Annual Report FY 2010-11
October 1, 2010 to September 30, 2011

Development and Delivery of Ecologically-based IPM Packages in Central Asia

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Michigan State University (MSU) in partnership with University of California-Davis, Kansas State University, ICARDA, AVRDC, and several local research and academic institutions and NGOs is implementing a regional IPM program in Central Asia. The three host countries include Tajikistan, Uzbekistan and Kyrgyzstan.

The technical objectives of the Central Asia Regional IPM Program are:

1. Develop ecologically based IPM packages for wheat, tomato and potato 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 2010-11 covering the period from October 1, 2010 to September 30, 2011 linked to the above five technical objectives.

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

One of the main activities of the Central Asia IPM CRSP program 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, Potato and Tomato in three host countries (Tajikistan, Kyrgyzstan, and Uzbekistan). The IPM packages include a range of methods, tools and approaches including cultural practices, botanicals and biopesticides, biological control agents/products, resistant varieties, pheromone traps, sticky traps, chemical pesticides where appropriate, etc. The applied IPM research and demonstration sites have been established and implemented for each of the three priority drops (see more details in the following sections).

1.1 Wheat Crop: Wheat is the main staple crop in Central Asia. A team of scientists consisting of Dr. Doug Landis (MSU), Dr. Megan Kennelly (KSU), Dr. Moustapha Bohssini (ICARDA), Dr. Nurali Saidov (Tajikistan) and Dr. Anvar Jalilov (Tajikistan) worked together and established two Wheat IPM applied research and demonstration sites in Tajikistan. Drs. Karim Maredia, Megan Kennelly, and Mustapha Bohssini traveled to Tajikistan from June 4 – 11, 2011 and worked with Drs. Saidov and Jalilov in reviewing these two sites in Tajikistan. The detailed progress on the Wheat IPM component is as follow:

Activity 1.1.1 Screening wheat varieties for resistance to Cereal leaf beetle (CLB)

Two field trials were conducted in 2010-11 to screen wheat lines for resistance to CLB. The first was established at the Research Institute of Farming "Zemledeliya" of the Academy of Agricultural Science of Tajikistan near the village of Sharora (Hissor District, Tajikistan) and planted on November 21, 2010. The experiment contained 36 experimental bread wheat lines and a susceptible check "Ziroatkor - 70" (locally grown variety) repeated every nine entries. Each experimental line was planted in a single row 1m long with all lines replicated n= 4 times in a block design. Prior to harvest each plot was independently evaluated for CLB damage, ranking the overall plot damage on a scale of <10% 10-25%, 25-50%, 50-75% and >75%.

The first field trial was evaluated on May 24, 2011. CLB pressure was high at this site with 50-75% of the local variety ("Ziroatkor-70") damaged by CLB adults and larvae. Of the 36 experimental entries, four showed high and three showed moderate levels of CLB resistance. Highly resistant lines (less than 10% damage) included: Erythrospermum13\Promin, Polucarlik 49\ Krasnovodopadskaya 210\P, Frunsenskaya 60\Tardo\ Intensivnaya\Erit. and Odesskaya. A second group of lines including Erythrospermum 13\7\Stoparka, Ferrugineum 205\ Frunsenskaya 60, Polucarlik 49\ Krasnovodopadskaya 210\P also generally had less than10% damage but in some replications damage was up to 25%. Other tested lines showed less resistance to CLB.

The second field trial was established near the village of Andreev Jamoat "Durbat" (Hissor district) and planted on December 9, 2010 using the wheat variety "Ormon" as the susceptible check. This trial was evaluated on May 26, 2010. CLB pressure was moderate at this site with 25-50% of the susceptible check "Ormon" damaged by CLB adults and larvae. Of the 36 experimental entries, five showed high and two showed moderate levels of CLB resistance. Highly resistant lines (less than 10% damage) included: Erythrospermum13\7\Stoparka, Erythrospermum13\Promin, Polucarlik 49\ Krasnovodopadskaya 210\P, Frunsenskaya 60\Tardo\ Intensivnaya\Erit. and Odesskaya. A second group of lines including Ferrugineum 205\ Frunsenskaya 60, and Polucarlik 49\ Krasnovodopadskaya 210\P also generally had less than 10% damage but in some replications damage was up to 25%. Other tested lines showed less resistance to CLB. These selected lines will be made available to wheat breeders to develop resistant varieties to CLB throughout Central Asia.

Table 1. Summary of moderate to highly resistant bread wheat lines from two research trials conducted in the Hissor District, Tajikistan, 2010-11.

	Trial #1	**Trial #2**	**Both Trials**
Highly Resistant Lines (<10% damage)			
Erythrospermum13\Promin	X	X	X
Erythrospermum 13\7\Stoparka		X	
Polucarlik 49\ Krasnovodopadskaya 210\P	X	X	X
Frunsenskaya 60\Tardo\ Intensivnaya\Erit	X	X	X
Odesskaya	X	X	X
Moderately Resistant Lines			
Erythrospermum 13\7\Stoparka	X		

Ferrugineum 205\ Frunsenskaya 60	X	X	X
Polucarlik 49\ Krasnovodopadskaya 210\P	X	X	X

Activity 1.1.2 IPM Applied Research and Demonstration Site for Wheat (Northern Tajikistan).

The wheat IPM package demonstration site for 2010-11 was located on a farm named for its founder "Ilhom Boimatov" in the Spitamen district of Sogd region, Tajikistan.Mr. Akmal Boimatovis the current local grower. At this demonstration site the focus was on management of 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 in this region include; oat grass (*Avena fatua*), *s*hepherd'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 "Orman"a variety resistant to yellow and brown rusts, 4 reps.
- 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.
- Best cultural practices (planting date, seed rate, fertilizer application, and weed control).
- Hand collection of Sunn pest adults during 2-3 weeks beginning at the time of migration to wheat fields.

Local growers (n=7) participated in the establishment of the trial and in the final yield evaluation (n=12). At harvest we measured: number of seeds in 1 ear of wheat (piece), mass of seeds in 1 ear (gram), thousand-kernel weight (gram), and overall yield of wheat from plots (kilogram).

Results Summary of Wheat IPM Package Demonstration

Location: Ujteppa village, Tagoyak Jamoat of the Spitamen district of Sogd region.
Farmer: Mr. Akmal Boimatov
GPS data: N 40.13258; E 069.31233; Altitude: 479m
Date of planting: November 08, 2010
Date of yield evaluation: June 12, 2011
Seed sowing rate: 2 kg per plot or 200 kg/ha
Farmer variety:"Starshina"
IPM Demo Variety: "Ormon"

On May 15 during a wheat rust diseases pressure monitoring and assessment with 7 farmers, we observed that the infestation rate of wheat leafs in Farmer practice field with "Starshina" variety was 40%. In contrast with that in IPM Demo plot, the rate of infestation of wheat leafs on "Ormon" variety was low and consisted only 5%.

On May 15 during the monitoring and assessment with 7 farmers shown that in 1 m^2 the numbers of Sunn pest adult and larva's was 24-28 numbers in Farmer practice field. In contrast with that in IPM Demo plot, a number of calculated Sunn pest adults and larvae was only 4-5 numbers in 1 m^2.

Table 2. The results of "Farmer Practice" plots and IPM package on wheat yield components, 2010-11.

	Thousand-kernel weight (gram)	Yield of wheat from plots (kilogram)
Farmer practice	31.2 $\pm$ 0.74 a	29.6$\pm$ 0.56 a
IPM package	51.1 $\pm$ 0.40 b	49.9 $\pm$ 0.48 b

Values within the same column followed by different letters are significantly different at the $P \leq 0.001$ level, T-test.

In contrast to the "Farmer Practice" plots, each of the yield components were higher in the IPM Wheat package plots resulting in a 41% increase in final yield (from 29.6 to 49.9 kg/plot) in wheat yield in the IPM Package plots. The farmers that participated in the evaluation were very impressed with the rust resistance they observed and requested access to the IPM variety in the future. The results was presented to the farmers through the Research Institute of Farming and were shared at various other meetings and programs with farmers (see Activity 5 below).

A second Wheat IPM Demonstration site was planted in the Hissor District (South Region) of Tajikistan. There were no data collected at this site due to error in planting and surrounding cropping areas/habitats in close vicinity of the demonstration site that influenced the pest and beneficial communities' dynamics.

1.2 Potato Crop: Potato is the main staple crop in Central Asia. A team of scientists consisting of Dr. David Douches (MSU), Dr. George Bird (MSU), Dr. Walter Pett (MSU) and Dr. Murat Aitmatov (Kyrgyzstan) worked together and have implemented Potato IPM applied research and demonstration sites in Kyrgyzstan. Prof. George Bird travelled to Kyrgyzstan from June 12 – 15, 2011 and worked with Dr. Murat Aitmatov.

Potatoes were introduced to Central Asia about 150 years ago. Today, potato consumption in the region, as the second bread, is among the highest in the world (*ca.*143 kg annual per capita). Average tuber yield is 21.2 metric tons per hectare, with an estimated 30% loss due to pests-diseases. Key pest-pathogens include *Phytophthora infestans*, *Leptinotarsa decemilineata*, *Globodera rostochiensis* and viruses. Weeds are controlled manually. Seed quality needs to be improved. In general, there is a lack of understanding of the nature of pest resistant varieties. Use of biological monitoring, environmental monitoring and damage/pathogenicity thresholds in pest management decision making is the foundation of IPM (Figure 1).

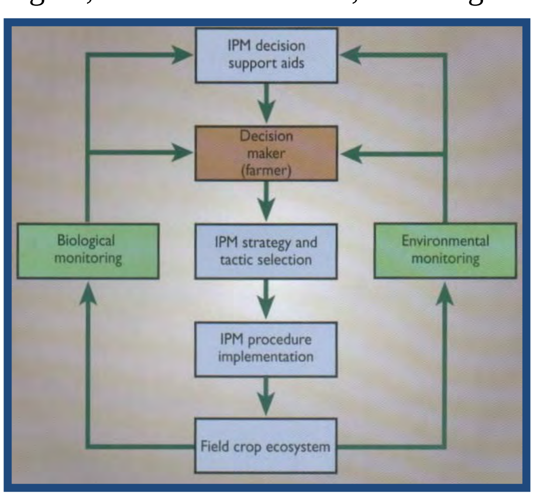

Figure 1

This requires accurate identification of potential key pests associated with potato seed piece production, field production and post-harvest storage. To assist in the resolution of these issues in Central Asia, the IPM CRSP project initiated a collaborative potato research and education program in Kyrgyzstan in 2010.

Figure 2

As a result of civil disturbance in Kyrgyzstan in 2010, there have been major changes in the Kyrgyz government and K. I. Skryabin Kyrgyz Agrarian University administration. This made implementation of the first year of the potato component of the IPM CRSP difficult. Dr. George Bird conducted a comprehensive site review of the project in June of 2011, and it appears that the changes will have a significant positive impact on the Central Asia IPM CRSP (Figure 2).

These are reflected in this report and will be described in greater detail in Dr. Bird's 2011 Trip Report. The 2011 Development and Delivery of Ecologically-Based IPM Packages for Field and Vegetable Crop Systems in Central Asia, Potato Project consisted of two research and two education components for potatoes: 1) Evaluation of the Suitability of Specific Potato Lines and Cultivars for Use in Central Asia, 2) Determination of the Role of Soil Amendments on the Growth and Development of Potato Plants, 3) Use of Farmer Field Schools for Implementation of Ecologically-Based Potato IPM Packages and 4) Training a Next Generation Potato IPM Scientist. Because of the regulatory significance and serve damage caused by potato cyst nematode species, identification of the current status of this pest was included as part of the 2011 project.

Activity 1.2.1 Evaluation of the Suitability of Specific Potato Lines and Cultivars for Use in Central Asia. After completing the necessary international regulatory requirements, 31 potato breeding lines/varieties were sent to Kyrgyzstan in 2011 for analysis. These lines/varieties were selected to represent a broad range of potato production characteristics, including resistance to key pests (Table 3). The research was conducted with Dr. Anara Chakaeva of the Kyrgyz National Sciences Laboratory and Jyldyz Egemberdieva, a Ph.D. candidate in Plant Breeding at the K. I. Skryabin Kyrgyz Agrarian University. The research was conducted in the Chui Region (Kyrg SSRI:P Sokuluk District Komsomolskiy Village). Ten tubers of each line/cultivar were planted using the square-cluster method of 60-40 cm in three tiers, with each plot being four meters in length with 0.60 meters between the rows, including one meter protective strips (Figure 3, Table 4).

The seed pieces were planted on May 5, 2011 at the OSX Experimental Farm of the Kyrgyz Research Institute of Livestock and Pasture, KNAU. All of the tubers, with the exception of Saginaw Gold, were in good condition (Figure 4). The tubers were maintained under location potato production practices, monitored for development and pests/diseases, and harvested on July 27, 2011 (Figure 5).

Figure 3 MSI 005-20Y

Figure 4

Figure 5

Figure 6

Figure 7

Above ground potato stem emergence ranged from 30 to 100% (Table 5). Emergence was low (30%) for both Saginaw Gold and MSJ 316-A. Tuber yields ranged from 2.1 to 18.8 metric tons per hectare, with a mean of 9.67 t/ha (Table 4). MSI 316-A, MI purple, Dakota Diamond, MSE-149-5Y, Beacon Chipper and MSM, 182-1 were the highest yielding, representing round-while, round yellow, purple skin, chip-processor, and tablestock lines-varieties. One or more of these contain genes for resistance to late blight, scab or Colorado potato beetle. Michigan Purple is known to be a high yielding variety under low input systems. The lowest tuber yields were associated with Saginaw Gold, MSS 582-1SPL and MSJ 316-A. The two varieties (Bolder and Missaukee) with genes for Golden Nematode resistance yielded an average of 6.0 mt/ha in this trial in the absence of *G. rostochiensis*.

The research demonstrated that some of the potato lines/varieties tested grow and yield in a satisfactory manner under Central Asia conditions. The results will be used to select a smaller number of specific lines-varieties for evaluation in replicated trials in 2012 at several locations in

Kyrgyzstan. The varieties for the lines-trials selected for the each trial will be based on the expected pest occurrence at each location.

Activity 1.2.2 Determination of the Role of Soil Amendments on the Growth and Development of Potato Plants. Poor soil quality is a significant problem throughout Central Asia, especially that of biologically mobilized phosphorus. It is known that potato plant health can have an impact on risk to pests-pathogens. Because of detrimental soil quality experiences in Soviet-times, the region is particularly interested in the use of procedures for enhancing soil biology.

The 2011 IPM CRSP potato research project was done jointly with Dr. Gulnara Zhumaniyazova of the Laboratory of Soil Microbiology of the Uzbekistan Academy of Science. It was conducted in a replicated trial near Sumerkand, using a biological system of three inputs: 1) Fosstim-3 [*Bacillus subtilis* BS-26 applied to the potato seed pieces the day of planting], 2) Serhosil [a bacterial preparation sprayed on the potato leaves prior to flowering] and 3) Biokom [a compost developed at the Laboratory of Soil Microbiology]. The bio-system included a 0.50 rate of the normal potato NPK fertilization recommendation. The bio-system was compared to normal fertilizer recommendations. The potato variety Sante was used in the research. In addition to potato tuber yield and normal soil nutrient indicators, soil from the plots were analyzed using analytical procedures generally accepted in Central Asia for ammonification, nitrogen fixing, oligonitrophilic and phosphorus mobilizing bacteria, in addition to soil-borne fungi (Appendix A).

