the varieties with erect flag leaves (SMII, MRI, PMI) seemed to be eaten by birds (Table 3). Additional research in this area should include cage-feeding studies using dehusked grain of different sizes, as well as further field studies to examine other morphological characteristics.

Damage Estimates

Estimates of actual economic loss due to crop pests are difficult to make. Techniques for assessing bird damage to rice have been devised in the United States (DeHaven 1974) and in the Philippines (Sanchez et al. 1974), but both techniques require extensive sampling of farmers' fields in order to obtain accurate damage estimates, and due to personnel shortages, it was not feasible to apply them in this study.

The results of the three damage assessment trials are presented in Table 5. There was an overall reduction in yield of about 5% on the experimental plots compared to the controls, but this difference was not statistically significant ($p>0.5$) at any of the locations. These findings, although preliminary in nature, indicate that bird damage, in this area at least, is not very great. Further field trials, at other sites and in different seasons, are necessary before the damage level can be adequately evaluated.

To obtain a second, independent estimate of the losses of rice to birds, I used the results of my banding study. It is possible to estimate damage in a given area over a given time span if the population size and the consumption rate per individual are known. The banding results (1787 captures, 250 retraps) obtained during the 23 months, April 1975 - March 1977, indicate that the sharp-tailed munia population has a rather small home range of 10-12 km radius (31,400 - 45,200 ha) from the Rice Research Center. Using the Lincoln index and the frequency of capture methods (Overton 1971), I calculated the size of this population within this area during the 23-month period to be about 16,000 birds. This is a total pressure of 11,040,000 bird-days.

The caged-feeding experiments indicated that a single sharp-tailed munia eats or knocks down about 5 g of rice per day. This is somewhat lower than the 7 to 10 g/day recorded in the Philippines for three similar species (Benigno et al. 1975). If 5g/bird-day is used, the total loss of rice due to the Bumbong Lima sharp-tailed munia population within an area of about 40,000 ha was 55,200 kg from April 1975 to March 1977, or approximately 13,800 kg/season.

The seasonal rice yield in this area is approximately 1800 kg/ha (Samy 1977). If it is assumed that the 40,000 ha home range area of the Bumbong Lima population is 10% rice fields (4,000 ha), the approximate seasonal rice yield in this area is 7.2 million kg. Thus, the amount of rice lost to the sharp-tailed munia population (13,800 kg/season) is roughly 0.2% of the total yield. This represents the loss to just one species. There is not enough information yet available to calculate similar estimates for other species, or to extrapolate this estimate to other areas of the country. However, based on these findings and on personal observations, rice losses to birds, although quite severe in some fields, do not appear to be great overall. Local problems should be addressed on a case-by-case basis with solutions designed to meet the specific circumstances in question.

SUMMARY

Experimental trials were conducted to determine food preferences of some Malaysian avian rice pests. In caged trials, sharp-tailed munias displayed preferences for rice over the common grass, *Echinochloa,* and for milky rice over ripe rice. In similar trials, spotted munias displayed no preference for rice or *Echinochloa.* In two varietal preference trials, two varieties with nonerect flag leaves and wide grains suffered more

bird damage than four other varieties tested. Out station damage assessment trials at three sites revealed little bird damage, and similarly, calculations based on banding-retrap data indicated an overall low level of rice loss to birds. Local damage by birds may be serious, however, and such cases should be addressed individually.

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DISCUSSION

Q: How did you arrive at the 5 gm/bird?

A: Simply by giving trials in the cages, seeing how much they either consume or knock off the plant during the day. That is a pretty low figure. Philippine studies have shown 7-10 gms. I used five to be conservative.

Q: Five grams seems like it would be pretty heavy.

A: Yes, as I say, it's not only the consuming; it is the destroying.

TABLE 1. Results of caged feeding trials to test for preferences between dough stage rice and *Echinochloa,*

Number and species of birds tested	Number of trials	Preferences for: Rice	Echinochloa	Neither
1 Sharp-tailed Munia	5	4	0	1
2 Sharp-tailed Munias	7	6	0	1
1 Spotted Munia	3	0	0	3
2 Spotted Munias	6	1	0	5

TABLE 2. Results of caged feeding trials to test Sharp-tailed Munias for preferences between rice of different ages.

Number of birds tested	Number of trials	Preference for:		
		90 DAS	112 DAS	Neither
1	2	3	0	1
		97 DAS	118 DAS	Neither
1	4	1	0	3
		103 DAS	116 DAS	Neither
2	4	1	0	3
		117 DAS	131 DAS	Neither
2	4	1	0	3

DAS = days after seeding

TABLE 3. Results of trials on varietal preferences by birds.

Variety	Control plot yield (g/plot)	Percent of control plot		
		I	II	III
Trial 1				
Bahagia	1990	77	93	56
Mahsuri	2800	101	105	109
Pulut Malaysia I	1520	109	98	97
Sri Malaysia I	2250	71	68	67
Trial 2				
Bahagia	4442	73	78	73
MRI	4169	123	96	106
Sri Malaysia I	3851	84	99	81
Sri Malaysia II	3121	120	105	132

TABLE 4. Morphological characteristics of the six rice varieties used in varietal preference trials.

Variety	Flag leaf angle	Plant height (cm)	Grain size (mm)		
			Length	Width	Thickness
Bahagia	drooping	103	7.5	2.3	1.6
SMI	45°	108	8.0	2.4	1.7
SMII	erect	100	7.2	2.1	1.7
Mahsuri	45°	110	5.5	2.1	1.6
MR	erect	106	6.7	2.2	1.7
PMI	erect	100	6.6	2.0	1.5

TABLE 5. Yields from three out-station localities to determine bird damage to rice. (Percentages of control plot are given in parentheses).

Locality	Yield (g/plot)			
	Control	I	II	III
Kampung Balan Dua	6150	6215	5382	5596
	-	(101)	(87)	(91)
Permatang Dirah	7965	7624	6680	8523
	–	(96)	(84)	(107)
Pekan Daral	6500	5760	6102	6789
	---	(89)	(94)	(104)