Annual Report FY 2012-13
October 1, 2012 to September 30, 2013

Development and Delivery of Ecologically-based IPM Packages in Tajikistan

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Michigan State University (MSU) in partnership with Kansas State University, ICARDA and several local research and academic institutions and NGOs is implementing the Tajikistan IPM program. The technical objectives of the Tajikistan IPM CRSP Program are:

1. **Develop ecologically based IPM packages for wheat through collaborative research and access to new technologies.**

2. **Disseminate IPM packages to farmers and end-users through technology transfer and outreach programs in collaboration with local NGOs and government institutions.**

3. **Build institutional capacity through education, training and human resource development.**

4. **Enhance communication, networking and linkages among local institutions in the region and with U.S. institutions, international agricultural research centers and IPM CRSP regional and global theme programs.**

5. **Create a "Central Asia IPM Knowledge Network" encompassing a cadre of trained IPM specialists, trainers, IPM packages, information base and institutional linkages.**

The following activities were implemented during the FY 2012-13 covering the period from October 1, 2012 to September 30, 2013 linked to the above five technical objectives.

Objective 1: Develop ecologically-based IPM packages for wheat cropping systems in Tajikistan through collaborative research and evaluation of new technologies and approaches.

One of the main activities of the Tajikistan IPM Innovation Lab is to establish IPM Applied Research and Demonstration Sites for testing and evaluating the existing and new approaches and technologies for IPM packages for wheat in Tajikistan. The IPM packages include a range of methods, tools and approaches including cultural practices, biological control agents/products, resistant varieties, etc. The applied IPM research and demonstration sites have been established and implemented for wheat (see more details in the following section).

Wheat Crop: Wheat is the main staple crop in Tajikistan and in the Central Asia region. A team of scientists consisting of Dr. Doug Landis (MSU), Dr. Megan Kennelly (KSU), Dr. Mustapha Bohssini (ICARDA), Dr. Nurali Saidov (Tajikistan) and Dr. Anwar Jalilov (Tajikistan) worked together and established three wheat IPM applied research and demonstration sites in Tajikistan.

The year 2013 was generally favorable for wheat production in Tajikistan. Yellow rust was observed in May-June with up to 50 percent infection in susceptible wheat varieties but little to no infection on resistant varieties. Brown rust was apparent by mid-June in irrigated areas and by harvest had reached a maximum of 50 percent infection on susceptible local wheat varieties including Navruz, Sharora. In contrast, the resistant variety "Ormon" only reached 10 percent infection. Due to the late infection of Brown rust and lack of progression of yellow rust infections, the overall impact of these diseases on wheat yield was minimal.

Suun pest pressure continued to be high in northern Tajikistan where it is a consistent pest. While the Suun pest can occasionally be found in the southern and eastern regions, populations remained quite low in 2013. In contrast, cereal leaf beetle was absent in the north, but populations were moderate to high in the southern and eastern regions in 2013.

IPM Applied Research and Demonstration Sites for Wheat 2012-2013

Three IPM research and demonstration sites were established for wheat, one in the Spitamen district of Sogd region in the North, a second in the Hissor district in southern Tajikistan, and a third in the Muminabad district of Khatlon region in eastern Tajikistan.

North Tajikistan: This demonstration site was located on a farm named for its founder "Ilhom Boimatov" in the Spitamen district of Sogd region, (north part of Tajikistan). Mr. Akmal Boimatov is the current local grower. In this site focus was on the Sunn pest (*Eurygaster integriceps)* and diseases including the wheat rusts: yellow rust (*Puccinia striiformis*) and brown rust (*Puccinia recondite*). The key weeds in wheat fields include oat grass (*Avena fatua*), shepherd's purse (*Capsella bursa-pastoris),* pigweed or lambsquarters (*Chenopodium album)* and Bermuda grass (*Cynodon dactylon*).

