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Attacks of munia bird (*Lonchura* spp.) on rice crops and control carried out by farmers in Tigo Nagari, Pasaman, West Sumatra, Indonesia

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Abstract

The cultivation of rice crop could not be separated from the disturbance caused by plant pests, one of which is munia bird (*Lonchura* spp.) which eat grain. The objective of this research is to observe the types of munia bird and its population level, as well as the farmers' perceptions to the presence of munia birds, and the control methods that farmers apply. This research was conducted in the Tigo Nagari Sub-district, Pasaman District, West Sumatra Province, Indonesia to calculate the population and intensity of munia birds' attacks through field observations. In addition, find out farmers' perceptions about the attack of bird, losses, and its control technique, through interview method. The intensity of attack was calculated based on the grain damage scoring. Results showed that there were two species of munia birds that dominate in field, namely white-headed munia (*Lonchura maja*) (397 heads) and scally-breasted munia (*L. punctulata*) (172 heads). The average intensity of the munia bird attack was 15.39%, the maximum reached 22.05%, and could reach losses up to one million rupiah per hectare. The presence of bird was influenced by the density of vegetation around the land. The higher number of bird presence, the higher damage intensity it caused. Control technique carried out by farmers using a net to cover crop and tying plastic to rope, then it can be pulled and cause noise and shock to bird, moreover farmers' screaming to keep birds away.

Keywords: Bird Population; Control of Munia; Damage of Rice

1. Introduction

Rice (*Oryza sativa* L.) is an important food source and the main resource for the Indonesian agricultural sector, apart from vegetables and secondary crops, considering that rice is the staple food of most Indonesian people (Firdauzi 2013). Nurmalina (2008) stated that rice farming in Indonesia is developing because more than 90% of Indonesian people rely on rice as a staple food compared to other staple foods. The level of rice consumption in Indonesia is quite high, reaching 97.4 kg/capita/year (Respati *et al.* 2013). Efforts to increase rice production continue to be made by the government considering the continuing increase in people's need for rice. However, various obstacles are faced in efforts to increase rice production, including human activities, plant pest organisms, and the environment. Plant-disturbing organism factors in the form of pest attacks are the most consistent obstacle in suppressing rice plant productivity levels each season (Amir *et al.* 2016).

Pests that attack rice plants can be grouped into two, namely invertebrate pests, namely animals without backbones and vertebrate pests, namely animals with backbones. Several groups of invertebrate pests that often attack rice crops are from the insect or insect class, such as rice stem borers, brown plant hoppers, grasshoppers, etc., while vertebrate pests that often attack rice plants include field rats, wild boars, and munia birds (Matnawy 1989). According to Harahap and Tjahjono (1994) several types of birds that commonly become pests of rice crop are the Javanese sparrow/munia

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(*Lonchura leucogastroides*), the white-headed munia (*L. maja*), the scally-breasted munia (*L. punctulata*), and the black munia (*L. ferruginosa*).

The sparrow/munia bird group is a group of seed-eating birds that can consume seeds as much as 10% of their body weight (Soemadi and Mutholib 2003). The scally-breasted munia can eat an average of 5 g of rice per day (Salsabila 1991). According to Nurjati (2014), rice crop losses caused by bird pests are around 20% to 30% and the munia bird is the type of bird with the highest ability to consume grain. Farmers use various methods to prevent bird pests, such as making scarecrows or tying used cans to ropes stretched over the rice fields so that when they are moved they make a sound which is expected to repel birds (Hardiansyah 2020). This research aims to determine the type of munia bird, population level, and the intensity of the attacks it causes. Likewise with farmers' perceptions of munia bird pests and control techniques used in Tigo Nagari Sub-District, Pasaman District, West Sumatra Province, Indonesia.

2. Materials and methods

2.1. Place and Time of Research

This research was carried out in Tigo Nagari Sub-District, Pasaman District, West Sumatra Province, Indonesia from September to December 2020.

2.2. Research Methods for Observing and Documenting Damage in the Field

Field observations were carried out on the farmers' land used as samples. The observation field is a generative phase of rice plants. Observations were carried out in 2 villages/nagari, each village/nagari determined 3 fields or rice field plots with 1,000 m apart. Then, 5 sub-plots were observed in each land as sample points. Sample points measuring 2 m x 2 m for each sub-plot of test rice fields at each location and treatment time. The sampling method is purposive sampling. Observations were carried out twice, namely in the morning from 6.30 am to 9.00 am and in the afternoon from 3.30 pm to 6.00 pm. Sampling to sub plots in rice fields was carried out using the diagonal transect method, as shown in Figure 1.