The bio-system increased the number of ammonification bacteria colony forming units (CFUs) one order of magnitude (10^7 to 10^8). The nitrogem fixing, oligonitrophilic bacteria 1.5 orders of magnitude and phosphorus mobilizing bacteria 3 orders of magnitude compared to the conventional production system. The population density of actinomycetes was enhanced, while that of pathogenic soil fungi was reduced three orders of magnitude. The bio-system resulted in an increase of nitrate nitrogen in the soil from 19.3 to 27.3 mg/kg, compared to the conventional system. Mobilized phosphorus was increased from 26.6 to 30.9 mg/ka soil compared to the system without Fosstim-3, Serhosil and Biokom. Humus degradation in the rhizosphere of cv Sante roots was reduced 0.02-0.03% in the presence of the bio-system. Tuber yield was increased 3.6 mt/ha (32.0 to 35.6) through the use of Fosstim-3, Serhosil and Biokom. Tuber dry matter, starch and ascorbic acid content were increased by using the bio-system; whereas, tuber nitrate concentration was reduced 10.58 mg/kg or 67% compared to the conventional soil fertility system.

The information obtained from the 2011 potato bio-system research with Fosstim-3, Serhosil and Biokom will be used in the design of the 2012 IPM CRSP potato research. It will be integrated into the research for continued evaluation of specific potato lines-varieties with resistance to late-blight, scab, Colorado potato beetle and Golden Nematode. The work will be done at more than one location and in a replicated plot design.

Potato Cyst Nematodes. There is evidence that potato cyst nematodes (*Globodera* sp,. spp.?) were introduced into Kyrgyzstan in 1994 on seed potatoes from Belorussia. Extra poor quality seed was given to limited resource farmers as a preferential trade credit. This extremely devastating pest of regulatory significance has spread throughout both large and small potato acreage. It is known to be present in the Kemin, Issyk Kul and Talas regions of Kyrgyzstan. The status of potato cyst nematodes is less clear in the other countries of Central Asia (Appendix B). There is an urgent need to determine the distribution and speciation of potato cyst nematodes in Central Asia, in addition to conducting research trials with *G. rostochiensis* resistant varieties. Dr. Anara Chakaeva has submitted a comprehensive research grant proposal to the International Science and Technology Center for funding for these objectives. Dr. Bird is listed as a cooperator in the proposal, forming a direct linkage to the potato IPM CRSP for Central Asia (Appendix C).

Summary. Information from the first two years of the potato IPM CRSP project will be used to develop specific research and education objectives with the main goal of having new and innovative potato IPM packages completed by the end of the five-year project. It is anticipated that by project end, a significant number of members of the Kyrgyzstan potato production community will have already been trained in these innovations, since they were an integral part of the development process through the FFS system.

Table 3. Potato lines-varieties evaluated in Kyrgyzstan in 2011 in the IPM CRSP.

Atlantic
Round-white chip-processor, good general adaptability.
Beacon Chipper
Round-white chip-processor, moderate common scab resistance.
Blackberry
Specialty tablestock; purple skin with deep purple flesh.
Boulder
Round-white, Dual-purpose chip and tablestock, moderate scab res, GN resistance, good yield under low inputs, adaptable.
Dakota Diamond
Round-white, chip-processor, scab resistance, moderate Colorado potato beetle res, late maturity.
Jacqueline Lee
Oval-yellow tablestock, late blight resistance (A2, US-8 genotype).
Kalkaska
Round-white chip-processor with strong scab resistance. Good yield.
Michigan Purple
Tablestock. Purple skin with bright white flesh. Good yield under low inputs, adaptable.
Missaukee
Round-white, Chip-processor, late blight resistance (A2, US-8 genotype), GN res, moderate scab res, good yield, adaptable.
MSE149-5Y
Round-yellow with scab resistance. Dual-purpose chip and tablestock.
MSI005-20Y
Round-yellow tablestock. High yield.
MSJ316-A
Round-white chip-processor with scab resistance.
MSL007-B
Round-white chip-processor with strong scab resistance.
MSL211-3
Round-Oval-white tablestock, late blight resistance (A2, US-8 genotype). Early maturity.
MSM171-A
Round-white tablestock, late blight resistance (A2, US-8 genotype), high yield, adaptable.
MSM182-1
Round-white tablestock, late blight resistance (A2, US-8 genotype), PVY resistance.

MSM288-2Y
Round-yellow tablestock.
MSP515-2
Round-white chip-processor with high yield.
MSQ086-3
Round-white dual purpose chip and table, late blight resistance (A2, US-8 genotype), early bulking potential.
MSQ130-4
Round-white dual purpose chip and table, late blight resistance (A2, US-8 genotype), early maturity.
MSQ176-5
Round-white tablestock, late blight resistance (A2, US-8 genotype), moderate scab res, good yield.
MSQ279-1
Round-white dual purpose chip and table, good scab resistance and high yield.
MSQ440-2
Round-white tablestock with scab resistance.
MSR058-1
Round-white chip-processor with late blight and scab resistance.
MSR061-1
Round-white chip-processor with scab resistance, moderate late blight resistance, PVY resistance.
MSR226-1RR (Raspberry)
Specialty tablestock; red skin with deep red flesh.
MSS582-1SPL
Specialty tablestock; round-white with purple splashes, high yield.
RMPR#1
Red-skinned tablestock with PVY resistance.
Saginaw Gold
Yellow tablestock with moderate scab resistance.
Spartan Splash
Specialty tablestock; round-yellow with purple splashes.
Spunta
Dutch variety. Yellow, long-type tablestock. Good adaptability.

Table 4. Potato line-variety 2011 field plot design.

Range 1	Range 2	Range 3
31– rotten tubers		
28	29	30
25	26	27
22	23	24
19	20	21
16	17	18
13	14	15
10	11	12
7	8	9
4	5	6
1	2	3

1. MSR 226-1RR
2. MSQ 279-1
3. MSP 515 -2
4. Spartan Splash
5. MSQ 086-3
6. Missaukee
7. MSQ 130-4
14. MSL 211-3
15. MSR 061-1
16. Jacqueline Lee
17. MSM 288-2Y
18. Atlantic
19. Dakota Diamond
20. MSR 058-1
26. MSM 182-1
27. Boulder
28. Spunta
29. Kalkaska
30. MSL 007 –B
31. Saginaw Gold

8. MSQ 176-5
9. RMPR#1
10. Beacon Chipper
11. MSE 149-5Y
12. MSS 582-1 SPL
13. MSQ 440-2
21. MSJ 316-A
22. MSI 005-20X
23. Michigan Purple
24. MSM 171 –A
25. Blackberry

Table 5. IPM CRSP Kyrgyzstan potato plant emergence (May 30, 2011).

Line-Variety No.	Seed pieces planted	Sprouted tubers	
		No.	%
1	10	8	80
2	10	10	100
3	10	10	100
4	10	10	100
5	10	10	100
6	10	10	100
7	10	10	100
8	10	10	100
9	10	10	100
10	10	10	100
11	10	10	100
12	10	8	80
13	10	10	100
14	10	9	90
15	10	10	100
16	10	9	90
17	10	9	90
18	10	10	100
19	10	10	100
20	10	10	100
21	10	3	30
22	10	10	100
23	10	8	80
24	10	6	60
25	10	10	100
26	10	10	100
27	10	9	90
28	10	9	90
29	10	9	90
30	10	10	100
31 (rotten)	6	2	33,33

Table 6. 2011 IPM CRSP Kyrgyzstan potato line-variety tuber yields.

No.	Line-Variety	Tuber yield (kg/plot)

1	MSR 226-1RR	2.2
2	MSQ 279-1	2.5
3	MSP 515-2	1.5
4	Spartan Splash	2.0
5	MSQ 086-3	3.2
6	Missaukee	1.3
7	MSQ 130-4	3.0
8	MSQ 176-5	1.6
9	RMPR #1	2.0
10	Beacon Chipper	3.5
11	MSE 149-5Y	3.7
12	MSS 582-1SPL	0.5
13	MSQ 440-2	2.3
14	MSL 211-3	3.3
15	MSR 061-1	1.5
16	Jacqueline Lee	3.6
17	MSM 288-2Y	2.0
18	Atlantic	2.1
19	Dakota Diamond	4.0
20	MSR 058-1	3.3
21	MSJ 316-A	0.5
22	MSI 005-20Y	4.5
23	Michigan Purple	4.1
24	MSM 171-A	2.0
25	Blackberry	3.0
26	MSM 182-1	3.5
27	Boulder	1.6
28	Spunta	1.0
29	Kalkaska	1.7
30	MSL 007-B	1.9
31	Saginaw Gold	0.5

Table 7. Ally Region 2011 potato line-variety trial tuber yields (planted May 18 and harvested September 18).

№	Species	Seed Piece Weight (kg)		Tuber Yield (kg)
		Original	At Location	
1	Spartan Splash	6.5	4.8	43
2	Michigan Purple	6.5	4.6	19
3	Kalkaska	6.5	5.1	40
4	Beacon Chipper	6.5	5.1	30
5	Atlantic	6.5	4.8	28
6	MSQ 130-4	6.5	4.8	26
7	MSQ440-2	6.5	4.6	31
8	MSM 182 -1	6.5	5.0	35
9	Dakota Diamond	6.5	5.1	45
10	MSP 515 - 2	6.5	4.7	35

11	MSJ 316 - A	6.5	4.8	36
12	MSE 149 -5Y	6.5	4.6	33
13	MSL 007-B	6.5	4.5	44
14	MSM 288 -2 Y	6.5	5.0	40
15	MSS 582 -1 SPL	6.5	3.9	27
		97.5	71.4	515

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Appendix A. Literature citation for the 2011 IPM potato soil quality research methodology.

1. D. Zvyagintsev. Methods of soil microbiolofy and agrochemistry. Moscow. 1991, Page 365

2. Methods of agrochemical, agrophysical and microbiological researches in irrigation cotton regions. Press of Academy of Science, Uzbek SSR, Tashkent 1999, Methods of chemical analyses of soil used in laboratory of mass analyses. Tashkent, 2005.

3. B. Dospekhov. Methodology of filed experience: M. Agroprompress. 1985. Pages 232-239.

Appendix B. Potato cyst nematode references prepared by Kyrgyzstan scientists.

1. Borovikov A.N. Measures to combat nematode. All union Conference on nematode diseases of crops. Abstracts of paper and communications. Voronezh 1987, 173-174p.
2. Vasytin A.S. Effective method of dealing with the golden potato nematode. Agro XXI. 1999.
3. GladkayaP.M.. The elimination of foci of the potato nematode complex control methods proceeding of the all union Symposium on the suppresiion of potato nematode. Tartu, 1973, 32p.
4. Gladkaya P.M. Cyst nematode in Belarus. The use of chemical and microbiological agents in the fight against quarantine pests diseases amd weeds. In the book abstracts of all union Conference seminar M, 1987 161-163p.
5. Guskov L.A. Makovskaya A. Study of pathptypes of potato cyst nematode in the North West area non black soil zone of the RSFSR. Free living soil, plant nematodes Entomopathogenic L. 1977, 78-81p.
6. Guskov L.A. Mayakovskaya. The method of differentiation of pathotypes of potato cyst nematode. L 1982,13p.
7. Guskov L.A. Mayakovskaya Protection of potato from potato golden nematode in home gardens and farms. Problems optimization phytosanitary condition of St Petersburg plant, 1997 336-337p.
8. Efremenkov V.P. Fighting potato nematode in the USSR and abroad nematode diseases of crop nematode Bull Proc. Helminthology Inst. VOl6, 1971.
9. Efremnkov V.P. Klimakova E.T., Rationalle and design of an integrated method to combat potato nematode Bull, ProcNelminthology Inst. VOl, 6,1971.
10. Efremnekov V.P. Potato cyst nematode and its control. Moscow Worker, 1982,48p.
11. Krianova E.S. Krall E.L. Parasitic nematodes of plants and their control measures Science, 1969 447p.
12. Kilyanova E.S Krall E.L. Parasitic nematodes of plants and their control measures. L. Science, 1971, 522p.

13. Makovskaya S.A. Aggressive pathotypes Plant protection 10,1978,51-52p.
14. Makovskaya S.A. Guskov J.A. The effective of getrofosa against golden potato nematode integrated protection of plants against pests and diseases. 1985,45-47p.

Appendix C. ISTC Letter of support for the Kyrgyzstan Golden Nematode Research Proposal

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September 6, 2011

To: International Science and Technology Center

Fr: Dr. George W. Bird, Professor
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birdg@msu.edu

Re: Recommendation for *New Biologically Active Substance and Strategy for Potato Golden Nematode Spreading Control* (2011-2014)

Dr. Chakaeva Anara Shakenovna of the Laboratory of Plant Protection at the Kyrgyzstan Institute of Livestock Breeding and Pastures has requested that I write on behalf of her International Science and Technology Center proposal entitled, *New Biologically Active Substance and Strategy for Potato Golden Nematode Spreading Control* for 2011-2014. As the nematologist for the USAID Integrated Pest Management Collaborative Support Research Program in Central Asia, I visited Dr. Anara's laboratory and Kyrgyz potato production sites infested with the Golden Nematode (*Globodera rostochiensis*) in the summer of 2011. After reviewing the final report for ISTC project KR-1122.2 (*Biotechnological Approaches to the Creation of New Botanical Pesticides and Molecular-Biological Aspects of their Influence on Harmful Organisms*), and the 2011-2014 proposal, I am pleased to say that I can highly and without reservation recommend approval of funding for this important potato nematode project.

Sixteen years ago, *G. rostochiensis* was introduced into Kyrgyzstan on potato seed from Belarus. It has spread and is causing major potato crop losses. Its distribution throughout the country and population densities, however, have not been determined. Objectives 1 and 2 in Dr. Anara's proposal are designed to obtain a comprehensive map of the distribution of this extremely important regulatory pest. This information is imperative for development and implementation of effective and environmentally sound Golden Nematode management programs for Kyrgyzstan.

Golden Nematode resistant potato varieties exist and are probably the best way to manage this pest. They have not, however, been evaluated in Kyrgyzstan. Objective 3. of Dr. Anara's proposal is designed to evaluate the suitability of these varieties for use in the various potato production regions of Kyrgyzstan. During the past year, a third potato species of *Globodera* n. sp. has been discovered in the U.S. (Phytopathology, 2011,Vol. 101:480-491). Since the Golden Nematode resistant varieties are not resistant to the Pale Potato Cyst Nematode (*G. pallida*), it is essential that local populations be identified to the species level. Dr. Anara's laboratory is well aware of the challenges associated with proper identification of potato cyst nematodes and has the skills to do the type of modern taxonomy required for this project to be successful. There is, however, a need for laboratory equipment up-grade. This is not uncommon in any biology laboratory in 2011.

During the past five years, Dr. Anara has completed a major and very impressive research initiative on the identification of new botanical derived chemical for use in pest management. Several of these show excellent activity against both potato and beet cyst nematodes. As described in Objective 4., these compounds need to be evaluated in more detail. In addition, it will be necessary to evaluate them in association with both resistant and susceptible potato varieties and with nematode populations from various Kyrgyzstan potato production regions.

New Biologically Active Substance and Strategy for Potato Golden Nematode Spreading Control is a strong proposal from an excellent scientist with a time-honored research record. I sincerely hope that this project will be funded. In Central Asia, potato is considered the *Second Bread.* The crop is currently being threatened by *G. rostochiensis*, a key major regulatory pest of local, national and international concern. Kindly do not hesitate to contact me directly if I can be of further assistance in your evaluation of Dr. Anara's research proposal.