The following IPM package components were compared to local farmers' practices in the same area:

- Plots of 10 X 10 m planted to a resistant variety to yellow and brown rusts, 4 replications with two strips of flowering plants including coriander *(Coriandrum sativum L.),* dill *(Anethum graveolens L.),* sweet basil *(Ocimum basilicum L.),* ziziphora *(Ziziphora interrupta* Juz.), marigold *(Calendula officinalis L.)* and winter cress (*Barbarea vulgaris)* alongside the wheat plots to enhance Sunn pest egg parasitoids.
- Cultural practices (planting date, seed rate, fertilizer application and weed control).
- Hand collection of Sunn pest adults during 2 to 3 weeks beginning at the time of migration to wheat fields.

Location: Ujteppa village, Tagoyak Jamoat of the Spitamen district of Sogd region
Farmer: Mr. Akmal Boimatov
Other Farmer Participants: (n=20)
GPS data: N 40.13382; E 069.30801; Altitude: 460m
Date of demonstration establishment: October 25, 2012
Date of rust evaluation: May 10, May 17 and May 26, 2013
Date of Sunn pest evaluations: April 14, May 10 and May 17, 2013
Date of yield evaluation: June 5, 2013
Seed sowing rate: 2 kg per plot or 200 kg/ha
Farmer variety: "Ulugbek"
IPM Demonstration variety: "Ormon"
Treatments: In the IPM practice, the wheat seeds were treated with "Vitavaks 200 FF" at 2 kg per ton wheat seed.

Yellow rust infection in May was high: 50 percent in the farmers practice plots, and 5 to 7 percent in the IPM Demonstration plots. Brown rust infection in May was low to moderate averaging 25 to 30 percent in the Farmers Practice Plots and 5 percent in the IPM Demonstration plots. Sunn pest pressure was high with an average of 5 to 8 adults and 8 to 10 larvae per m2 in the Farmers Practice Plots and 3 to 4 adults and 4 to 6 larvae per m2 in the IPM Demonstration plots in April and May respectively.

The analysis of yield results at this site showed that in IPM Demonstration plots, the wheat yield was 48.10 kg per plot, which was 15.65 kg more compared with yield in Farmers Practice Plots.

Photo 1. Farmers during the training in the Spitament district.

South Tajikistan: The location of the demonstration site was at the private farm of Mrs. Makhbuba Sattorova located in the Hissor district of the Hissor region. At this site the focus was on the cereal leaf beetle (*Oumela melanopa)* and diseases including the wheat rusts: yellow rust (*Puccinia striiformis*) and brown rust (*Puccinia recondite*). The key weeds in the wheat field at this site include oat grass (*Avena fatua*), shepherd's purse (*Capsella bursa-pastoris),* pigweed or lambsquarters (*Chenopodium album)* and Bermuda grass (*Cynodon dactylon*).

Figure 2 shows the field plots of this demonstration site. At this site, we tested the following IPM package components compared to farmers' practices in the same area:

- Plots of 10 X 10 m planted to a resistant variety "Ormon" to yellow and brown rusts, 4 replicates with two strips of flowering plants including coriander *(Coriandrum sativum L.),* dill *(Anethum graveolens L.),* sweet basil *(Ocimum basilicum L.),* ziziphora *(Ziziphora interrupta* Juz.) and marigold *(Calendula officinalis L.)* along side the wheat plots to enhance cereal leaf beetle natural enemies.
- Cultural practices (planting date, seed rate, fertilizer application and weed control).
- Biopesticide application as "Nim" from China.

Location: Andrevka village, Hissor district of Hissor region

Farmer: Mrs. Makhbuba Sattorova
Other farmer participants: (n=20)
GPS data: N 38.51392; E 068.64054; Altitude: 750m
Date of demo establishment: November 9, 2012
Date of rust evaluation: May 7, May 15 and May 24, 2013
Date of cereal leaf beetle evaluations: April 14, May 7 and May 15, 2013
Date of yield evaluation: June 11, 2013
Seed sowing rate: 2 kg per plot or 200 kg/ha
Farmer variety: "Irishka"
IPM demonstration variety: "Ormon"
Treatments: In the IPM practice, the wheat seeds were treated with "Vitavaks 200 FF" at 2 kg per ton wheat seeds.

The analysis of yield results at this site showed that in IPM Demonstration plots the wheat yield was 39.95 kg per plot, which was 9.7 kg more compared with the yield in farmers practice plots.

Photo 2. Farmers during the training in the Hissor district.