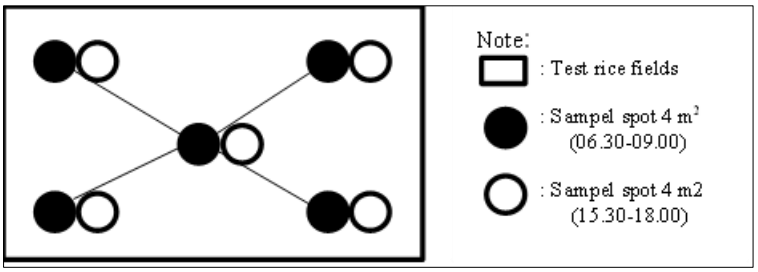


Figure 1 Scheme for determining observation points

At each sample point, 4 clumps of rice crops were observed using purposive sampling. Then the number of infected and unaffected tillering was counted to score the intensity of the attack. The scoring number starts from 0 to 4, calculated from the percentage of the number of grains lost on each tiller. Score **1** for grain loss < 25%, score **2** for 25% to < 50%, score **3** for 50% to < 75% and score **4** for ≥ 75%. Next, the number of munia birds was calculated in a certain period with a specific observation duration of 10 minutes for each sample point. The aspects observed were the population of munia birds that visited the sample points and damage to rice plants due to attacks by munia birds. Documentation of damage and surrounding environmental conditions to complete the research data.

2.3. Identification of Types and Calculation of Bird Population

Individual birds that visited the sample points were counted and species identified by direct observation and taking pictures using a camera. The key to identification was using the field observation guidebook Field Guide Series for Birds of Sumatra, Java, and Bali (Mac Kinnon 1990).

2.4. Interview Data Collection

Data collection was carried out through the interview method using a structured questionnaire. Interviews are carried out by visiting farmers at their homes or agricultural land. The number of respondents was 30 farmers with a

breakdown of 15 farmers per village/nagari. The questionnaire used consisted of several questions which included information regarding the farmer's identity, cultivation techniques, and pest management, especially the munia bird.

2.5. Data Analysis

The formula used to determine the intensity of an attack is as follows:

Attack intensity (%) : $\{\sum(n\ x\ v)\}\ \div (ZxN)\}\ x\ 100\ \%$

Note:

- n = Number of plants in v-scoring
- v = Plant damage scoring value (0, 1, 2, 3, 4)
- N = Number of sample plants observed
- Z = Highest damage scale value (4)

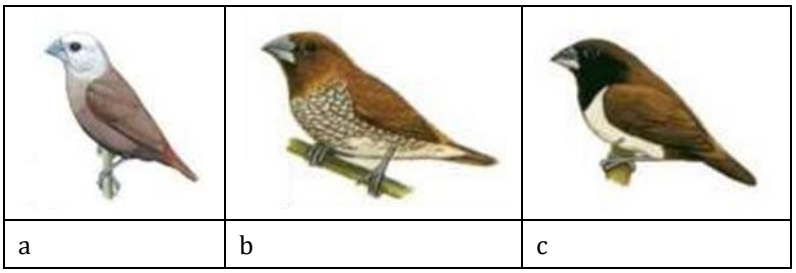
3. Result and discussion

3.1. General Condition of Observation Location

Tigo Nagari District is one of the sub-districts in Pasaman Regency, West Sumatra, Indonesia with an area of 352.92 km^2 with a geographical location of 99°59' - 100°09' East, and longitude 00°08' North - 00°01' South. This sub-district is divided into three nagari (villages), namely Nagari Ladang Panjang, Malampah, and Binjai. The research locations were carried out in Nagari Ladang Panjang and Binjai. Nagari Ladang Panjang has an area of 62.16 km^2 or 17.61% of the total area of Tigo Nagari District, while Nagari Binjai has an area of 152.79 km^2 or 43.29% of the sub-district area. Total area of agricultural land in Tigo District Nagari, namely 22,866 ha, of which 2,796 ha (12.23%) is used for rice fields, the rest is agricultural land, not rice fields, namely plantation land 9,383 ha (41.03%), forest 4,100 ha (17.93%) and 28.81% of temporary land not attempted (BPS Pasaman 2019).

