



## Sustainable large-scale biological control of the Millet Head Worm in the Sahel

# TECHNICAL REPORT



October 2015

## OVERVIEW

The McKnight foundation funded \$US 798 600 for activities continuation over 4 years from the former Waf CoP GIMEM project. The new project aims is to develop parasitoid industry for controlling the millet head worm (MHW) in the Sahel. 1) The project will start with studies related to the level of MHW incidence and determining the recurrent infested areas. Meetings will be initiated for selecting, training and launching of private and community marketing units of the parasitoids. It is expected all delivery of parasitoid for MHW biocontrol will be supported locally in each country with an annual coverage of at least 500 000 hectares of millet and a reduction in losses of MHW by 40 %. 2) Biological control methods against the MHW will be also enhanced with the use of egg parasitoids, this in order to obtain early and most important pest mortality. An inventory of natural egg parasitoids of the MHW, mass rearing and test on-farm for species considered successful will be done in the three countries. 3) Additional data on the biology and dynamics of larvae and adults of MHW will be collected each year of the project for better understanding of factors influencing the pest infestations. This information will contribute to establish warning and preventive system for MHW control. 4) Varietal resistance for MHW will be studied through on-farm evaluation of new genotypes of millet developed by teams of breeders in the 3 countries. Information will be shared with producers groups and organizations through participatory assessments and field open days. 5) The project will involve 3 PhD students and 6MSc students, all the students will be enrolled in local universities and identify their research topic related to the project objectives. 6) Monitoring and evaluation of the project will be done through annual meetings between countries, exchange visits and workshops organized by the regional monitoring team.

### A. What? (Activities)

#### A-1 Establishment of private unit

##### A.1.1. Base line survey

Base line survey for establishing private unit for *H. hebetor* production was carried out in the region of Maradi and the district of Tera in Niger from 1<sup>st</sup> to 30<sup>th</sup> May by the agro economic team of SMIL project involving four enumerators from the INRAN entomology Lab and ICRISAT. In each location 200 producers from 20 villages were interviewed. Data of the survey are being processed.

##### List of villages surveyed in Maradi region

Dargué	Kandoussa	Karazomé	Takalahiya
Kalgo	Garin Barmo	Guidan Taouayé	Elhaji dango
Dan Matchatchi	Zagué	Boungougi	Dan matchadi
Mayki	Maiguemé	Chadadi	Matada
Saounawa	Batata	Kaga dama	Guidan Koube

##### A.1.2. Private units for parasitoids production

A total of 7 pilots private production unit of parasitoid was established in Niger, including 6 run by farmer organization and one by an NGO. In Burkina Faso the production is run by INERA in Dori. These private units contributed to protect about 2.875.193 ha by producing a total of 5494 bags available to farmers in Niger and Burkina Faso (Table 1)

**Table 1: Release bags production by private units**

Countries	Name of organisation	Localities	Contacts	Number of released bags produced and sold to farmers	Number of released bags produced sold to NGOs/projects
<b>Niger</b>	Union <b>harey ben</b>	Téra	+22796470075	180	643
	Union <b>aiki lafia</b>	Sarkin Bindiga	+22796927582	15	330
	Union <b>foussaha</b>	Guidan Ider	+22796722883	0	225
	Union <b>dubara</b>	Serkin Hausa	+22796885846	0	250
	Union <b>famey</b>	Dan Tchandou	+22796203098	0	0
	<b>NGO Sahel bio</b>	Maradi	+22797591515	0	3686
<b>Burkina Faso</b>	<b>INERA</b>	Dori	+22671386030	165	0
<b>Total</b>				<b>360</b>	<b>5134</b>
<b>TOTAL</b>					<b>5494</b>

In Mali three localities have been identified for establishment of parasitoid production units but the activity will start in 2016. However IER produced and placed 225 release bags in 15 villages in Mopti and Segou regions.

In parallel the ICRISAT-ARDT SMS project produced and placed 375 release bags in 25 villages within district of Bandiakara, Koro, Bankass, Djenné and Mopti. The coverage areas are estimated to 196 250 ha.

## **A.2. Screening of millet varieties for resistance or tolerance to MHW**

This activity is under the Output 4 of the project “Varieties with resistance/tolerance to the MHW are identified”. Host plant resistance is a component of integrated pest management that has never been fully investigated for the MHW.