For your information, I have attached a one-page copy of my vita.

Sincerely,

George W. Bird
Professor of Nematology
birdg@msu.edu

<u>1.3 Tomato Crop:</u> Tomato is an important vegetable crop widely grown in Central Asia. A team of scientists consisting of Dr. Frank Zalom (UC-Davis), Dr. Razva Mawlanavova (AVRDC) and Dr. Tashpulatova (Uzbekistan) worked together and implemented the Tomato IPM research, outreach and training activities in Uzbekistan.

The focus of the Tomato IPM Research Team from October 2010 till September 2011 was development of diagnostic technique for improving tomato production, screening of antagonists fungi (*Trichoderma lignorum*) and bacteria (*Bacillus subtilis*), study the use of effective microorganisms as biological agents, test of yellow sticky traps against whitefly and use of botanical insecticide (technical gossypol) against Lepidoptera pests.

Activity 1.3.1 Diagnostic Techniques for improving Crop production
Crop production requires increased inputs of fertilizers, water, reduced pesticide use, and development of biological control. Failure to use the various inputs properly has led to soil degradation, pollution of air and water, contaminated fruits and vegetables, greater pest damage and undue costs of producing crops (Benjamin Wolf, 1996).

Using diagnostic technique in time can provide intelligent use of different inputs including IPM methods. It allows the grower to modify the physical and chemical characteristics so that they are ideal for a plant's growth and development. Soil tests by using diagnostic methods have been conducted in the laboratory of the Institute of Microbiology. Soil samples were taken from a tomato greenhouse located with a private farmer (Kybray district tomato greenhouse, Tashkent region and Zangyota distr. Tashkent region) before planting of tomato to analyze the availability in the soil nutrients, pH and mineral content using special soil sampling tube.

Before planting of tomato seedlings in a greenhouse located on a private farm named "Jasmina-Azizbek", and in open field of a farm association named «Shuhrat-Ziyo», Tashkent region (Uzbekistan) there were soil samples analyzes made for establishing what kind of fertilizers and preparations (organic matters) are necessary to be applied there. Soil samples were collected from arable soil horizons (0-20 cm of depth) and placed into sterilized small plastic boxes. Microbiological and agrochemical analysis were conducted at the Institute of Microbiology in laboratory condition. Such microorganisms as ammonificators, oligonitrofiles, phosphorus mobilizing bacteria, micromycetes and actinomycetes were determined according to different methods using various types of solid agar mediums. Agrochemical analyses were conducted regarding methods given in recommendation books edited by the Uzbek Academy of Sciences, Tashkent, 1999 and 2005. Meaning of pH – hydrogen indication of soil water suspension was determined by standard pH meter. Humus content was detected by Turin's method, gross form of nitrogen and phosphorus content were analyzed according to Ginzburd's method, and active ammonium $N\text{-}NH_4$ and P_2O_5 were determined by colorimetric method, K_20 content by flame photometric method.

Activity 1.3.2. Utilization of beneficial effective microorganisms "BAIKAL-EM-1" in a tomato greenhouse located in the Tashkent region

Materials and methods: The experiment has been conducted in tomato greenhouse located in private farm named «Jasmina-Azizbek», Tashkent region (Uzbekistan). Tomato plant variety is apple shaped named “Sharlotta 1402” (Israel). The scheme of tomato seedling planting on plot was 70+70/2x40cm taking into account experimental part and control in variation of chess order. This means 10 plants of control followed by 10 plants treated with Baikal and 1 row treated with Baikal soil. Experiment was started on November 25, 2010, and finished on March 17, 2011. The plot area consisted of 5 rows, 4 of which divided into 4 parts (by 10 plants) taking into account of 4 replicates (105m² of total area), and 1 row treated soil with Baikal. Total number of seedlings planted is 95-100. Preparation “Baikal” EM-1 was prepared according to Shablin’s method at the same place where the experiment has been conducted. It was used on the plants and soil as diluted 1,000 times liquid (100 ml of preparation diluted in 10 l of water). First variant – plant seedlings treated with Baikal and sprayed with preparation during tomato plant growth till fruitification (4 times); Second variant – treated with Baikal soil area and sprayed with preparation till fruitification (4 times); Third variant is on 1 row (10 m) treated soil and seedlings and spraying with Baikal during plant growth. 4. Control: untreated area and plants. Treatment of soil was conducted before planting of tomato seedlings. Before planting seedlings were treated in big container putting them to container consisted of Baikal solution.

Results and discussion: The experiment has been conducted in tomato greenhouse located in northern Tashkent region (Uzbekistan) in an area where soil damaged with growing several years monoculture (tomato and cucumber), and where chemicals (fertilizers, fungicides, insecticides etc.) were used regularly. Analysis showed that this soil is an alkaline gray desert (sierozem) in texture. According to the concept of Dr. Teruo Higa (Japanese scientist who discovered effective microorganisms), it belongs to disease-inducing soils which contain pathogenic microorganisms, such as Fusarium, which often comprise a significant proportion of the microbial population (up to 20 percent). Moreover analyses identified presence of a large amount of insoluble salts. According to Dr. Teruo Higa the soil of the investigated area can be classified as having disease-inducing soils and notes that in these soils the addition of high-N organic matter (i.e. fresh manure) leads to incomplete oxidation and results in malodorous and plant toxic substances. Moreover, these soils are characterized by having poor physical properties (i.e. compaction) and many plant nutrients are immobilized into unavailable forms. That is why the purpose of the work was to recover soil texture using effective microorganisms named “Baikal” EM-1 and enhance tomato crop production with improving fruit test.

Effective microorganisms (EM) were discovered and developed by a Japanese agronomist Teruo Higa 17 years ago. And till present time application of this preparation is actual in worldwide as fertilizers, growth stimulators and natural fungicides. The preparation used in the Tashkent region tomato greenhouse named “Baikal” has been developed by Russian microbiologist in 1998 and differs from the Japanese preparation which contains mostly lactic bacteria instead of photosynthesized strains. One of advantages of the preparation is that it consists of different types of beneficial microorganisms: actinomycetes, bacteria, yeasts and fungus that can suppress the pathogen microorganism growth and enrich soil with useful microflora and nutrients.

Results obtained during the experiment showed that Baikal EM1 significantly effected tomato growth and fruit formation. Best results were obtained in variant where plant seedlings and soil were treated with Baikal (Table 1). Besides high yield obtained there were no any diseases noticed in this variant comparing to others where in control variant some tomato leaves were suffered with Cladosporios (*Cladosporium fulvum*) disease but occasionally. Insecticide was applied only against greenhouse whitefly (when its number was in small quantity), in all variants.

In treated with preparation Baikal EM-1 soil there were beneficial fermentations performed including the breakdown of complex organic molecules into simple organic molecules and inorganic nutrients such as amino acids, vitamins and antioxidants (all of which contribute to enhanced plant growth). These soils are generally characterized with a pleasant fermentative odor and have favorable soil physical properties. Moreover, despite being dominant with anaerobic microbes, there are few pathogenic fungi or bacteria and the production of methane, ammonia and carbon dioxide are minimized. Treated soils contain significant populations of microorganisms that fix atmospheric nitrogen and carbon dioxide into amino acids, carbohydrates, and proteins.

Table 8. Effect of preparation Baikal –EM 1 on tomato plant growth in greenhouse

Preparation	**The way of treatment with Baikal-EM1**	**Use rate (concentration) for 1 treatment**	**Height of main stem (cm)**	**Number of fruits, n/plant**
Control	-	-	102 ±0,7	25,0±0,4
«Baikal-EM-1»	Seedlings and plant treatment	10 l of solution (1: 1000)	115 ±0,2	32,0±0,9
«Baikal-EM-1»	Soil treatment and spray on plants	30 l (1:1000)	126±0,5	37,3±0,2
«Baikal-EM-1»	Seedlings treatment+ soil treatment and spray on plants	10 l of solution(1:1000) 30 l (1:1000)	175±0,3	43,7±0,6

Activity 1.3.3 Selection of bioantagonistic bacteria and use in biological control of *Fusarium oxysporum wilt* in laboratory conditions

In a laboratory experiment at the Institute of Microbiology, the main emphasis was the selection of antagonist bacteria available in rhizosphere root system of tomato plant that can be antagonists against fusatium wilt. Rhizobacteria are a natural and most suitable source for the isolation of potential microbiological control agents that can protect plants from soilborne pathogens and consequently improve crop quality and yield. The beneficial effect of such bacteria on plant health depends in many cases on their ability to aggressively colonize the rhizosphere and compete with the indigenous, including pathogenic, microflora for nutrients and niches on the plant root.

For an experiment among such rhizobacteria as *Pseudomonas chlororaphis, P. fluorescens and Bacillus subtilis* that employ antibiosis and induced systemic resistance, the bacterial strains *Bacillus subtilis* has been chosen as a bioconntrol agent, respectively, to control tomato foot and root rot caused by phytopathogenic fungus *Fusarium oxysporum* f.sp. *radicis-lycopersici* (Forl) because of its stability and possessing to play an important role for phosphorus salts solubilization to be acceptable for plant roots. Fifteen bacterial isolates were initially selected and from these only 2 isolates showed antagonistic properties against *F.oxysporum*. These two bacterial isolates were identified as *Bacillus subtilis* № 4 and *Bacilus subtilis* № 9. Isolate *Bacillus subtilis* № 26 taken from the collection of the Institute of Microbiology was used in experiment as etalon (standard).

Fusarium wilting disease is of great economic importance and is caused by *Fusarium oxysporium* f. sp.lycopersici, which attacks tomato root system, causing necrosis of stem tissues, yellowing of old leaves, wilting and plant death (FILGUEIRA, 2000). *Fusarium* wilting is a difficult control soil borne disease, which remains indefinitely in the plant and soil.

For the selection of biocontrol *Bacillus subtilis* bacteria acting via the mechanism “competition for nutrients and niches” there have developed an enrichment method for enhanced tomato root tip colonizers, starting from a crude mixture of rhizobacteria coated on the seed.

Preparation of Fusarium oxysporum culture. The infested by fungus tomato plants with roots were brought to the laboratory and identified under the microscope of 40X magnification. The obtained cultures were transferred to Petri plates with potato dextrose agar culture medium (PDA) and incubated at 28±2°C, for eight days. After incubation, 5ml of sterile distilled water were added to each plate, under aseptic conditions, and the fungus colonies were scrapped with a flamed inoculating loop. The suspension was filtered in cheesecloth and the spore concentration was determined by counting under a light microscope, and was adjusted with sterile distilled water to a final concentration of 105 spores mL-1.

Forty microliters of the metabolite suspension and 40µl of the fungal spore suspension were transferred to a microscope slide with three wells. The microscope slides were incubated at room temperature (28±2°C) in a growth chamber prepared with Petri plates with wet filter paper at the bottom, and covered with plastic wrap. After 14 hours of incubation, spore germination was paralyzed with the addition of one drop of lactophenol blue, and the germinated and non-germinated spores, from a total of 200 spores, were counted on the slide, under a light microscope at 40X magnification. This period of incubation (14 hours) was determined on observations and estimations of spores numbers germinated in the control treatment, for both fungi. The adequate incubation period was considered by the time at which the majority of the fungal spores had germinated in the control treatment. Spores which had their germinating tube with a length of at least 50% greater than the normal spore size were considered germinated.

Activity 1.3.4 Effect of antagonist bacteria *Bacillus subtilis* taken from rhizosphere of tomato roots to tomato growth in laboratory condition

The first series of experiment has been conducted using pots with 1 kg of soil of each where “Avicena “ tomato variety seeds where sown. Seeds were germinated for 60 days, then sprouts were taken for studying their roots’ micro flora. At the pepton agar medium using method of limited cultures dissolving the bacteria were inoculated taken from tomato roots rhizosphere. Totally 15 cultures were isolated. All isolated cultures were tested to evaluate their ability to suppress the number of phytopathogen fungus *Fusarium oxysporum*. From 15 cultures only 2 cultures of rhizobacteria which are № 4, 9, were selected as active antagonists. To compare their ability there were pattern used which is soil strain of № 26, presented by scientists of the Institute of Microbiology of Uzbek Academy of Sciences.

The antibiotic activity of 3 cultures, which are 2 of tomato rhizobacteria monoculture and 1 of soil strain against Fusarium oxysporu (etalon) are presented in the Table 2.

Table 9. Inhibition of phytopathogen growth with tomato rhizobacteria and soil strain

№ of cultures	Growth inhibition of phytopahogen fungus	
	Fusarium solani	
	d, мм	%
4	70	70
9	36	40
26	35	45

Results: The experiment showed that 2 bacteria strains marked as №4 and 9 possess the antagonist activity suppressing the growth of pathogen fungus *Fusarium oxysporum* in PDA plate and are able to be the biocontrol agents to combat fungal diseases having the potential to become a complement or alternative to more traditional chemical treatment. This is a more environmentally friendly option than chemicals. Another advantage is that kind of biocontrol might be effective against pathogens that are difficult to control by conventional means. A pathogen that infects plant roots might be hard to control using chemical treatment while a biocontrol bacterium introduced in the soil is in the appropriate place to combat the pathogen.

Figure 6: Effect of seed treatment with rhizobacteria (4 and 9) and with association of *Bacillus subtilis* on tomato seeds emergence and growth of plant (laboratory experiment, in 60 days)

Activity 1.3.5 Test of 2 strains of *Trichoderma lignorum (harsianum)*

Trichoderma is a unique genus that is made up of fungi most commonly used as biocontrol fungi against many pathogens *in vitro* and *in vivo*. Mycoparasitism, competition, and antibiosis, amongst others, are different mechanisms by which members of the genus bring about their biocontrol activity. In Uzbekistan, this biocontrol agent has been studied mostly to control cotton wilts. That is why the Institute of Plant Protection has in its collection the fungus *Trichoderma harzianu* (lignorum) isolated in 2003 from cotton growth soils in the Tashkent region (Uzbekistan). Amongst several other reports, *T. harzianum* isolated from roots of cotton plants was reported to suppress radial colony extension of *F. verticillioides in vitro* (Yates *et al.* 2000). *In vitro* experiment was a preliminary study to examine effectiveness of *T. lignorum (harzianum)* as an antagonist of the tomato stem and root rot pathogen *F. oxysporun* as well as the effect of pairing method on its antagonistic potential.

Antagonist effect of *Trichoderma harzianum* strains on *Fusarium oxysporum* - Two *Trichoderma* lignorum strains were taken from the collection kept in the laboratory of phytopathology at the Institute of Plant Protection. Number 1 T. harzianum is an Uzbek strain that was isolated in 2001 from different parts of cotton plant rhizosphere and soils using stalk sectioning and soil dilution plate method (Tuite 1969). It has been sent to the Moscow Research Institute of Phytopathology for identification after pure cultures of each fungus were stored in a refrigerator at 4º C.

The second one has been presented by the China Research Institute of Plant Protection. Petri plates of PDA were inoculated with a 5 mm disc from five-day-old cultures of the phytopathogens 10 mm from the edge of the plate. After two days a 5 mm disc of the *Trichoderma harzianum* isolate was placed into phytopathogen disc. Paired cultures were incubated at room temperature for six days. The growth of the fungi was recorded by measuring the radial growth of the pathogens. The percentage growths of the pathogens were calculated as follows: % Growth = Radius of the growth in the direction of the test strain/radius of the growth in the absence of the test strain x100.