East Tajikistan: The location of the demonstration site was at the private farm of Mr. Haidar Rakhimov located in the Muminabad district of Khatlon region. At this site, the focus was on the cereal leaf beetle (*Oumela melanopa)* and diseases including the wheat rusts: yellow rust (*Puccinia striiformis*) and brown rust (*Puccinia recondite*). The key weeds in the wheat field include oat grass (*Avena fatua*), shepherd's purse (*Capsella bursa-pastoris),* pigweed or lambsquarters (*Chenopodium album)* and Bermuda grass (*Cynodon dactylon*).

The following IPM package components were compared to local farmers' practices in the same area:

- Plots of 10 X 10 m planted to a resistant variety to yellow and brown rusts, 4 replicates with two strips of flowering plants including coriander *(Coriandrum sativum L.),* dill *(Anethum graveolens L.),* sweet basil *(Ocimum basilicum L.),* ziziphora *(Ziziphora*

interrupta Juz.) and marigold (*Calendula officinalis L.)* alongside the wheat plots to enhance cereal leaf beetle natural enemies.
- Cultural practices (planting date, seed rate, fertilizer application and weed control).

Location: Muminabad district of Khatlon region
Farmer: Mr. Haidar Rakhimov
Other farmer participants: (n=15)
GPS data: N 38.08113; E 069.98137; Altitude: 1187 m
Date of demonstration establishment: December 12, 2012
Date of rust evaluation: May 11, June 1, 2013
Date of cereal leaf beetle evaluations: April 30, May 16, 2013
Date of yield evaluation: June 27, 2013
Seed sowing rate: 2 kg per plot or 200 kg/ha
Farmer variety: "Norman"
IPM demonstration variety: "Ormon"
Treatments: In the IPM practice, the wheat seeds were treated with Vitavaks 200 FF" at 2 kg per ton wheat seeds.

Yellow rust infection in May was low to moderate averaging 40 percent in the Farmer Practice Plots and 5 percent in the IPM Demonstration plots. Brown rust infection in May was low averaging 25 percent in the Farmers Practice Plots and 5 percent in the IPM Demonstration plots. Cereal leaf beetle pressure was moderate with an average of 7 to 14 adults and larvae per m^2 in the Farmers Practice Plots and 5 to 11 per m^2 in the IPM Demonstration plots in April and May respectively.

The analysis of yield results at this site showed that in IPM Demonstration plots the wheat yield was 35.55 kg per plot, which was 8.23 kg more compared with yield in Farmers Practice plots.

Photo 3. Farmers during field training in the Muminabad district.

Objective 2: Disseminate IPM knowledge and packages to farmers and students through technology transfer and outreach in collaboration with local NGOs, universities and government institutions.

Farmers Field Schools for Wheat: One of the important objectives of Tajikistan IPM Innovation Lab is to transfer IPM knowledge and demonstrate existing and new IPM technologies to local farmers through Farmers Field Schools (FFS) in collaboration with local agriculture ministries, local NGOs and universities. To accomplish this transfer of IPM knowledge, we are conducting farmer field schools (FFS) at the IPM demonstration sites. In FY 2013, a total of 213 farmers were trained in various aspects of Wheat IPM (**136 male farmers and 95 female farmers trained**).

Publications:

- Jalilov A.U., Hotamov D. G., Azamov U.O. Effective control methods of yellow rust in Tajikistan. Proceeding materials of the Fifth International conference on "Ecological Features of Biological Diversity", Khujand, Tajikiatan, May 13-14, 2013, p. 137.

- Jalilov A.U., Eshanova Z.SH. Azamov U.O. Bases of genetic protection of wheat from a yellow and brown rust in Tajikistan. In the bulletin of scientific works, Dzhizzakh, Republic of Uzbekistan, 2013, p. 194-199.

- Jalilov A.U., Hotamov D. G. Influence of fungicides on variability of structure of population of the activator of a yellow rust of wheat in Tajikistan. Bulletin of Pedagogical University, Dushanbe, Tajikistan, 2013, No. 3 (52), p. 89-93.