A trial was setup in 2015 in ICRISAT Campus in Sadore with 15 entries (early and medium maturing varieties). The material was planted within a randomized alpha design with 3 replicates. Replicate for each variety was planted on one row of 5m long with an intra-row spacing of 0.8 m and inter-row spacing of 0.8 m. A space of 1.6 m was left between replicates. Mineral fertilizer NPK (14-23-14) was applied to the entire plots at planting at a dose of 200kg/ha. In addition Urea (46%N) was applied at tillering stage (50kg/ha) and at boot stage (50kg/ha). All the plots were kept free of any pesticide application. At panicle boot stage, 18 panicles were randomly selected per variety (6 panicles per rep) and individually covered with screen head-cage. At one-third panicles heading stage 9 panicles/variety (3 per rep) were each infested with 40 eggs of the MHM. To obtain eggs, MHM adult females were caught daily from light traps and allowed to lay eggs overnight on sections of early-planted millet panicle in oviposition cages in the laboratory. After infestation, the panicles were kept covered with screen

cloth-cages and monitored daily to keep off insects and ants as well as to maintain the cage structure. The remaining covered panicles were not infested with any insect. At harvest the screen cages were carefully removed and the panicles were cut and visually assessed to score the damage using a 1-9 scale. Number of larvae and pupae of the MHM, number of mines and length of mine were also recorded. Larval production index, which represent the percentage of eggs that developed to larvae and pupae stage was computed for each variety.

The varieties PE00077, PE01490 and PE08043 appeared promising (Table 2)

**Table 2: Damages, mine length and larval production index on most interesting varieties as compare to sensitive varieties**

Varieties	Damage rating*	Mines Length (cm)	Larval production index**
PE08043	3.58 ± 0.57	18.63 ± 3.47	17.5
PE00077	4.00 ± 2.51	5.00 ± 1.00	1.25
Moro	4.08 ± 0.52	20.75 ± 3.53	14.15
PE00025	4.62 ± 0.56	19.37 ± 3.89	6.87
SNY-03-11	5.00 ± 0.01	19.00 ± 0.15	2.50
PE01490	5.33 ± 2.02	11.50 ± 6.50	2.50
PE05927	6.00 ± 2.50	16.00 ± 2.32	12.50
PE02783	6.12 ± 0.50	35.28 ± 3.84	26.62
GB8735	6.90 ± 0.56	37.85 ± 6.25	8.75
ICMV IS 92222(sensitive Check)	7 ± 0.40	44 ± 3.80	46.87
***P<0.05			

\*1=<10% damaged panicle; 2=10-20%; 3=21-30%; 4=31-40%; 5=41-50%; 6=51-60%; 7=61-70%; 8=71-80% and 9=>80% damaged panicle

\*\* Larval production index= % of eggs that developed to larvae and pupae stage

\*\*\* The ANOVA was computed with all the 15 varieties

The same material along with local checks was screened at Kouroungoussaou in Maradi region in Niger, at Dori in Burkina Faso at 4 Banankoro, Biya, Zanaboubou and Sokolon in Mali. The data are being processed.

### A-3 Early warning system of MHW control

#### A-3-1. Awareness about Biological control

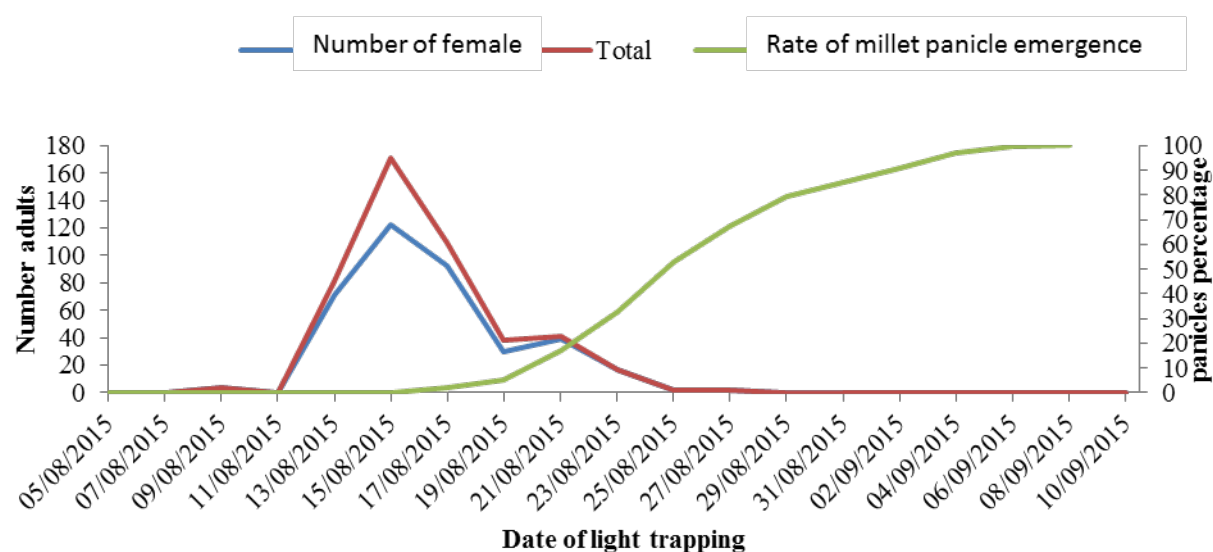
In Niger about 76 extension agents were trained to sensitized farmers during millet head miner prospection and during parasitoid release periods

