CGAHR
Center for Grain & Animal Health Research

Research Kernels

Our Latest Research Results - August 2013 part 1

Effect of condensed tannins from sorghum (*Sorghum Bicolor* (L.) Moench) on *in vitro* starch digestibility and α-amylase activity

Authors: N.L. Mkandawire, R.C. Kaufman, S.R. Bean, C.L. Weller, D.S. Jackson, D.J. Rose
Submitted to: Journal of Agricultural & Food Chemistry
Recently, the effects of sorghum tannins on starch digestibility in humans have been of interest, since tanins may inhibit starch digestion and contribute to reducing glycemic index and increasing resistant starch. Sorghum tannins could inhibit starch digestion by binding to starch or by inactivating starch degrading enzymes. Tannin containing sorghum lines have been reported to vary widely not only in tannin content, but also in molecular weight and antioxidant activity. Thus, the objectives of this study were 1) to determine the effect of tannins on starch digestion and 2) to investigate the mode, if present, in which tannins inhibit digestion of cooked starches. Significant variability was seen in the impact on starch digestibility in cooked sorghum samples from a diverse set of tannin-containing sorghum varieties. Data collected in this study indicate that sorghum tannins reduce starch digestibility by binding starch digestive enzymes rather than starch. The degree of amylase inhibition depended on tannin molecular weight, with high molecular weight tannins having greater inhibitory activity. This research points out the importance of considering tannin chemistry in addition to simply tannin content when developing sorghum lines with improved human health characteristics.
Contact Scott Bean, telephone 785-776-2725, email Scott.Bean@ars.usda.gov

Development of phytosanitary cold treatments for oranges infested with *Bactrocera invadens* and *B. zonata* (Diptera: Tephritidae) by comparison with existing cold treatment schedules for *Ceratitis capitata* (Diptera: Tephritidae

Authors: G.J. Hallman, S.W. Myers, M.F. El-Wakkad, M.D. Tadrous, A.J. Jessup
Submitted to: Journal of Economic Entomology
A new invasive fruit fly attacking a wide variety of fruits has been described in Africa (*Bactrocera invadens*). It is rapidly spreading throughout central Africa and threatens other continents. As part of management strategies, phytosanitary treatments are needed. Cold treatments were attempted for *B. invadens* and another invasive fruit fly for which treatments are lacking, *Bactrocera zonata*, by comparison with the Mediterranean fruit fly (Medfly), for which cold treatments exist. Oranges were infested by puncturing holes in the peel and allowing the flies to oviposit there. Results show that *B. invadens* is less cold tolerant than Medfly and *B. zonata* at 1.0±0.1°C and lend support to the use of Medfly cold treatments for *B. invadens*. It cannot be concluded that Medfly cold treatments could be used against *B. zonata* because *B. zonata* could be more cold tolerant than Medfly.
Contact Guy Hallman, telephone 785-776-2705, email Guy.Hallman@ars.usda.gov

Role of Non-Covalent Interactions in the Production of Visco-Elastic Resins from Zein

Authors: B.M. Smith, S.R. Bean, G. Selling, D. Sessa, F.M. Aramouni
Submitted to: Journal of Food Chemistry
Isolated zein has been shown to produce wheat-like dough when mixed at elevated temperatures or in the presence of plasticizers and zein-starch mixtures have been successfully used in the production of wheat-free bread. How zein is able to form dough is not fully understood however. Thus, the purpose of this research was to investigate various types of protein-protein interactions and their role in zein dough formation. Non-covalent interactions were found to play a critical role in zein's ability to form dough and zein functionality was very sensitive to salts such as sodium chloride. This information will be useful in developing both food and industrial products from zein.
Contact Scott Bean, telephone 785-776-2725, email Scott.Bean@ars.usda.gov

Soil and Environmental Benefits of Cover Crops in the Semiarid Central Great Plains