- Jalilov A.U., Davlatova O.S. Basis of genetic protection of wheat against brown rust in Tajikistan. Bulletin of Pedagogical University, Dushanbe, Tajikistan, 2013, No. 3 (52), p. 110-115.

Objective 3: Enhance communication, networking and linkages with U.S. institutions, international agricultural research centers and IPM CRSP regional and global theme programs to access IPM technologies, information and expertise.

Participation in International Meetings: Dr. Karim Maredia attended the International Conference on Biodiversity and Integrated Pest Management (IPM) in Manado, Indonesia from July 4-7, 2013. Dr. Maredia participated in the IPM Innovation Lab TC meeting in Mananado, Indonesia July 8, 2013, and gave a presentation on the progress made in the Tajikistan IPM Innovation Lab. He also attended the TC meeting September 10, 2013 that was held via conference call and presented the work plans for the FY 2014.

Objective 4: Create a "Central Asia IPM Knowledge Network" - Information base

IPM Communication (Ms. Joy Landis, Michigan State University): The Central Asia IPM CRSP project web site (http://www.ipm.msu.edu/central-asia.htm) was updated to include links to:

- New plan of work
- May 2013 travel report to Tajikistan by wheat team members (Dr. Doug Landis and Dr. Mustapha Bohssini) and photos of current work in Tajikistan (shared with the IPM CRSP website)
- Latest reports, new publications
- Updates to program components, team members and partners
- Updates related to project name change (Feed the Future Food Security Innovation Lab: Collaborative Research on IPM)

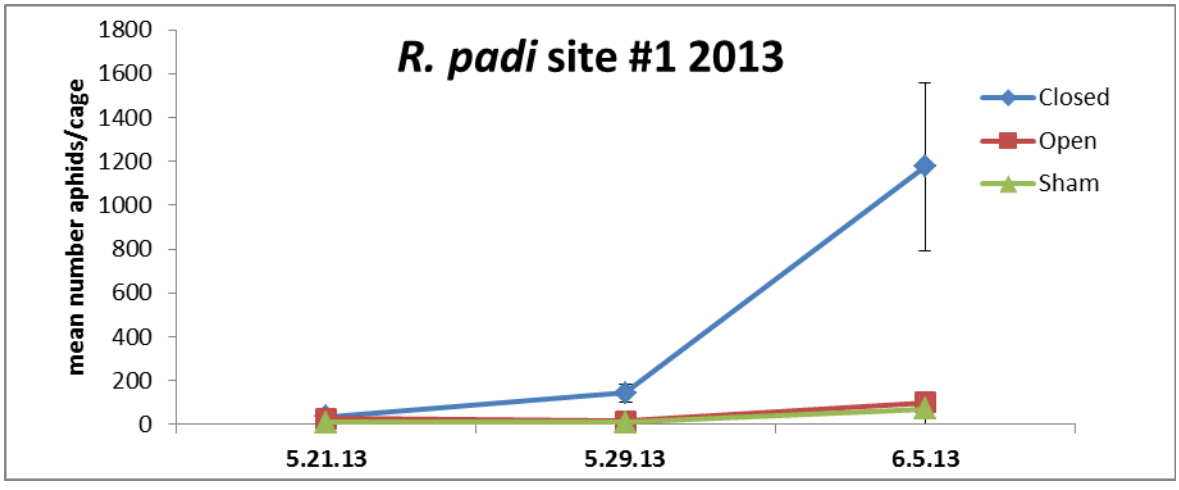
Objective 5: Build institutional capacity through training and human resource development.

Long-term Training - Graduate Student Training in IPM in Wheat: Ms. Shahlo Safarzoda from Tajikistan is currently a graduate student in the Department of Entomology at Michigan State University. Her research focuses on the biological control of cereal aphids in Michigan. As part of her graduate studies, Ms. Safarzoda conducted field research into the role of insect natural enemies in suppressing cereal aphids in Michigan. The objectives of the 2013 studies included determining if existing natural enemy communities provide significant aphid suppression, and the relative contribution of ground versus foliar-dwelling predator communities.

