บทความที่น่าสนใจประจำเดือนตุลาคม 2556

1. Time-dependent climate impact of a bioenergy system – methodology development and application to Swedish conditions

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วารสาร: GCB Bioenergy, Volume 5, Issue 5, pages 580–590, September 2013

Abstract: The area of dedicated energy crops is expected to increase in Sweden. This will result in direct land use changes, which may affect the carbon stocks in soil and biomass, as well as yield levels and the use of inputs. Carbon dioxide (CO_2) fluxes of biomass are often not considered when calculating the climate impact in life cycle assessments (LCA) assuming that the CO_2 released at combustion has recently been captured by the biomass in question. With the extended time lag between capture and release of CO_2 inherent in many perennial bioenergy systems, the relation between carbon neutrality and climate neutrality may be questioned. In this paper, previously published methodologies and models are combined in a methodological framework that can assist LCA practitioners in interpreting the time-dependent climate impact of a bioenergy system. The treatment of carbon differs from conventional LCA practice in that no distinction is made between fossil and biogenic carbon. A time-dependent indicator is used to enable a representation of the climate impact that is not dependent on the choice of a specific characterization time horizon or time of evaluation and that does not use characterization factors, such as global warming potential and global temperature potential. The indicator used to aid in the interpretation phase of this paper is global mean surface temperature change ($\Delta T_s(n)$). A theoretical system producing willow for district heating was used to study land use change effects depending on previous land use and variations in the standing biomass carbon stocks. When replacing annual crops with willow this system presented a cooling contribution to $\Delta T_s(n)$. However, the first years after establishing the willow plantation it presented a warming contribution to $\Delta T_s(n)$. This behavior was due mainly to soil organic carbon (SOC) variation. A rapid initial increase in standing biomass counteracted the initial SOC loss.

2. Environmental impacts of future bioenergy pathways: the case of electricity from wheat straw bales and pellets

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วารสาร: GCB Bioenergy, Volume 5, Issue 5, pages 497–512, September 2013

Abstract: This study presents the life cycle assessment of electricity generation from straw bales and pellets. Straw is the most abundant biomass residue in Europe and its use for energy purposes is promoted on the premise of high greenhouse gas savings. This assumption has delayed the study of sustainability of straw-fired systems on a broader sense and the literature on the topic is almost absent. This study uses data from specific literature and emissions inventories to model a number of straw pathways. The plant modeled is a medium-scale straw-fired power plant of 50 MWth capacity. The results show that electricity from straw-fired power plants can indeed realize high greenhouse gas savings compared both with existing coal plants and with the European electricity mix. The savings are in the range 70–94%. The influence of the geographical origin of straw is analyzed by using datasets for the cultivation of wheat in five different European countries. The highest emissions are recorded for the case of straw from Spain due to the small yields, whereas cultivation processes in United Kingdom and the Netherlands

show high environmental impacts due to the high level of fertilization. Other environmental impacts are evaluated, such as acidification potential, eutrophication, particulate matter emissions, and photochemical ozone formation. The bioenergy system scores worse than the current European electricity mix for all the categories. However, it is important to notice that in Spain and United Kingdom the straw system shows lower impacts compared with the local average coal electricity. Finally, the study investigates the 'break-even' distance at which the higher emissions from the pellets production are paid off by the saved emissions in their transport compared with the bales. The results show that no reasonable break-even distance exists for road transport, whereas advantages for pellets are evident in any configuration for transoceanic transport.

3. How does bioenergy compare with other land-based renewable energy sources globally?

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Abstract: The potential power generation from land-based bioenergy is predicted globally using a computer model. Simultaneous consideration of land use, cost and carbon restrictions enables practical evaluation of net power output. Comparisons are made with wind and solar power, and a sensitivity analysis is used to explore the effects of different policy assumptions. Biomass is shown to offer only moderate power-generating potential, and would satisfy less than half of current demand even if all suitable existing arable land were used to grow bioenergy crops. However, bioenergy can be cheap to generate given current economics, and is able to remove atmospheric carbon in some cases if coupled with carbon capture and storage. Wind turbines are able to provide more power globally, but photovoltaic solar panels are the only source considered with the potential to satisfy existing demand. Since land-based bioenergy is also restricted by the need to grow food for an expanding population, and technological developments are likely to greatly increase the viability of other renewable sources, the role of land-based bioenergy appears relatively limited and short-term.

