



Fall armyworm, *Spodoptera frugiperda* (J.E. Smith) Damage on Rice in the Philippines

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Received: 3 Oct 2023 | Revised: 13 Nov 2023 | Accepted: 28 Nov 2023

Fall armyworm (FAW), *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) is a global invasive pest of corn, and is also common on sorghum, rice and millets, and is reported to be a larval host of 353 cultivated and uncultivated plants. FAW, a native to the tropical and subtropical regions of north, Central, and South America, continues to rapidly spread to Africa and Asia since 2016, threatening food security worldwide. In the Philippines, its first damage on corn was reported in June 2019 in Piat, Cagayan, while that on rice was in May 2021 in Gonzaga, Cagayan, and subsequently to other municipalities in Region 2. Unlike corn, however, little is known about FAW damage and host preference for rice in the Philippines. Rice, a key food security crop for the Philippines and in Asia, is amongst the key host of the FAW elsewhere (e.g., USA). The injury that the FAW will inflict in the rice plant should be known and assessed to quantify the potential yield losses, and predict when an intervention is necessary to avoid incurring potential yield losses. With this background, we conducted FAW monitoring and damage assessment in the areas reported to have FAW occurrence starting May 2021. During 2021 and 2022 assessment periods, monitoring was conducted during the months of May, June, and July. However, starting January 2023, the monitoring and damage assessments were conducted monthly with the exception for May and June wherein it was done weekly since these months coincided with the seedling stage of the rice in a majority of rice-growing areas in the Philippines and where FAW attack was reported during the previous years. FAW larval population and damage were assessed in rice seedbeds. The number of FAW larvae were counted and visual damage was estimated in a 1 m² with three replicates.

Keyword : Fall armyworm, Rice, Damage, seedbeds, invasive species, *Spodoptera frugiperda*, Philippines

FAW-infested areas in the Philippines

The locations where FAW infestations were observed are presented in Table 1 and Figure 1. A week after the first reported FAW infestation in Cagayan in 2021, a follow-up visit cum validation was conducted in the neighboring barangay of Callao in Gonzaga, Cagayan (18° 16' 08.0" N, 121° 59' 30.5" E), wherein 276 larvae/m² with an assessed crop damage of 60% were observed in the inbred NSIC Rc222 seedlings, and 32

larvae/m² in the hybrid Longping 2096 rice seedlings aged about 20-25 days after seeding (DAS) were recorded (Table 1). It was further observed that different growth stages of FAW were present during the validation activities (Figure 2.) High population of FAW larvae were also documented in Rapuli, Santa Ana, Cagayan (Figure 3). With the continued monitoring activities during the months of May and June 2021, more FAW attacks were recorded in the rice seedbeds and in some of the direct-seeded rice at seedling stage

in 14 municipalities in Region 2 (Valdez et al., 2021; Valdez et al., 2023). In May 2022, Valdez et al. (2023) reported that a re-invasion was observed in nine barangays in Gonzaga and one barangay in Santa Ana, Cagayan wherein FAW in the seedbeds were again documented (Figure 4 A & B). Further, the first reported FAW occurrence and damage in the province of Nueva Ecija were recorded in June 2022.