Results: Mean diameter of F.oxysporum colonies formed after six days of incubation at 20ºC depended on antagonistic treatments tested and pathogen. A significant interaction was observed in variant with *T. harzianum* № 1. The most important mycelial growth reduction of about 73% compared to the untreated control was recorded in the case of isolate№ 1. Second isolate № 2 showed no *F. oxysporum* mycelial growth reduction. It can be concluded that *T. lignorum* isolate of cotton growth soil of Tashkent region is able to significant suppress *F. oxysporum* pathogen comparing to fungus isolated in China. The active Uzbek isolate will be tested in pots with tomato culture.

Activity 1.3.6. Test of Yellow Sticky Traps

Two types (commercial and made in the laboratory) yellow sticky traps were tested in tomato greenhouses located at the University Experimental Station against whiteflies (*Trialeroydes vaporariorum*).

Yellow sticky traps capture insects that are attracted to the color yellow. According to commercial advertisements, they are intended for use indoors or in the greenhouse against whiteflies, thrips, fruit flies, midges and more. In the experiment the traps were targeted to whitefly which is most spread and economically important pest in greenhouses. Yellow sticky traps are a non-toxic way to control and monitor aphids, cucumber beetles, fruit flies, fungus gnats, leafhoppers, froghoppers, moths, whiteflies, flea beetles, leafminers, etc. An integral part of any integrated pest management program, they can be used in greenhouses, homes, orchards, flower and vegetable gardens -- anywhere insects are a problem. The glue does not dry out and the traps will last until the surface area is completely covered with insects, even through rain.

Materials and methods: Yellow paper, plastic knives, tanglefoot and cord were needed to make the yellow sticky traps. Tangle foot glue was prepared at the Institute of Bioorganic Chemistry and was presented by the Institute's scientists.

Stiff, yellow papers were cut into strips of 10cm wide and 20cm long to form a card. Tanglefoot brand pest barrier was spread onto one side of the yellow paper using a plastic knife. (If Tanglefoot spread on both sides of the paper, it would be a sticky mess). Laboratory-made traps were hung with cord near tomato plants or in the branches of tomato plants infested with whiteflies. Full insects cards were substituted with new ones. Observation was made every 24 hours.

Results: The results obtained showed that commercial traps were more effective then that made in the laboratory. In one hour there were about 3,000 whiteflies captured on one commercial trap but on the laboratory trap, only 500 whiteflies were counted. Because of the great number of pests captured on the card, there was no way to count the number of captured whiteflies any longer on the card. During the experiment we have noticed that commercial traps lightly suppressed white fly numbers for a while but in a few days the population of pest increased twice. It is concluded that yellow sticky traps can be used only for signalization of whitefly appearance and not for control of the pest.

Activity 1.3.7 Use of Fosstim (*Bacillus subtilis*) and Serhosil preparations on tomato plant in the open field

Material and methods: An experiment was conducted in the tomato field on light serosem soil in the "Shuhrat Zyo" privet association Farm, Zangiota district of Tashkent region. Before planting, agrochemical and microbiological soil analysis were made at the Institute of Microbiology. Soil samples were taken 3 times: before planting, in the tomato plant's bud phase and at the end of growth (Figure 9).

The object of investigation is the local tomato variety "Uzbekiston", serosem soil of Farm "Abdullaev", Zangyata district, Tashkent region, bacterial fertilizer Fosstim-3, and biopreparation Serhosil.

Scheme of experiment:
1 variant – control – planting seedlings that were previously treated with water+ 50% solution of Nitrogen, Phosphorus, and Potassium + manure.

2 variant – experiment - planting seedlings that were previously treated with Fosstim-3 +treatment with Serhosil during plant growth+ NPK – 50% + manure.
Bacterial fertilizer Fosstim is based on phosphorus mobilizing strain *Bacillus subtilis* BS-26. Biopreparation Serhosil is based on micro algae. During the tomato growing season, the plant was attacked by pests (whiteflies, leafminers and rust mites) that is why there were applications 3 times of different insecticides.

Before planting, the seedlings were treated with Fosstim (Figure 7).

1 2 3

Figure 7. 1. Preparation of Fosstim solution in the cesspool made near the field; 2) tomato seedlings treatment with Fosstim solution for 20 min; 3) planting of treated tomato seedlings.

Tomato plants in the field were treated with Serhosil by spraying leaves for nutrition.(Figure 8)

Figure 8. Four times spray of preparation Serhosil on tomato leaves. In the phase of budding, there was second spray with Serhosil and the third was in phase of fruitification.

Figure 9. Experimental tomato plot: The study on influence of Fosstim и Serhosil on tomato plant development showed stimulating effect of microbiological preparations on the tomato roots and leaves growth comparing to control.

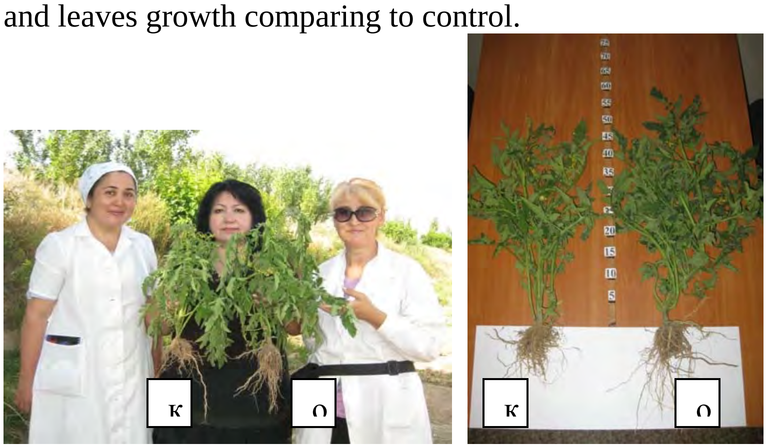


Figure 10. Development of tomato roots and steams: Influence of Fosstim и Serhosil on tomato plant root leaves and stem development k –control *NPK elements -50% + manure*; o – treated tomato plant *NPK elements-50%* + manure + *Fosstim* + *Serhosil*

Diagnostic test of initial soil condition was provided to study agrochemical and microbiological content of the soil. Initial soil content before planting was rich with Humus -2,68%. Content of active forms of Nitrogen was normal: 36,0 mg/kg, phosphorus- 87,7 mg/kg and potassium 493 mg/kg – very high. High level of active phosphorus demonstrates too much immobile phosphorus content and not sufficient supply to plants with phosphorus. Reaction of soil sample solution was neutral pH 6,9. Amount of toxic salts was 0,078%. Amount of salts was 0,113%. The soil was not salted.

Results: According to microbiological indications the soil contained large amounts of microorganisms that assimilate nitrate well (10^9 CFU (colonies formatting unit/g of soil). Quantity of olygonitrofiles, assimilating mineral forms of nitrate indicated 10^6 CFU/g of soil. Quantity of phosphorus mobilizing bacteria – 10^7 CFU/g of soil, quantity of micromicetes (soil mold fungi) is high 10^5 CFU/g of soil that can cause plant diseases. Actinomicetes quantity is low – 10^4 CFU/g of soil.

According to soil diagnosis to improve plant roots feeding with phosphorus, Nitrate and Potassium there bacterial fertilizer Fosstim was applied to treat tomato seedlings. Bacterial content of the Fosstim preparation can provide for plant resistance to dry conditions; it can transfer unacceptable for plant soil phosphor substances into acceptable forms, and stimulate roots development. To stimulate plant growth and enhance plant resistance as well as improve plant root growth and leaf feeding, there was Serhosil applied as well (3 times during of tomato plant growth). For this purpose phosphorus and potassium fertilizers were recommended not to use and nitrate fertilizer to be reduced up to 50%.

Evaluation of biological processes activity taken place in soil under the effect of microbiological preparations «Fosstim» and «Serhosil» was conducted according to data of microbiological analysis, reflecting dominating processes in the soil caused by some groups of microorganisms. Soil diagnosis of tomato plant rhizosphere was made (up to 30 cm of depth) during phases of flowering and ripening. Data on microbiological indications in dynamics are presented in the Tables 1-5 and Figures 6-10.

Table 10. The number of ammoniphicators in the soils during the tomato plant growth (CFU/g of soil) (Field experiment, 2011)

Place to take a sample	Phase of vegetation of tomato		
	initial soil	phase of flowering-fruiting	phase of ripening
1. control - NPK + manure	$1.1x10^9$	$2.4x10^8$	$2.7x10^8$
2.exp. – NPK + Fosstim + Serhosil + manure	$1.1x10^9$	$6.7x10^7$	$6.4x10^8$

Table 11. The number of olygonitrofiles in the soils during the tomato plant growth (CFU/g of soil) (Field experiment, 2011)

Place to take a sample	Phase of vegetation of tomato		
	initial soil	phase of flowering-fruiting	phase of ripening
1. control - NPK + manure	$6.8x10^6$	$2.1x10^6$	$3.0x10^6$
2.exp. – NPK + Fosstim + Serhosil + manure	$6.8x10^6$	$3.7\ x10^6$	$3.1x10^6$

Table 12. The number of phosphormobilizing bacteria in the soils of during the tomato plant growth (CFU/g of soil) (Field experiment, 2011)

Place to take a sample	Phase of vegetation of tomato		
	initial soil	phase of flowering-fruiting	phase of ripening
1. control - NPK + manure	$3.7x10^7$	$1.5x10^5$	$1.3x10^5$
2.exp. – NPK + Fosstim + Serhosil + manure	$3.7x10^7$	$2.2x10^6$	$2.1x10^6$

Table 13. The number of micromycetes in the soils of during the tomato plant growth (CFU/g of soil) (Field experiment, 2011)

Place to take a sample	Phase of vegetation of tomato		
	initial soil	phase of flowering-fruiting	phase of ripening
1. control - NPK + manure	$2.2x10^5$	$7.5x10^4$	$7.5x10^5$
2.exp. – NPK + Fosstim + Serhosil + manure	$2.2x10^5$	$3.0\ x10^4$	$3.1\ x10^4$

Table 14. The number of actinomycetes in the soils of during the tomato plant growth (CFU/g of soil) (Field experiment, 2011)

Place to take a sample	Phase of vegetation of tomato		
	initial soil	phase of flowering-fruiting	phase of ripening
1. control - NPK + manure	$7.5x10^4$	$8.2x10^4$	$3.0x10^4$
2.exp. – NPK + Fosstim + Serhosil + manure	$7.5x10^4$	$3.7x10^5$	$3.8x10^5$

Fig. 8. The number of ammoniphicators in the soils of during the tomato plant growth, lg

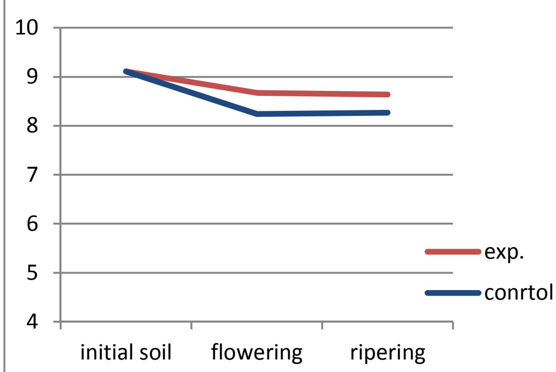
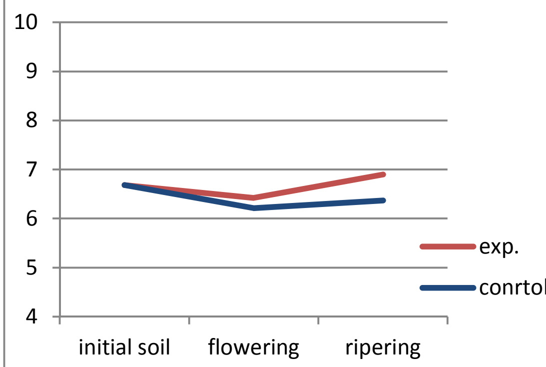


Fig. 9. The number of olygonitrofiles in the soils of during the tomato plant growth, lg



During the Fosstim application, the volume of Ammonificators (participating in the decomposition of nitrogen containing organic matters in the soil) was slightly increased compared to control evidencing with this the process of activation of decomposition of nitrogen in organic matter of soil and better assimilation of Nitrogen with plants. Oligonitrofiles (taking place in mineral Nitrogen assimilation) also were increased in number a little in soil treated with Fosstim-3 comparing to the control. This indicates improvement of mineral Nitrogen assimilation with plant. The number of phosphorus-mobilizing bacteria that convert hard splitting phosphorus into available form of that was increased under effect of Fisstim-3 indicating with this the improvement of phosphorus regime in the soil to become nutrition for plants.

Number of micromicetes and actinomicetes after treatment indicates the process of decomposition of polymer compounds in the soil. Number of micromicetes (mould fungi) was decreased 1-1,5 fold in the experiment plot after Fosstim-3 use comparing to control. That is sufficient indications because of the decreased number of fungi and increase actinomicetes promote to recovering the soil from phytopathogens.

The data on agrochemical soil properties in dynamics during the tomato plant growth are presented in Tables 15-22. At the end of tomato growth, the amount of gross Nitrogen is decreased on place of treated with Fosstim plant about 0,022% comparing to the control (Table 15, Figure 8). The amount of mobile nitrogen was increased in experimental plot about 19,5-13,2 mg/g of soil (Table 16, Figure 9), reflecting enhance of soil nitrogen mode of operation to be nutrient for tomato plant.

During tomato growth there was no change of gross phosphorus (Table 17). The amount of mobile phosphorus increased in the experimental plot with use of Fosstim at the middle of tomato growth about 8,3 mg/g of soil and decreased at the end of tomato growth as much as 10,9 mg/g of soil (Table 18), testifying of the improvement of soil phosphorus mode to be phosphorus nutrient for plant feeding.

The amount of gross Potassium was increased during tomato growth (Table 19). The amount of mobile potassium was increased in the experimental plot only at the middle of tomato growth about 55 mg/g of soil and decreased at the end of plant growth about 17 mg/g of soil. (Table 20, Figure 11).

Humus content in the experimental plot was decreasing as less as 0,15% compared to the control, but at the end of plant vegetation the content of humus in the experimental plot was about 0,02% (Table 21). pH was decreased in the experimental plot from 6,7 to 6,5 then in the control where pH was increase from 6,7 to 7,5 that means it is became lightly alkaline, that is not good for tomatoes (table 13).

