2013 Annual Meeting
Western Society of Crop Science
June 11-12, Pendleton, OR

Water, Food, Energy, & Innovation for a Sustainable World

Notes:
- WSCS meeting registration will be at the Pendleton Ag Research Center on Tuesday. The address is 48037 Tubbs Ranch Road, Adams, OR 97810
- There will be a shuttle from the Wildhorse Resort, leaving from the main front doors at approximately 7:00 am. It will also be available for return transportation at 1:00 pm.
## Agenda Pendleton Agricultural Research Center Field Day Tuesday June 11, 2013

<table>
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<tr>
<th>Time</th>
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<tr>
<td>7:45</td>
<td>Registration</td>
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<tr>
<td>8:10</td>
<td>Welcome and Introduction</td>
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<tr>
<td>8:15</td>
<td>Dr. Dan Arp, OSU Dean of Agricultural Sciences</td>
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<td>8:25</td>
<td>Blake Rowe, CEO Oregon Wheat</td>
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<td><strong>Group 1 Tour</strong></td>
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<td>Loading Buses</td>
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<tr>
<td>8:45</td>
<td>“New Insights into Diseases And Disease Management”</td>
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<td>8:45</td>
<td>Dr. Dick Smiley, OSU Plant Pathologist</td>
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<td>8:45</td>
<td>“Nitrogen Fertilization Timing on Biennial Canola and the Potential for Forage Production”</td>
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<td>8:45</td>
<td>Dr. Jack Brown, UI Plant Breeder</td>
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<td>8:45</td>
<td>Dr. Don Wysocki, OSU Extension Soil Scientist</td>
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<td>9:20</td>
<td>“Update on Winter Wheat Breeding”</td>
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<td>9:20</td>
<td>Dr. Bob Zemetra, OSU Wheat Breeder</td>
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<td>9:20</td>
<td>“Screening for Resistance to Wheat Diseases”</td>
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<td>9:20</td>
<td>Dr. Chris Mundt, OSU Plant Pathologist</td>
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<td>9:45</td>
<td>“State Wide Wheat Variety Trials”,</td>
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<td>9:45</td>
<td>Dr. Mike Flowers, Extension Cereal Specialist</td>
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<td>9:45</td>
<td>“Growth Regulator Herbicide Impacts on Seed Production in Downy Brome”</td>
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<td>Dr. Dan Ball, OSU Weed Scientist</td>
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<td>10:05</td>
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<td>10:25</td>
<td>“Vegetation Index Development with Unmanned Aerial Systems”</td>
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<td>10:25</td>
<td>Dr. Dan Long, USDA-ARS Agronomist</td>
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<td>Dr. John Sulik, USDA-ARS Post Doc</td>
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<td>10:25</td>
<td>“Malt, Feed, and Food: An OSU Barley Update”</td>
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<td>Scot Fisk, OSU Barley Breeding Program</td>
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<td>10:25</td>
<td>Brigid Meints, OSU Barley Breeding Program</td>
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<td>10:50</td>
<td>“Winter Field Peas: Alternative Fall Seeded Crop for NE Oregon”</td>
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<td>Dr. Kurt Braunwart, Progene Plant Research LLC</td>
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<td>11:15</td>
<td>“Quinoa, a Potential Dryland Crop”</td>
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<td>Dr. Steven Petrie, Yara US</td>
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<td>Dr. Stephen Machado, OSU Agronomist</td>
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<td>12:00</td>
<td>Hosted Lunch</td>
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<td>Loading Buses for return to Wildhorse</td>
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1:00 pm-2:00pm  WSCS On-site Registration

Professional Oral Presentation Section I  Moderator: Earl Creech

2:15pm – 2:30pm
Welcome and Opening Remark, Dr. Stephen Machado, WSCS President

2:30pm – 3:00pm
Climate Condition and Agricultural Systems in the PNW Inland Region, Dr. Stephen Machado, Pendleton Agricultural Research Center, Oregon State University.

3:00pm-3:20pm
Multi-Year Yield and Quality Performance of Cereal Forages in Montana. David Wichman, Research Centers, CARC Montana State University, Moccasin, MT, Peggy F. Lamb, Montana State University, Havre, MT, Martha knox, Research Centers, WARC Montana State University, Corvallis, MT, James E. Berg, Montana State University, Bozeman, MT and Valtcho Jeliazkov Zheljazkov, SREC University Wyoming, Sheridan, WY (Abstract id# 78213)

3:20pm-3:40 pm
Review of Sunflower Water Management Research. Abdelfettah Berrada, Colorado State University, Yellow Jacket, CO (Abstract id# 77896)

3:40pm-4:00pm
Soybeans for Hay Production. O. Steven Norberg\textsuperscript{1}, Earl Creech\textsuperscript{2}, Don A. Llewellyn\textsuperscript{3}, Kefyalew Girma Desta\textsuperscript{4}, Steven C. Fransen\textsuperscript{4} and Joseph Shannon Neibergs\textsuperscript{5}, (1)Washington State University, Pasco, WA, (2)Utah State University, Logan, UT, (3)Extension, Washington State University, Kennewick, WA, (4)Washington State University, Prosser, WA, (5)Ag. Economics, Washington State University, Pullman, WA (Abstract id# 78090)

4:00pm-4:20pm
Foliar Applied Nitrogen Fertilizers in Spring Wheat. Olga S. Walsh\textsuperscript{1}, Robin Christiaens\textsuperscript{1} and Martha Knox\textsuperscript{2}, (1)Western Triangle Ag. Research Center, Montana State University, Conrad, MT, (2)Western Ag. Research Center, Montana State University, Corvallis, MT (Abstract id# 77248)

Tuesday Evening – Dinner on your own.
June 12, 2013, Wednesday

7:30am – 8:15am On-site Registration

Student Oral Competition Section  Moderator: Leonard Lauriault

8:20 am-8:40 am
Seedling Vigor of Switchgrass Influenced By Cold Storage Temperatures. Emi Kimura, Washington State University, Pullman, WA and Steven C. Fransen, Washington State University, Prosser, WA (Abstract id# 77938)

8:40am-9:00am
Genetic Mapping of Quantitative Trait Loci Associated With Important End-Use Quality Parameters in the Winter Wheat (Triticum aestivum L.) Cross ‘Coda' x ‘Brundage 96’. Kendra L. Jernigan¹, Arron H. Carter¹, Robert S. Zemetra² and Jianli Chen³, (1)Washington State University, Pullman, WA, (2)Oregon State University, Corvallis, OR, (3)University of Idaho, Aberdeen, ID (Abstract id# 78037)

9:00am-9:20am
Optimal Agronomic Conditions for Spring and Winter Canola Production in Northern Idaho. Katie Reed, Plant, Soils and Entomological Sciences, University of Idaho, Moscow, ID (Abstract id# 78144)

9:20am-9:40am
Termination Method of Glyphosate Resistant Alfalfa Affects Yield and Quality of First-Year Silage Corn. Jason Daniel Clark¹, Earl Creech¹, Corey Ransom², Ralph Whitesides² and Grant E. Cardon¹, (1)Utah State University, Logan, UT, (2)Plant, Soils, and Climate, Utah State University, Logan, UT (Abstract id# 78204)

9:40am-10:00am
Plant and Animal Performance in Grass/Legume Pastures. Troy J. Bingham¹, Blair L. Waldron², Earl Creech¹, Dale ZoBell¹ and Rhonda L. Miller¹, (1)Utah State University, Logan, UT, (2)USDA-ARS, Logan, UT (Abstract id# 78212)

10:00am-10:20am Break

10:20am-10:40am
Spring Safflower Physiology, Growth and Yield As Affected By Different Irrigation Management Practices in Semi-Arid Conditions. Sukhbir Singh, PES, New Mexico State University, Las Cruces, NM, Kulbhushan K. Grover, New Mexico State University, Las Cruces, NM, Sultan Begna, Plant and Environmental Sciences, New Mexico State University, Clovis, NM, Clovis, NM and Sangamesh V. Angadi, Plant and Environmental Sciences, New Mexico State University, Clovis, NM (Abstract id# 78215)
10:40am-11:00am
Nitrogen Use By Pacific Northwest Dryland Canola (Brassica napus) and Its Effect On Rotational N Balances. Tai McClellan Maaz¹, William L Pan², Richard Koening³, Warren Ashley Hammac² and Frank L. Young⁴, (1)Crop and Soil Sciences, Washington State University, Pullman, WA, (2)Washington State University, Pullman, WA, (3)Washington State University, Pullman, (4)USDA-ARS, Pullman, WA (Abstract id# 79490)