In Burkina Faso 31 leaders / head of association were met and informed about the biological control for MHW and the availability of parasitoids for purchase.

#### A-3-2. Solar light traps

A new solar Light trap was setup at 7 localities in Eastern Niger. The light traps operated from 5th August to 10th September 2015. The prototype was tested at ICRISAT in 2014 and allowed the capture of different moths including the millet head worm, *Heliocheilus albipunctella*.

At Kouroungoussaou in Niger a total of 465 *H. albipunctella* was catch with 82% females within 20 days of trapping. The peak population was noted on mid-August with 171 adults and the last capture was recorded on 27th August. The flights of adult started before pearl millet panicle emergence (fig 1).



**Fig.1:** The light trap capture of *Heliocheilus albipunctella* and millet panicle emergence percentage

#### A-4 Identification of indigenous egg parasitoids of MHW

Eggs of the MHW were collected from early planted/flowering pearl millet in farmers' fields in 10 locations of Tahoua and Zinder in Niger from 17<sup>th</sup> to 28<sup>th</sup> August 2015.

At each location eggs were collected from 60 millet spikes and kept in plastics vials. Total number of eggs was counted and the eggs were then incubated in the laboratory at ambient temperature until emergence of parasitoids.

In Niger, eggs were collected from 600 spikes in 200 boxes; the analysis showed that about 63.20% of the samples have emergences of eggs parasitoids. The percentage of parasitized eggs ranged from 3.31 to 29.41 in Niger (Table 3).

In Burkina Faso with the same activities it was recorded egg parasitism level from 3 to 5%.

**Table 3 : Millet head worm eggs infestation by trichogram**

Localities	N	Total number of collected eggs	Number of emerged larvae <i>Heliocheilus abilpunctella</i>	Number of steril eggs	Total number of parastized eggs	Pertcentage of parasitized eggs
Daurawa	20	590	529	14	47	7,97
Gangara	20	685	568	43	74	10,80
Goumda	20	612	506	72	34	5,56

Madaoua	20	563	413	14	136	24,16
Rouga	20	906	820	56	30	3,31
Tirmini	20	708	485	12	211	29,80
T. Agouwa	20	801	521	61	219	27,34
Tsarnawa	20	639	414	50	175	27,39
Tunfafi	20	711	494	15	202	28,41
Zourare	20	950	821	41	88	9,26
<b>Total</b>	<b>200</b>	<b>7165</b>	<b>5571</b>	<b>378</b>	<b>1216</b>	<b>16,97</b>

## B. So what?

The carried out activities led to formulate the following conclusions:

- The *H. hebetor* production by private units is possible. In Niger and Burkina out of 7 private units established, 6 units (85.71%) produced and sold 5494 bags. The Parasitoid commercial unit SAHEL BIO seems to be the most efficient as it produced 67.09 % of release bags;
- The production system established in Niger and Burkina Faso led coverage of more than 2.875.193 ha with 366 release points within 55 districts. 93.45% of release bags is funded by rural development projects and 6.55% of bags were purchased by farmers;
- At the 3 countries the biological control concerned 3.071.443 ha. Evaluation will be carried out to record the pest mortality and yield gain;
- Two types of eggs parasitoids are naturally observed in the collected samples and the rearing and release methods will be studied at the laboratory;
- From the preliminary study conducted by ICRISAT with 15 varieties, three varieties PE00077, PE01490 and PE02783 appeared to be more tolerant to MHW ; At Maradi in Niger ICMV-221 seem to bear early panicle emergence among the tested varieties;
- For the early warning system, the local made solar light trap seem to be an effective device to predict the occurrence and attack of the MHW;
- The project team in the three countries allowed the training of 76 technicians, 7458 farmers including 1152 women on the early warning system and release bag handling ;
- For the staff and students building capacity; two PhD students were registered at University of Maradi and Ouagadougou. During 2015 cropping season four bachelor students carried out their final study project with the project activities.

