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A Survey of the Insect Pest and Their Natural Enemy in Rice Growing Area of Central Gondar, Ethiopia

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Abstract

The study was carried out in the rice-growing area of Central Gondar in 2020 to evaluate the incidence and distribution of insect pests on rice crops. Insect pests were determined by the visual search for damages done by insects throughout the field. The current survey found insect pests: Creatonatus spp., stalk-eyed fly, stem borer, leafhopper, and sting bugs. Additionally, the study found natural enemies of insect pests, including, dragonflies and spiders. The farmers perceived that rice crops are less attacked by insects and diseases than other crops currently they grow. Very few farmers used insecticide for rice storage pest control; when they want to store for more than 7 months. Low rice yield loss due to insect pests in the study area may be due to their low dependence on pesticides for insect and disease control, which enhance conservation biological control.

Key words: rice insect; survey; insect natural enemy; farmers perception.

1. Introduction

Rice (Oryza sativa L.), one of the most important cereal crops worldwide, has the potential to play a significant role in achieving global food security. Rice is one of the most widely cultivated cereals and globally important food crops [1]. Rice crop is also a staple food for almost over 60% of the world's population [2]. According to [3] report rice is a recently introduced crop compared with other major crops in Ethiopia, although now it is an important staple food crop grown in the wetland; where other crops do not grow due to water loge effect. Farmers increasingly prefer to grow rice instead of other crops due to its high yield and market price compared to other crops [4]. The introduction of rice has changed income source and distribution. The government of Ethiopia has given due emphasis to rice as a millennium crop for assuring food security and as an income source [5].

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Currently rice production in central Gondar, for instance, in Dembiya, is a dominant and major life-changing crop for smallholder farmers. The national productivity increased from 27.3 quintals to 50 quintals per hectare during the same period. These low yields are affected by different biotic and abiotic constraints. According to [6] some 15% of global rice production is lost to animal pests. The other study by [8], carried out in Nigeria, from all the production constraints of one major reason for the low yield are insect pests. Insect pests constitute one of the major yield-reducing factors [8]. Losses due to insect pests in the developing countries of Africa have been estimated at 20% [9]. In another hand, the Global Rice Science Partnership (GRiSP) identifies birds as the second most important biotic constraint in African rice production after weeds, based on farmer surveys in 20 African countries [10]. The survey was primarily intended to assess and quantify rice production insects in the rice-growing area of central Gondar. However, insect pests are an important rice production constraint; there is limited research on the incidence and distribution of rice insects and their natural enemy. Identifying the insect pest found in rice-growing areas is very important because insects have different activities, and different ways to damage the crop [11]. The necessity of identification of the insects may lead to the controlling and management of the insect pests. Therefore, this study is conducted to determine the diversity and distribution of the insect pests in the rice-growing area of central Gondar. Therefore, the objective of the survey was to assess the distribution and measure the relative importance of rice insect pests and identify natural enemies associated with insect pests in the rice-growing area of central Gondar and to assess rice growers' knowledge and perceptions regarding rice pests and pest management options on their rice.

2. Material and Method

A survey was conducted in fields of major rice-growing areas of Ethiopia; in Gondar Zuria and Dembiya districts of Central Gondar in 2020 cropping seasons. The altitude of surveyed fields ranged from m.a.s.l. At every 5-10 Km intervals along access roads, several plants in a cross diagonal line were examined for presence or absence of insect pests and associated natural enemies. Where insect infestation was encountered, the type of insect was identified and a visual estimate of damage was taken. In all areas covered by the survey, sampling of insects was extended to alternate host plants near the crop, in order to identify the host plants. The new insect found in the study area named Creatonatus sp. was identified by the Canada pest control organization. This study assesses the farmers' rice pest perception and current pest control practice used In addition the assessment of rice pest incidence in a rice-growing area of central Gondar. Smallholder rice growers' knowledge and perception concerning pest and pest management were gathered through a semi-structured questionnaire that was prepared by entomologists. The questionnaire was first prepared and pretested to improve it and thereafter translated to local language for convenience communication between farmers and interviewers. The multi-stage sampling technique was used to select the respondents for the study. Within 2 selected districts, three kebele were included for the interview and 3-10 households were randomly selected for individual interviews. A total of 33 growers who have more than one year of production and pest management experience, were interviewed.