4. Experimental assessment of the accuracy of genomic selection in sugarcane

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วารสาร: Theoretical and Applied Genetics, October 2013, Volume 126, Issue 10, pp 2575-2586

Abstract: Sugarcane cultivars are interspecific hybrids with an aneuploid, highly heterozygous polyploid genome. The complexity of the sugarcane genome is the main obstacle to the use of marker-assisted selection in sugarcane breeding. Given the promising results of recent studies of plant genomic selection, we explored the feasibility of genomic selection in this complex polyploid crop. Genetic values were predicted in two independent panels, each composed of 167 accessions representing sugarcane genetic diversity worldwide. Accessions were genotyped with 1,499 DArT markers. One panel was phenotyped in Reunion Island and the other in Guadeloupe. Ten traits concerning sugar and bagasse contents, digestibility and composition of the bagasse, plant morphology, and disease resistance were used. We used four statistical predictive models: bayesian LASSO, ridge regression, reproducing kernel Hilbert space, and partial least square regression. The

accuracy of the predictions was assessed through the correlation between observed and predicted genetic values by cross validation within each panel and between the two panels. We observed equivalent accuracy among the four predictive models for a given trait, and marked differences were observed among traits. Depending on the trait concerned, within-panel cross validation yielded median correlations ranging from 0.29 to 0.62 in the Reunion Island panel and from 0.11 to 0.5 in the Guadeloupe panel. Cross validation between panels yielded correlations ranging from 0.13 for smut resistance to 0.55 for brix. This level of correlations is promising for future implementations. Our results provide the first validation of genomic selection in sugarcane.

5. Genome-wide association analysis for nine agronomic traits in maize under well-watered and water-stressed conditions

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วารสาร: Theoretical and Applied Genetics, October 2013, Volume 126, Issue 10, pp 2587-2596

Abstract: Drought can cause severe reduction in maize production, and strongly threatens crop yields. To dissect this complex trait and identify superior alleles, 350 tropical and subtropical maize inbred lines were genotyped using a 1536-SNP array developed from drought-related genes and an array of 56,110 random SNPs. The inbred lines were crossed with a common tester, CML312, and the testcrosses were phenotyped for nine traits under well-watered and water-stressed conditions in seven environments. Using genome-wide association mapping with correction for population structure, 42 associated SNPs ($P \leq 2.25 \times 10^{-6}$ 0.1/*N*) were identified, located in 33 genes for 126 trait × environment × treatment combinations. Of these genes, three were co-localized to drought-related QTL regions. Gene GRMZM2G125777 was strongly associated with ear relative position, hundred kernel weight and timing of male and female flowering, and encodes NAC domain-containing protein 2, a transcription factor expressed in different tissues. These results provide some good information for understanding the genetic basis for drought tolerance and further studies on identified candidate genes should illuminate mechanisms of drought tolerance and provide tools for designing drought-tolerant maize cultivars tailored to different environmental scenarios.

6. Fine mapping of the *Ph-3* gene conferring resistance to late blight (*Phytophthora infestans*) in tomato

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วารสาร: Theoretical and Applied Genetics, October 2013, Volume 126, Issue 10, pp 2643-2653

Abstract: Late blight, caused by the oomycete pathogen *Phytophthora infestans* (Mont.) de Bary, is a devastating disease for tomato and potato crops. In the past decades, many late blight resistance (*R*) genes have been characterized in potato. In contrast, less work has been conducted on tomato. The *Ph-3* gene from *Solanum pimpinellifolium* was introgressed into cultivated tomatoes and conferred broad-spectrum resistance to *P. infestans*. It was previously assigned to the long arm of chromosome 9. In this study, a high-resolution genetic map covering the *Ph-3* locus was constructed using an F_2 population of a cross between *Solanum lycopersicum* CLN2037B (containing *Ph-3*) and *S. lycopersicum* LA4084. *Ph-3* was mapped in a