3.2. Population and Types of Birds

There are three types of bondol birds found in rice fields which are pests of rice in Tigo Nagari Sub-district, namely the white-headed munia (*L. maja*) (Figure 2a), the scally-breasted munia (*L. punctulata*) (Figure 2b) and the Javanese bondol (*L. leucogastroides*) (Figure 2c). These three types of munia have their own physical characteristics that differentiate them between species. The most striking physical characteristic is that the white-headed munia has a white head in addition to its brown body, the scally-breasted munia is brown with a scale-like pattern on the chest, while the Javanese munia is darker brown with a white chest.



a b c

Figure 2 (a) White-headed munia (b) Scally-breasted munia (c) Javanese munia (Mac Kinnon 1990)

The white-headed munia is found in large groups when attacking rice plants, while the scally-breasted munia is more often found alone or in pairs, but some are also part of the white-headed munia group. Two species of birds are dominant as pests of rice plants in the Tigo Nagari Sub-district, namely white-headed munia and scally-breasted munia, while Javanese bondol is very rare to find. Thus, the counting of individual birds at the sample points was only for the white-headed munia and scally-breasted munia species. The presence of munia birds in each observation field area is presented in Table 1.

Table 1 Number of presence of individual munia bird in each observation area

No. of rice field	Munia Population				Total
	White-headed munia		Scally-breasted munia		
	Morning	Afternoon	Morning	Afternoon	
1	36	47	19	15	117
2	20	17	10	6	53
3	53	28	30	14	125
4	25	28	12	14	79
5	55	7	22	2	86
6	49	32	19	9	109
Total	238	159	112	60	569
	397		172		

The number of white-headed munia individuals (397 heads) is greater than that of scally-breasted munia (172 heads). White-headed munia is the dominant individual in each observation area, with quite large numbers and in groups. Land No. 3 is the plot with the highest number of munia, namely 125 individuals, while land No. 2 has the most slightly, namely 53 individuals. The presence of munia is influenced by the condition of the agro ecosystem around the land. Land No. 3 is land close to trees, directly adjacent to oil palm land, there are many area palm trees planted in rice fields, and is a village area. This allows munia birds to build nests and perch on the vegetation after attacking rice plants. Meanwhile, land No. 2 is land directly adjacent to the main road. The sound of busy traffic makes the presence of birds the least among other areas.

The presence of munia birds is most often found in the morning at 06.00-07.00 (350 heads) because at that time the sun was not yet shining and the environment was still not hot. Likewise in the afternoon at 16.00-17.00 (219 heads) because conditions are shadier. At the time of observation, conditions in the afternoon were cloudy and tended to drizzle or even rain. When the sun starts to shine hotly and the environment is hot, the presence of munia birds decreases. Ziyadah (2011) stated that munia birds usually attack in shady weather conditions and attack in groups.

3.3. Attack Intensity

Observations of the intensity of attacks on rice crops were carried out in six rice fields at different locations with a distance of more than 1,000 m (Table 2). The land chosen is land with generative phase rice crops.

Table 2 Intensity of munia bird attacks on six rice fields

No. of rice field		Intensity Attack (%)	
	Morning	Afternoon	Average
1	23.34	14.73	19.04
2	8.30	9.64	8.97
3	17.85	26.24	22.05
4	16.34	13.04	14.69
5	15.06	12.41	13.74
6	12.30	15.35	13.83
Average	15.53	15.24	**15.39**

Calculation of attack intensity based on panicle damage level scoring. The highest attack intensity was on land No. 3 at 22.05% and the lowest was on land No. 2 at 8.97% (Table 2). This is in accordance with the presence of munia birds, where land No. 3 is the most numerous and land No. 2 is the least (Table 1). Comparison of the average attack intensity in the morning (15.53%) and afternoon (15.24%) did not show a significant difference. The average intensity of munia bird pest attacks in Tigo Nagari sub-district in a sample of six observation fields was 15.39%. Differences in attack intensity can be influenced by several factors including the type and density of surrounding vegetation, for example oil palms plantation (Figure 3a) and areca nut plant (Figure 3b), age or develop-mental stage of rice crops, and bird management techniques.

a b

Figure 3 Vegetation around the area: Oilpalm plantation (a) and areca nut plant (b)

The existence of trees is important for the life of the munia bird group, such as nesting places, shelter, and availability of other food sources. Good management techniques will reduce the level of intensity of munia bird attacks. Ardjansyah *et al.* (2017) explained that rice crops that were less than 70 days old were visited more often by birds than those that were more than 70 days old. This is because the rice grains are still young, still liquid, and have not yet hardened into rice, the hardened condition of the rice will make it difficult for munia birds to eat the grains.