## C. Now what?








The continuation of building capacity for private units is necessary. The activities carried out in 2015 allowed them to learn the production process, the support should be maintained for improving their ability to produce more bags, enhance the production rate and satisfy the farmer demand in time;

It will be important to discuss about the establishment of permanent committee at national level about the early warning system for effective control of millet head worm;

The studies should be repeated to obtain the most effective eggs parasitoid to be added to the present list, the parasitism rate due to egg parasitoid is low ranged from 3.31 to 29.41% this needed to be increased through the parasitoids release Efficacy test will allow the team to determine the most effective candidate for biological control at farmer level;

## I. APPENDICES

### A. Appendix A – Students list .

	Students identity	Topics
	Name : Adama Kabore Gender : male Institution : University of Ouagadougou Level : PhD student Cel : +226 71386030 Country :Burkina Faso	Bioecology of millet head miner, <i>Heliocheilus albipunctella</i> De Joannis (Lépidoptera : Noctuidae) and the parasitoïd, <i>Habrobracon hebetor</i> Say (Hymenoptère :Braconidae).
	Name : Oumarou Nassirou Gender : male Institution : University of Maradi Level : PhD student Cel : +22796068117 Country : Niger	Contribution to improve strategies of integrated millet head miner management
	Name : Moussa Mahamane Abdoul Aziz Gender : male Institution : University of Maradi Level : Bachelor student Cel : +227990479195 Country :Niger	Study of millet head miner dynamic at Kouroungoussaou in the region of Maradi.
	Name : Maman Inoua Boubacar Gender : male Institution : University of Maradi Level : Bachelor student Cel : +22796412530 Country : Niger	Screening of 16 millet varieties for millet head miner attacks at Kouroungoussaou, Maradi
	Name : Boly Aboubacar Gender : male Institution : University of Ouaga Level : Bachelor student Cel : +226 73211696 Country : Burkina Faso	Screening of 18 millet varieties for millet head miner resistance <i>Heliocheilus albipunctella</i> De Joannis (Lépidoptère ; Noctuidae
	Name : Zandou Sidnoma Daniel Gender : male Institution : University of Ouaga Level : Bachelor student Cel : +226 70085721 Country : Burkina Faso	Comparison of two release methods of <i>Habrobracon hebetor</i> Say (Hymenoptère : Braconidae for biological control of millet head miner <i>Heliocheilus albipunctella</i> De Joannis (Lépidoptera : Noctuidae) in Burkina Faso Sahélienne région.
	Name : Didy Keita Gender : male Institution : Agrhymet Level : Master Country : Mali	Screening of 17 millet varieties for millet head miner at 4 villages in Segou region (Banankoro, Zanabougou, Sokolo e Biya)



## ***APPENDICES B: List of persons worked in the project***

### **Niger:**

Dr. Ibrahim Baoua Maître *de Recherche*, University of Maradi Entomologist National Project Coordinator

Mr. Sani Moudi

Mr Salissou Oumarou

Dr. Madougou Garba

Mr. Mayaki Gaya, Technician;

Mr. Laouali Amadou, Msc

Mr. Nassirou Oumarou; Msc

Mr. Nassirou Saidou Msc ;

### **ICRISAT**

Pr. Niango Malick BA, *Maître de Recherche*

Mr. Laouali Karimou Msc

Mr. Halarou Salha Technician

### **Burkina Faso**

Pr. Clémentine DABIRE, *Maître de Recherche*, INERA, *Responsable du L.C.E.A.K*

Pr. Antoine SANON, *Maître de Conférences*, *Université de Ouagadougou*

M Fousseini Traoré Entomologist INERA.