Table 15. Content of nitrogen in soils (N total,%)

Place to take a sample	Phase of vegetation of tomato		
	initial soil	phase of flowering-fruiting	phase of ripening
1. control - NPK + manure	0.144	0.094	0.092
2.exp. – NPK + Fosstim + Serhosil + manure	0.144	0.097	0.070

Table 16. Content of phosphorus in soils (P total,%)

Place to take a sample	Phase of vegetation of tomato		
	initial soil	phase of flowering-fruiting	phase of ripening
1. control - NPK + manure	0.330	0.330	0.330
2.exp. – NPK + Fosstim + Serhosil + manure	0.330	0.341	0.322

Table 17. Content of potassium in soils (К total,%)

Place to take a sample	Phase of vegetation of tomato		
	initial soil	phase of flowering-fruiting	phase of ripening
1. control - NPK + manure	1.007	1.220	1.200
2.exp. – NPK + Fosstim + Serhosil + manure	1.007	1.390	1.301

Table 18. Content of mobile nitrogen in soils ($N\text{-}NH_4$, mg/kg)

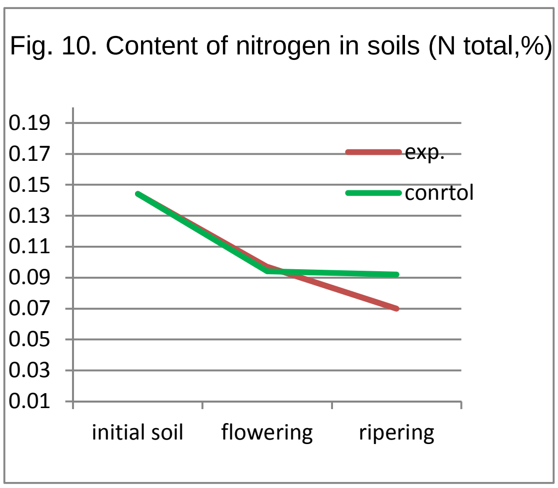
Place to take a sample	Phase of vegetation of tomato		
	initial soil	phase of flowering-fruiting	phase of ripening
1. control - NPK + manure	36.0	18.7	17.1
2.exp. – NPK + Fosstim + Serhosil + manure	36.0	38.2	30.3

Table 19. Content of mobile phosphorus in soils (P_2O_5, mg/kg)

Place to take a sample	Phase of vegetation of tomato		
	initial soil	phase of flowering-fruiting	phase of ripening
1. control - NPK + manure	87.7	79.2	78.0
2.exp. – NPK + Fosstim + Serhosil + manure	87.7	87.5	67.1

Table 20. Content of mobile potassium in soils (K_2O, mg/kg)

Place to take a sample	Phase of vegetation of tomato		
	initial soil	phase of flowering-fruiting	phase of ripening
1. control - NPK + manure	493	241	237
2.exp. – NPK + Fosstim + Serhosil + manure	493	296	220



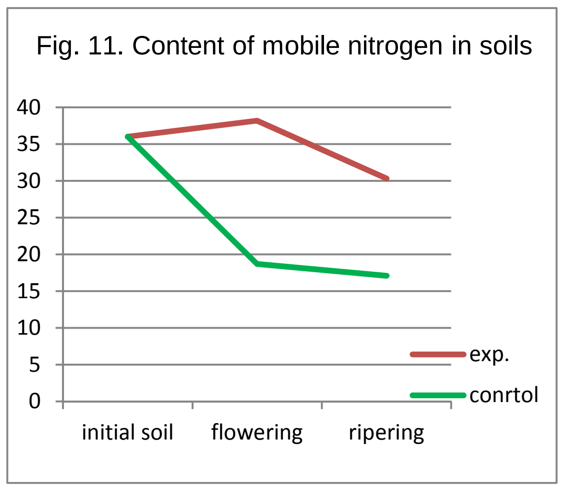


Table 21. Content of humus in soils (%)

Place to take a sample	Phase of vegetation of tomato		
	initial soil	phase of flowering-fruiting	phase of ripening
1. control - NPK + manure	2.68	1.88	1.72
2.exp. – NPK + Fosstim + Serhosil + manure	2.68	1.73	1.74

Table 22. Reaction of soil solution, pH

Place to take a sample	Phase of vegetation of tomato		
	initial soil	phase of flowering-fruiting	phase of ripening
1. control - NPK + manure	6.7	7.5	7.5
2.exp. – NPK + Fosstim + Serhosil + manure	6.7	6.5	6.5

In general according to the soil micro flora data it can be concluded that bacterial fertilizer Fosstim influences on microbiological processes in tomato plant rhizosphere during the growth that promotes for soil recovering. Agrochemical indications showed the positive effect of Fosstim-3 on content in the soil mobile, digestible for plants forms of Nitrogen, Phosphorus and Potassium testifying with this the nutrient supply for tomatoes. Except of bacterial fertilizers of Fosstim-3 we have tested biological preparation Serhosil as a nutrient for leaves 4 times during tomato growth.

Table 23 indicates the data of yield obtained at the end of tomato growth (August 2011). As it is seen from the table, total increase of yield compare to the control was 256kg/100m^2 or 26,3%. This means that micro biopreparations provided a beneficial effect on tomato production.

Table 23. Data on measurement of tomato plant growth (25 August, 2011)

№	Variants	Height of the main stem (см)	Number of fruits (шт)	Yield kg/100m^2
1	Control	58,9±0,2	11,9±0,2	256
2	Fosstim+ serhosil	62,7±0,2	14,2±0,2	277
Total increase comparing to control- 21 kg/100m^2				
In % - 26,3%				

Activity 1.3.8. Use of technical gossypol as botanical insecticides against turnip moth
Turnip moth (*Agrotis segetum* Schiff.) is one of the significant rodent pests (soil dwelling insect) for vegetables in Uzbekistan. Its larvae damage the vegetable seedlings and seeds gnawing out the holes in the seed-lobe, in young growing plant shoots, roots and stems near of cingulum, and sometimes they cause injury to above-ground parts of the sprouts. In the budding phase, the root and the main part become callous and caterpillars only gnawing them out. In years of their mass development the maggots destructive habit of biting off the shoots of small seedlings gave rise to the name “cutworms.” Application of natural insecticides particularly technical gossypol against cutworm is a method corresponding to IPM package program.

Material and methods: Gossypol and its derivatives are the compounds of polyphenol nature available in cotton plant leaves and seeds. Technical gossypol was presented by researchers of Institute of Bioorganic Chemistry. It is the waste product isolated as precipitate from oil seed processing.

Turnip moth larvae were reared in the soil in 3 l plastic containers feeding them with leaves of grasses, and their butterflies were fed with sugar syrups, in 3 l jars. The powder of technical gossypol was weighed in electron scales and obtained preparation masses (1mg, 2,5mg and 3mg) each of them were mixed with 500 g of soil in 3 l plastic containers containing 30 turnip moth larvae. The control was just soil with larvae. The experiment was conducted in three replicates in the laboratory room at a temperature of 25-27º C.

Results

At the laboratory of Uzbek Research Institute for Plant Protection a new way of sterilization of Lepidoptera pests of soil dwelling larvae has been developed. For this purpose there was technical gossypol tested that was obtained at the Institute of Bioorganic Chemistry AS RU as a preparation of first cotton seed processing.

Technical gossypol was added once in small dosages, as a dust into soil containing 4-5 instar turnip moth larvae (*Agrotis segetum* Schiff., Lepidoptera: Noctuidae) of first generation with 30 larvae per 500g of soil. During the experiment there were no changes in insect growth and development of the first 2 generations noticed. However further observations of treated in soil larvae, feeding them with leaves of grasses in the usual way their (as control) showed preparation effect to insect reproduction of third generation when butterflies oviposited completely sterile eggs. Lower concentrations of technical gossypol preparations (>0,5mg/500g of soil) notably effected only the fifth and six generations in changes (compared to the control) of butterflies' sex correlations – the number of males exceeded females (32±3:19±5). It was estimated that this insect generation became weak during its further development. The technical gossypol field test on this summer's tomato crop demonstrated that the dust preparation application in use rate 5g per 1 hectare can suppress bollworm numbers during 1 month. But this experiment on bollworms needed to replicated further.

Main advantages:

1. Technical gossypol is less harmful to the environment and humans than synthetic insecticides and sterilants;
2. Easy, not costly in compound obtaining technology and waste less in application;
3. Usage of secondary raw materials;
4. Easy in the compound application as a dust in a very small dosage;
5. Can be used combining with insecticides and baits;

CONCLUSIONS

1. Development of diagnostic technique for identification of tomato plant diseases and pests including soil analysis can provide for growers' intelligent use of different inputs and methods for plant protection.
2. Screening of fungi (*Trichoderma lignorum*) showed that the local strain of the fungi can be an effective antagonist against *Fusarium oxysporum*. As well as it positively enhanced the tomato growth in laboratory conditions;

3. Isolated from tomato rhizosphere bacteria association (*Bacillus subtilis*) strain # 26 showed antagonist effect against pathogen fungi *Fusarium oxysporum* and significant influenced on tomato growth as a very effective fertilizer;
4. Study the use of effective microorganisms as biological agents Fosstim (bacterial association of Bacillus subtilis #26) and Serhosil (based on algae biopreparation) showed very good results on the effect of preparations as the biofungicides and biofertilizers on tomato plants in open field;
5. Baikal EM-1 appeared to be the unique biopreparation in tomato greenhouses for recovering soil texture as fertilizer, enhancing plant immunity and stimulating plant growth;
6. Test of yellow sticky traps against whitefly showed that this method of capturing whitefly adults can not be sufficient to suppress numbers of this pest. It can serve as a signal for the pest appearance;
7. A new method of insect sterilization has been developed, by adding into a soil with Lepidoptera larvae natural insecticides by means of technical gossypol.

Activity 1.3.9 Screening tomato varieties/lines for main diseases.

Tomato is the most popular crop in Central Asia and is used year-round fresh and processed. But local varieties are not resistant to various diseases. Therefore, research on selection of a new germplasm is very important.

In October 2010, the program to evaluate new tomato germplasm was elaborated. Collaborative research was conducted with the following research institutes 1) Kyrgyz Research Institute of Farming, Kyrgyzstan; 2) Research Institute of Horticulture and Vegetable Growing (RIHVG), Tajikistan and 3) Uzbek Research Institute of Plant Industry (UzRIPI), Uzbekistan.
Processing on a collection of six samples from the AVRDC gene bank and Breeding Unit, quarantine permission and shipping of new tomato varieties and lines to the partner in Uzbekistan was conducted. Introduced germplasm seeds were sown for seedlings in greenhouses the end of January 2011. Varietal trials in an open field were initiated in May 2011. Study of germplasm was conducted during a vegetation period in 2011 and results will be received in late October 2011. Disease-resistant tomato varieties and lines with a high yield will be revealed and seeds will be multiplied for further research.

Activity 1.3.10 Tomato grafting method introduction and evaluation, demonstrational field.

Plant grafting is used widely in developed countries and allows to increase tolerance of plants to unfavorable environmental factors and to have higher yield of high quality fruits.
For the first time, innovative research of tomato grafting and its adoption was conducted in Uzbekistan for further introduction into vegetable production in the republic and neighboring countries.

Collaborative research was conducted with the State Agrarian University, Uzbekistan. Mr. Bakhtiyor Karimov from TSAU started this research within the magister thesis.

Processing on quarantine permission and shipping of disease-resistant tomato varieties and lines from AVRDC to Uzbekistan were conducted.

Tomato is the leading culture among vegetable crops. In 2011, tomato planting area in the open field was over 50 thousand ha, and in protected culture, tomato is grown over an area of 4.5 thousand ha Varieties included in the State registry are used for the cultivation of tomato, recommended for cultivation of agricultural crops on the territory of the Republic of Uzbekistan.

The most affected by the defeat of the soil diseases are plants of cultivated vegetable crops. Plants grafting method is one of the ways to prevent diseases, ensuring the plant's water needs and mineral nutrition due to sustainable rootstock with a strong root system.

In Uzbekistan before present time, tomato grafting was not used as there were not suitable tomato samples for using as rootstock. Also tomato grafting technique had not been developed for Uzbekistan conditions. Questions of study and recommendations developing on tomato grafting in protected fields are held for the first time in Uzbekistan, that is relevant direction for researches in vegetable production.

The purpose of the research: conduct research on the selection of tomato samples for protected field using as a rootstock, to develop suitable grafting technology and recommendations for tomato grafting to increase yield and production quality to increase the farmers' income and tomato production in Uzbekistan.

The following objectives were to achieve this goal in 2011:

1. Study of the 16 tomato lines from the World Vegetable Centre (AVRDC-The World Vegetable Center) for using as a rootstock of released tomato variety Gulkand.
2. Setting of optimal diameter and height of the tomato rootstock and scion for grafting optimization.
3. Improvement of elements of grafting technique.
4. Selection of promising rootstocks for tomato scion, study of the characteristics of grafted plants by yield, marketability, resistance to diseases and pests, product quality and other economic-valuable characteristics.

Materials and methods: Experiments conducted September 2010 – June 2011 in greenhouse of training experimental field of Tashkent State Agrarian University to study the tomato cultivation in autumn-winter rotation. Research was conducted using the following guidelines: "Guidelines for the study of the tomato world collection of World Plant Institute " (1977) and "Methodological instructions of AVRDC – the World Vegetable Centre for tomato grafting (1999)," "Statistical analysis of experimental farm held by Dospehov B.A. methodic" (1985). We also implemented agricultural technology common for growing tomatoes in greenhouses.

Material for studies: released tomato variety Gulkand in Uzbekistan, and 16 lines of tomatoes from the World Vegetable Center (Taiwan).

Experiment 1. Study of 16 tomato lines from the World Vegetable Centre for use as a rootstock for released tomato variety Gulkand. In 2011, seedlings of 16 tomato lines grown in the greenhouse were planted in an open field the first week of May for breeding of new seed reproduction and later for grafting. During the vegetation period, monitoring and accounting were conducted as well as biometric measurements on 10 plants of each tomato line.

Experiment 2. Setting of optimal diameter and height of the tomato rootstock and scion for grafting optimization. Seeds of 16 lines and Gulkand tomato variety were planted in cassettes at the end of August and the end of October. During sprouting and early growth of seedlings, research and monitoring were carried out: the number of days from sowing until sprouting, appearance of the first and the second leaves, as well as height and stem diameter were measured.

Experiment 3. Improvement of elements of grafting technique: A record of temperature, humidity and soil was conducted during the cultivation of plants. Grafting was done when plants reached the stem diameter 1.6-1.8 mm (up to 2 mm) in the 2-3 leaf phase. We used the following grafting technique: stem edge of rootstock and scion, the joining of edge and fixing for stem concretion.

Experiment 4. Selection of promising rootstocks for tomato scion, study of the characteristics of grafted plants by yield, marketability, resistance to diseases and pests, product quality and other economic-valuable characteristics. In the autumn-winter rotation of 2010-2011 economically valuable characteristics of tomato variety Gulkand were studied, grafted on 16 lines-rootstocks of tomatoes from the World Vegetable Center. As a standard, we used plants of released tomato variety Gulkand, and the same variety grafted on 16 rootstocks. In connection with a limited number of tomato seeds, experience lies in one replication, on 10 plants in each version. Seeds sowing terms in the greenhouse and planting seedlings in greenhouse were generally accepted for Tashkent region. Planting scheme – single row, 70 x 50 cm. Tracks were between plots. Ahead, at the end and at the edges of an experienced experimental field, we planted tomato protective lanes.

Experience included study of the influence of rootstock on scion and variability of the following features in comparison with non-grafted plants of standard: 1) vegetation period; 2) morphological features; 3) resistance to diseases and pests; 4) yield; 5) biochemical composition of fruit.

Phenological observation. Stated dates: sowing, early sprouts (10%), the mass of sprouts (75%), seedling planted into the ground, the beginning (10%) and the mass flowering (75%), the beginning (10%) and mass (75%) ripeness of the fruit.

Evaluation of disease resistance. Analysis of the soil was conducted. Phytophathological and entomological evaluation of plants of tomato varieties were carried out every 10 days since the beginning of the appearance of sprouts before biological maturity of the fruit. Phenological observation was conducted every 3 days from sprouting to harvest.