3.4. Respondent Characteristics

The results of interviews with respondent farmers show that the male and female gender ratio is 66.7% and 33.3%. This is in accordance with the role of a man in earning a living for the family. The most common age category is over 50 years which reached 43.3%. Most farmers in Tigo Nagari Sub-district's final education level are elementary school graduates (33.3%), these educated farmers are in the age category of more than 50 years (Table 3).

Table 3 Characteristics of respondent farmers

Characteristics of farmer	**Number**	**(%)**
Gender		
Male	20	66.7
Female	10	33.3
Age (year)		
20 - 29	3	10.0
30 - 39	6	20.0
40 - 49 > 50	8 13	26.7 43.3
Education		
No Education	5	16.7
Elementary School	10	33.3
Junior High School	5	16.7

Senior High School	8	26.7
Bachelor Degree	2	6.7
Experience in Farming (year)		
< 5	5	16.7
5 - 10	8	26.7
> 10	17	56.7
Ownership Status		
Owner-cultivator	21	70.0
Tenant-cultivator	9	30.0
Land Area (m^2)		
< 2,500	2	6.7
2,500 - 5,000	7	23.3
5,000 - 10,000	16	53.3
> 10,000	5	16.7

Farmers already have sufficient experience in farming, namely more than 10 years. This is related to the age of farmers who are 40 years and over. Apart from that, farming has been done and introduced to them since they were young because their parents also work as farmers. Farmers with a bachelor's degree have the excuse that farming is just a side job. Most farmers (53.3%) work on land area of 5,000 - 10,000 m^2. Furthermore, 23.3% of farmers have a land area of 2,500 - 5,000 m^2. Ownership status is private property and cultivators or owner-cultivator (70%), the remainder (30%) are share croppers who rent land or tenant-cultivator (Table 3).

3.5. Cultivation Action

The rice varieties that are widely planted by farmers in Tigo Nagari Sub-district are IR 42 (43.3%) and Batang Piaman (36.7%). Apart from that, there is the Anak Daro (local) variety (16.7%). The seeds of the three rice varieties were obtained by farmers with buying (96.7%) them at kiosks (Table 4). Another variety, namely Sijunjuang rice, was planted by one respondent farmer and obtained it from fellow farmer friends (3.3%).

Table 4 Cultivation actions of respondent farmers

Cultivation Characteristics	**Number**	**(%)**
Variety planting		
IR 42	13	43.3
Batang Piaman	11	36.7
Anak Daro	5	16.7
Sijunjuang	1	3.3
Source of seed/seedling		
Buy from the kiosk	29	96.7
Obtained from fellow farmers	1	3.3
Obtained from previous plantings	0	0
Planting System		
Monoculture	29	96.7
Polyculture	0	0

Mina rice	1	3.3
Planting distance (cm)		
20 x 20	30	100
Watering		
Irrigation system	23	76.67
Water springs	7	23.33
Fertilizer		
Urea + NPK	27	90.0
Urea + SP 36	3	10.0

All farmers grow rice in monoculture, and there are no farmers who apply the inter cropping method. This is done based on farming experience which has been growing rice in monoculture for generations. Inter cropping has never been practiced due to farmers' lack of knowledge of this planting technique. There is one farmer who uses the technique of planting ***mina*** rice, namely planting rice while raising fish in the rice fields. This technique has just been introduced in Tigo Nagari Sub-district aims to be followed by other farmers because it has many advantages. Some of the advantages of ***mina*** rice are that it can increase income by 20%, rice fields become fertile with the presence of fish waste which contains nutrients thereby reducing the use of fertilizer. In addition, fish limit the growth of other plants, reduce the cost of weeding, and income from fish cultivation (Lestari and Rifai 2017). According to farmers, the presence of fish can reduce insect pests attack, such as brown plant hoppers and grasshoppers.