Experiments were conducted in two commercial winter wheat fields on the Michigan State University General Farm, East Lansing, MI (herein called site 1 and site 2). In both experiments, laboratory reared bird cherry oat aphid (*Rhopalosiphum padi*) and naturally occurring English grain aphid (*Sitobion avenae*) were provided varying levels of protection from naturally occurring predators and their population dynamics monitored over several weeks. Artificial infestations and cage treatments were initiated on May 21, 2013, when wheat was in the fourth stage (after Feekes). One hundred *R. padi* were used to infest the wheat plants. If no aphids were observed in the closed cage in the first week after infestation, it was assumed that the aphids had failed to establish, and this cage was not included in analysis.

Figure 1. Predator exclusion, sham, and open plots (left to right)

The first experiment contrasted aphid populations under treatments of complete protection from predation, no protection from predation and a sham cage to control for the effect of cages. Manipulations consisted of wheat plants enclosed in; a) tomato cages with no-see-um mesh totally closed and buried 5 cm into the soil, b) sham cages with 9 to 12 holes 4-6 cm in size on each side of the mesh and c) open plots (Figure 1). Treatments were replicated 5 times in a completely randomized design and the entire experiment was repeated in two separate fields. At both sites, *R padi* populations increased exponentially in predator exclusion cages, while aphid numbers were similar in sham and open plots and remained below 150 aphids per plot (Figure 2, below).



Sham cages did not affect aphid population growth compared to the open cages. From this experiment we concluded that existing natural enemy communities are important in the suppression of cereal aphid populations under the conditions we tested.

A second experiment was conducted in the same fields to determine the relative contribution of ground versus foliar-dwelling predator communities to aphid suppression. Predator exclusion treatments were established in $1m^2$ plots. Each plot was randomly assigned to the following treatments; a) totally closed PVC frame covered with no-see-um mesh to exclude foliar predators and surrounded by a 30 cm tall corrugated plastic barrier, 5 cm of which was buried to prevent entry of ground-dwelling predators (Figure 3A on next page), b) bottom closed as in the closed treatment, but no mesh, to exclude ground-dwelling predators but allow foliar predators access to the plots, (Figure 3B), c) top closed but bottom open, to exclude foliar predators but allow ground-dwelling predators access (Figure 3C), and d) open, to allow complete access to the plot by all types of predators (Figure 3D).

Aphid populations grew rapidly when both foliar and ground predators were excluded. Excluding either ground or foliar predators alone resulted in aphid populations that grew slowly or not at all and was not different from the open control. Overall, the conclusion is that both ground-dwelling and foliar predator communities community are very important agents in suppressing cereal aphid population growth.

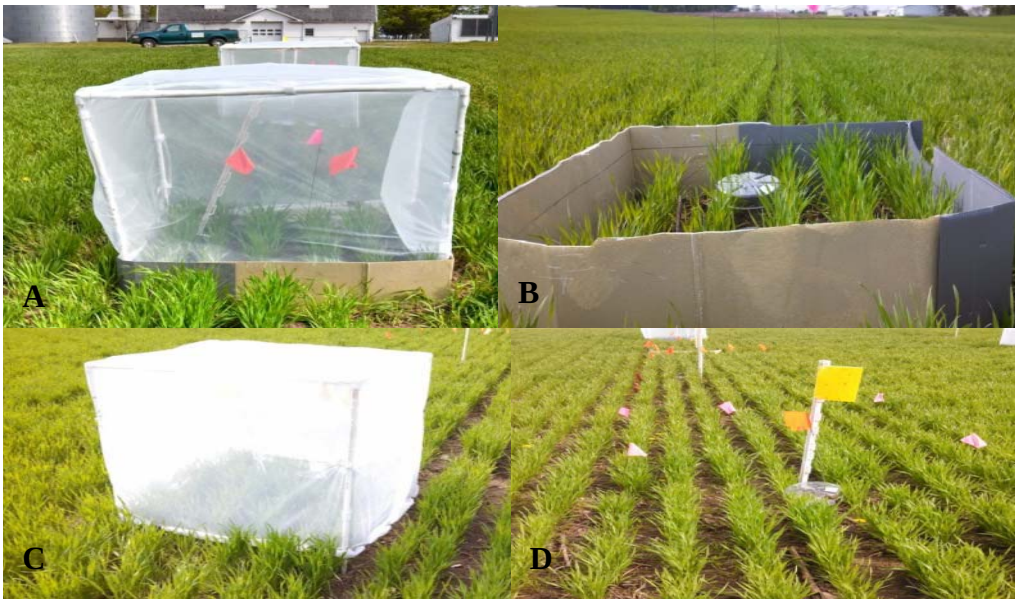


Figure 3. Total (A), ground (B), and foliar (C) predator exclusions and open control (D).