Morphological description. Conducted on 10 plants. Biological maturity characteristics: a form of bush, branching and the size of bush (height and diameter), color and downiness of the stem; form, color, downiness, size of lamina; the length of leafstalk; place of fruits on the bush; location, shape, length and diameter, the color of the fruit; shape and size of the stalk; place of calyx, pericarp wall thickness, taste of fruit placenta; coloring, density, taste, consistency of the flesh; quantity of seed cells, number of seeds in the fruit.

Crops yield. Harvesting and crop yields in weight and quantity indicators were conducted with mature fruit, separately for each harvest. The following records were done: date of harvesting, number of plants, total harvest of fruits (standard, sick, damaged); number and weight of the fruit (standard, ugly and non-market); average mass of marketable fruit; percentage of marketable fruit to the common harvest.

Results

Experiment 1. Study of 16 tomato lines from the World Vegetable Centre for using as a rootstock for released tomato variety Gulkand. In November, the data will be processed and presented in a report.

Experiment 2. Setting of optimal diameter and height of the tomato rootstock and scion for grafting optimization: We have conducted research on the study of seedlings indicators rootstock and scion for tomato grafting. In the first phase of the research an important issue is to set the optimal diameter and height of the rootstock and scion of tomato for grafting optimization.

Autumn-winter rotation: Sowing seeds of 16 tomato lines and released variety Gulkand conducted at the end of August into special cassettes. Beginning of sprouts from all entries observed in September,3 and mass sprouts have appeared in September,5 (Table 23).

Table 23. Indicators of diameter and height of tomato seedlings stalk before grafting for autumn-winter rotation (2010-2011)

№ Entry	Sprouts (50%)	Mass sprouts (75%)	Phase: first leaf		Phase: second leaf	
			Stem diameter,cm	Stem height , cm	Stem diameter,cm	Stem height , cm
1	03.09	05.09	0.14	2.85	0.14	3.85
2	03.09	05.09	0.12	2.92	0.14	4,00
3	03.09	05.09	0.11	3.10	0.13	4.20
4	03.09	05.09	0.11	2.75	0.13	4,00
5	03.09	05.09	0.14	4,00	0.17	4.94
6	03.09	05.09	0.09	2.96	0.14	4.03
7	03.09	05.09	0.14	3.15	0.14	4.16
8	03.09	05.09	0.12	3.10	0.16	4.25
9	03.09	05.09	0.10	4.00	0.12	4.95
10	03.09	05.09	0.09	2.74	0.09	3.82
11	03.09	05.09	0.14	4.02	0.15	4.79
12	03.09	05.09	0.14	3.20	0.15	4.18
13	03.09	05.09	0.10	3.32	0.13	4.42
14	03.09	05.09	0.10	3.67	0.13	4.70
15	03.09	05.09	0.10	4,00	0.13	5.02
16	03.09	05.09	0.15	3.80	0.19	4.90
Gulkand	03.09	05.09	0.13	4.50	0.15	4.70

Conducted records of stem diameter seedlings in the phase of first leave showed that stem diameter of Gulkand variety is 0,13 cm. Diameter of 50% of the samples have varied from 0,12 to 0,15 cm, it was 0,10 -0,11 cm in another part of the samples. Only accession № 16 had a large diameter of the stem-0,15 cm. Seedlings height in this phase of the Gulkand variety was 6,5 cm and plants were higher in comparison with all the studied accessions. Height of accessions № 5, 9, 11, 15 was 4,0 cm, and the rest of accessions it was below within 2,7 -3,8 cm. In the phase of second leaf stem diameter of Gulkand variety was 0.15 cm. The accessions № 1,2, 6, 7, 11, 12, had 0,14 -0,15 cm, accessions № 5 and 6 had 0.16 -0.17 cm and the rest of accessions had smaller diameter and it varied within 0.09-0.13 cm. Plants height in this phase of Gulkand variety was 4.7 cm, but most accessions- ranging from 4.0 to 4.9 cm, except the accession № 15, which was the highest (5.02 cm). In general, temperature conditions in September were favorable and almost all accessions, except № 10 had a diameter and stem height suitable to grafting carrying out.

Conclusions from Experiment 2.

1. Conducted studies allowed making a conclusion about the seedlings cultivated in uncontrolled natural conditions, there are differences between the accessions in stem diameter and plant height, which is important for follow-up grafting.

2. In connection with backwardness for seedlings of tomato accessions, it requires time for their growth to complete, that leads to lengthening of the term of rootstock and outgrowth of scion (local variety). Therefore, it recommended conducting additional seeds sowing of local varieties for 3-4 days later to use it as scion.

3. With the use of the grafting method, it is necessary to use quality seeds for rootstock and scion, otherwise quality differences of seeds leads to backwardness of plants and additional expenses on completion of growing.

4. We have identified the optimal diameter and plant height for tomato accessions grafting ((№1,5,7,9,11,12 and 15) for use as a rootstock.

Experiment 3. Improvement of elements of grafting technique**.**

Grafting was conducted when the stems of tomato seedlings reached a diameter of 1.6-1.8 mm (up to 2 mm) in the phase 2-3 of leaves. An edge of stem of scion and rootstock, the joining of cuts and fixing for stem concretion was done.

The first experience of grafting had shown that the necessary requirement is a strict abidance of the parameters of a certain temperature (+ 25° C) at grafting, correct cut of stem (30^0) and cut fixing, as well as the developing of special conditions for cut acceptance. We used special built shelters of black polyethylene film. Inside we placed the cassettes with grafted seedlings for 3-4 days. During this period, the air temperature in the shelter was permanent ($+24^0$C) and humidity - 90-95%. In 3-4 days, the film was gradually opened for to expose plants to light within 2-3 days and then, grafted seedlings were carried in a greenhouse for planting in a permanent place.

Conclusions from experience 3.

1. Grafting technique requires strict abidance of temperature conditions and humidity and soil, and also time for adoption of plants.

2. Non-observance of one of these factors leads to death of grafted seedlings or poor development of plants that greatly weaken effectiveness of grafting carrying out.

Experiment 4. Selection of promising rootstocks for tomato scion, study of the characteristics of grafted plants by yield, marketability, resistance to diseases and pests, product quality and other economic-valuable characteristics

In the autumn-winter rotation in 2010-2011 economical-valuable characteristics of tomato variety Gulkand were studied, grafted on 16 lines-rootstocks of tomatoes. As a standard were used not grafted plants of released tomato variety Gulkand.

Cultivated grafted seedlings and a standard were planted in greenhouse on January 5, 2011. After plant acceptance, they began to develop and in late February - early March, started beginning of flowering (Table 24). Most early beginning of flowering (February 25) has been characterized accessions №10 and 11. Two to three days later, beginning of flowering was noted in accessions № 6,7,8,9,12,13,14,15. Another accessions had the beginning of floweringMarch 1-2.
Mass flowering of accessions of tomato had differences by terms. The most early beginning of flowering has been characterized accessions№ 10 and 11 (March 2). Mass flowering of accessions№ 6,7,8,9,12,13,14 and 15 was on March 6, and other accessions this phase were 2-3 days later.

Table 24. Phenological observations on tomato (greenhouse, autumn-winter rotation,2010-2011)
Location: Tashkent region, Kibray box, TSAU

Entry	Date of the beginning of flowering (10%)	Date of mass flowering (75%) (March 2011)	Date of the beginning of fruit ripening (10%) (May 2011)	Date of mass fruit ripening (75%) (May 2011)
Gulkand-standard	02.03.	09	08	14
1	02.03.	09	07	14
2	02.03.	08	07	13
3	01.03.	09	07	14
4	02.03.	08	07	13
5	02.03.	08.	08	13
6	27.02.	06	04	11
7	28.02.	06	03	11
8	28.02.	06	03	11
9	27.02.	06	04	11
10	25.02.	02	02	07
11	25.02.	02	02	07
12	28.02.	06	03	11
13	27.02.	06	04	11
14	28.02.	06	03	11
15	28.02.	06	03	11
16	01.03.	10	06	15

Beginning of ripening of tomato also differs. Most early beginning of fruit ripening (May 2-4) characterized № 10, 12 and 12, as well as 7, 8, 12, 14 and 15. These accessions were early by mass economic availability of fruits, in comparison with other accessions. Study of morphological features showed differences between the accessions by quantitative indicators (Table 4).

Leaf length between the accessions changed from 28.4 to 32.7 cm, leaf width changed from 23.0 to 36.0 cm, diameter of the stem above the grafting place -from 2.5 to 3.3 cm, diameter of the stem beneath the grafting place – from 2.8 to 3.3 cm, height of location of the grafting place above the ground- from 1.3 to 2.4 cm, the number of flowers on each blossom cluster- from 3.8 to 5.8 cm. The fruit length between the accessions changed from 4.1 to 6.2 cm, fruit diameter - from 5.5 to 5.7 cm, the fruit stem length - from 1.7 to 2.2 cm, the number of fruit on each blossom cluster- from 5.0 up to 5.8 cm. Such features, as the number of sections (3-4), thickness of fruit (4 mm), color of the leaf and stem, as well as matured fruit remained practically unchanged.

Table 25. Description of the tomato morphological characters (greenhouse, autumn-winter rotation, 2010-2011.)

Features /№ entry	**St. Gulkand**	**1**	**2**	**3**	**4**	**5**
Leaf 00,0						
Leaf length (cm)	31.2	31.4	28.4	33.7	31.5	31.7
Leaf width (cm)	27.8	27.9	27.7	25.2	23.3	23.0
Leaf color	Dark-green	Dark-green	Dark-green	Dark-green	Dark-green	Dark-green
Stem 00,0						
Type of stem growing	Determ.	Determ	Determ	Determ	Determ	Determ
Stem downiness	soft	soft	soft	soft	soft	soft
Stem color	green	green	green	green	green	green
stem diameter above the grafting place	2.7	2.9	2.8	2.5	3.1	3.0
stem diameter under the grafting place	2.9	2.9	2.9	3.1	3.0	3.0
height of location of the grafting place above the ground	2.0	2.0	2.4	1.3	1.7	1.7
Blossom cluster						
Type of blossom cluster						
Quantity of flowers on each blossom cluster	3.9	3.8	5.8	5.1	5.2	5.4
Fruit 00,0						
Fruit length (см)	4.5	4.3	4.1	4.6	5.0	5.0
Fruit diameter (см)	5.7	6.2	5.9	6.7	5.5	6.0
Length of the stem	1.8	2.0	2.2	1.7	2.0	2.0

dominant form of the fruit	Round shaped	Round shaped	Round shaped	Round shaped	Round shaped	Round shaped
variation of fruit sizes on one plant	average	average	average	average	average	average
Quantity of flowers on each blossom cluster	5.2	5.8	5.8	5.1	5.2	5.4
Color of unripe fruits peeling	pink	pink	pink	pink	pink	pink
Color of ripe fruits peeling	red	red	red	red	red	red
Quantity of sections	3-4	3-4	3-4	3-4	3-4	3-4
Fruit wall thickness, mm	4.0	4.0	4.0	4.0	4.0	4.0
Fruit hardness	medium	medium	medium	medium	medium	medium
Fruit cracking	medium	medium	medium	medium	medium	medium

Features /№ entry	**6**	**7**	**8**	**9**	**10**
Leaf 00,0					
Leaf length (cm)	31.9	31.6	31.7	32.4	32.7
Leaf width (cm)	36.0	23.5	23.6	23.3	23.3
Leaf color	Dark-green	Dark-green	Dark-green	Dark-green	Dark-green
Stem 00,0					
Type of stem growing	Determ.	Determ	Determ	Determ	Determ
Stem downiness	soft	soft	soft	soft	soft
Stem color	green	green	green	green	green
stem diameter above the grafting place	3.2	3.0	3.0	3.0	3.1
stem diameter under the grafting place	3.0	3.0	3.0	3.1	3.3
height of location of the grafting place above the ground	1.8	1.6	1.8	1.6	1.7
Blossom cluster					
Type of blossom cluster					
Quantity of flowers on each blossom cluster	5.2	5.6	5.2	5.0	5.1
Fruit 00,0					
Fruit length (см)	5.4	5.9	5.5	5.3	5.6
Fruit diameter (см)	5.8	5.9	6.1	5.9	6.0
Length of the stem	1.9	1.9	1.9	1.7	2.2
dominant form of the fruit	Round shaped	Round shaped	Round shaped	Round shaped	Round shaped
variation of fruit sizes on one plant	average	average	average	average	average
Quantity of flowers on each blossom cluster	5.2	5.6	5.2	5.0	5.1

Color of unripe fruits peeling	pink	pink	pink	pink	pink
Color of ripe fruits peeling	red	red	red	red	red
Quantity of sections	3-4	3-4	3-4	3-4	3-4
Fruit wall thickness, mm	4.0	4.0	4.0	4.0	4.0
Fruit hardness	medium	medium	medium	medium	medium
Fruit cracking	medium	medium	medium	medium	medium

Features /№ entry	**11**	**12**	**13**	**14**	**15**	**16**
Leaf 00,0						
Leaf length (cm)	31.5	32.1	32.0	31.9	32.0	32.0
Leaf width (cm)	23.5	24.3	23.6	23.3	23.5	23.6
Leaf color	Dark-green	Dark-green	Dark-green	Dark-green	Dark-green	Dark-green
Stem 00,0						
Type of stem growing	Determ.	Determ	Determ	Determ	Determ	Determ.
Stem downiness	soft	soft	soft	soft	soft	soft
Stem color	green	green	green	green	green	green
stem diameter above the grafting place	3.0	2.9	2.9	3.3	3.0	3.2
stem diameter under the grafting place	3.0	3.0	2.8	3.2	3.0	3.2
height of location of the grafting place above the ground	1.7	1.4	1.3	1.6	1.6	1.9
Blossom cluster						
Type of blossom cluster						
Quantity of flowers on each blossom cluster	5.1	5.1	5.0	5.4	5.2	5.0
Fruit 00,0						
Fruit length (cм)	5.6	5.3	5.5	6.2	4.0	5.0
Fruit diameter (cм)	5.5	5.9	6.1	6.0	6.1	6.1
Length of the stem	1.9	2.0	2.0	1.7	1.8	2.0
dominant form of the fruit	Round shaped	Round shaped	Round shaped	Round shaped	Round shaped	Round shaped
variation of fruit sizes on one plant	average	average	average	average	average	average
Quantity of flowers on each blossom cluster	5.1	5.1	5.0	5.4	5.2	5.0
Color of unripe fruits peeling	pink	pink	pink	pink	pink	pink
Color of ripe fruits peeling	red	red	red	red	red	red
Quantity of sections	3-4	3-4	3-4	3-4	3-4	3-4
Fruit wall thickness, mm	4.0	4.0	4.0	4.0	4.0	4.0
Fruit hardness	medium	medium	medium	medium	medium	medium
Fruit cracking	medium	medium	medium	medium	medium	medium

Yield: The first harvest of tomato accessions have done (table 5). There were differences on plants productivity. Yield from 10 plants accessions varied from 5.8 to 9.0 kg. Standard Gulkand had yield- 6.0 kg. All accessions exceeded it by yield, except the accession № 8. The highest yield had accession №14 – 9.0 kg. Accessions №1, 5, 7 and 10 had harvest amounted to 7.4 -7.8 kg. The rest of accessions had- 6.0 -6.6 kg harvest. The crops marketability ranged from 84 to 97% and the overwhelming majority of accessions, it was more than 90%. The average fruit mass varied from 90 to 200g. Standard Gulkand had an average fruit mass -140g, Close to it indicators had accessions № 1 and 2. The greatest weight characterized accession №10 – 200 g and accession №14 – 155 g.