0.5 cM interval between two markers, Indel_3 and P55. Eight putative genes were found in the corresponding 74 kb region of the tomato Heinz1706 reference genome. Four of these genes are resistance gene analogs (RGAs) with a typical nucleotide-binding adaptor shared by APAF-1, *R* proteins, and CED-4 domain. Each RGA showed high homology to the late blight *R* gene *Rpi-vnt1.1* from *Solanum venturii*. Transient gene silencing indicated that a member of this RGA family is required for *Ph-3*-mediated resistance to late blight in tomato. Furthermore, this RGA family was also found in the potato genome, but the number of the RGAs was higher than in tomato.

7. Food security, climate change, and sustainable land management. A review

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วารสาร: Agronomy for Sustainable Development, October 2013, Volume 33, Issue 4, pp 635-650

Abstract: Agriculture production in developing countries must be increased to meet food demand for a growing population. Earlier literature suggests that sustainable land management could increase food production without degrading soil and water resources. Improved agronomic practices include organic fertilization, minimum soil disturbance, and incorporation of residues, terraces, water harvesting and conservation, and agroforestry. These practices can also deliver co-benefits in the form of reduced greenhouse gas emissions and enhanced carbon storage in soils and biomass. Here, we review 160 studies reporting original field data on the yield effects of sustainable land management practices sequestering soil carbon. The major points are: (1) sustainable land management generally leads to increased yields, although the magnitude and variability of results varies by specific practice and agro-climatic conditions. For instance, yield effects are in some cases negative for improved fallows, terraces, minimum tillage, and live fences. Whereas, positive yield effects are observed consistently for cover crops, organic fertilizer, mulching, and water harvesting. Yields are also generally higher in areas of low and variable rainfall. (2) Isolating the yield effects of individual practices is complicated by the adoption of combinations or “packages” of sustainable land management options. (3) Sustainable land management generally increases soil carbon sequestration. Agroforestry increases aboveground C sequestration and organic fertilization reduces CO_2 emissions. (4) Rainfall distribution is a key determinant of the mitigation effects of adopting specific sustainable land management practices. Mitigation effects of adopting sustainable land management are higher in higher rainfall areas, with the exception of water management.

8. Food web-based simulation for agroecology

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วารสาร: Agronomy for Sustainable Development, October 2013, Volume 33, Issue 4, pp 663-670

Abstract: Ecosystems are increasingly manipulated for agricultural and conservation goals. Ecosystem functions need to be sustained socially and ecologically. New frameworks must be built to simulate agrosystems based on ecological processes instead of external chemicals. Food web structures of agrosystems highly influence their agronomical performance and stability. Although it has been observed that living communities are ruling the performance of agroecosystems, these living communities are generally ignored by agronomists who focused mainly on abiotic factors. Indeed, agronomists usually focus

on the soil–plant–atmosphere continuum. Now, ecological modellers can link food web models with soil–plant models to create innovative frameworks. Here, we advocate that food webs must be included in simulations of production and in studies of emerging properties. We emphasize the role of trophic chains in the regulation of pests. Emerging properties include aboveground and belowground interactions, pest control, and positive feedbacks on soil properties. We propose a conceptual structure for this framework and discuss how the structure of linked food web/cropping system models can account for the specific properties of agroecosystems. The proposed structure includes a process-based approach to link food webs with crop models. Such comprehensive models address the issue of trade-offs between ecosystem services, including regulation of crop pests by the ecosystem community, nutrient cycling, and crop production.