11:00am-11:20am
A Comparison of Oilseed and Grass Crop Residue Silicon and Fiber Composition and Impacts On Soil Quality. Taylor Lynn-Marie Beard¹, Tai McClellan Maaz¹, Kristy Borrelli², Canming Xiao³ and William L Pan², (1)Crop and Soil Sciences, Washington State University, Pullman, WA, (2)Washington State University, Pullman, WA, (3)Washington State Department of Ecology, Yakima, WA (Abstract id# 79531)

Professional Oral Presentation Section II    Moderator: TBA

11:20am-11:40am

11:40am-12:00pm
Biomass Production and Energy Content of Grass and Alfalfa Mixture in CRP Land Affected By Nitrogen and Harvesting Time in Central Montana. Yesuf Assen Mohammed¹, Chengci Chen¹, Johnna Heser¹ and Lee Dokyoung², (1)Central Ag Research Center, Montana State University, Moccasin, MT, (2)University of Illinois, Urbana, IL (Abstract id# 77916)

12:00pm-1:00pm Lunch

Professional Oral Presentation Section III    Moderator: TBA

1:00pm-1:20pm

1:20pm-1:40pm
Phenotypic Diversity and Association Mapping for Pea Quality Traits in Landrace Pea and Related Species. Peng Cheng, Department of Crop and Soil Sciences, Washington State University, Pullman, WA, Rebecca J McGee, Grain Legume Genetics Physiology Research, USDA-ARS, Pullman, WA and Clarice J. Coyne, Plant Introduction, USDA-ARS, Pullman, WA (Abstract id# 78209)
1:40-2:00pm  
Evaluation of Winter Wheat Rotation Agroecosystem Based on Yield and Nitrogen Use Efficiency: A Case Study in Central Montana. **Ruiyu Lin**, Montana State University, Moccasin, MT and **Chengci Chen**, Central Ag Research Center, Montana State University, Moccasin, MT (Abstract id# 77776)

2:00pm-2:20pm Break

**Professional Oral Presentation Section IV  Moderator: TBA**

2:20pm-2:40pm  
Carbon and Water Flux Responses to Physiology By Environment Interactions: A Sensitivity Analysis of Climate Impacts On Model Parameters. **William Bauerle**, Alex Daniels and Dave Barnard, Colorado State University, Fort Collins, CO (Abstract id# 77921)

2:40pm-3:00pm  
Evaluation of Sensor-Based Technologies and Nitrogen Sources for Improved Recommendations for Dryland and Irrigated Spring Wheat Production. **Olga S. Walsh**\(^1\), Robin Christiaens\(^1\) and Martha Knox\(^2\), (1)Western Triangle Ag. Research Center, Montana State University, Conrad, MT, (2)Western Ag. Research Center, Montana State University, Corvallis, MT (Abstract id# 77250)

3:00pm-3:20pm  
Potential of Camelina Sativa Fitting Into the Pulse-Cereal Rotation Systems in Montana. **Chengci Chen**, Central Ag Research Center, Montana State University, Moccasin, MT (Abstract id# 78161)

3:30pm-4:30pm Business Meeting

**Professional Poster Presentation Section**

4:30pm-5:30 pm  
1. Effect of Nitrogen Sources, Rates, and Application Time On Spring Wheat Yield and Grain Protein. **Olga S. Walsh** and Robin Christiaens, Western Triangle Ag. Research Center, Montana State University, Conrad, MT (Abstract id# 77251)

2. Comparison of Nitrogen Sources for Spring Wheat Production. **Olga S. Walsh**\(^1\), Robin Christiaens\(^1\) and Martha Knox\(^2\), (1)Western Triangle Ag. Research Center, Montana State University, Conrad, MT, (2)Western Ag. Research Center, Montana State University, Corvallis, MT (Abstract id# 77252)
3. Sustainable Kentucky Bluegrass Seed Production Without Field Burning. **William J. Johnston**¹, Richard C. Johnson², Charles T. Golob¹, Kathleen L. Dodson¹ and Gwen K. Stahnke³, (1)Washington State University, Pullman, WA, (2)USDA-ARS, Pullman, WA, (3)Washington State University, Puyallup, WA (Abstract id# 78198)

4. Fenugreek May Have Potential for Multipurpose Use. **Anowarul Islam**¹, James M. Krall¹, Jerry J. Nachtman², Robert E. Baumgartner², Manjula Bandara³ and Surya N. Acharya⁴, (1)Plant Sciences, University of Wyoming, Laramie, WY, (2)Plant Sciences, University of Wyoming, Lingle, WY, (3)Alberta Ag Food & Rural Development, Brooks, AB, Canada, (4)Agriculture & Agri-Food Canada, Lethbridge, AB, Canada (Abstract id# 79233)

5. Effect Of Strobilurin Fungicides Applied At Two Timings On Seed Yield in Tall Fescue. **Nicole P. Anderson**, Oregon State University, McMinnville, OR and Thomas G. Chastain, Crop and Soil Science, Oregon State University, Corvallis, OR (Abstract id# 79557)


6:00pm-7:30pm  Banquet and Student Competition Awards
Moderator: Chengci Chen
Abstract id# 77607  

Stephen O. Guy, Washington State University, Pullman, WA, Mary Lauver, Crop and Soil Sciences, Washington State University, Pullman, WA and Doug Finkelnburg, District 1 Cooperative Extension, University of Idaho, Lewiston, ID

Abstract Text: Dry pea, lentil, and chickpea are grain legumes that can be direct seeded and do not require nitrogen fertilizer. They are low energy input crops and produce a high quality food commodity. From 1994 to present, grain legume varieties have been evaluated for adaptation and performance in the Pacific Northwest Palouse region of Idaho and Washington. Trials were supported by the University of Idaho, Washington State University, USDA-ARS, USA Dry Pea and Lentil Council, the pulse seed industry, and private breeders. Variety testing results provided information for Extension programing to educate growers on variety performance and selection for their growing conditions including conventional and no-tillage management. This supports the adoption of new, improved varieties adapted for an area. Seed yield and size, and plant length and canopy height were determined. Results varied greatly depending on location, year, cultivars entered, and management. ‘Columbian’ green pea, ‘Pardina’ and ‘Brewer’ lentils, and ‘Dwelley’ chickpea were common varieties across all trials for 19 years. In conventional tilled trials, Columbian yielded an average of 1925 kg ha\(^{-1}\), Pardina and Brewer yielded, respectively 1755 and 1585 kg ha\(^{-1}\), Dwelley yielded 1450 kg ha\(^{-1}\). These varieties do not show an upward or downward yield trend across the study period showing no agronomic improvement in yields, unlike with cereals, and indicating yield improvements has been from genetic improvements, and there is a need for agronomic research. This successful variety evaluation program has supported growers and enhanced the pulse industry for 19 years on the Palouse.

Abstract id# 77776  

Ruiyu Lin, Montana State University, Moccasin, MT and Chengci Chen, Central Ag Research Center, Montana State University, Moccasin, MT