Anticipating a recurring FAW invasion in 2023, monitoring activities were intensified particularly in Cagayan (Gonzaga and Santa Ana). Consequently, FAW was again documented in some barangays of Gonzaga and Santa Ana on May 17-18, 2023. On May 17, 2023, 8 larvae/m² was recorded with 16.67% damage in Flourishing, Gonzaga, Cagayan (18°15' 12.9" N, 121°59' 58.9" E) wherein it was very near the area (18°15'7.7476" N, 121°59'54.9823" E) where the reported FAW re-invasion was documented the previous year of the same month. On the following day (May 18), FAW infestations were again recorded in some seedbeds in Rapuli, Santa Ana, Cagayan wherein one seedbed of NSIC Rc 402 was infested with an average of 87 larvae/m² with approximately 40% damage (Table 1, Figure 5). Further, in barangay Smart, Gonzaga, Cagayan several seedbeds of different rice varieties (hybrids LongPing 534, Pioneer 79, NK 5017 and the inbred NSIC Rc222) were attacked by FAW though the population was already low (1-8 larvae/1m²) with some dead larvae observed due to the frequent application of insecticides. Some of the interviewed farmers of the FAW-infested seedbeds in both municipalities said that the insecticides they applied were Chlorpyrifos, Methomyl, Cypermethrin, Chlorantraniliprole, Lambda-cyhalothrin, and Lufenuron. These insecticides were applied singly or as a mixture of two and applied 1 to 4 times before pulling of seedlings at 3-8 days interval starting at the time when the farmers observed the damage on the foliage. The FAW sightings for this year were observed in seedbeds areas undergoing pulling of seedlings activities wherein the seedlings were mostly aged 21 days after sowing (DAS) or younger. Majority of the FAW larvae observed were 4th to 6th instars with some pupae and adults. Recently this July 2023, FAW sightings were documented in one farmer's field outside of Philippine Rice Research Institute Central Experiment Station (15° 40' 43.8751" N, 120° 53' 30.3212" E) but only one larva was collected with several pupae of FAW and other defoliators. The seedbed of NSIC Rc222 was completely destroyed hence it was plowed under. Also, some rice seedbeds of the experimental field of PhilRice Central Experiment Station (15° 40' 22.9771" N, 120° 53' 35.1686" E) were severely infested (Figure 6A & B) by FAW larvae with an average of 16-19 larvae/m² and a damage of 60-90% in NSIC Rc622, NSIC Rc624 and

NSIC Rc626. Seedlings of NSIC Rc632 and NSIC Rc636 grown in the same area as the three varieties previously mentioned were also attacked by FAW larvae but not as severe as the larvae were mostly at 6th instar and pre-pupation stage. Some FAW larvae were also collected in barangay Camanacsacan, San Jose City, Nueva Ecija (15° 46' 20.2235" N, 15° 46' 20.2235" N). In all the locations, the damage caused by FAW to rice seedlings was observed as a combination of cut leaves and cut plants up to ground level (Figure 6A & B).

Future Directions

Since the first report of FAW on rice in the Philippines in 2021, it was observed that it consistently attacks the rice seedlings during the months of May, June and July. It is also spreading from Region 2 to Region 3. FAW occurrence during seedling stage in the seedbed will be easier to manage since the area is smaller, but the misuse and abuse of pesticides can trigger crop losses from other minor pests. In addition, if the seedlings are completely damaged due to FAW attack, the crop establishment will be delayed thereby prone to attack by pests such as stemborer, brown planthopper and other pests and diseases. This can be catastrophic in the hybrid rice seed production where damage to one of the parents will result in poor seed setting and hybrid vigor. Direct-seeded rice at seedling stage is also vulnerable to FAW attack although direct-seeding technology has been promoted as labor-saving. There is a need to continuously monitor FAW presence and spread in the country and to develop a standard damage assessment protocol to determine the FAW density. Early interventions to prevent significant yield losses are crucial in addition to the formulation of an effective location-specific management strategy with nature-based solutions.

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Acknowledgment

The project “Monitoring the Occurrence, Host Plant Specificity, and Management of the Fall Armyworm (*Spodoptera frugiperda*) in- and around-Rice Ecosystems in the Philippines” is funded by the Department of Agriculture – Bureau of Agricultural Research (DA-BAR); and PhilRice funded the implementation of the phase 2 of the project. We acknowledge the farmers and staff of Municipal Agriculture Offices of Gonzaga and Santa Ana, Cagayan, and San Jose City, Nueva Ecija; and Mr. Alejandro Cinense, Jr. for assisting us during the monitoring and damage assessment activities.

Table 1. Locations where fall armyworm damage was observed in the Philippines from 2021 to 2023 .

