1. COVER PAGE
Award Period (e.g. Spring 2012): Fall 2014
Principle Investigator(s) Alex Latchininsky
Department: Ecosystem Science and Management
Email: latchini@uwyo.edu
Project Title from Application: Biological Control of Rangeland Grasshoppers in Wyoming: Insights from Russia
Amount spent: $4,000
Non-technical summary: Provide a one paragraph non-technical summary that most people can understand. **Maximum of 1500 characters plus spaces**.

Project summary

Travel to Astrakhan, Lower Volga region in Southern Russia was undertaken in May 2014. The PI assisted the local specialists from the Russian Agro Center in planning and executing lab and field trials of two biopesticide formulations of pathogens, the fungus *Beauveria tenella* and the microsporidian *Paranosema maroccanus* against hoppers of Migratory locust *Locusta migratoria*. Application of the fungus resulted in 87% mortality of test insects two weeks after treatment in the lab and 65% mortality in the field. Treated hoppers started to show first signs of fungal infection (reduced feeding and movement) 6 days after treatment. The microsporidian caused up to 60% mortality of hoppers in both lab and field tests. Methods of fungal pathogen cultivation using artificial media were also studied. Ways to increase the biopesticide efficacy, including using adjuvants for UV-light protection and better adherence of biopesticide formulations to treated plants were examined. Project results suggest that the two studied pathogens may be perspective for use against pest rangeland grasshoppers in the Western US, provided the appropriate permits and clearances are received from USDA-APHIS-PPQ. Of particular interest are the methods of increasing the biopesticide efficacy using different adjuvants. These techniques can be applied to biopesticide formulations currently used against pest grasshoppers in the US.

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2. REPORT: Maximum of two pages of text plus unlimited photos. Must be written in a style understandable by the lay person.
Include:
1. Main results of activities planned in the proposal**.**
2. Describe any future plans
3. Outline potential impacts to a) the College of Agriculture and Natural Resources, b) the University of Wyoming, and c) the State of Wyoming

Biological Control of Rangeland Grasshoppers in Wyoming: Insights from Russia

Principal Investigator: Alexandre V. Latchininsky, Dept. of Ecosystem Science and Management, College of Agriculture and Natural Resources

PROJECT REPORT

All planned project activities were fulfilled and all objectives achieved.

1. The PI became familiar with the spectrum of pathogens, natural enemies of locusts and grasshoppers in Russia, which are currently used there for microbiological control of these pests. These pathogens include fungi *Beauveria bassiana, Beauveria tenella* and *Metarhizium anisopliae* and a Protozoa microsporidian *Paranosema maroccanus.*

The fungus *Beauveria tenella* is formulated in the form of suspension of spores (conidia) in a vegetable oil. The concentration of spores is 1×10^{12} per liter. The recommended application rate varies from 0.5 to 1.0 liter of the biopesticides formulation per hectare. Two sets of experiments, one in the lab, and the other under field conditions were executed in collaboration with specialists from the Astrakhan Division of the Russian Agro Center of the Russian Ministry of Agriculture. In the lab, the biopesticide formulation was applied in cages to 20 early-instar hoppers of the Migratory locust *Locusta migratoria* at a dose rate equivalent to 1 l/ha. There were 4 replicates.

Treated insects started to exhibit signs of fungal infection (a disease called “white muscardine”) as early as 6 days after application. Their feeding was decreased, they became sluggish and slow-moving. Two weeks after treatment, the average insect mortality was 87.2%. In the small-scale field trials, the biopesticide formulation was applied to early-instar hopper bands of *Locusta migratoria*. Pest density was very high ranging from 1.500 to 2.200 individuals per square meter. The application rate was one liter of formulation per hectare. Treated hopper bands were followed daily for a two-week period. The treated hopper bands lost their aggregation; the insects slowed down their movement and feeding 8 days after application. The biopesticide yielded an average 65.1% mortality two weeks after treatment.

Application of another biopesticide, a formulation of spores of microsporidian *Paranosema maroccanus* followed the same protocol as described above. It was less successful and inconsistent producing between 32% and 60% hopper mortality two weeks after treatment.

During these two sets of experiments, the PI received first-hand experience in working with microbiological pesticides used in Russia, which would not has been possible without in-person travel.

2. PI learned about methods of formulation of biopesticides used for locust and grasshopper control in Russia. Of particular interest was the use of several adjuvants, which aimed at increasing the efficacy of the biopesticide formulation. Being made of fungal spores, the biopesticide is a living organism. The spores are vulnerable to elements, especially to direct sunlight. To ensure the UV-light protection, certain adjuvants were added to the biopesticide formulation. This allowed increasing the duration of the action of the biopesticide, which remained available on treated vegetation for 3 to 7 days longer than the formulation without the adjuvants. Fungal pathogens need to get in contact with host insects in

order to infect them. During application, some spores fall directly on insects, while others fall on vegetation or soil. The longer such spores stay alive, the longer they are available for the insects to pick them up and subsequently become infected. Applying adjuvants which increase the spore longevity results in increasing the biopesticide efficacy.

3. The studied biopesticides, particularly the one based on the fungus *Beauveria tenella* are of interest for possible use to control rangeland grasshoppers in the US, particularly in Wyoming. Bringing an exotic pathogen to the US for grasshopper biological control is a laborious venture involving a rigorous permit and clearance process by USDA-APHIS-PPQ. Currently there is a precedent: an African strain of fungus *Metarhizium acridum* is being studied by USDA-ARS with an objective of applying this biopesticide for grasshopper biocontrol on Western rangelands. It causes a disease called "green muscardine," which kills grasshoppers two to three weeks after application. The fungus is known to be very specific as it attacks only insects from the order Orthoptera.