9. Differential responses of trees to temperature variation during the chilling and forcing phases

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วารสาร: Agricultural and Forest Meteorology, Volume 181, 15 November 2013, Pages 33–42

Abstract: Temperate-zone trees must fulfill cultivar-specific chilling and heat requirements during the dormant period, in order to produce leaves and flowers in the following growing season. Timing and accumulation rate of chill and heat are understood to determine the timing of spring events, but both processes are difficult to observe in dormant tree buds. Where long-term phenological observations are available, Partial Least Squares (PLS) regression offers a statistical opportunity to delineate phases of chill and heat accumulation and determine the climatic requirements of trees. This study uses PLS regression to explore how the timing of spring events of chestnut in China, cherry in Germany and walnut in California is related to variation in the daily rates of chill and heat accumulation, as calculated with horticultural models. Dependent variables were 39 years of flowering dates for chestnuts in Beijing (China), 25 years of cherry bloom in Klein-Altendorf (Germany) and 54 years of walnut leaf emergence in Davis (California, USA). These were related to daily accumulation rates of chill, calculated with the Dynamic Model, and heat, calculated with the Growing Degree Hours Model. Compared to an earlier version of the procedure, in which phenological dates were related to unprocessed temperature data, delineation of chilling and forcing phases was much clearer when using horticultural metrics to quantify chill and heat. Chestnut bloom in the cold-winter climate of Beijing was found to depend primarily on the rate of heat accumulation, while cherry bloom in the temperate climate of Germany showed dependence on both chill and heat accumulation rates. The timing of walnut leaf emergence in the mild-winter climate of California depended much more strongly on chill accumulation rates. Chilling (in Chill Portions = CP) and heat (in Growing Degree Hours = GDH) requirements determined based on PLS regression were 79.8 ± 5.3 CP and 13,466 ± 1918 GDH for chestnut bloom in Beijing, 104.2 ± 8.9 CP and 2698 ± 1183 GDH for cherry bloom in Germany, and 37.5 ± 5.0 CP and 11,245 ± 1697 GDH for walnut leaf emergence in California. Spring phases of cherry in Klein-Altendorf and especially chestnut in Beijing will likely continue to advance in response to global warming, while for walnut in California, inadequate chilling may cause delays in flowering and leaf emergence. Such delays could serve as an early-warning indicator that future productivity may be threatened by climate change. The R package ‘chillR’ makes the method used in this study available for wider use.

10. Estimation of solar radiation based on air temperature and application with the DSSAT v4.5 peanut and rice simulation models in Thailand

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วารสาร: Agricultural and Forest Meteorology, Volume 180, 15 October 2013, Pages 182–193

Abstract: Estimation of solar radiation (SRAD) from daily air temperature by the modified Bristow–Campbell (B–C) model requires three empirical coefficients that are area specific. Previous estimates of these coefficients for Thailand were based on limited data without any evaluation. Accurate estimation of solar radiation has become more important with the wider application of environmental models. The objective of this study was to calibrate and evaluate the coefficients for Thailand with a broader range of data. Meteorological data from 2008 to 2011 were obtained from eight weather stations, three in the North (Chiang Mai, Chiang Rai and Nakhon Sawan), two in the Northeast (Khon Kaen and Ubon Ratchathani), one in the Central (Lop Buri) and two in the South (Chumporn and Surat Thani). Data for 2010 for all locations except Chiang Rai were used for calibration of the coefficients and the remaining data were used as independent data sets for evaluation. The coefficient of determination (R^2), root mean square error (RMSE) and normalized root mean square error (RMSEn) were used as indicators of the agreement between the observed and the calculated SRAD. The results showed that the calibration was acceptable (R^2 = 0.56, RMSE = 3.07 MJ m^{-2} d^{-1} and RMSEn = 17.5%). The derived values are a = 0.63, b = 1.89 and c = 1.54. These new coefficients performed well during evaluation with the 13 independent data sets from the eight locations for all four regions, with the R^2, RMSE and RMSEn values in the range of 0.39–0.70, 2.42–3.79 MJ m^{-2} d^{-1} and 14.0–21.7%, respectively. In addition, simulations using estimated SRAD from the derived values provided high R^2 values for peanut and rice yield and total dry matter. These new coefficient values can be used to estimate solar radiation from air temperature data for all locations in Thailand and similar environments in Southeast Asia.