No.	Location	Coordinates		Date Observed	Damage (%)	Number of FAW larvae/m ²	Rice Variety	Age of rice plant (days after seeding)
		Latitude	Longitude					
1	Pateng, Gonzaga, Cagayan	18°14'18.05" N	121°59'49.08" E	May 17, 2021	-	-	-	-
2	Rapuli, Santa Ana, Cagayan	-	-	May 20, 2021	-	-	-	-
3	Enrile, Cagayan	-	-	May 21, 2021	-	-	-	-
4	Cabarroguis, Quirino	-	-	May 26, 2021	-	-	-	-
5	San Pablo, Isabela	-	-	May 27, 2021	-	-	-	-
6	Maddela, Quirino	-	-	May 28, 2021	-	-	-	-
7	Bagabag, Nueva Vizcaya	-	-	June 02, 2021	-	-	-	-
8	Solano, Nueva Vizcaya	-	-	June 04, 2021	-	-	-	-
9	Bayombong, Nueva Vizcaya	-	-	June 08, 2021	-	-	-	-
10	San Mateo, Isabela	-	-	June 08, 2021	-	-	-	-
11	Roxas, Isabela	-	-	June 09, 2021	-	-	-	-
12	Santiago, Isabela	-	-	June 2021	-	-	-	-
13	Diffun, Quirino	-	-	June 2021	-	-	-	-
14	Jones, Isabela	-	-	June 2021	-	-	-	-
15	Callao, Gonzaga, Cagayan	18° 16' 08.0" N	121° 59' 30.5" E	May 23, 2021	60	276	NSIC Rc222 (inbred)	20 - 25
16	Callao, Gonzaga, Cagayan	18° 16' 08.0" N	121° 59' 30.5" E	May 23, 2021	-	32	Longping 2096 (hybrid)	20 - 25
17	Rapuli, Santa Ana, Cagayan	18° 22' 30.9" N	122° 9' 7.0" E	May 25, 2021	-	215	-	-
18	CSU Gonzaga Campus, Flourishing, Gonzaga, Cagayan	18° 15' 7.7476" N	121° 59' 54.9823" E	May 24, 2022	-	19	NSIC Rc222 (inbred)	17
19	CSU Gonzaga Campus, Flourishing, Gonzaga, Cagayan	18° 15' 7.7476" N	121° 59' 54.9823" E	May 24, 2022	-	3	Pioneer (hybrid)	17
20	Pateng, Gonzaga, Cagayan	18° 14' 50.8200" N	121° 58' 29.2440" E	May 25, 2022	7.12	9	Syngenta S6003 (hybrid)	19
21	Rapuli, Santa Ana, Cagayan	18° 22' 36.3367" N	122° 8' 40.3710" E	May 25, 2022	1.21	21	NSIC Rc402 (inbred)	22
22	Porais, San Jose City, Nueva Ecija	15° 44' 44.3" N	121° 02' 46.2" E	June 24, 2022	-	-	-	-
23	Flourishing, Gonzaga, Cagayan	18° 15' 12.9" N	121° 59' 58.9" E	May 17, 2023	16.67	8	-	-
24	Rapuli, Santa Ana, Cagayan	18° 22' 31.5" N	122° 8' 52.3" E	May 18, 2023	10	6	NSIC Rc222 (inbred)	-
25	Rapuli, Santa Ana, Cagayan	18° 22' 33.4" N	122° 8' 40.7" E	May 18, 2023	40	87	NSIC Rc402 (inbred)	25

26	Smart, Gonzaga, Cagayan	18° 15' 17.1" N	122° 0' 7.8" E			1	Longping 534 (hybrid)	18 - 21	
27	Smart, Gonzaga, Cagayan	This area is in between 2 locations: # 26 and #32... almost all seedbeds in the area (approximately less than a kilometer)		Very Minimal		2	NSIC Rc222 (inbred)		
28	Smart, Gonzaga, Cagayan					1	Pioneer 79 (hybrid)		
29	Smart, Gonzaga, Cagayan					7	Pioneer 79 (hybrid)		
30	Smart, Gonzaga, Cagayan					6	NK 5017 (hybrid)		
31	Smart, Gonzaga, Cagayan					5	NK 5017 (hybrid)		
32	Smart, Gonzaga, Cagayan	18°15'35.6" N	121°59'57.7" E			-	-		8
33	Pateng, Gonzaga, Cagayan	18° 14' 48.4" N	121° 58' 10.3" E			-	-	11	Double Diamond (inbred)
34	Pateng, Gonzaga, Cagayan	18° 14' 13.7" N	122° 0' 16.4" E	-	-	41	-		
35	Maligaya, Science City of Muñoz, Nueva Ecija	15° 40' 43.8751" N	120° 53' 30.3212" E	July 16, 2023	100 (plowed under)	1 (but many larvae of FAW and other defoliator)	NSIC Rc222 (inbred)	20	
36	PhilRice-CES, Maligaya, Science City of Muñoz, Nueva Ecija	15° 40' 22.9771" N	120° 53' 35.1686" E	July 18, 2023	90	19	NSIC Rc622 (inbred)	21	
37	PhilRice-CES, Maligaya, Science City of Muñoz, Nueva Ecija	15° 40' 22.9771" N	120° 53' 35.1686" E	July 18, 2023	90	16	NSIC Rc624 (inbred)	21	
38	PhilRice-CES, Maligaya, Science City of Muñoz, Nueva Ecija	15° 40' 22.9771" N	120° 53' 35.1686" E	July 18, 2023	60	19	NSIC Rc626 (inbred)	21	
39	Camnacsacan, San Jose City, Nueva Ecija	15° 46' 20.2235" N	120° 59' 23.5133" E	July 21, 2023	-	4 larvae/100m ²	NSIC Rc506 (inbred)	27	