Abstract Text: Crop rotations have been a successful strategy in managing wheat-based agroecosystem. Several rotation systems, including wheat-legume, wheat-oil crop and wheat-potato etc., have been setup in such a typically cold dry weather region in the Northern Great Plains of central Montana. The objective of this study was to estimate 1) winter wheat biomass and grain yield and nitrogen use efficiency (NUE)
affected by rotation and tillage, and 2) if introducing legume to the rotation will increase winter wheat yield and NUE in till and no-till practices. Four crop rotations were initiated in a) long-term no-till field and b) long-term tilled field for 6 years. The treatments included four crop rotations (fallow-winter wheat, spring pea-winter wheat, spring wheat-winter wheat, and winter pea-winter wheat) and two tillage regimes (till and no-till), four N rates (0 kg ha\(^{-1}\), 45 kg ha\(^{-1}\), 90 kg ha\(^{-1}\) and 135 kg ha\(^{-1}\)). When the experiment was initiated in the long-term no-till field (Experiment I), winter wheat biomass(BM) and grain yields were consistently greater in FW–WW rotation than in the others, showing in the order of FW–WW(5.585 Mg ha\(^{-1}\)) > WP–WW(5.169 Mg ha\(^{-1}\)) > SP–WW(4.619 Mg ha\(^{-1}\)) > SW–WW(2.910 Mg ha\(^{-1}\)). After converting no-till to till, ABMs of WW were enhanced by 9.4%, 8.2%, 13.0% and 13.1% for FW–WW, SP–WW, SW–WW and WP–WW, respectively, and grain yield increased 8.5%, 11.0%, 19.6%, and 14.1%. Similar results were found on long-term tilled field (Experiment II), however, the ABMs in the four rotations increased by 21.4%, 25.4%, 24.5% and 52.9% and the grain yields were by 22% times, 27% times, 30% and 1.62% in experiment II, respectively, and no significant differences were found after converting till to no-till. The total N uptake was consistently greater in till than in no-till, especially in Experiment I, Nitrogen use efficiency was consistently higher in till than in no-till in Experiment I, but was not different between the tillage regimes in Experiment II. The NUEs were in the order of FW–WW (0.492) > SP-WW (0.454) > WP-WW (0.452) > SW-WW (0.291) in experiment I. After converting no-till to till, NUEs were significantly enhanced, showing in the order of FW–WW (0.578) > SP-WW (0.534) > WP-WW (0.472) > SW-WW (0.341). The lowest NUE was 0.462 observed in SP-WW rotation in experiment II, following by SW-WW (0.513), FW-WW (0.523) and FW-WW (0.558) rotations. Introducing peas in rotation with winter wheat greatly increased winter wheat yield and N use efficiency compared with spring wheat-winter wheat mono-cropping. Winter wheat following winter pea harvested for hay produced similar yield at low N level compared with winter wheat following fallow. However, fallowed field conserves more water than the field after growing winter pea for hay, therefore, winter wheat yield was higher in the fallow-winter wheat rotation than in winter pea-winter wheat rotation at higher N levels. Adding legume to the rotation can add more crop residues with low C:N ratio, which may expedite the residue decomposition and N cycling in no-till system. Further study is needed to determine N cycling in different crop rotations in no-till systems.

Abstract id# 77896
Review of Sunflower Water Management Research.

Abdelfettah Berrada, Colorado State University, Yellow Jacket, CO

Abstract Text: Reports in the literature indicate that sunflower’s taproot grows to as much as 10 ft. deep below ground, which gives it the ability to extract water from a large volume of soil and hence withstand extended periods of drought. Greater soil water depletion was observed with standard height sunflower cultivars than with dwarf cultivars in western Canada. In NW Kansas, sunflower required 2.3 in. less irrigation than corn to meet crop ET. In NE Colorado, a 60% water saving was achieved when
irrigation was applied at the R-4 (immature ray flowers visible) to R-5 (beginning of flowering) growth stages, compared to full irrigation. Seed and oil yields were equal or higher than those obtained with full irrigation in 2 out of the 4-yr of the study. In SW Colorado, full-season irrigation (FSI) produced the highest seed yield (2,715 lb/ac), oil content (43.8%), and plant height (44.8 in.) in 2012. Irrigation from the beginning of the reproductive stage through flowering (R1-6) produced 2,397 lb/ac with 46% less irrigation water than FSI. In 2010 and 2011, applying water mostly during flowering produced similar yields as with R1-6. These and other studies demonstrate that substantial water conservation and use efficiency can be achieved with limited but targeted irrigation of sunflower.

Abstract id# 77916

Yesuf Assen Mohammed¹, Chengci Chen¹, Johnna Heser¹ and Lee Dokyoung², (1)Central Ag Research Center, Montana State University, Moccasin, MT, (2)University of Illinois, Urbana, IL

Abstract Text: Biomass from Conservation Reserve Program (CRP) can be used for biofuel feedstock. But there is no information how harvesting time and nitrogen application rate affect amount and quality of biomass in grass and alfalfa mixed pastureland for biofuel feedstock in central Montana. Therefore, we carried out an experiment to investigate the effect of harvesting times and N application rates on biomass yields, species and major cell wall composition and energy content, and post-harvest major soil nutrient content. The experiment was executed from 2009 – 2012 in mixed grass and alfalfa CRP land in central Montana in split plot design with three replications. Nitrogen application rates were (0, 56, and 112 kg N ha⁻¹) assigned to main plots and subplots were harvesting times (July and October). Averaged over years, increased nitrogen application rates increased total dry biomass (alfalfa plus grass) significantly from 3175 kg ha⁻¹ at 0 kg N ha⁻¹ to 3685 kg ha⁻¹ at 112 kg N ha⁻¹. The percentage of alfalfa dry biomass reduced significantly from 47% at 0 kg N ha⁻¹ to 35% with the application of 56 kg N ha⁻¹. But this situation was reversed for grass. Nitrogen application rates did not affect cellulose, hemicellulose, lignin and energy content of the biomass. Early harvesting (July) significantly increased total dry biomass and percentage of alfalfa by 27% and 82%, respectively, compared to late harvesting (October). Cellulose, hemicellulose, lignin and energy density of biomass were significantly higher for October than July harvest. However, because of more biomass in July harvest, more total energy per hectare was obtained with the application of 112 kg N ha⁻¹ than October. For October harvest, the maximum total dry biomass and energy content per unit area was achieved at lower N fertilization rate (56 kg ha⁻¹). October harvesting tends to increase residual available soil nitrogen, phosphorus and potassium perhaps due to remobilization. It can be concluded that harvesting in October provide elongated time for wildlife habitat achieving one of the envisioned objective of CRP. In addition, harvesting in October tends to minimize nutrient mining and reduce
transportation cost of biomass per unit energy content to the processing facility than July. Economic analysis should follow to make recommendation.

Abstract id# 77921
Carbon and Water Flux Responses to Physiology By Environment Interactions: A Sensitivity Analysis of Climate Impacts On Model Parameters.

William Bauerle, Alex Daniels and Dave Barnard, Colorado State University, Fort Collins, CO

Abstract Text: Leaf physiological traits are key factors in carbon and water exchange, providing important vegetation constraints on crop production. Sensitivity of carbon uptake and water use estimates to changes in physiology was determined with a coupled photosynthesis and stomatal conductance ($g_s$) model, linked to canopy microclimate with a spatially explicit scheme (MAESTRA). The sensitivity analyses were conducted over the range of physiology parameter variation observed for Acer rubrum L. (intraspecific) and woody deciduous C$_3$ (C$_3$) vegetation under different climate conditions. Five key physiological inputs (quantum yield of electron transport ($\alpha$), minimum stomatal conductance ($g_0$), stomatal sensitivity to the marginal water cost of carbon gain ($g_1$), maximum rate of electron transport ($J_{\text{max}}$), and maximum carboxylation rate of Rubisco ($V_{\text{cmax}}$)) changed carbon and water flux estimates ≥15% in response to climate gradients; variation in $\alpha$, $J_{\text{max}}$, and $V_{\text{cmax}}$ input resulted in up to ~50% and 82% intraspecific and C$_3$ photosynthesis estimate output differences respectively. Transpiration estimates were affected up to ~46% and 147% by differences in intraspecific and C$_3$ $g_1$ and $g_0$ values – two parameters previously overlooked in modeling carbon and water exchange. We show that a variable environment, within a canopy or along a climate gradient, changes the spatial parameter effects of $g_0$, $g_1$, $\alpha$, $J_{\text{max}}$, and $V_{\text{cmax}}$ in photosynthesis-$g_s$ models. Since variation in physiology parameter input effects are dependent on climate, this approach can be used to assess the spatial importance of key physiology model inputs when estimating carbon and water exchange.

Abstract id# 78090
Soybeans for Hay Production.