Authors: H. Blanco-Canqui, J.D. Holman, A.J. Schlegel, J. Tatarko
Submitted to: Soil Science Society of America Journal
Substituting cover crops for the fallow period in crop-fallow systems may improve soil properties. We assessed whether replacing fallow in no-till winter wheat-fallow with winter and spring cover crops for five years reduced wind and water erosion, increased soil organic carbon, and improved soil physical properties on a Ulysses silt loam in the semiarid central Great Plains. Winter triticale, winter lentil, spring lentil, spring pea, and spring triticale cover crops were compared with wheat-fallow and continuous wheat. We also studied the effect

of triticale haying on soil properties. Results indicate that spring triticale and spring lentil increased soil aggregate size, while spring lentil reduced the wind erodible size aggregates by 1.6 times, indicating that cover crops reduced the soil's susceptibility to wind erosion. Cover crops also increased wet aggregate stability and reduced runoff loss of sediment, total P, and Nitrate-N. Winter and spring triticale increased organic carbon in the soil by 500 pounds per acre per year and spring lentil increased soil organic carbon by 393 pounds per acre per year in the top 3 inches. Aggregate size increased and wind erodible size aggregates decreased with cover crop-induced increase in soil organic carbon content. Harvesting Triticale straw compared with no haying for five years did not affect soil properties. Nine months after the completion of the study, cover crops had, however, no effects on soil properties, suggesting that cover crop benefits are short lived in this climate. Overall, no-till cover crops, grown in each fallow phase, can reduce soil erosion and improve soil properties in this semiarid climate.

Contact John Tatarko, telephone 785-537-5542, email John.Tatarko@ars.usda.gov

Dosage rate, temperature, and food source provisioning affect susceptibility of flour beetles to insecticide Phantom®

Authors: F.H. Arthur
Submitted to: Journal of Pest Science

Phantom® is a new insecticide that is being evaluated for control of stored-product insects. A series of tests was conducted to evaluate residual control of adult flour beetles and also determine if the presence of a food source compromised effectiveness of the insecticide. No adult red flour beetles survived exposure to the maximum label rate, and no progeny were produced. A ten-fold reduction in application rate also produced complete mortality and complete progeny suppression of red flour beetles. Starvation of adult red flour beetles and adult confused flour beetles increased susceptibility to the insecticide, but when these starved beetles were given food after exposure survival increased. Also, the confused flour beetle was the more tolerant species. Results show the importance of specific identification of target insect pests and also the importance of sanitation in conjunction with pesticide applications.

Contact Frank Arthur, telephone 785-776-2783, email Frank.Arthur@ars.usda.gov

Phytosanitary Cold Treatment for Oranges Infested with *Bactrocera zonata* (Diptera: Tephritidae)

Authors: G.J. Hallman, S.W. Myers, G. Taret, E. A. Fontenot, M.J.B. Vreysen
Submitted to: Journal of Economic Entomology

The peach fruit fly (PFF) attacks many fruits and occurs from Egypt to Vietnam. Occasionally it is trapped in subtropical US states and may result in costly quarantines until it is declared eradicated. Treatments are required to export fruit hosts of the pest out of quarantined areas to non-infested areas where it could become established. This research describes a cold treatment of 18 days at 1.7°C (35°F) that was developed for infested oranges. The PFF was not found to be less cold tolerant than the Mediterranean fruit fly; therefore, treatments for the latter could not be used for PFF. PFF was found to be more susceptible to cold than the Mexican fruit fly (Mexfly); therefore, treatment schedules for Mexfly could be used for PFF. However, the treatment for Mexfly requires 22 days. A shorter treatment was desired and verified for PFF when a total of 36,820 large larvae reared in oranges were treated at 1.7°C for 18 days with no larvae moving upon examination 24 hours after cold treatment. This information will be useful for developing treatments for fruits exported from quarantine areas.

Contact Guy Hallman, telephone 785-776-2705, email Guy.Hallman@ars.usda.gov

USDA-ARS Center for Grain and Animal Health Research

1515 College Avenue
Manhattan, KS 66502

800-627-0388
ars.usda.gov/npa/cgahr

CGAHR
Center for Grain & Animal Health Research

Research Kernels

Our Latest Research Results - August 2013 part 2

Distribution of Psocids (Psocoptera) in Temperature Gradients in Stored Wheat

Authors: J.E. Throne, P.W. Flinn
Submitted to: Journal of Stored Products Research