Foot Note: Locations number 1 to 22 were reported in Valdez et al. (2023)

- No Data

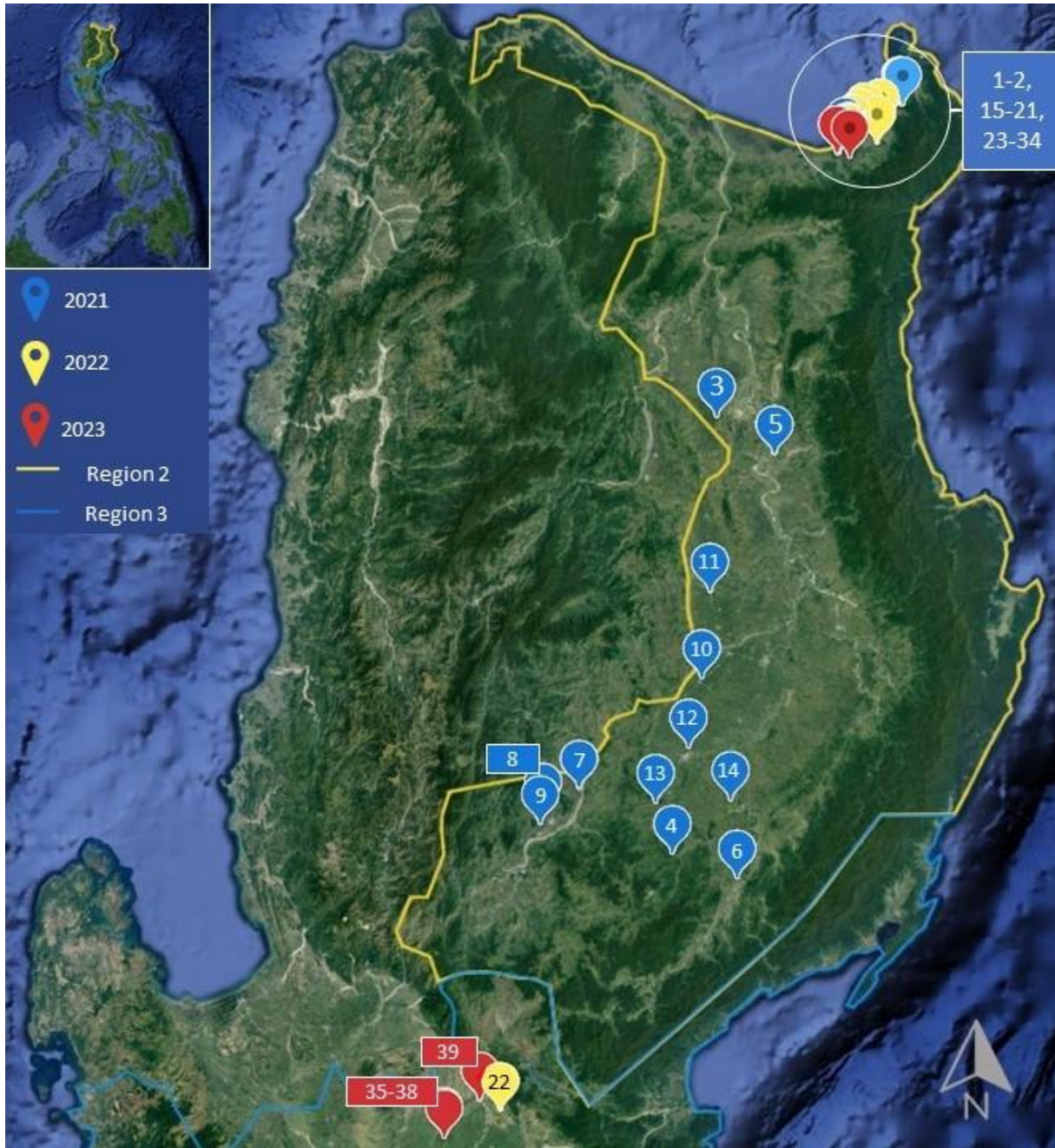


Figure 1. Map of reported FAW infestation (refer to the Table 1 for the corresponding number of each location) in Region II (Cagayan Valley) and Region III (Central Luzon), Philippines, during wet season (WS) of 2021, 2022, and 2023.