FUTURE PLANS

Results of the present Global Perspective project will be reported in January 2015 at the Annual Meeting of the US National Grasshopper Management Board in Denver, CO. Should APHIS-PPQ find them of interest, the permitting process to bring the promising Russian strains of entomopathogenic fungi may be started for *Beauveria tenella.* The use of such biopesticides will allow for a more environmentally friendly method of rangeland grasshopper control in the US.

Research on biological control of locusts and grasshoppers using pathogens will continue in Russia, and further contacts of UW researchers with specialists of the Russian Agro Center will be mutually beneficial for both sides. It is planned to submit a joint UW-Russian Agro Center grant proposal application on the subject to Civilian Research and Development Foundation on developing locust and grasshopper biopesticides.

POTENTIAL OUTCOMES

Potential impacts to the *College of Agriculture and Natural Resources* include enhanced opportunities for research and graduate student training in the domain of biological control of pest grasshoppers.

The *University of Wyoming* benefits from the project by maintaining its international reputation as the world-renowned leading institution and source of expertise in the domain of applied acridology, i.e. practical locust and grasshopper control. Methods developed during the project can be extended to other geographic areas where these pests threaten food security of rural populations.

The *State of Wyoming* benefits from the project as it offers a promising agent for grasshopper biological control. Rangeland grasshoppers are recurrent pests, and during outbreaks they are controlled on millions of acres. For example, in 2010, six million acres of Wyoming rangelands were protected from pest grasshoppers with insecticide applications. Biopesticides will allow reducing the negative impact of chemical pesticides on the environment, resulting in increased benefits to state ranchers and to rangeland biodiversity.

P H O T O S

Photo 1. Swarm of adult Migratory locusts in Astrakhan, S. Russia. ©I. Zanchipova

Photo 2. Adult female Migratory locust. ©A. Latchininsky

Photo 3. Typical vegetation – common reed *Phragmites australis* – in the Migratory locust habitat in Astrakhan, S. Russia. ©I. Zanchipova

Photo 4. Reed damage by Migratory locust in Astrakhan, S. Russia. ©I. Zanchipova

Photo 5. Chemical treatments against Migratory locust in Astrakhan, S. Russia. ©I. Zanchipova

Photo 6. High density hopper bands of Migratory locust in Astrakhan, S. Russia, which were treated with biopesticides. ©I. Zanchipova

Photo 7. Hopper band of Migratory locust in Astrakhan, S. Russia, which lost its aggregation after treatment with biopesticide. ©I. Zanchipova

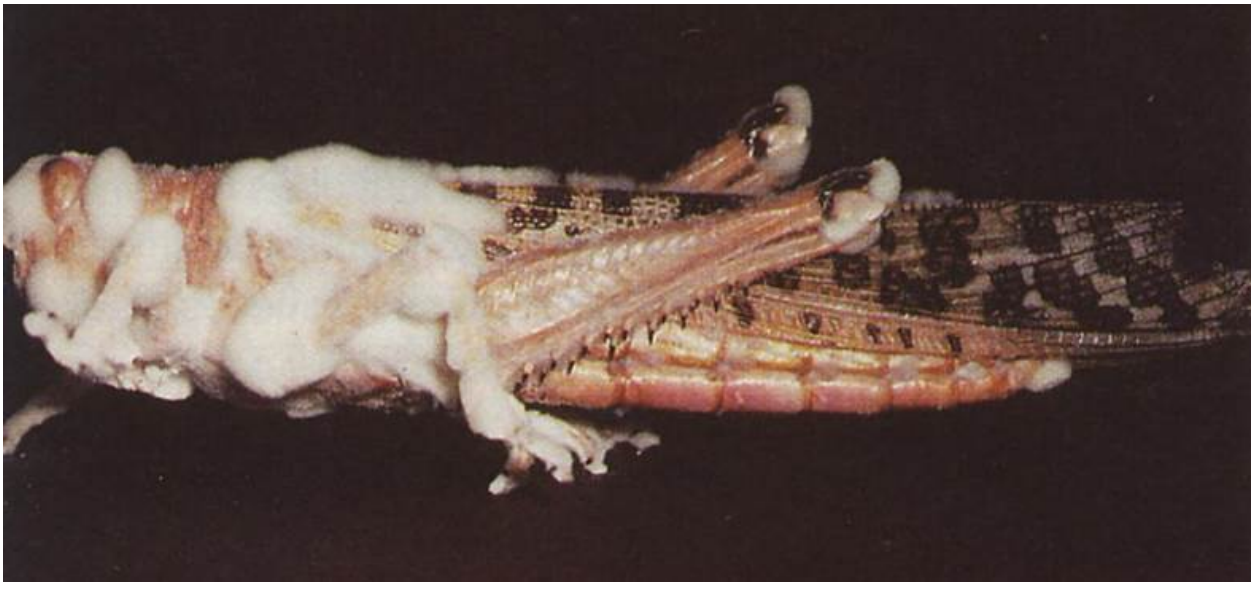

Photo 8. Adult locust infected with fungus *Beauveria basiana.* ©C. Lomer

Photo 9. Locust nymph infected with fungus *Metarhizium acridum.* ©S. Jaronski

Photo 10. Grasshoppers infected with fungus *Metarhizium anisopliae.* ©S. Jaronski