Psocids (insects which are also called booklice) are pests of stored grains in most of the world, but little is known about their behavior or ecology. We examined distribution of three of the main psocid pests of stored grain in temperature gradients in small bulks of wheat to determine their ecological preferences. Few psocids were found in the coolest region of the grain, which was at 68 degrees F. Psocids consistently preferred the warmest regions of the gradients, except when the high temperatures reached 108 degrees F. Females of *Liposcelis bostrychophila* and both sexes of *L. paeta* still preferred this warmest region of the grain, but not *L. entomophila* males and *L. entomophila* females were evenly split between the warm and hot regions of the grain. Temperatures can be below 68 degrees F. during much of the storage season for grains, so the current results help to explain why psocids move to warmer regions of the grain which occur toward the center of the grain mass as grain temperatures cool in the fall. This may allow psocid populations to continue to grow during the colder months. Knowing how different species of psocids respond to temperature gradients in grain may help us improve sampling and management methods for psocids as the temperatures in a grain mass change throughout the year.

Contact James Throne, telephone 559-596-9757, email James.Throne@ars.usda.gov

Variation in susceptibility of laboratory and field strains of three stored-grain insect species to beta-cyfluthrin and chlorpyrifos-methyl plus deltamethrin

Authors: B. Sehgal, B. Subrmanyam, F.H. Arthur, B.S. Gill
Submitted to: Journal of Economic Entomology

Residual insecticides are often applied inside grain bins before grains are loaded into the bin or to structural surfaces supporting those bins, and there are questions regarding effectiveness of insecticides on field strains of stored product insects compared to laboratory strains. We exposed different fields strains of some common stored product insects on concrete treated with labeled insecticides, and then placed them on untreated concrete with flour. Insects survived when given food, there was variation among the insecticides regarding effectiveness for control of the field strains, and in general the field strains were harder to kill than comparable laboratory strains. Results show that no single insecticide was completely effective for control of all species and field strains, and application of a specific residual insecticide may depend largely on the intended target species.

Contact Frank Arthur, telephone 785-776-2783, email Frank.Arthur@ars.usda.gov

Variation in susceptibility of field strains of three stored grain insect species to spinosad and chlorpyrifos-methyl plus deltamethrin on wheat

Authors: B. Sehgal, B. Subrmanyam, F.H. Arthur, B.S. Gill
Submitted to: Journal of Economic Entomology

Grain protectants are insecticides that are applied as the grain is being loaded into a grain bin or elevator silo. In the United States, there is one grain protectant called Storicide II that has only been sold for several years, and another one called spinosad that is registered but not yet sold, but there are no studies evaluating different field strains of stored-grain insects for susceptibility to these new products. We exposed different field strains of several insect species on wheat treated with these two new insecticides. The Storicide II insecticide killed adults of all the various field strains of the insect species and prevented reproduction. The spinosad insecticide was more effective on some species than others, and field strains of some species were harder to kill than the laboratory strains. Results show that field strains of insect species may not be as susceptible to certain insecticides as laboratory strains, and this factor should be taken into account when introducing new grain protectants into management programs.

Contact Frank Arthur, telephone 785-776-2783, email Frank.Arthur@ars.usda.gov

Experimental infection of white-tail deer with Northern European bluetongue virus serotype 8

Authors: B.S. Drolet, L.M. Reister, T.D. Rigg, P. Nol, B.K. Podell, J.O. Mecham, K.C. Vercauteren, P.A. Van Rijn, W.C. Wilson, R.A. Bowen
Submitted to: Veterinary Microbiology

Bluetongue is an insect-transmitted, economically important disease of sheep, cattle, deer and antelope. Of the 26 types of bluetongue virus (BTV), only five are considered endemic to the U.S., but 10 exotic types have been found in the southeast since 1999.