Data Collected and Analysis

Insect infestation was encountered, the type of insect was identified and visual estimate of damage taken,

number of insect pests, and natural enemies per field found in the survey area were collected and analyzed using SPSS software.

3. Result and discussion

3.1 Rice agronomic practice and production system

All crop production practices affect insect pest populations either positively or negatively. Hence, our survey assessed agronomic practices carried out by rice producers in the study area. Those agronomic practices were draining a rice field, transplanting, crop rotation, and fertilization. Even though direct seeding onto dry soil is not advantageous to aquatic pests such as the rice water weevil, almost all current surveyed area farmers practice direct seeding and broadcast planting methods. Recently very few farmers used row planting methods. On the other aspect of agronomic practice, all of the surveyed fields of rice production were by the rain-fed system. In the rainy season in all three study areas, the rice production was dominant and it is in a cluster base. Regarding the crop rotation, each year the rice crops are grown in the rainy season (June-November) and then followed by non-rice crops (mostly vegetable, and grass pea) by irrigation (from December-May) this practice is perhaps to remove the pests' food source and reduce their population buildup. Even though continuous single cropping year to year allows exponential insect population growth and increase the abundance of insect, some current fields in the study area used continuous rice cropping year to year. In the other aspect of agronomic practice, flooding the field after harvest is mainly recommended for controlling stem borers, though this practice is not totally known in the study area.

3.2 Distribution of insect pests in a rice-growing area of central Gondar zones

Insect pests found in the study area are categorized into three major categories namely, leaf/stem feeding, grain sucking insect, and root-feeding insect pests. Regarding leaf/stem feeding insects, the current study found that four-leaf/stem feeding insects; stalk-eyed fly, leafhopper, planthopper, and stem borer. In the other view, two-grain sucking insects namely sting and rice bugs found throughout the study area (Table1). Additionally, our study found, that gall midge and termite, whorl maggot, and armyworm were in the study area.

Table 1: showed that insect pest found in rice crops

Zone	Farm Surveyed		Number of insects/assessed field	
			Gondar Zuria districts	Dembiya districts
		Types of insect pest		
Central Gondar	19 21	Stalk eyed fly	6	11
		Green leaf hopper	5	4
		Plant hopper	2	1
		White Stem borer	9	5
		Gall midge	0	0
		Sting bug	5	4
		Creatonatus spp	3	7

3.3 Natural enemy found in the study area

In the current surveyed area different types of natural enemies were found in the rice field. Damselfly, dragonflies, and spiders were found in the study area; especially in the wetland area. In general, the low density of stem borer and other insect pests on in the study area of rice crop may be due to the effect of those above maintained natural enemies.

4. Farmers' perception of rice production constraints (pests)

In addition to our field assessment, the farmers also asked about the rice main production constraints. Figure 2 showed the major pests or production constraints of the smallholder rice growers in the rice-growing area of Ethiopia. The majority of farmers; 80.88%, 77.92%, and 47.06% perceived that weeds, birds, and storage pests respectively important production constraints for rice producers respectively (Figure 1). This result is in line with a previous study conducted by [8] who found that weed infestation was ranked as the most important followed by birds and rodents. But our finding contradicts the study conducted in Uganda, which found that insects were perceived as the first most important rice production constraints, followed by disease and weed as the second and third important pest. The current finding inconsistency may be the presence of severe natural enemies of insects and disease in Ethiopia than in Uganda.

4.1 About storage pest

Most of the farmers in the current study area store the rice grain or seed as paddy for 6-9 months and they store it as brown (milled and dehulled) in small quantity which is expected for home consumption purposes. Despite the fact farmers involved in the current study are unable to estimate the quantity of rice postharvest losses due to pests, most of them (47.6%) strongly agree storage pests being a cause for rice grain quantitative and qualitative

loss (figure 2). In respect to the important effect of storage pest in rice grain, the current survey participant response agrees with the previous study which exemplified insects infesting stored foods are one of the most destructive and common problems which turn out to be very serious if leave untreated.