O. Steven Norberg$^1$, Earl Creech$^2$, Don A. Llewellyn$^3$, Kefyalew Girma Desta$^4$, Steven C. Fransen$^4$ and Joseph Shannon Neibergs$^5$, (1)Washington State University, Pasco, WA, (2)Utah State University, Logan, UT, (3)Extension, Washington State University, Kennewick, WA, (4)Washington State University, Prosser, WA, (5)Ag. Economics, Washington State University, Pullman, WA

Abstract Text: Harvest is a major expense in hay production that could be reduced if a one cut hay system was developed. Soybean is a potential forage crop for the West with high protein and, due to its growth habit, would work best in a one-cut system.
Irrigated soybean grain variety trials have been conducted in Idaho, Oregon and Washington in recent years with yields similar to Midwest irrigated areas. Very little is known about soybean forage production in the West. The objective of this study was to determine the effect of soybean maturity group and harvest date on yield and quality. Soybean was planted at 140,000 seeds/acre on May 15, 2012 at the Othello Research Farm near Othello, WA and the Utah State University Greenville Farm near Logan, UT. Varieties tested included: Asgrow 1431 [Maturity group (MG) 1.4], Asgrow 4531 (MG 4.5), Eagle Seeds Large Lad (MG 7), and Eagle Seeds Big Fellow (MG 7). Harvests occurred September 4th, 14th, 27th at Othello, WA and August 30, September 13, and 27th at Logan, UT. At Othello, forage yields increased with later harvesting and averaged 3.9, 4.7, and 5.6 dry tons per acre. Yields between varieties were not significantly different. Averaged over timing of harvest timings dry matter yields in tons/acre were: Asgrow 1431 4.91, Big Fellow 4.88, Asgrow 4531 4.80, and Large Lad 4.45. On September 27th, maturity of the soybeans ranged from just flowering (growth stage R2) for Large Lad and Big Fellow to full seed development and leaves beginning to drop (growth stage R5) for Asgrow 1431 growth stage R5, with Asgrow 4531 between at growth stage R3. On September 27th the forage percent moisture content was 65.5, 77.4, 76.4, and 75.2 for Asgrow 1431, Asgrow 4531, Large Lad and Big Fellow, respectively. The maturity of the soybean varieties at Logan, UT, exceeded that in Othello and was: Asgrow 1431 growth stage R8, Asgrow 4531 growth stage R6, Large Ladd R3, and Big Fellow R4. Asgrow 1431 had peak dry matter 3.0 tons/acre at the earliest harvest. The other varieties continued to increase dry matter until the last harvest. On September 27th forage harvest moisture content was 41.4, 68.2, 70.3, and 68.0 for Asgrow 1431, Asgrow 4531, Large Lad and Big Fellow, respectively. Averaged over the harvest timings, dry matter forage production for Large Lad and Asgrow 4531 was greater than Big Fellow and Asgrow 1431 with yields of 5.2, 5.1, 4.7 and 2.6, tons/acre, respectively. Further research needs to occur to determine the quality and feasibility of drying hay with yields which reached as high as 6.3 tons with Large Lad in Utah and 6.0 tons per acre with Asgrow 1431 at Othello, WA.

Abstract id# 78145

Stephen Machado, Crop and Soils, Oregon State University, CBARC, PENDLETON, OR

Abstract Text: Soil organic matter (SOM) is essential for sustaining crop productivity. SOM consists of carbon (C) based compounds that improve soil structure, nutrient storage and water holding capacity. In agricultural lands, cropping systems that maintain or increase SOM sequester C, thereby reducing emission and buildup of carbon dioxide (CO2) in the atmosphere. Tillage, crop rotations, and cropping intensity influence the rate at which C is added to or removed from soil. Cropping systems that result in C gain can lead to sustained soil and crop productivity. SOC (58% of SOM) has been monitored at 10-year intervals in the Pendleton, OR and Moro, OR long-term experiments (LTEs) since their inception in 1931 and 2004, respectively. The most
recent sampling was conducted in 2010. At Pendleton, with mean annual precipitation of 400 mm, SOC in the 0-60 cm depth profile continued to decline in winter wheat-summer fallow (WW-SF) based cropping systems except where 22.4 Mg ha\(^{-1}\) of steer manure was added biennially or under annual cropping. SOC from a nearby grassland plot was significantly higher than all cultivated treatments. At, Moro, with a mean annual precipitation of 280 mm, SOC from the grassland plot was significantly different from SOC in WW-SF but not from SOC in no-till annual cropping systems in the 0-60 cm soil depth profile. Differences in SOC from grassland and from cultivated plots were more pronounced in Pendleton, a higher precipitation zone, than at Moro, a dryer site. In conclusion, tillage and crop intensity influences SOC accretion; WW-SF system depletes SOC; annual cropping maintains SOC even under conventional tillage; no-till or direct seeding has the potential to increase SOC; increasing cropping frequency and reducing or eliminating tillage increases the potential for SOC accretion and for sustaining soil productivity.

**Abstract id# 78161**
Potential of Camelina Sativa Fitting Into the Pulse-Cereal Rotation Systems in Montana.

**Chengci Chen**, Central Ag Research Center, Montana State University, Moccasin, MT

**Abstract Text**: Camelina sativa is an underutilized oilseed crop, which has potential to serve as non-food oilseed bioenergy feedstock. Production of camelina for bioenergy should not compete with food crops for land use. In Montana, wheat is the dominant crop, which is commonly rotated with barley or pulse crops (pea and lentil). To reduce root diseases, pulse crops are recommend being grown once every three to four years. The objective of this study was to investigate if camelina can be grown between pulse and wheat in the pulse-cereal rotation. Results showed that winter wheat following camelina produced a yield (2430 lb/a) similar to that following dry pea (2230 lb/a), but the yield was greater than that following barley (1670 lb/a). Winter wheat protein contents did not differ in the three rotations (~13.5%). Camelina following lentil produced a yield (950 lb/a) and oil content (36.0%) similar to that following winter wheat (893 lb/a and 36.6 %, respectively). These results will help to design a cropping system for food crop and energy feedstock production.

**Abstract id# 78209**
Phenotypic Diversity and Association Mapping for Pea Quality Traits in Landrace Pea and Related Species.

**Peng Cheng**, Department of Crop and Soil Sciences, Washington State University, Pullman, WA, Rebecca J McGee, Grain Legume Genetics Physiology Research, USDA-ARS, Pullman, WA and Clarice J. Coyne, Plant Introduction, USDA-ARS, Pullman, WA
Abstract Text: Association mapping has been proposed as an efficient approach to assist in the identification of the molecular basis of agronomical traits in plants. For this purpose, we analyzed the phenotypic and genetic diversity of a large collection of the single plant derived core of the USDA *Pisum germplasm* collection including 316 landraces and cultivars (*Pisum sativum*), 26 *P. sativum* subsp. *elatius*, 16 *P. sativum* var. *arvense*, 11 *P. sativum* subsp. *sativum*, 4 *P. sativum* var. *pumilio*, 3 *P. sativum* subsp. *asiaticum*, 3 *P. abyssinicum*, 2 *P. fulvum*, 2 *Pisum* spp., and 1 *P. sativum* subsp. *transcaucasicum*, accessions from 64 countries. The accessions were genotyped using an iPLEX assay of 363 published SNPs, among which 342 were informative for subsequent analysis. Linkage disequilibrium (LD) of pairwise loci and population structure were analyzed, and the association analysis between SNP genotypes and a few valuable traits such as disease, seed weight/size, flower color, carbohydrate content, mineral nutrients and protein will be reported using a mixed linear model. Genetic structure analysis showed that the population was structured into three main groups. Interestingly, the three groups were corresponded to neither the taxon nor the country of origin. This study will show the potential and limits of using association mapping in pea populations.

Abstract id# 78213
Multi-Year Yield and Quality Performance of Cereal Forages in Montana.