Figure 2. Rice seedlings with larva and pupa of FAW as well as the damage in leaves observed in Callao, Gonzaga, Cagayan in 2021. (Photo credits: Dindo King Donayre).

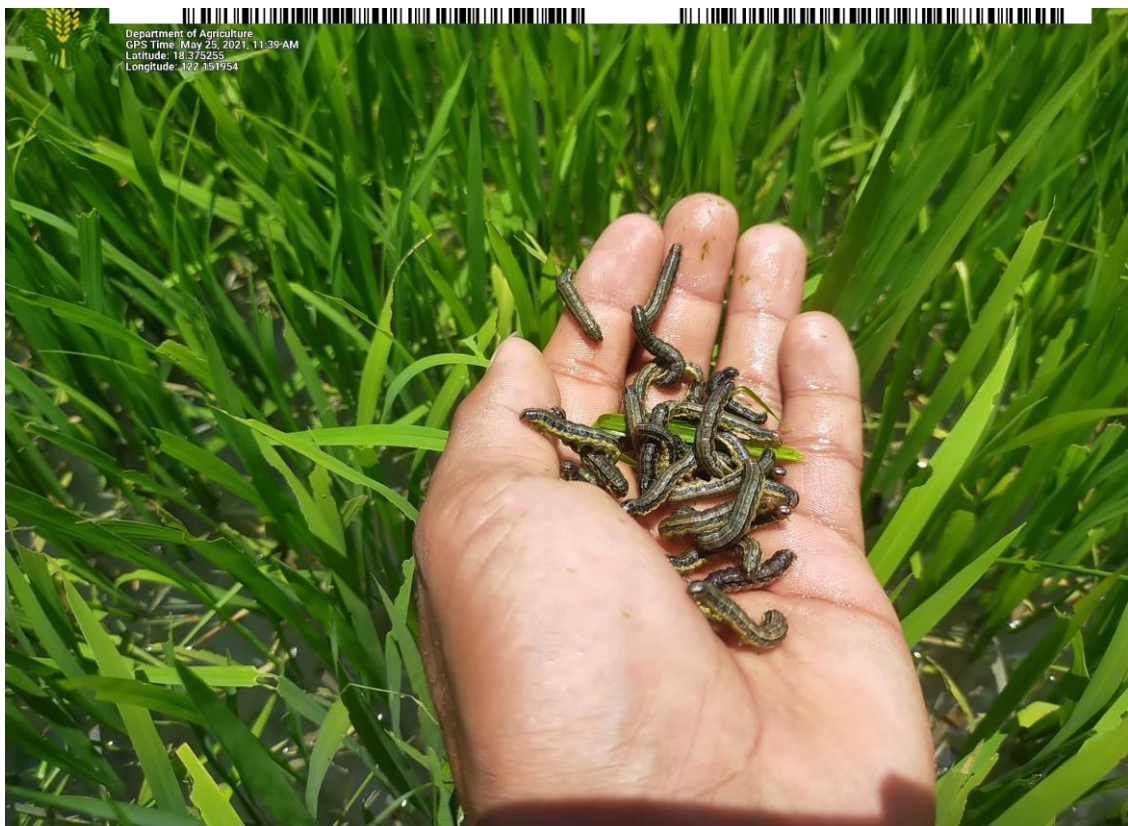


Figure 3. FAW larvae collected in rice seedbeds of Rapuli, Santa Ana, Cagayan, 2021. (Photo credits: Omar Faypon DA-RCPC2).