Table 26. Tomato accessions yield on rootstocks at 1 harvest (greenhouse, autumn-winter rotation 2010-2011)

Entry №	Common yield		Marketability, %	Average fruit mass, g
	Fruit quantity, psc.	Fruit weight, kg		
Gulkand,St.	64	6.0	93	140
1	64	7.2	89	138
2	56	6.2	84	134
3	66	6.4	94	115
4	83	6.6	88	94
5	84	7.4	92	100
6	66	6.4	91	112
7	86	7.8	95	106
8	66	5.8	93	92
9	56	6.4	97	129
10	52	7.2	92	200
11	80	7.0	04	96
12	82	6.6	91	100
13	78	6.0	90	90
14	62	9.0	94	155
15	72	6.0	67	102
16	60	6.6	96	126

Conclusions from Experience 4.

1. As a result of the study of the grafted tomato plants development phases we have differences.
2. Standard Gulkand, not grafted on scion, when all phases of development began, it was slow from majority accessions for 7 days.
3. Standard Gulkand plants, grafted on rootstocks of № 6, 7, 8, 9, 12, 13, 14 and 15 had development phase in 5 days earlier than standard, and accessions№ 10 and 11 outstripped in all phases of development in 7 days earlier than standard. The data received by us are in keeping with available information in literature – grafting has an impact on the early beginning of development phases.

4. Research conducted by us on studying of the quantitative morphological features had shown differences between the accessions. There aren’t any differences on qualitative indicators (color, form, downiness).
5. Yield study showed that at the first harvest there are differences on plant productivity, marketability and fruit mass. The best indicators on fruit weight and yield had accessions № 14 and 10 by the first harvest. Accessions № 5 and 7 had also higher indicators in comparison with other accessions. Research will be continued.

CONCLUSION: As a result of the 2010-2011 researches were established differences in development phases and yield of grafted tomato plants and not grafted tomato plants. Research will be continued in 2011-2012 years. Grafting method of tomato plants was demonstrated on April 13-15, 2011. And also a booklet on tomato grafting was published.

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 and Student Field Schools: One of the important objectives of this IPM CRSP project is to transfer IPM knowledge and demonstrate existing and new IPM technologies to local farmers and students through the establishment of Farmers Field Schools (FFS) and Student Field Schools in collaboration with local agriculture ministries, local NGOs, universities.

Activity 2.1. Farmer training and student field school on Wheat IPM.
Various training programs and workshops implemented in Year 2 in Tajikistan are presented in Table 27.

Table 27. List of training program, workshop, farmers field schools, training of master trainers, farmers training and farmer field days.

#	Name, dates and location of the training program, workshop, farmers field schools and etc.	Total number of the participants		
		Total	**Male**	**Female**
1	Farmer field school on IPM of wheat, October 1, 2010 – June 10, 2011, Hissor district of Tajikistan	20	8	12
2	Farmer field school on IPM of wheat, October 10, 2010 – June 15, 2011, Spitamen district of Tajikistan	25	15	10
3	Training for farmers on IPM of potato pest control, May 5, 2011, Muminabad district of Tajikistan	18	10	8
4	Training for farmers on IPM of tomato pest control, May 26, 2011, Shahrinav district of Tajikistan	24	15	9
5	Pest Diagnostics Workshop for Central Asia Region 6 - 11 June 2011, Dushanbe, Tajikistan (Photo 1-3)	80	35	45
6	Field day for farmers on IPM FFS on wheat crop, June 9, 2011, Hissor district of Tajikistan	30	10	20
7	Field day for farmers on IPM FFS on wheat crop, June 15, 2011, Spitamen district of Tajikistan	45	30	15
8	Field day for farmers on IPM FFS on tomato crop, June 9, 2011, Shahrinav district of Tajikistan	24	15	9
9	Field day for farmers on IPM FFS on	18	10	8

	potato crop, June 11, 2011, , Muminabad district of Tajikistan			
10	Training for farmers on IPM of wheat pest control, June 20, 2011, Jirgatol district of Tajikistan	25	23	2
11	Training for farmers on IPM of potato pest control, June 21, 2011, Jirgatol district of Tajikistan (photo 6-8)	25	23	2
Total number of participants		**334**	**194**	**140**


Left, Photo 1. Workshop participants in wheat demo plot field, June 2011, Hissor district, Tajikistan. Right, Photo 2. IPM potato training for farmers, June 2011, Jirgatol distict, Tajikistan.

Photo 3. Pest scouting in potato field, June 2011, Jirgatol District, Tajikistan.

Activity 2.2. Local Students from Tajik National University involvement in research with the IPM CRSP project and their research area/topic, 2010-2011

1) Ms. Madina Pulatova –Biological faculty of Tajik National University, Dushanbe, Tajikistan; Tomato pests and their control.

2) Ms. Mijgona Siyamardova - Biological faculty of Tajik National University, Dushanbe, Tajikistan; Potato pests and their control.


Left Photo 4. Student and farmer field day in wheat field, Hissor District, June 2011.
Right Photo 5. Pest Diagnostics Workshop, June 7-9, 2011, Dushanbe, Tajikistan. Participants came from Tajikistan, Kyrgyzstan and Uzbekistan.

Activity 2.3 Use of Farmer Field Schools for Implementation of Ecologically-Based Potato IPM Packages. IPM CRSP Farmer Field Schools (FFS) are used as the educational component for implementation of ecologically-based potato IPM packages. Although it is difficult to design potato IPM packages from innovations developed during the first year of a research project, the FFS included information on the bio-systems reported in the 2010 annual report, general potato IPM packages based on the existing literature and experience of Murat Aitmatov. Potato seed was distributed to trainers for use in their 2012 FFS (Figures 12-17). In 2011, a total of eight FFS were conducted in Kyrgyzstan; four in the Alay Region and four in the Chong-Alay Region. There were a total of 1,080 participants, 151 of which were women (Table 5). Six topics were covered in each region: 1) FFS Management, 2) Use of Biological Seed Treatments, 3) Agroecology, 4) Potato Pests and Diseases, 5) a general field day and 6) a potato production field day (Table 5). Fifteen of the potato lines-varieties from Michigan State University were transported to Alay on May 11, 2011 (Table 7). They were planted on May 18 and harvested on September 18. Most of the lines yielded very well and the 2013 FFS Trainers received more than 500 kg of good quality seed material for use in their 2013 educational programs.


Figures 12 and 13.


Figures 14 and 15.


Figures 16 and 17.

Activity 3. Training a Next Generation Potato IPM Scientist. While the selection of the Central Asia IPM CRSP doctoral candidates from Uzbekistan and Tajikistan was completed in the first year of the project, the process took longer in Kyrgyzstan. Saltanat Membetova was selected for the potato Research Assistantship and she arrived at Michigan State University early in 2011.

While her initial responsibility was to enhance her English skills, she was immediately assigned to Dr. David Douches as her major professor. Dr. Douches is a world-renown potato breeder with responsibilities for the USDA Trans-Gene Potato Initiative. During summer 2011, Saltanat learned the potato breeding procedures used in Dr. Douches' group through practical field experience. Her Ph.D. dissertation will be based on the design of systems of certified potato seed production for Central Asia with special reference to lines-varieties with resistance to pests-diseases. Saltanat is currently enrolled in two formal units of academic instruction, General Entomology and Statistics, in addition to preparation of her Ph.D. dissertation proposal.
G. W. Bird-Frank Zalom's counter-part Central Asian Ph.D. student, Bahodir Eshahanov of Uzbekistan and the tomato component of the Central Asia IPM CRSP, indicated that the rigors of the course work at Michigan State University are significantly greater than what he experienced for his B.S. and M.S. degrees in his country. He has recommended that a comprehensive program be developed to allow B.S. students from Central Asia to be educated in the United

States. He is also emphatic about the necessity for these individuals to sign an agreement that they will return to their native country upon completion of the academic degree. It is our impression that the Training a Next Generation Potato IPM Scientist component of the Central Asia IPM CRSP is progressing in a satisfactory manner. All three of the students are highly talented. All three of them are very different.

Table 28. Potato IPM Package Farmer Field School topics, participants and gender distribution.

Place	Theme	Number of participants	Women of them
Alay region 4 FFS	Management of FFS	80	10
	Planting of seeds	76	8
	Using of biopreparation: treatment of seed materials	73	7
	Agroecosystem 2-7	65	9
	Pests and potato diseases	77	6
	Field day	83	22
	Potato day	103	28
Total		**557**	**90**
Chong-Alay region 4 FFS	Management of FFS	80	8
	Planting of seeds	72	7
	Using of biopreparation: treatment of seed materials	63	5
	Agroecosystem 2-7	65	5
	Pests and potato diseases	67	6
	Field day	80	12
	Potato day	96	18
Total		**523**	**61**

Table 29. Summary of Training programs and workshops held in Uzbekistan related to Tomato IPM

№	Name, dates and location of the training program, workshop, farmers field schools and etc.	Total number of participants		
		Total	Male	Female
1.	**Presentation on Rearing of Amblyseius mckenziei**	107	65	42

	and application the entomophage in open field and greenhouses , March 18, 2011; Training for biolaboratory specialists, organized by "Biomarkaz" Tashkent State Agrarian University:			
2	"**Grafting of tomato resistant varieties and IPM for tomato pest and disease control"** **<u>will be organized</u>** by December 5, 2011, under CA Regional IPM project in Uzbekistan at Experimental Station of Tashkent State Agrarian University (Tashkent 100140, Kibray district), Training for farmers.	15	12	3

Local Students from Uzbekistan conducting research with the IPM CRSP project:

1. Rashidov Sherzod – Student for Master degree "Whitefly control on vegetable crops", Tashkent State Agrarian University;
2. Zufarov Sobir - Student for PhD degree "Disease control on vegetable crops", Tashkent State Agrarian University;
3. Karimov Bahtiyor – Student for Master degree on "Screening and grafting of resistant tomato varieties"

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.

<u>Participation in International Meetings and workshops:</u> Facilitate participation of IPM CRSP coordinators and local scientists from host countries to interact with IPM CRSP Regional Programs and other international meetings and workshops: Dr. Nurali Saidov, Team leader of the IPM CRSP project based in Tajikistan and Dr. Barno Tashpulatova, Tomato IPM Coordinator based in Uzbekistan participated in the 14^{th} Annual Meeting of the Steering Committee of the CGIAR Program for Central Asia and the Caucasus held in Tashkent, Turkmenistan from September 20 - 23, 2011. Dr. Saidov gave a presentation on the "Ecologically-Based Participatory and Collaborative Research and Capacity Building in IPM in Central Asia Region" based on achievements 2010-2011. This meeting was attended by more than 50 senior administrators, high level government officials, and program leaders from 8 countries in Central Asia and Caucuses and international agricultural research centers.

Dr. Karim Maredia attended the annual meeting of the American Phytopathological Society (APS) and International Association of Plant Protection Sciences (IAPPS) held in Honolulu, Hawaii from August 6 – 10, 2011. Dr. Maredia coordinated a special session/workshop on IPM Packages for Vegetable Crops and also presented the ongoing work on IPM Packages in Vegetable and Food Security Crops in Central Asia.

Objective 4: Create a <u>"Central Asia IPM Knowledge Network"</u> - Information base

A. Update, expand and enhance the website of the Central Asia regional IPM program in collaboration with project team members. Use social networking and other means to publicize on-going activities of the project. Ms. Joy Landis continues to support the communication activities for the Central Asia IPM CRSP project. The Central Asia IPM CRSP project web site (http://www.ipm.msu.edu/central-asia.htm) was updated to include:

- An introduction to the project's three Central Asian graduate students
- Google Earth or Google Maps links to view the project's research plot locations in Central Asia
- Updates to program components, team members, and partners
- Latest reports, new publications
- Photos were posted from three events: (1) from the team's 2011 partners meeting and diagnostic workshop in Tajikistan; (2) Photos from Tajik Ambassador Abdujabbor Shirinov visit with the Central Asia CRSP IPM team at MSU; (3) Central Asia Day at Michigan State University.

Photos were provided to IPM CRSP headquarters for its website photo gallery.

A press release was written in May 2011 about the visit of Tajik Ambassador Abdujabbor Shirinov. It was circulated by MSU University relations through its media outlets and at its main website as well as with IPM CRSP headquarters. A flyer was developed that explains the groundwork and accomplishments of Phase 1 and the plans proceeding for Phase 2. Flyers for IPM packages are nearing completion. The communication specialist also wrote sample test questions to help the graduate students prepare for TOEFL testing and edited reports.

Press releases have also been submitted to the ***American Phytopathological Society (APS) Notes*** **and** *IPMnet News* about the 2011 Diagnostic training delivered in Tajikistan to students and agronomists from the three Central Asian countries.

Publications (Wheat IPM):

a) Articles in Refereed Journals

- Saidov N.Sh., A.U. Jalilov, T. K. Mirzoev, D.A. Landis, (2011). Ecological approaches in protection of the agricultural crops from insect pests in Tajikistan. Proceeding materials of 4th International Scientific Conference of "Ecological Peculiarity of Biological Diversity in the Republic of Tajikistan," Kulob, Tajikistan, October 20-21, 2011 5 p. in the press *(in Russian).*
- Saidov N.Sh., A.U. Jalilov, M. Bouhssini D.A. Landis, Sh. Safarzoda (2011). Resistant of varieties and lines of winter wheat to damage of cereal leaf beetle *(Oulema melanopus L.)* in condition of Central Tajikistan. Bulletin of the Academy of agricultural sciences of the Republic of Tajikistan, Dushanbe-2011, 5 p., in the press *(in Russian).*

b) Books, Brochures, Manuals

- Saidov N., A. U. Jalilov, D. Landis, M. Kennelly**,** M. Bouhssini (2011): Wheat pest and diseases and methods of control. Brochure, Dushanbe-2011, 14p., published copies 200 unit (*in Tajik*).

Publications (Tomato IPM):

1 Tashpulatova B.A. 2010, Mass production and application of Amblyseius species predator mites in Uzbekistan. Proceedings of Republic scientific-applied conference of farmers Tashkent- No 3, p.25-27 (Russian)
2. Tashpulatova B.A., Rashidov M.I. Khamraev A. Sh. Rearing of Amblyseius mckenziei on artificial diet. 2011 Uzbek biological Journal, in press (Russian)
3. Tashpulatova B.A., Djumaniyazova G.I. Monitoring of pest and diseases in Uzbekistan, 2011, "Vestnik" of Kyrgyz Agrarian University, in press;
4. Tashpulatova B.A., Rashidov M.I. 2011 Book: "Tomato production and its protection from pests and diseases", P. 27 (Russsian);
5. Junusov K., Aitmatov M.I., Tashpulatova B.A., Saidov N., Pulatov Z. 2011. Book: "Russian-Uzbek-English-Latin Dictionary" Tashkent, P. 63

Posters and Presentations:
1. "Development of tomato IPM package in Uzbekistan";
2. "Development of biological control of whitefly"
3. "Biological control of diseases in solanaceae crops"

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

I. Long-term Training:

Under the Phase II of the Central Asia IPM CRSP Project, three students, one from each of the three host countries in Central Asia (Tajikistan, Kyrgyzstan, and Uzbekistan) are receiving long-term training at Michigan State University. Through a competitive process, the following three students were selected by the Central Asia IPM CRSP Team in consultations with the host country collaborators.