David Wichman, Research Centers, CARC Montana State University, Moccasin, MT, Peggy F. Lamb, Montana State University, Havre, MT, Martha knox, Research Centers, WARC Montana State University, Corvallis, MT, James E. Berg, Montana State University, Bozeman, MT and Valtcho Jeliazkov Zheljazkov, SREC Universty Wyoming, Sheridan, WY

Abstract Text: Cereal forages are utilized as an alternative source of forage while perennial forage stands are being renovated. Improved genetics and production methods are enhancing the stature of cereal forages from the status of alternate forage to a standard component of many forage production systems. Spring hooded barley lines becoming increasingly popular as cereal forage displacing oats due to both yield potential and quality. The cereal forages yields are often greater than those of alfalfa in both high and low yield environments. The superior yields of cereals in low yield environments has resulted in more wide spread use of cereals as standard component of may forage production systems. Cereal cultivars and development lines were evaluated under diverse environments for relative yield and quality over multiple years. Winter and spring seeded cereals are not included within the same trials. Comparisons are made with adjoining trials for winter cereals, spring cereals and alfalfa.
Abstract

Multiple foliar N fertilizer products are currently marketed as more efficient, advantageous N sources. Proposed benefits of foliar N products include increased N use efficiency (NUE), higher yields and, and savings in money, labor and time to wheat producers. The objective of this study was to evaluate the effect of foliar N fertilizer sources, rates and dilution ratios on spring wheat grain yield. Spring wheat is produced for its quality, represented by high grain protein content. Combining yield and protein into protein yield makes sense because N is vital to both yield and protein production. This study was initiated in the spring of 2012 at three locations: two dryland - at Western Triangle Agricultural Research Center (WTARC) (near Conrad, MT) and in a cooperating producer’s field (Jack Patton, Choteau County, MT), and one irrigated - at Western Agricultural Research Center (WARC) (near Corvallis, MT) using Choteau spring wheat. At planting, 90 kg N ha\(^{-1}\) was applied as urea. At Feekes 5 growth stage, 56 kg N ha\(^{-1}\) was foliar applied utilizing an all-terrain vehicle (ATV)-mounted stream-bar equipped sprayer. Three foliar N sources – urea ammonium nitrate (UAN), liquid urea (LU), and high NRG-N (HNRGN) and three dilution ratios of fertilizer%/water% - 100/0, 66/33, and 33/66 - were evaluated. Preliminary results from the first year of study are reported here. When undiluted N products were used, the highest grain yields were obtained with HNRGN at all 3 sites. There were no significantly difference differences in yield, protein or protein yield associated with product to water ratio at any of three sites. In general, the highest yield, protein and protein yield were achieved with the ratio of 33%/66%, followed by 100%/0%, and the lowest – at the ratio of 66%/33% at all three sites. Highest grain yields were obtained with HNRGN at all 3 sites, independent of the product to water ratio. At dryland sites grain yields increased significantly as follows: UAN<LU<HNRGN. At the irrigated site, yields obtained with UAN and HNRGN were comparable, while LU resulted in lower yields. Grain protein was maximized with LU at the irrigated location; lower protein was obtained with UAN and HNRGN. At WTARC, similar trend was observed, but the differences were not significant. At Patton, grain protein increased as LU>HNRGN>UAN. At dryland sites, HNRGN resulted in a combination of highest protein yield. At the irrigated site, the same trend was observed, but the differences were not significant. The lowest protein yield at the dryland sites was achieved with UAN, and with LU - at the irrigated site. Due to LU and HNRGN’s lower corrosiveness compared to UAN, even when applied undiluted, LU and HNRGN may be a better choice among the three foliar products evaluated. The cost of HNRGN at the time of application was approximately 25% higher than cost of LU, and almost 30% higher than cost of UAN.
Abstract id# 77250
Evaluation of Sensor-Based Technologies and Nitrogen Sources for Improved Recommendations for Dryland and Irrigated Spring Wheat Production.

Olga S. Walsh¹, Robin Christiaens¹ and Martha Knox², (1)Western Triangle Ag. Research Center, Montana State University, Conrad, MT, (2)Western Ag. Research Center, Montana State University, Corvallis, MT

Abstract Text: Precision agriculture tools such as sensor-based technologies allow us to accurately access the crop’s nutrient status and account for spatial and temporal variability. This enables adjusting fertilizer application rates according to site-specific conditions which results in more efficient, profitable, and sustainable crop production. The feasibility of various sensor-based systems must be evaluated before a recommendation can be made as to what system is more efficient and appropriate for Montana conditions. The major objectives of this study were: 1. To evaluate two sensors – GreenSeeker, and Pocket Sensor – for developing NDVI-based topdress fertilizer N recommendations for dryland and irrigated spring wheat production in Montana, and 2. To determine whether sensor-based recommendations have to be adjusted depending on what N fertilizer source (liquid urea ammonium nitrate (UAN), or granular urea) is used. Three experiments: two dryland studies – at WTARC and in a producer’s field (Pat Wheeler, Valier, Pondera County), and one irrigated study at WARC were established using the spring wheat variety Choteau. There were a total of 10 treatments, each replicated 4 times. The preplant N rates of 0, 20, 40, 60, and 80 lb N ac⁻¹ were applied as broadcasted urea. There were two reference treatments at each site – the unfertilized check plot (0 lb N ac⁻¹), and the non-limiting N-rich reference (220 lb N ac⁻¹). The NDVI readings from each treatment were collected at Feekes 5 growth stage. Topdress N rates (applied as urea, broadcasted or as UAN, foliar sprayed) were prescribed using NDVI values and six algorithms experimentally developed for spring wheat. Also, a new generalized algorithm was tested. Grain yield, protein content, and NUE data were analyzed to determine whether there were statistically significant differences depending on what sensor was used to make fertilizer N recommendations. There were no substantial differences in grain yields associated with topdress fertilizer N source (urea vs UAN) at any of 5 site-years. This indicated that topdress N fertilizer rates do not need to be adjusted based of fertilizer sources used, i.e. the same N rates should be prescribed whether urea or UAN is applied. GreenSeeker NDVI was able to predict 91 % of variation in spring wheat grain yields across site-years, while Pocket Sensor NDVI explained 96% of variation on yield. Spring Wheat (Canada) Algorithm and Generalized Algorithm did not prescribe any topdress N fertilizer to be applied at any of the 5 site-years. The recommended application rates generated by the Sensor-Based Nitrogen Optimization Algorithm (USA/Canada/Mexico) ranged from of 0 lb N ac⁻¹ at Martin in 2012 to 99 lb N ac⁻¹ at WARC at 2012, depending on the NDVI values. Sensor-based generated topdress N rates did not always optimize grain yields, some rates were excessive, and others were not adequate. Spring wheat is produced for its quality, represented by high grain protein content. Evaluating NUE in spring wheat should take into an account both grain yield and protein content. Results underline the importance of currently undergoing development of sensor-based algorithms for
Montana wheat varieties and growing conditions from the point of view of maximizing both yield and grain quality.

**Professional Poster Presentation (6 papers)**

**Abstract id# 77251**

Effect of Nitrogen Sources, Rates, and Application Time On Spring Wheat Yield and Grain Protein.

Olga S. Walsh and Robin Christiaens, Western Triangle Ag. Research Center, Montana State University, Conrad, MT

**Abstract Text:** Numerous important questions remain unanswered regarding the optimum fertilization strategies for maximizing spring wheat yield and grain protein. The major objective of this study is to determine the most efficient N fertilizer source, rate, and application time combination for optimizing Montana spring wheat yield while maximizing grain protein. Two dryland experiments were established in 2011 - at Western Triangle Agricultural Research Center (WTARC) near Conrad, MT, and Jack Patton (Chouteau County, MT), and three in 2012 – WTARC, Patton, and Lindsay Martin (Teton County, MT). Choteau spring wheat variety was used for all site-years. A combination of 4 preplant N rates (0, 40, 80, and 120 lbs N ac⁻¹), 3 topdress N rates (0, 40, and 80 lb N ac⁻¹), 2 topdress N fertilizer sources (granular – urea, 46-0-0, and liquid – urea ammonium nitrate (UAN), 28-0-0), and 2 topdress application times (before flowering and after flowering) were evaluated. Urea prills were manually broadcasted and UAN was applied as a foliar spray using backpack sprayers. At maturity, grain yield and protein content were determined. Treatment effect (preplant N rate, topdress N source, rate, and application time) on spring wheat grain yield, grain total N (protein) were evaluated. In most site-years evaluated, the rate of preplant N fertilizer rate affected spring wheat grain yields. For example, at WTARC in 2011 and 2012, and at Martin in 2012, preplant application of 80 lb N ac⁻¹ resulted in significantly higher grain yields. On the other hand, increasing preplant N fertilizer rate to 120 lb N ac⁻¹ did not further increase grain yields at most site-years, except for WTARC in 2012. The plots that received topdress N as broadcasted urea yielded the same as those that were foliar sprayed with UAN solution. There were no significant differences in spring wheat grain yield associated with preplant N fertilizer source (urea vs UAN) at any of the 5 site-years. There were not statistically significant differences in grain yields associated with the time of topdress N fertilizer application (before flowering vs after flowering) were observed at any of the site-years. Practically the same yields were achieved whether the topdress was applied prior to or after the anthesis. Grain protein response to preplant N was only observed in the second year of the study. However, increasing the preplant rate from 40 to 80 to 120 lbs N ac⁻¹ did not further increase protein. Similarly, topdress N resulted in significantly higher protein in the second year, but no response to topdress N was observed in 2011. Protein was significantly higher for the UAN treatments compared to urea in 3 of 5 site-years. As with yield, there were not
Abstract

Abstract id# 77252
Comparison of Nitrogen Sources for Spring Wheat Production.