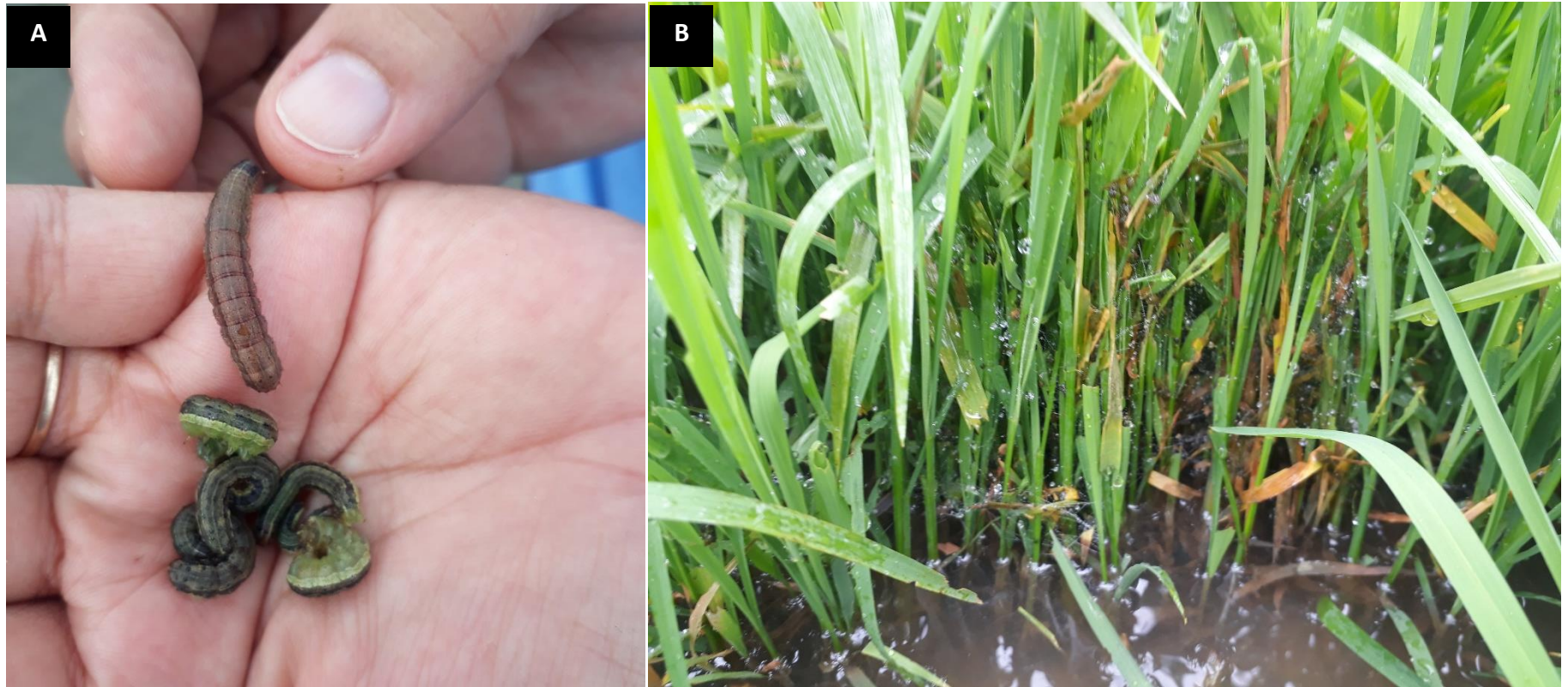


Figure 4. (A) FAW larvae and (B) FAW damage in the rice seedbeds in Barangay Pateng, Gonzaga, Cagayan, May 25, 2022.



Figure 5. FAW larvae attacking the rice seedlings in seedbeds of Rapuli, Santa Ana, Cagayan, May 2023. (Photo credits: Kennedy dela Cruz).