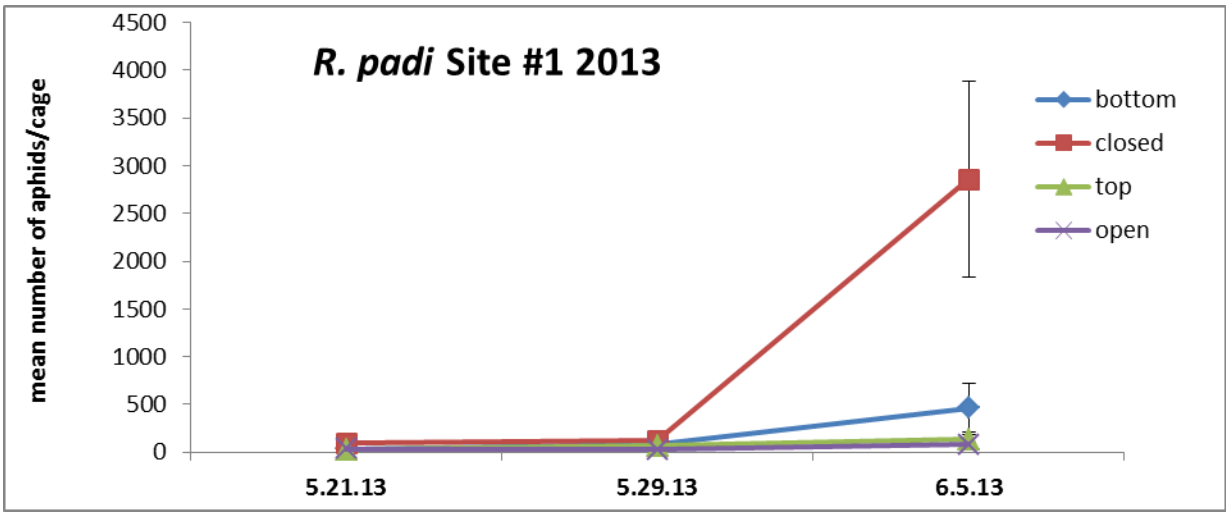


Figure 4. Experiment 2 results for site 1: Aphid population growth when ground dwelling predators were excluded (bottom), all predators were excluded (closed), foliar predators excluded (top) and no predator exclusion was used (open)

Objective 6: Links with Global Themes

Viruses – Dr. Naidu Rayapati (WSU): During our visit to the Buston region of Tajikistan in June 2011, beans (*Phaseolus vulgaris*) and peas (*Pisum sativum*) in farmers' fields were observed with overall stunting of plants and severe mosaic mottling symptoms on leaves. Leaves with clear symptoms from five bean and pea plants were pressed to FTA cards and brought to Rayapati's lab for further analyses. Total nucleic acids eluted from FTA cards were subjected to RT-PCR using 'universal' primers specific to the cytoplasmic inclusion body protein of potyviruses. The amplified DNA was cloned, sequenced and the nucleotide sequence compared with corresponding sequences of potyviruses available in GenBank. The results indicated the presence of bean common mosaic virus and bean yellow mosaic virus as mixed infections in peas and beans. Since these two viruses are spread by aphids and via seed, the results provide avenues for additional studies to develop strategies for producing virus-free seed benefiting subsistence farmers in Tajikistan.

Socio-Economic Impact Assessment: Dr. Mywish Maredia and Richard Bernsten, Michigan State University, Ms. Tanzila Ergasheva, Agricultural Economics Division of Tajik Academy of Agricultural Sciences.