Introductions of new types of BTV into the U.S. is a constant disease threat to livestock owners. Exotic types can become established if there are susceptible animals and insects to transmit it. One type of particular concern, BTV type 8, was recently introduced into Northern Europe causing unprecedented livestock disease and mortality. In the U.S., sheep and white-tailed deer (WTD) are the primary sentinel livestock and wildlife species, respectively, and the insects that transmit BTV feed on both. To determine if WTD could be infected by type 8, and understand the role they could play in disease spread if a similar introduction were to occur, deer were experimentally exposed to virus. All deer became infected, amplified the virus, and developed moderate to severe disease. We conclude that North American WTD are highly susceptible to BTV type 8 and may play an important role as virus sources for biting insects and disease spread.
Contact Barbara Drolet, telephone 785-537-5569, email Barbara.Drolet@ars.usda.gov

A heterozygous moth genome provides insights into herbivory and detoxification

Authors: M. You, Z. Yue, W. He, X.Yang, G. Yang, M. Xie, D. Zhan, S.W Baxter, L. Vasseur, G.M Gurr, C.J Douglas, J. Bai, P. Wang, K. Cui, S. Huang, X. Li, Q. Zhou, Z. Wu, Q. Chen, C. Liu, B. Wang, X. Li, X. Xu, C. Lu, M. Hu, J.W. Davey, S.M Smith, M.S. Chen, X. Xia, W. Tang, F. Ke, D. Zheng, Y. Hu, F. Song, Y. You, X. Ma, L. Peng, Y. Zheng, Y. Liang, Y. Chen, L. Yu, Y. Zhang, Y. Liu, G. Li, L. Fang, J. Li, X. Zhou, Y. Luo, C. Gou, J. Wang, J. Wang, H. Yang, J. Wang
Submitted to: Nature Genetics
The diamondback moth, *Plutella xylostella*, is a serious pest of vegetable worldwide. The insect feed on plants that produce glucosinolates, which are toxic to other types of insects. The diamondback moth is also highly capable of developing new strains that are resistant to various synthetic chemical pesticides. This study sequenced and analyzed the whole genome of the diamondback moth. The genome is highly heterogeneous and contains 18,071 protein-coding and 1,412 unique genes. Several gene families associated with perception and the detoxification of plant defense compounds are expanded in comparison with those of other insect species. Particularly, a recent expansion of retrotransposons near detoxification-related genes and a wider system used in the metabolism of plant defense compounds are shown to be involved in the development of insecticide resistance. This work revealed genetic and molecular bases for an herbivore to adapt toxic chemicals of host plants.
Contact Ming-Shun Chen, telephone 785-532-4719, email Ming-shun.Chen@ars.usda.gov

'Billings' Wheat Combines Early Maturity, Disease Resistance, and Desirable Grain Quality for the Southern Great Plains of the USA

Authors: R.M. Hunger, J.T. Edwards, R.L. Bowden, L. Yan, P. Reyes-Duarte, G. Bai, G.W. Horn, J.A. Kolmer, K. Giles, M.-S. Chen, Y. Jin, R.D. Osbrun, M.BG. Bayles, B.W. Seabourn, A.R. Klatt, B.F. Carver
Submitted to: Journal of Plant Registrations
The new hard red winter wheat cultivar 'Billings', released in 2009 by the Oklahoma Agricultural Experiment Station, was derived from a cross of Great Plains × eastern European germplasm lines. It has improved fungal disease resistance, large kernel size, superior yielding ability, and favorable quality. Billings is widely adapted to the region and seed is available for commercial production.
Contact Robert Bowden, telephone 785-532-2368, email Robert.Bowden@ars.usda.gov

Molecular Markers for Leaf Rust Resistance Gene *Lr42* in Wheat

Authors: Z. Liu, G. Bai, R. Bowden
Submitted to: Crop Science
Wheat leaf rust is an important wheat foliar disease worldwide. Growing resistant cultivars is one of the most effective approaches for the disease control. *Lr42* is gene from a wheat relative *Aegilops tauschii* Coss and shows resistance to leaf rust after it was transferred into a hard winter wheat 'KS93U50'. In this study, we confirmed *Lr42* on the short arm of chromosome 1D and located it between DNA markers *Xwmc432* and *Xgdm33. Lr42* was recessive when rust pathogen isolate PNMR was inoculated. The DNA markers for *Lr42* should be useful for cloning of *Lr42* and stacking *Lr42* with other resistance genes in breeding.
Contact Robert Bowden, telephone 785-532-2368, email Robert.Bowden@ars.usda.gov

USDA-ARS Center for Grain and Animal Health Research

1515 College Avenue
Manhattan, KS 66502

800-627-0388
ars.usda.gov/npa/cgahr