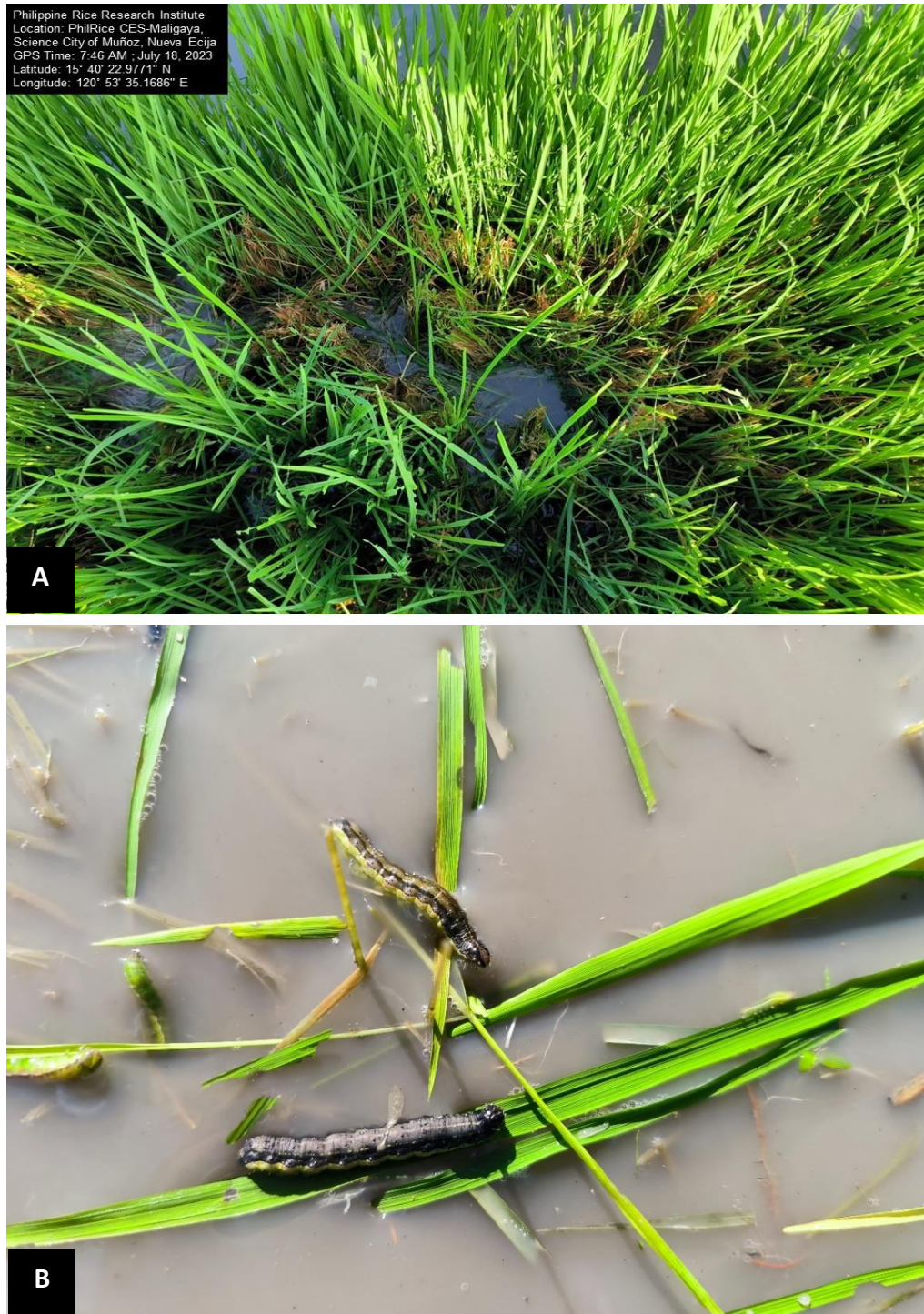


Figure 6. (A) FAW damage in rice seedlings pruned to the ground level. (B) Cut leaves serving as pathway or floaters to FAW larvae to transfer to other plants or weeds that were along the bunds, PhilRice Central Experiment Station, July 18, 2023. (Photo credits: Kennedy dela Cruz).