Impact Assessment: The socioeconomics team is responsible for implementing a study to document the short-term impact of the project's wheat-focused farmer field schools (FFS), which the project is implementing in two districts of Tajikistan (Hissor and Spiteman District). As part of this project component, a baseline survey was conducted in Tajikistan in May-June 2012. The survey covered 171 respondents located in Hisor District (near Dushanbe) and Spitamen District. In each location, the sample included all IPM project participants (Hisor=21, Spitamen=13) and non-participants selected at random from nearby villages—approximately 12 in each of 5 villages in each district. Non-participant farmers will serve as a comparison group in the impact

evaluation to be conducted after the completion of a follow-up survey. Recall data were collected for the winter 2010 growing season (Oct 2010 to June 2011) (i.e., season prior to the IPM CRSP's intervention).

Data were delivered by the collaborator in early 2013. With the help of a graduate student, the socio-economic team members at MSU did a through data consistency check and identified several issues that required input from the Tajik collaborators. Several Skype calls between the MSU and Tajik collaborators were conducted to go through the identified issues in a step-by-step process. Additional information and clarification provided during these calls helped resolve some of the major issues. However, several issues identified require the Tajik collaborator to consult the hard copies of the questionnaire and systematically address the issues of outliers, unidentified codes or values, and non-adherence of skipping instructions. This data review and cleaning process is still on going. Hence a thorough report on the results of the baseline survey is not yet completed. But some of the preliminary results in the form of characteristics of project participants and non-participants (e.g., socioeconomic traits, wheat technology/inputs utilized, knowledge of IPM) are reported in Table 1 and 2.

Table 1. Socioeconomic Characteristics of Wheat Farmers in Two Project Sites in Tajikistan

Characteristic	**Hisor District**		**Spitamen District**	
	Collaborators	Control	Collaborators	Control
Number	21	59	13	78
Age (mean years)	52.7	48.5	41.3	52.9
Gender (female)	15%	40%	8%	6%
Education (mean years)	12.2	11.8	11.7	11.0
Source: ***Baseline Survey (2012), IPM CRSP Project***				

Table 2. Farming Characteristics of Wheat Farmers in Two Project Sites

Characteristic	**Hisor District**		**Spitamen District**	
	Collaborators	**Control**	**Collaborators**	**Control**
Number	21	59	13	78
Grew wheat in winter 2010	57%	80%	85%	60%
Farming experience (mean years)	5.5	4.1	6.5	9.1
Wheat experience (mean years)	4.1	4.1	4.0	8.3
Household fields (mean number)	1.2	2.2	2.2	1.8
Household holdings (mean has)	1.2	2.1	14.5	11.3
Wheat area (mean has)	0.9	1.4	5.9	4.3
Wheat area per HH (after adjusting for intercropping) (ha)	0.5	1.3	3.4	4.0

Wheat yield (kg/ha)	5,122	3,704	2,971	2,059
Value of wheat production per ha (Somoni)	8,195	4,793	3,865	2,974
Mean value of wheat production per HH (Somoni)	2,308	4,957	10,218	8,269
Source: ***Baseline Survey (2012), IPM CRSP Project***				

The baseline data indicate that farmers are highly educated in Tajikistan (Table 1). More women are involved in wheat farming in the Hisor district than in Spitamen district. This variability may provide an opportunity to draw some gender implications of research conducted in the two project sites. In general, collaborating farmers have 5 to 7 years of farming experience and about four years of wheat growing experience (Table 2). Many farmers selected as collaborators in the CRSP project are relatively new to wheat farming (as reflected in percent of farmers that DID NOT grow wheat in winter 2010, but were growing wheat at the time of the survey). Farmers in Spitamen district are relatively larger scale farmers (and devote more area toward wheat) than in Hisor district (which is closer to the capital) (Table 2). This may have implications on the type of IPM packages to be designed for different locations and the potential for impact.

Wheat yields (after adjusting for intercropping) and value of wheat production per ha are quite variable across districts and HH type (Table 2). Mean value of wheat production per HH is also quite variable across HHs, which means, the HHs included as collaborators may differ significantly in terms of importance of wheat within the farming system.

A follow-up household survey of the same farmers will be conducted in Year 5 of the project. The combined panel data from the baseline and follow-up surveys for the project participants and non-participants will be used to assess the short-term impact of the project using the difference-in-difference analysis techniques.