4.2 About birds

A previous study that supports our result conducted by Global Rice Science Partnership (GRiSP) identifies birds as the second most important biotic constraint in African rice production after weeds, based on farmer surveys in 20 African countries [10]. Additionally, our finding is in line with the study conducted by [7], who found that some 15% of global rice production, is lost to animal pests (arthropods, nematodes, rodents, birds, slugs, and snails). Throughout maturation (milk to hard-dough stages) the rice crop is highly susceptible to bird damage [11]. From this literature and current finding, we can advise rice farmers to be aware of birds management at milk to hard-dough stages.

4.3 Regarding rice weed

The majority of (80.88%) farmers in our study perceived that weeds as the first rank and major production constraint, which supported by [12] , who found that weeds cause high rice yield losses that range from 25 to 30% for the low and upland rice respectively. Most farmers in the study perceived grasses as prevalent weeds of rice in the Fogera plain and the other two study districts. This result is also in support of the fact that the majority of weeds available in lowland ecology are either grasses or a mixture of grasses and broadleaves, hence the need for an herbicide with selectivity for broadleaves and grasses in lowland fields. A large percentage of farmers depend fully on the chemical methods of weed control.

4.4 About termite

In the study area, termites are considered as pests for many crops like maize, but it is perceived by the farmers less important pest in the lowland rice production area of Fogera plain.

4.5 About Field insect and disease

Crop losses due to insect pests on rice in the developing countries of Africa, for example, 34.9% rice yield loss recorded due to stem borer in Tanzania. In contrary to the above study, 38.24% and 17.65% of farmers in the current study perceived disease and insects as rice production constraints. During our survey, we observed that rice disease (blast and sheath rot) affected the rice crop and insect pests like stalk-eyed fly and stem borer also rarely occurred. This low number of farmers' perceptions about rice insects and disease, maybe due to lack or ignorance of scouting on rice pests. The other possibility may be due to the high infestation of rice insects and disease by the natural enemies in the study area.

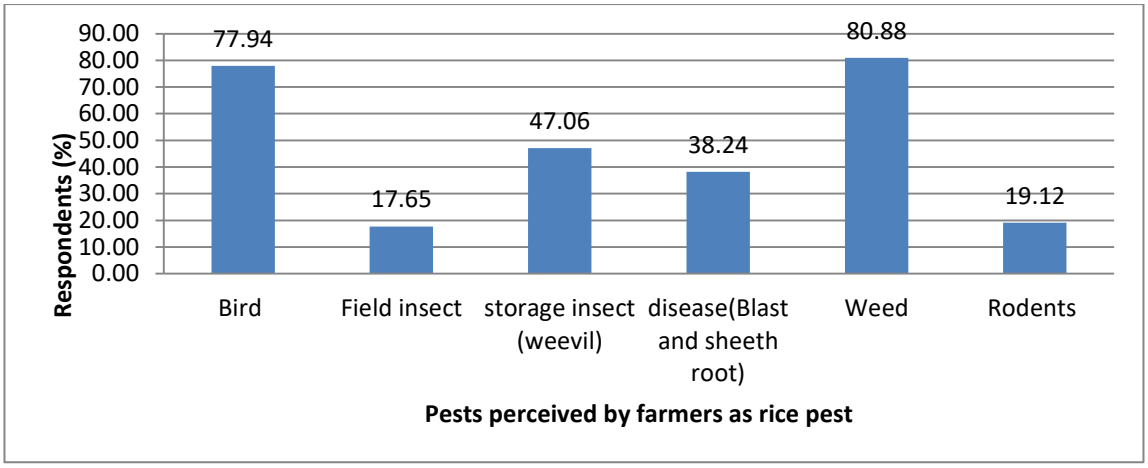

Figure 1: showed that rice pest identified by farmers in the study area

Farmers current practice for storage, field pest, weeds and disease control in study area of Ethiopia