Olga S. Walsh¹, Robin Christiaens¹ and Martha Knox², (1)Western Triangle Ag. Research Center, Montana State University, Conrad, MT, (2)Western Ag. Research Center, Montana State University, Corvallis, MT

Abstract Text: There is a growing interest in new fertilizer technologies among Montana growers, dealers and crop advisors. Environmentally Smart Nitrogen (ESN) is a relatively new slow-release form of urea nitrogen (N) fertilizer contained within a proprietary polyurethane coating. The proposed benefits of ESN include increased grain yield and quality and higher fertilizer use efficiency. The objectives of this study were: 1) to evaluate ESN as a N fertilizer source for spring wheat production in comparison to conventional urea, and 2) to evaluate nitrogen use efficiency, and grain yield and protein response to these two fertilizer materials, alone and in combination. This study has been funded by Montana Fertilizer Tax Advisory Committee and initiated in 2011, and continued in 2012. Two dryland sites - Western Triangle Ag Research Center (WTARC, Conrad, MT) and Northwestern Agricultural Research Center (NWARC, Kalispell, MT) and one irrigated site - Western Agricultural Research Center (WARC, Corvallis, MT) were established for 2 consecutive growing seasons. Three sources - urea, ESN, and a 50%-50% urea-ESN blend were evaluated. Following yield-goal based recommendations for spring wheat, four N rates - 0, 50, 100, and 150 lbs N ac⁻¹ (at WTARC and WARC) and 0, 100, 200, and 300 lbs N ac⁻¹ (at NWARC) applied to hard red spring wheat at seeding were evaluated. Additionally, 2 topdress rates applied at Feekes 5 growth stage – 0 and 40 were lbs N ac⁻¹ assessed. At Feekes 5, crop canopy reflectance – Normalized Difference Vegetative Index (NDVI) was measured in each plot using the GreenSeeker (GS)(except for NWARC in 2011) and Pocket Sensor (PS) (except for WTARC in 2012) optical sensors as a means of assessing N status of the crop. At harvest grain yield and grain protein content were determined. The response of spring wheat to N sources and their rate of application were evaluated to develop N fertilizer application guidelines. Statistically significant effect of fertilizer N source on grain yield (independent of N rate) was observed at 2 of 6 site-years with no consistent trend among the site-years. At NWARC in 2011, the yield increased as: urea<blend<ESN, and at WARC in 2012, urea produced higher yields compared to blend and ESN. Grain yield response to both N applied at seeding and to topdress N was observed (P<0.05) at 5 of 6 site-years. In general, higher N rates applied at seeding resulted in significantly higher grain protein content at 5 of 6 site-years. Grain protein content response to topdress N was evident at 3 of 6 site-years only. The crop reflectance measurements obtained with the two sensors were very consistent at 3 of 4 sites (where both GS and PS NDVI data were available). The GS and PS NDVI values were highly correlated with spring wheat grain yield at 3 of 5 site-years (P<0.0001). On the other hand, grain protein content was highly correlated with sensor measurements...
only at 1 of 5 site-years. This agrees with previous findings that, unlike grain protein content, yield potential can be accurately estimated mid-season using sensor-derived data. This study will be continued for one more growing season in 2013 at 3 locations.

Abstract id# 78198
Sustainable Kentucky Bluegrass Seed Production Without Field Burning.

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Abstract Text: Open-field burning of Kentucky bluegrass (Poa pratensis L.) post-harvest residue has been eliminated in Washington and is severely restricted in Idaho and Oregon. The objective of our study was to develop bluegrasses that have sustainable seed yield without post-harvest field burning and still maintain acceptable turfgrass quality. This long-term study consisted of 10 Kentucky bluegrass entries; eight are USDA/ARS Plant Introduction (PI) accessions and two are commercial cultivars (‘Kenblue’ and ‘Midnight’). The selected PI accessions, in previous research, had expressed high seed yield without burning of post-harvest residue and good turfgrass quality. Several agronomic yield parameters were then evaluated over a 2-yr period and individual plants were reselected within each accession, or check, with the highest seed weight, highest seeds panicle\textsuperscript{-1}, highest panicles area\textsuperscript{-1}, and highest seed yield. Remnant seed of the original USDA/ARS population were also included. Turfgrass plots were established in 2006 at Pullman and 2010 at Puyallup, WA. Seed production plots (irrigated and non-irrigated) were established in 2007 at Pullman, WA. The turfgrass trials were evaluated according to NTEP (National Turfgrass Evaluation Program) protocol to determine turfgrass quality. Seed production plots were harvested (2008 to 2011) and clean seed yield was determined. Results indicated that reselection for seed yield components had a variable response and seed yield was primarily dependent on accession. Among the 50 entries, PI 368241, selection panicles area\textsuperscript{-1}, showed the most promise of being able to provide long-term turfgrass seed yield without field burning in both non-irrigated and irrigated seed production. Kenblue, selection seed panicle\textsuperscript{-1}, had good seed yield and fair turfgrass quality at Pullman. PI 371775, selection seed panicle\textsuperscript{-1}, had good turfgrass quality while maintaining good seed yield with irrigation. Although Kentucky bluegrass is not recommended as a turfgrass for western WA, PI 371775, selection seed panicle\textsuperscript{-1}, showed acceptable turfgrass quality at Puyallup. These three selections are currently in seed increase at Pullman, WA and germplasm should be released by 2014.

Abstract id# 79233
Fenugreek May Have Potential for Multipurpose Use.

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Abstract Text: Fenugreek (*Trigonella foenum-graecum* L.) is a specialty crop of the *Fabaceae* family and used both as herb and spice. Fenugreek can decrease cholesterol levels and is considered as a good breastmilk stimulator. Fenugreek has potential to be used as animal feed. The objective of this study is to evaluate most promising genotypes/accessions of fenugreek under varying environments for the phenotypic adaptability and stability for growth, seed yield, and quality. Thirteen genotypes/accessions were sown with four replicates during the spring of 2010, 2011, and 2012 at two locations of the University of Wyoming: Lingle (irrigated and dryland) and Laramie (irrigated). The seeding rate was 27 kg ha\(^{-1}\). The plots were divided into two groups: forage production and seed production. Forage was mechanically harvested in mid-August to early September and seeds were harvested in early to mid-October of 2010, 2011, and 2012. At Lingle, line F80 produced the highest dry matter (DM) yield (2,380 kg ha\(^{-1}\)) while line IT produced the lowest DM (1,060 kg ha\(^{-1}\)) under irrigation in 2010. Line IT produced the highest DM (825 kg ha\(^{-1}\)) in dryland in 2010. In 2011, DM increased 3-7 folds under irrigated (range 5,830-10,700 kg ha\(^{-1}\)) and 2-7 folds under dryland (range 1,385-2,340 kg ha\(^{-1}\)) conditions, compared to DM of 2010. The highest yield was 10,700 kg ha\(^{-1}\) (line F70) under irrigated and 2,340 kg ha\(^{-1}\) (line L3068) under dryland conditions. In Laramie under irrigation, the highest yield was 1,550 kg ha\(^{-1}\) from line F96 in 2010 and 3,000 kg ha\(^{-1}\) from line LRC3708 in 2011. Large variations were also observed for seed yield under irrigated (range 820-2,250 kg ha\(^{-1}\) in 2010; 545-1,990 kg ha\(^{-1}\) in 2011) and dryland (range 62-390 kg ha\(^{-1}\) in 2010; 64-530 kg ha\(^{-1}\) in 2011) conditions at Lingle and under irrigation at Laramie (range 25-580 kg ha\(^{-1}\) in 2010). The highest seed yield (2,250 kg ha\(^{-1}\)) was obtained from line F96 under irrigation at Lingle in 2010. Forage quality was in the acceptable range at both locations (e.g., 140-200 g kg\(^{-1}\) crude protein). Similar results were also obtained in 2012. It appears that line F96 is one of the best performers. Selection of well-adapted high performing fenugreek genotypes/accessions will result in development of superior cultivars.
seed producers have begun integrating an early application of a strobilurin fungicide at BBCH growth stage 32-33, prior to the typical onset of stem rust in the crop. This study was conducted to determine if and under what circumstances this early strobilurin fungicide treatment increases tall fescue seed yield compared to a standard fungicide treatment applied when stem rust begins to develop. Results were obtained from large scale, on-farm yield trials conducted on five turf-type tall fescue seed fields from 2010 – 2012. Seed yield and weight and flag leaf N concentration were measured. Treatments included 1) control, 2) 10 oz/a axoystrobin + propiconazole applied at BBCH 32-33, 3) 12 oz/a axoystrobin + propiconazole applied at BBCH 59, and 4) 10 oz/a axoystrobin + propiconazole applied at BBCH 32-33 plus 12 oz/a applied at BBCH 59. Strobilurin fungicide treatments increased tall fescue seed yield by an average of 17% over the untreated control across sites and years. Applying the strobilurin fungicide early increased seed yield by 52% in 2012 when stem rust pressure was severe and 7% in 2010 and 2011 when stem rust pressure was minimal. The increase in seed yield due to strobilurin fungicide treatments was attributed to increased seed weight. Nitrogen tissue concentrations were not influenced by fungicide treatments. The results of this study suggest that early strobilurin fungicide application is beneficial in tall fescue seed crops in years of severe rust pressure.