M Adama KABORE, Msc. INERA

Mr Woango Antoine

M. Théodore OUEDRAOGO, Technicien, INERA, Kamboinsé

M Simon Tarpidiga, Technicien, INERA, Kamboinsé

### **Mali**

Mr. Mamadou N'diaye, Entomologiste, chef de projet

Mr. Ibrahima Sory Ouattara, appui recherche

Mr. Amadou Tembely, appui recherche

Mr. Seydou Togo, Chef sous station de Kopro, appui recherche

Mr. Didy Kieta Msc student

Mr Jean Claude Kamaté, Appui recherche

### ***APPENDICES C: Pictures related to project activities***



Unit of parasitoid production from Téra, Niger. (Farmers union Harey Ban)



Visit of parasitoid production unit of Dori (Burkina Faso) by Ministry of Research and CNRST General Delegate during August 2015



Solar light trap tested in Niger for MHW awareness system



Training on GIMEM technologies use at Sokolon (Mali)



Screening millet varieties at Cinzana station (Mali)

*Appendices D:* **ANNUAL EXPENDITURE RESPONSIBILITY  
CAPITAL EQUIPMENT REPORT**

For Fiscal Year Ending \_\_31\_\_ December \_\_\_\_\_

**CAPITAL EQUIPMENT REPORT**

Description of Item	Cost (U.S. Dollars)	Date of Purchase (mm/yyyy)	Useful life
Toyota Hilux 4x4x	46 872.96	02/2010	5 years
Motobike Qlink	1607.78	10/2010	3 years
Office table	736.71	10/2010	7 years
Laptop	1024.22	04/2011	3 years
Laptop	946.37	07/02/2012	3 years
M Qlink 125	1294.86	27/06/2012	3 years
Motobike yamaha50	980.96	25/04/2013	3 years
Laptop	1348.81	28/03/2013	3 years
Projector	1594.05	12/06/2013	3 years
Visitor Chairs	117.71	09/07/2012	5 years
Office table	189.18	29/05/2012	3 years
Air condition	607.22	19/10/2012	3 years
Chairs(seminar room) and flit chart	959.35	26/11/2012	5 years
Photocopying machine	3188.11	18/07/2013	3 years
Fountain	306.55	03/09/2013	3 years
Laboratory building extension room	2469.21	27/09/2013	10 years
Building <i>Corcyra cephalonica</i> rearing local	3913.74	24/10/2013	10 years
<i>H hebetor</i> rearing room	1850.33	24/09/2013	10 years
Balance Scout pro	1876	12/04/2015	5 years
Euromex Iliminator	2025	12/04/2015	5 years
Binocular OPTIKA	613	02/02/2015	5 years
Binocular SZ STL1	2299	02/02/2015	5 years
Analytic scale 0.01mg	3240	02/07/2015	5 years
Microscope stereo bino 455	2887	02/02/2015	5 years
6 Light traps	2175	27/07/2015	5 years
<i>Add additional rows as necessary</i>			

The vehicle is in very good condition. It is used only for GIMEM project activities. It facilitate GIMEM team mobility

Please contact your program administrator to confirm the useful life of any item that is purchased using McKnight grant funds with an individual value over US\$5,000.

## *Appendices E: STATEMENTS OF GRANTEE*

1. **Purpose Statement.** Grantee hereby confirms that it has made all expenditures of McKnight grant funds. Including expenditures of income or gains earned on the grant funds. in furtherance of the stated purpose of the grant.
2. **Terms and Conditions.** Grantee hereby confirms that it has complied with all of the terms and conditions of the grant specified in the grant agreement signed by the grantee and McKnight dated **[September 10<sup>th</sup> 2014]**.
3. **Statement of Compliance.** Grantee confirms that no grant funds (or income earned on grant funds) have been used:
  - a. To carry on propaganda. or otherwise to attempt to influence legislation (lobbying);
  - b. To influence the outcome of any public election. or to carry on. directly or indirectly. any voter registration drive;
  - c. To make a grant to any individual for travel. study or similar purposes or to make a grant to any other organization; or
  - d. For any purpose other than charitable. scientific. literary or educational purposes. (OR to undertake any activity for any purpose other than as specified in Section 170(c)(2)(B) of the Code (charitable purpose).
  - e. For organizations based outside the United States: For activities in. or travel to and from. the United States per IRS code 1441.
4. **[If applicable]** Grantee's budget (or prior report) indicates that grantee will purchase (or has purchased) capital equipment with McKnight grant funds. Please complete the capital equipment report (pages 10-11) for each item purchased using McKnight funds that have a value that exceeds \$5,000. Grantee confirms:
  - a. Any and all capital equipment purchased with McKnight funds continues to be used for the stated purpose of the grant; and
  - b. Such equipment has not been used for any of the purposes described in Section 3 above.

I declare that I am authorized to sign this report on behalf of grantee, that I have examined the foregoing statements and related attachments, and that to the best of my knowledge, they are true, correct, and complete.

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Institutional Official

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Date 10/20/2015

Pr SAADOU Mahamane  
Recteur de l'Université de Maradi