5. Storage insect pest control

Despite farmers perceived significant losses by the storage pests, less than 2.88% of the respondents used modern storage practice (Pics bag for rice weevil control) (Table 2) and only six percent (6%) of farmers used fumigate (phosphate) to control rice storage insect pests. Nearly half percent of the respondents do nothing strategy for storage rice pest control, whereas 47% of the respondents used cultural practice (drying the grain on the sun) for storage pest reduction. Even though a previous study showed that postharvest losses caused by stored-product insects range from 10-20% annually less than a half percent of our current study participants perceived insects as important rice storage pests. To mitigate the loss caused by the storage pests most of the respondent practices is sun-drying, storage sanitation, and cleaning as insect pest management options, with an average of 47% (Table 2). Nearly half of the respondents do nothing for storage pest management and they store their grain with a traditional storage system called 'Gota' which is made from mud and bags (Table 2). Thus the majority of the respondent stored in traditional granaries, mainly due to the inability to afford this modern storage material as well as due to lack of awareness regarding the importance of modern storage facilities. An interesting finding in our current result, 99.4% of farmers did not use pesticide for rice storage and/ or field insect pest control which is contrary to a study conducted in Uganda who found that 65% of farmers rely on the use of insecticides to control rice insect pests [14]. Further, our respondents replayed that rice grain is less affected by storage pests than Maize, chickpea, and grass pea; most of the farmers used phosphate and other hazardous insecticides for maize, chickpea, and grass pea grain control from storage pests. Furthermore, none of the rice-growing farmers used pesticides for field disease and/ or insect control in the study area (Table 2). This is contrary to the findings of Wang and his colleagues who found insects often rely heavily on the use of pesticides to control a range of insects and pests, to ensure a high yield of rice and thus high income. The reason beyond farmers did not rely on pesticides for rice pest control may be due to most of the farmers perceived that insects had no significant yield loss. This low yield loss perception of farmers by pests on rice crops may due to the presence of biological control in the study area which may regulate pest populations. From this result, we can conclude that Ethiopian rice farmers had a low contribution to environmental pollution and

insecticide residues for consumers.

5.1 Regarding bird control

Even though, the literature review showed the effectiveness of existing bird control techniques (Bishop and his colleagues this study concluded that the effectiveness of each technique varies with the bird species involved and that optimal bird control methods combine several techniques or randomly use them. Almost our entire current study participant follows traditional protective methods such as manual bird scaring, flags, and scarecrows. None of the farmers used pesticides for bird control in the study area. A previous study regarding the importance of the traditional bird control method implied and advised that it is important for small scale and when the bird pleasure becomes low, otherwise pest bird pressure is elevated, and these methods become ineffective (de Mey and his colleagues). This result implied a need to evaluate the effect of birds in rice fields and to develop effective bird control strategies for these crops. And also this result gives insight into the bird damage on rice crops and is important to put the bird problem into perspective and provide useful information for future research.

5.2 Farmer weeds control methods.

In our current study, farmers depend on chemical- manual (hand weeding) methods for rice weed control. Hence, 63.24% of farmers spray herbicide on rice at the early growth stage thereafter they used hand weeding methods (Table 2). Farmers still engage in hand weeding to support the use of herbicides may result from farmers' inability to afford herbicide costs for weed control. Table 2. Pest control used by the formers for field, storage insects, weed and disease in rice crop

Table 2

Pest control used by the formers	Respondent (%)
Pics bag for weevil (Yes)	2.88
Pesticide for storage pest control (Yes)	0.0
Metal silo for storage pest (Yes)	0.0
Fumigate stored grain/seed (Yes)	6.0
Aeration/sun drying (Yes)	47.0
Doing nothing (Yes)	51.0
Pesticide for field insect control (Yes)	0
Other insect control option (Yes)	0
Fungicide for disease control (Yes)	0.00
Herbicide for weed control (Yes)	63.24
Pesticide for birds (Yes)	0.0

6. Conclusion

More than 7 different rice insect pests found in two districts of rice growing areas of central Gondar. In the current surveyed area more than four types of natural enemy were found. The natural enemy is list out in the

study area; but the level of infestation for each specific natural enemy on different insect should be done. Most of growers in the study area perceived that insect had no significant yield loss on rice production; thereby they did not use any insecticide for insect control.

7. Recommendation

An attempt should do to list and discuss the insects according to the sequence in which they normally appear during the growing season from transplanting to harvest). Insect species that only damage occasionally are not discussed in detail.

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