Abstract id# 81479

Melba Ruth Salazar-Gutierrez, Jakarat Anothai, Bernardo Chaves and Gerrit Hoogenboom, Washington State University, Prosser, WA

Abstract Text: Multi-environment trials of crop breeding lines are conducted annually to identify superior cultivars for the target region and also to develop understanding of the target region. The objectives of this study were to determine whether subdividing the hard winter wheat (Triticum aestivum L.) production areas in the eastern of state of Washington into mega-environment and to classify wheat genotypes and existing relations among agronomic traits. The information that was used in this study regarding grain yield, percentage of protein, plant high and heading date were obtained for 17 winter wheat genotypes from WSU field trials that were conducted in 17 locations of the eastern region of Washington State during 2000-2012. The genotype and genotype x environment (GGE) biplot method was used to subdivide the wheat production areas into subregions. In addition, Principal Component Analysis (PCA) and Cluster analysis by Ward method use of standardized means was carried out to study the main source of variability of winter wheat cultivars. All statistical analysis was performed using the Statistical Analysis System (SAS) V.9.2. The preliminary results showed that the GGE biplot analysis based on the averaged seven varieties that were common to trials in 2000 to 2006 and the 10 varieties that were common to trials in 2007 to 2012 separated Walla Walla from other locations, indicating that the subdivision of wheat production areas into mega-environment is justified for eastern Washington. Therefore, eastern Washington should be considered as two winter wheat mega-environment: a minor
mega-environment (Walla Walla) and a major one. Multivariate Statistical Analysis using PCA identify that two components explained 81.6 percent of the variation and both components were associated with yield. The first one was also associated with protein concentration and the second one with plant height. The weight of protein concentration in the first component was (-0.594300) and (0.503976) for yield; the weight of the second component was (0.628284) and (-0.546083) for plant height and yield, respectively. Yield and protein concentration responded to environmental conditions. However, the variation in protein concentration is not always associated with high yield. The cluster analysis of data placed the genotypes into three groups. Comparison of traits average in the given groups showed that existing genotypes in the first group have the highest yield followed by medium and low yield.

Student Oral Competition (8 papers)

Abstract id# 77938
Seedling Vigor of Switchgrass Influenced By Cold Storage Temperatures.

Emi Kimura, Washington State University, Pullman, WA and Steven C. Fransen, Washington State University, Prosser, WA

Abstract Text: Switchgrass (*Panicum virgatum* L.) is a perennial warm season grass that produces small seeds with high percentage of dormancy. The seeds produce scattered seedling emergence in the field, resulting in weak competition for resources against vigorously growing weeds during the establishment year. Our group has observed that the seedling vigor of switchgrass was enhanced when seeds were stored in a freezer. The objective of this study is to examine the influence of storage temperatures and time on the seedling vigor of switchgrass. Seeds of Kanlow (seedlots: 2008, 2010, and 2010), Blackwell (seedlots: 2010 and 2011), and Trailblazer (seedlots: 2010 and 2011) were stored at three temperatures (room temperature, -20°C, and -80°C) for 1, 6, or 12 months. The seeds were planted in square pots in a greenhouse condition (Day/night, 22/17°C; 16 hours photoperiod). Emergence rate index (ERI) was used to assess the seedling vigor and was calculated based on the number of seedlings emerged each day. Plants were harvested when three fully collared leaves were observed. Leaf and root dry mater were obtained from the harvested samples. The seed storage conditions that produced the highest ERI was at -20°C and -80°C with 1 month storage for the three seedlots of Kanlow, and at -20°C with 1 month storage for two seedlots of Blackwell and Trailblazer. Dry matter of leaf and root were greater for the seeds stored at -20°C and -80°C for 1 month for all cultivars, compared to the seeds stored at room temperature. Short term cold storage is recommended to enhance seedling vigor and early stage seedling biomass of the three cultivars of switchgrass.
Abstract id# 78037

Kendra L. Jernigan¹, Arron H. Carter¹, Robert S. Zemetra² and Jianli Chen³,
(1)Washington State University, Pullman, WA, (2)Oregon State University, Corvallis, OR, (3)University of Idaho, Aberdeen, ID

Abstract Text: Wheat has many different end uses, each one requiring different quality parameters. Due to the time constraints associated with milling and baking tests, understanding the quantitative nature of end-use quality traits as well as identifying molecular markers will allow breeders to more efficiently select wheat cultivars with superior end-use quality. A set of 207 recombinant inbred lines (RIL) from a soft white wheat ‘Coda’ x ‘Brundage 96’ bi-parental mapping population was grown at three locations throughout the Pacific Northwest to identify quantitative trait loci (QTL) associated with end-use quality measurements including flour protein, flour yield, flour ash, milling score, break flour and cookie diameter. JMPGenomics was used in the creation of the linkage map, consisting of 181 SSR markers and 1,494 SNP markers. The constructed linkage map covers all 21 wheat chromosomes with the exception of 1D. Significant QTL will be reported and presented. Identification of end-use quality QTL lays a foundation for wheat breeders to increase gains from selection by use of marker-assisted selection for these complex traits.

Abstract id# 78144
Optimal Agronomic Conditions for Spring and Winter Canola Production in Northern Idaho.

Katie Reed, Plant, Soils and Entomological Sciences, University of Idaho, Moscow, ID

Abstract Text: Canola acreage in Idaho continues to rise, and has doubled over the past two seasons. Many growers are attracted to canola as higher yielding cultivars are now available, and crop prices are competitive with others in the region. The University of Idaho has been conducting regional variety trials throughout the Pacific Northwest for over 20 years which has helped identify the regions and cultivars with most adaption and highest yield. However, there has been no attempt to optimize productivity of specific adapted cultivars in any of the Idaho regions. This study will determine optimized seeding rates, planting dates and fertility management of the most adapted spring and winter canola cultivars. Information will provide growers with specific agronomic condition to ensure sustained productivity and profitability of these cultivars in specific environments that exist in northern Idaho and throughout the Pacific Northwest. Field results will be integrated with a large two year grower survey to offer Idaho growers with production guidelines for integrating canola into cereal based rotations. K. Reed, reed2987@vandals.uidaho.edu, (208) 885-6272
Abstract id# 78204
Termination Method of Glyphosate Resistant Alfalfa Affects Yield and Quality of First-Year Silage Corn.