The planting distance applied is 20 cm x 20 cm, some farmers do not measure the exact planting distance applied by just estimating using one hand span less. Most (76.67%) of the irrigation system comes from irrigation water and the remainder (23.33%) from mountain (water) springs that flow naturally. Fertilization for rice crop uses chemical fertilizers, i.e. urea, NPK, and SP 36. Ninety percent of farmers combine two types of fertilizer (urea and NPK) and the remainder (10%) combine urea and SP 36 with a ratio of urea and NPK or SP 36, namely 50:50. Fertilization is carried out twice, namely when the rice is 20 days after planting (DAP) and 40 DAP.

Harvesting is done manually, the harvesting process is by cutting the lower stem using a knife. Next, the rice that has been cut is collected, then separated into the stems and grains using a machine. The grain is collected in sacks and sold to middlemen. The harvested land is leveled using a tractor. The remaining straw is burned and then the ash is spread at the land as an organic fertilizer.

3.6. Munia Bird Pest

Munia bird attacks are one of the disturbances in rice cultivation in the Pasaman district. All farmers felt that their rice crops were attacked by the munia bird pest which caused yield losses (Table 5). Losses due to munia attacks reached one million rupiah per hectare, experienced by the majority (46.7%) of respondent farmers. Meanwhile, 86.7% of respondent farmers had never received socialization regarding rice cultivation, especially regarding pest management.

Table 5 Control and losses due to munia bird pests

Characteristics	**Number**	**(%)**
Rice crop attacked by munia birds		
Yes	30	100
No	0	0
Control		
Use of nets	8	26.7
Using a rope tied with plastic and screaming to dispel it	19	63.3
Just leave it alone, occasionally push it away	3	10.0

Losses due to bondol attacks (Rupiah per Ha)		
< 100.000	8	26.7
100.000 - 500.000	8	26.7
> 500.000 - 1000.000	14	46.7
Socialization of munia bird management		
Have been several times	4	13.3
Never	26	86.7

Apart from the munia (*Lonchura* sp.) bird, the pests that are a threat in the sub-district of Tigo Nagari, namely brown plant hoppers (*Nilaparvata lugens*), rice field rats (*Rattus argentiventer*), and grasshoppers (*Oxya* sp.). According to farmers, brown plant hopper pests are more feared than other pests, even though birds and rats can attack at any time with significant damage. Brown plant hoppers (BPH) will only cause damage when their numbers are already abundant in the rice crop. Apart from that, farmers in Tigo Nagari Sub-district does not implement simultaneous planting (planting together), so that food is continuously available for the munia birds and the vegetation around the land is very supportive. The presence of munia bird pests should be a concern for farmers, so that their population does not become abundant, causing greater losses.

The control carried out by farmers is the use of nets (26.7%) which cover the entire land when the rice enters the generative phase to avoid attacks by bird pests. According to farmers, the use of nets is effective in preventing bird attacks, but this control requires quite a large cost because nets are expensive. Most farmers (63.3%) control by using plastic tied to a rope that is pulled when birds come to the land. This control technique requires the farmer's constant presence to pay attention to his land, especially in the morning and evening when birds attack rice the most. Sometimes farmers also have to shout while going around their land so that the rice grains are not eaten by birds. Some farmers (10%) simply leave their land alone, and only occasionally rejecting the birds. This farmer's rice field is directly adjacent to the main road, so the noise from vehicle traffic reduces the attacks of the munia birds.

4. Conclusion

The types of munia bird found in the rice field are white-headed munia (*L. maja*), scally-breasted munia (*L. punctulata*), and Javanese munia (*L. leugastroides*), the first two are the dominant. The number of munia bird in the six observation fields was 569 heads, consist of white-headed munia (397 heads) and scally-breasted munia (172 heads). The presence of munia birds is most often found in the morning (350 heads) compare to the afternoon (219 heads), although the average attack intensity in the morning (15.53%) and afternoon (15.24%) did not show a significant difference. The intensity of bird attack was 15.39%, the maximum reached 22.05%, influenced by the presence of bird. The greater the number of munia birds, the greater the intensity of the attack.

The losses caused by this pest reach one million rupiah per hectare. In the perception of munia bird farmers, it is not the main pest that is feared, but the brown plant hoppers (BPH). The control carried out by farmers is by installing nets and using plastic tied to ropes to pull, causing noise and shaking while shouting to chase them away.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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