1. Ms. Shahlo Safarzoda (Female), Tajikistan - Wheat IPM Ph.D Program in Department of Entomology at MSU from Fall 2010 (Major Professor, Dr. Doug Landis).

2. Mr. Bahodir Bahodir Eshchanov (Male), Uzbekistan – Tomato IPM Ph.D Program in Department of Entomology at MSU in collaboration with UC-Davis from Fall 2010 (Major Professors, Dr. George Bird and Dr. Frank Zalom).

3. Ms. Saltanat Mambetova (Female), Kyrgyzstan – Potato IPM Ph.D Program in Department of Crop and Soil Sciences at Michigan State University from Spring 2011 (Major Professor, Dr. David Douches).

II. Short-term Training:

1. **IPM Short Course at Michigan State University**: Two young scientists from Tajikistan and Uzbekistan (Ms. Tanzila Ergasheva and Mr. Murodjon Nasedjanov) were invited to receive short

term training in IPM at Michigan State University in June 2011. They both attended the International Agroecology, IPM and Sustainable Agriculture short course at MSU from June 19 – 29, 2011. This program provided hand-on training on various aspects of ecologically based IPM practices on field crops, vegetable and fruit crops and was taught by more than 20 faculty members at MSU working on various aspects of IPM programs design, implementation and outreach.

2. Workshop on Production of Biological Control Agents at TNAU, Coimbatore, India: Dr. Barno Tashpulatova (Uzbekistan) and Dr. Murat Aitmatov (Kyrgyzstan) attended the training workshop on the 'Production of biocontrol agents' (*Trichoderma* & *Pseudomonas*) from July 18 – 22, 2011held at the Department of Plant Pathology Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore, India. They also visited a private biological control company in Banglore, India.

Objective 6: Links with Global Themes:

The Central Asia regional project maintains active links with the four Global Theme projects of the IPM CRSP (Pest Diagnostics, Viruses, Gender, and Impact Assessment).

1. **Pest Diagnostics:** In collaboration with the Global Theme program, a three-day regional workshop on "pest and disease diagnostics" was organized from June 7 – 10, 2011 in Dushanbe, Tajikistan through the collaborative links with Tajik National University (see the Group Photo below). More than 60 participants from three host countries (Tajikistan, Uzbekistan and Kyrgzystan) attended this workshop along with the students and faculty members from the Tajik National University.

The workshop covered pest diagnostics methods, tools, and techniques encompassing insects, bacteria, fungi, and viruses. There were classroom sessions as well as field visits covering pest diagnostics in specific crops that are of priority to IPM CRSP project. The U.S. and ICARDA collaborators, Dr. George Bird (MSU), Dr. Frank Zalom (UC-Davis), Dr. Walter Pett (MSU), Dr. Megan Kennelly (KSU), Dr. Naidu Raypati (WSU), Dr. Muniappan Rangaswamy (VT), and Dr. Mustapha Bohssini (ICARDA) served as a resource faculty for this workshop along with IPM CRSP Coordinators from Central Asia (Dr. Nurali Saidov, Dr. Murat Aitmatov, Dr. Barno Tashpulatova, and Dr. Ravza Mavlyanova). The participants requested additional in-depth training in Viruses and establishment of a new course in viruses and virus disease management at local universities in Central Asia.

2. Viruses: In June 2011, Dr. Naidu Rayapati visited Tajikistan to assess virus disease problems in vegetables, with emphasis on potato. He collected plant samples suspected for virus infections from potato, onion, peas and beans. Tissue from select samples were directly pressed gently on FTA® cards, allowed to air dry and brought to the Rayapati lab (WSU) for further processing and testing for different viruses. Testing of nucleic acids recovered from FTA cards was carried out by PCR and RT-PCR using group- and species-specific primers for the detection of viruses infecting vegetables and non-vegetable crops. The results indicated the presence of potyviruses in potato, pea and bean samples and *Iris yellow spot virus* in onion samples. None of these samples tested positive for other viruses. Preliminary results indicated that two strains of Potato virus Y (PVY) - an ordinary strain (PVY^{O}) and a tuber necrosis strain (PVY^{NTN}) - could be present in Tajikistan. Further research is being conducted to gain molecular data for accurate identification of PVY strains in potatoes, beans and peas. In addition, FTA cards imprinted with potato samples are being tested for the presence of other potato viruses.

As a part of the Central Asia regional workshop on "pest and disease diagnostics" held in Dushanbe, Tajikistan, during June 7 - 10, 2011, Dr. Naidu Rayapati gave presentations on the nature of viruses, diagnostics, and management in relation to specific crops that are of priority to IPM CRSP. Some host country participants made presentations on their activities and capabilities in virology at their institutions and discussions were held on field- and lab-based diagnosis of plant viruses. A field trip was organized to observe virus disease symptoms in potato fields in two geographically separated regions of Tajikistan. Rayapati demonstrated detection of virus-infected potatoes and onion by visual symptoms in the field. He collected samples from potato plants showing disease symptoms and demonstrated diagnosis of Potato virus Y at the field level using immunostrips. Dr. Rayapati also gave lectures on virus diseases and their management for students at the Tajik National University.

3. Gender Issues in IPM: Addressing gender issues is an important component of the IPM CRSP project. Dr. Linda Racioppi and Dr. Zahra Jamal are providing support towards the gender component of the project in collaboration with the Global Theme Leader Ms. Maria Elisa Christie from Virginia Tech University. Dr. Zahra Jamal and Dr. Linda Racioppi undertook a number of activities in FY 2011, including organizing a monthly Central Asia Faculty Working Group at which presentations were made. Zahra gave a presentation on religion, society and politics in Central Asia to the group. They both oversaw student research. One of those students (who is studying Tajik language) was funded by James Madison College to join the IPM team on its June visit to Tajikistan. He is continuing his research this year under Linda's direction and will complete a senior honor's thesis on gender and rural development in Central Asia. Dr. Racioppi and Dr. Jamal were also active in helping to organize a special one-day symposium before the Central Eurasian Studies Society Conference held at MSU in October 2010. They also organized and participated in a roundtable on gender, society and politics in Central for the CESS Conference. And of course, they engaged in bibliographic research and field work directly related to the IPM CRSP project.

Our major activity with the IPM Team was to attend Regional Workshop in Dushanbe, which brought together faculty and students from a range of partner institutions in the United States, Uzbekistan, Kyrgyzstan, and Tajikistan. As gender specialists on the team, the workshop gave us an opportunity to hear more about the key components of pest diagnostics and their critical role in this project. The Gender Team also gained insights into plant pathology, entomology, virology, especially with respect to the three key crops. The Gender Team especially enjoyed observing the practicums both for our own benefit and to see the ways in which hands-on learning is important for the students. It seemed to us that the practicums were also a hit with students. wonder if they might have been interested in a session on gender issues in IPM as well. The IPM CRSP team might consider adding a pilot gender component at next year's workshop, along with an evaluation so that we could gauge its effectiveness.

Dr. Racioppi and Dr. Jamal were prepared to run gender awareness workshops, as stipulated by the GGT director at VT, for each of the IPM sites. We developed these workshops for women and children of different age cohorts. When it was indicated that running the workshops would not be desirable, we quickly revised our plans, generating an interview protocol. At each site, therefore, we interviewed women farmers to ascertain their perceptions of (a) access to groups and information related to IPM issues, (b) decision-making about crops and seed selection; (c) planting and harvesting processes; (d) pests and their management, including through the use of local [*narodnyi*] plants; (e) capital; (f) land rights; (g) general educational, legal, economic and social contexts; and (h) gender relations in the home as they affect IPM technology uptake.

Women farmers at both sites were interested in extension services being offered solely for women in Tajik close to their farms/homes given that their time is limited and the males in their homes do not assist them with domestic chores. They were interested in seminars, practical workshops, and brochures. Those who have cell phones said that if a useful educational tool were developed for them to access through their phones, they would consider it. This insight should be investigated further to consider who in the home controls use of the cell phone (if it is the men, then women may not be able to access the intended education), how much excess capital farmers have to purchase data plans, etc. The women farmers particularly in Muminabad were keen to highlight a range of local [*narodnyi*] plants, such as *ispand, popalak,* and many others, in the management of pests. In the Muminabad site, they grew these plants very close to the house, which was located within several meters of the field. This might be a point of further investigation for the team's scientists to identify which plants are being used, in what ways, how they may interact with IPM technologies, whether they may attract beneficial or harmful pests, etc. Because focus groups of women were not assembled, a female translator with adequate skills could not be found and there was little time to fully engage with farmers, the effectiveness of information gathering was reduced. Interruptions, no doubt inevitable with a group of our size, also affected the quality and integrity of our research.

The details of findings from interactions with farmers at the field sites can be found in the Gender Global Theme IPM CRSP for Central Asia Trip Report for 2011 and in the Gender Global Theme IPM CRSP Annual Report Fiscal Year 2.

Finally, during a visit to Dushanbe, Dr. Racioppi and Dr. Jamal contacted the only Tajik women's organization that works with rural women. The local NGO called Zan va Zamin (meaning "Women and Land") works with local women farmers across the country, including in Muminabad, on pest management and other IPM related issues. It may be helpful to engage them in a conversation with our team's scientists.

4. Impact assessment of IPM CRSP project activities in Central Asia: Following activities were undertaken by Dr. Richard Bernsten and Dr. Mywish Marediain FY 2011 under the impact assessment component.

1. A focused discussion with the wheat research team member at MSU was conducted to better understand the research activities planned and their impact pathway. A detailed log-frame was

developed to document and inventory the wheat research team's plans to generate major outputs, outcomes and realization of the vision of success. The results of this analysis are detailed in Table 30. Major outputs expected from wheat IPM research in Tajikistan include increase in farmers' knowledge and awareness of pest complexes and method/practices to control them. Other outputs expected from a student's thesis research include identification and promotion of varieties resistant to major pests and disease in the region. To translate these outputs into outcomes and impacts beyond the demonstration fields, the research team has integrated strategy for large-scale dissemination of project outputs, which include, engaging with the local research institutes and universities in the conduct of research and dissemination, conducting regional workshops, organizing field days, developing training materials and publications, and engaging with local bio labs to introduce parasitoids into the cropping system.

Important elements of the impact pathway analysis are the identification of outcomes in terms of size/scale of expected adoption, use and uptake of research outputs by the end users and a time frame for achieving these outcomes. Unfortunately, the wheat research team was unable to provide this information to the impact assessment team as they found it too 'speculative' to estimate that at such as early stage of the research project. Despite this limitation, the exercise proved useful and will help guide the scope of the baseline survey in Tajikistan planned in coming months.

We are awaiting similar information from the potato (Kyrgyzstan) and tomato (Uzbekistan) research teams, so we can complete the pathway for these two crops.

2. Baseline assessment: The impact assessment team met with Dr. Tanzila Ergasheva (Head of the Department of Multi-sectorial Economy for the Agricultural Sector, Institute of Agricultural Economics, Tajik Academy of Agricultural Science), during her visit to MSU in Summer 2011. As an outcome of this meeting, Dr. Ergasheva has been identified as the host country collaborator for undertaking the baseline survey in Tajikistan. Data needs were identified and a detailed plan for questionnaire design, pre-testing, sampling, implementing the farm survey, data entry and data analysis has been developed. The plan is to conduct the survey in November-December 2011.

This baseline survey will include: a) data on input, output, and price; b) crop management practices (including the use of biological, cultural, chemical, etc.) and their associated costs; c) farm household characteristics and demographic data; d) farmer perspective on potential constraints to adoption of IPM technologies; e) gender role in the cropping systems of focused commodities.

"Given the limited budget, it will not be possible to carry out a farm-level survey in Uzbekistan or Kyrgyzstan. However, in the coming FY we will carry out key informant surveys to collect baseline information."

Table 30. Impact pathway for Wheat IPM research in Tajikistan

	Research activities planned	Expected Outputs **by 2014**	Plan/Strategy for large scale dissemination of project outputs	Expected Outcomes from your research (i.e., maximum scale of adoption you reasonably expect from your efforts of dissemination noted in previous column)	Time frame for achieving each outcome
1. IPM demonstration plots for wheat	Planned **every year** in two sites in **TAJIKISTAN and will include the following IPM packages.** **Site 1: Spitamen district of Sogd region** (Northern Tajikistan) • Resistant variety to rusts with flowering plants along side to enhance Sunn pest egg parasitoids. • Cultural practices (planting date, seed rate, fertilizer application, and weed control) • Hand collection of Sunn pest adults during 2-3 weeks beginning at the time of migration to wheat fields. **Site 2: Andreevka village, Hissor district** (South part of Tajikistan) • Resistant variety to rusts with flowering plants along side to enhance cereal leaf beetle parasitoids. • Cultural practices (planting date, seed rate, fertilizer application, and weed control). • Weed management with Cultural practices and application of low toxic herbicides	For those farmers in FFS (i.e., 50-60 in Tajikistan): • Farmers knowledge of pest complexes increased • Farmers recognize the value of rust resistant wheat varieties • Farmers recognize the value of CLB resistant wheat varieties • Famers made aware of good cultural practices • Increase in farmers' knowledge of habitat management for natural enemies for the control of Sunn Pest (site 1) • Increase in farmers' knowledge of habitat management for natural enemies for the control of CLB (site 2)	• Engage local research and institutes and universities in the conduct of research and dissemination • Conduct regional workshops • Organize Field days (invite larger groups of farmers beyond FFS participants) • Engage with bio labs to introduce parasitoids • Develop training materials and publication of brochure and leaflet on wheat pest and disease control • Develop publications in peer reviewed venues	1. Adoption of resistant varieties by farmers Not able to indicate scale of adoption	1. The team was not able to provide this information
				2. Adoption of improved cultural practices by farmers Not able to indicate scale of adoption	2. The team was not able to provide this information
				3. Adoption of bio control methods to control CLB and Sunn pest by farmers Not able to indicate scale of adoption	3. The team was not able to provide this information

	Research activities planned	Expected Outputs **by 2014**	Plan/Strategy for large scale dissemination of project outputs	Expected Outcomes from your research (i.e., maximum scale of adoption you reasonably expect from your efforts of dissemination noted in previous column)	Time frame for achieving each outcome
2. Farmer Field Schools	FFS of 25-30 farmers at each of the above two sites. These farmers will meet regularly to learn about how to produce a good wheat crop. They will also learn about the biology of Sunn pest, Yellow rust, the damage they cause, the economic threshold, natural enemies, and hand collection for Sunn pest management, and safe use of pesticides.				
3. Student research projects in three countries	**<u>Tajikistan:</u>** Screen Yellow leaf rust resistant varieties; identify alternate rust hosts; Identify Rust overwintering sites; Screen Cereal leaf beetle resistant varieties; Survey Cereal leaf beetle parasitoids **<u>Kyrgyzstan:</u>** Screen cereal leaf beetle resistant variety screening; Survey of Cereal leaf beetle parasitoids. **<u>Uzbekistan:</u>** Evaluate the effect of flowering plants such as coriander, dill, sweet basil, ziziphora, marigold and winter cress in enhancing Sunn Pest egg parasitoids; Conduct wheat nematode survey	• CLB resistant wheat varieties identified for introduction (Tajikistan and Kyrgyzstan); • Rust resistant wheat varieties identified for introduction (Tajikistan) • Greater knowledge about the presence (or absence) of parasitoids to control CLB -->improved cultural practices and biocontrol methods • Greater knowledge about the presence (or absence) of parasitoids to control Sunn pest-->improved cultural practices and biocontrol methods			