Jason Daniel Clark¹, Earl Creech¹, Corey Ransom², Ralph Whitesides² and Grant E. Cardon¹, (1)Utah State University, Logan, UT, (2)Plant, Soils, and Climate, Utah State University, Logan, UT

Abstract Text: Glyphosate containing herbicides are a common and highly effective method to terminate alfalfa stands. With the development of glyphosate resistant alfalfa, this tool is no longer an option. The purpose of this research was to determine the best combination of termination methods to rotate from glyphosate resistant alfalfa into silage corn. Studies were conducted on a Trenton Silty Clay Loam in Cache Junction, Utah and a Layton Loamy Fine Sand in Cornish, Utah to determine the effect of tillage type and timing (fall conventional till, spring conventional till, fall strip-till, spring strip-till, and no-till), herbicide timing (fall, spring, in-crop, and a control), and N rate (0, 56, 112, and 224 kg N ha⁻¹) on the amount and timing of alfalfa re-growth, available N, corn emergence, and subsequent yield and quality of silage corn. There was a significant interaction between tillage type and timing and herbicide timing. The combinations that consistently performed the highest were those that contained fall conventional tillage, spring conventional tillage and/or fall or spring herbicide timing. Followed by the combinations containing fall strip till, spring strip till, no-till with in-crop herbicide timing. The lowest yields were the control plots unless they received the spring conventional tillage treatment. Fertilizer rate did not significantly affect yields at either site.

Abstract id# 78212
Plant and Animal Performance in Grass/Legume Pastures.

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Abstract Text: Tall fescue is the one of most used grasses in irrigated pastures throughout the Intermountain West. Two limitations of tall fescue are decrease in productivity during hot summer months and the need for supplemental nitrogen (N). The objective of this research is to examine the efficacy of tall fescue+alfalfa (TF+ALF), tall fescue+birdsfoot trefoil (TF+BFT), tall fescue+nitrogen fertilizer (TF+N), and tall fescue without nitrogen fertilizer (TF-N) on forage quality, forage quantity and livestock performance. Research plots were planted at the Utah State University Pasture Research Facility in Lewiston, UT in 2010 and grazed in 2012. Treatments were arranged in a randomized complete block design with four replications and divided into four paddocks per replication. Three Angus crossbred steers with an average starting weight of 380 kg were placed on each treatment and rotated to a new paddock every 7 days. A put-and-take method was used throughout the growing season such that each
paddock received 80% utilization. Four forage samples were collected from each paddock just prior to grazing using a 1-m² quadrat for determination of dry matter (DM) and nutrient content. ADF, NDF, IVTD, and TDN were used to calculate nutrient content. Steers were weighed every 28 days. DM was similar among the TF+N (3568 kg ha⁻¹), TF+BFT (3456 kg ha⁻¹), and TF+ALF (3141 kg ha⁻¹) treatments. Whereas, DM in TF-N treatment was lower (2468 kg ha⁻¹). Steer average daily gains (ADG) were also similar among the TF+BFT (0.76 kg d⁻¹), TF+N (0.66 kg d⁻¹), and TF+ALF (0.62 kg d⁻¹). However, ADG on TF-N treatment was much lower (0.31 kg d⁻¹). Pasture performance appears to be equal or higher on TF+BFT and TF+ALF than TF+N in both DM yields and steer ADG.

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Abstract Text: Safflower is a deep rooted, stress tolerant crop that originated in desert environment and could be well adapted to the semi-arid agriculture. A field experiment was conducted to assess drought physiology and yield formation of two diverse spring safflower genotypes with or without full profile moisture. Half of experimental blocks were pre-irrigated with 160 mm of water to fill the empty profile from previous crop of corn, while other half remained depleted. Irrigation levels I₁ (75 mm), I₂ (150 mm), I₃ (225 mm), I₄ (300 mm) and I₅ (375 mm) were given to both pre-irrigation and no pre-irrigation blocks. Pre-irrigation treatment increased seed and oil yield by 28% and 29% over no pre-irrigation, respectively. Highest seed and oil yield was observed under I₅ irrigation level which was not significantly different from I₄. Higher water extraction from soil profile and lower transpiration were observed in low water availabilities. Improved water availability through pre-irrigation and higher irrigation levels increased RWC, photosynthesis and WP. Plants that received pre-irrigation treatment had higher WUE than no pre-irrigation treatment. Safflower utilized water with same efficiency even under limited water availabilities and WUE did not differ among irrigation levels or between cultivars. Biomass partitioning increased with increase in irrigation water, up to a certain level. Among all irrigation levels, lowest biomass partitioning was noticed in I₅. Results indicate that the pre-irrigation is beneficial for safflower to improve its physiology, growth and productivity. Improved head number, seeds per head and photosynthesis increased seed yield in safflower with increasing water availabilities. In general, both the cultivars responded similarly to water stress treatments.
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Nitrogen Use By Pacific Northwest Dryland Canola (Brassica napus) and Its Effect On Rotational N Balances.

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Abstract Text: Nitrogen (N) fertility recommendations vary widely within canola production regions including the Pacific Northwest. Canola has a high N uptake efficiency (unit of total plant N per unit of supplied N) but a low N utilization efficiency (unit of grain per unit of total plant N), leading to an overall low N use efficiency (NUE) (unit of grain produced per unit of N supplied) compared to wheat. Therefore, canola is able to take up nitrogen from the soil very well, but is poorer at allocating that nitrogen to its seeds. Calculations for estimating the N requirement for canola based upon maximum theoretical yields have proven unsuccessful in our region. Recent research indicates that spring canola can root up to 1.5 m, and efficiently scavenges high levels of residual soil N thereby minimizing responses to N fertilizer. Though rainfall gradient largely determines yield potential of canola in the Pacific Northwest, yields at economically optimum N supply (EONS) are consistently lower than maximum theoretical yields and reached at a relatively lower total N supply. The N requirement of canola at EONS can vary among years, but a single unit N requirement (UNR) of 11 kg N per kg seed was determined by considering multiple years and locations within a rainfall gradient. In order to better understand the effect of canola fertility on overall N balances, we developed a component analysis of NUE of an entire cropping sequence featuring canola (spring canola-spring pea-winter wheat). This approach provided insight into the propensity of cropping systems to retain and recycle N within a rotation by factoring in crop yields, grain and residue N, fertilizer N, N mineralization estimates, and changes in soil residual inorganic N. The inclusion of field peas led to positive N balances (N output exceeding N inputs) due biological N fixation. Interestingly, N balances were also more positive for sequences that received higher rates of N fertilization during its spring canola cropping. This result suggests elevated N mineralization due to the return of canola residues with higher N concentrations, as well as contributions of fertilizer carry-over to the overall rotational NUE. By tracking changes in soil N supply between crops, the rotational NUE will help us evaluate and adopt alternative cropping systems with the propensity to retain and recycle N within a rotation.

Abstract id# 79531
A Comparison of Oilseed and Grass Crop Residue Silicon and Fiber Composition and Impacts On Soil Quality.

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Abstract Text: Structural components (e.g. lignin and silicon (Si)) vary between crop types. Grasses, such as wheat, tend to have higher levels of Si and lower amounts of lignin as compared to oilseeds. When such residues are left on the soil surface after harvest, soil crusting can result due to a combination of raindrop impact and the release of Si during the decomposition of high Si containing crops. The two goals of this research are (1) to characterize the specific structural components in wheat and canola residue in order to understand their potential to resist degradation and (2) to grasp the effects of a long-term rotation history on soil crusting. Wheat (*Triticum aestivum* L.) and canola (*Brassica napus* L.) residues grown under different nitrogen (N) rates from a greenhouse experiment were analyzed for neutral detergent fiber (NDF; primarily hemicellulose, cellulose, and lignin), acid detergent fiber (ADF; primarily cellulose and lignin), acid detergent lignin (ADL; primarily lignin), total carbon (C), nitrogen and Si. Wheat residue had proportionately more hemicellulose than canola, at each N fertilizer rate. In comparison, canola residue was comprised of more cellulose and lignin. Due to its greater biomass production with increasing N, canola accumulated higher amounts of lignin, cellulose, and soluble compounds than wheat. Wheat accumulated 10-times more silica in its residue than canola, and unlike canola, exhibited a decline in %Si at increasing fertilizer levels and thus was diluted at higher yields. In a laboratory incubation, soil was collected from fields previously cropped in winter wheat or winter canola in order to compare the effect of contrasting crop histories on soil crusting. Initial values of soil Si were significantly higher in the soil collected from the wheat field when compared to the canola field. Three rates of silica solution (SiO$_2$) representative of amounts that would be found in wheat and canola residues were added to each soil type. High amounts of Si solution and soil Si had a positive effect on soil crust thickness and surface resistance, suggesting that crops high in Si have the ability to contribute to soil crusting. Therefore, it may be beneficial to consider crops with lower amounts of Si when planning crop rotations in areas where soil crusting can be a concern. Further research on this topic will include conducting a field survey on comparable fields this summer.