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& Environment:
Food, Water, Soil, Air

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Preface

The 2016 International Conference on Environmental and Agriculture: Food, Water, Soil, Air (ICAE 2016) is designed to cover all aspects of agricultural and environmental sciences with a clear focus on interdependent areas of food production, water, soil and air. The ICAE 2016 aims to bring together scientists, researchers, subject-matter experts, academicians, students and practitioners for information interchange by sharing their views, experiences and research results in Agriculture- and Environment-related areas, and also for enhancing scientific collaborations around the world. The ICAE 2016 is organised by New Zealand House of Science (NZHS) and proudly is in an academic partnership with the Department of Agricultural & Resource Economics, University of Connecticut, USA and Centre for Research in Waste Management, University of Malaya, Malaysia. The Water Network is the media partner of the ICAE 2016 and the conference is held in Kuala Lumpur, Malaysia during May 25-27, 2016.

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Keynotes



Dr Richard Bell
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Conservation Agriculture and Mechanisation for Smallholder Agriculture: A Win-win for Agriculture and the Environment

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Conservation agriculture (CA) is now practiced on over 157 million hectares worldwide but adoption is still limited in smallholder farms of Asia and Africa. The practice of CA involves crop production with minimum soil disturbance, soil cover with crop residue or mulch and diverse rotations of crops. Research in Bangladesh demonstrates the benefits of CA for smallholders: yields are maintained or increased, savings of fuel, savings of labour, and more timely sowing of crops. In addition, the benefits for the environment include: decreased greenhouse gas emissions, increased soil organic carbon, and decreased erosion. Development of CA in rice-based cropping systems is occurring in Bangladesh and the Eastern Gangetic plain. Here, shortages of labour and intensive crop production (cropping intensity in Bangladesh is 190 %) are driving interest among farmers in small-scale mechanisation based around the Chinese-made two-wheel tractor (2WT; 12-15 horsepower). The machinery is normally purchased and operated by small agricultural contractors known as local service providers (LSP) who hire their planting services to farmers. A number of planters, attached to the 2WT, have been developed for sowing seeds with minimum soil disturbance. At this stage strip planting (rotating blades till a strip 5-8 cm wide for planting seeds and placing fertiliser but < 25 % of the soil is disturbed) is favoured over tyne or disk openers. Agronomic practices for mechanised seeding are under development including systems for effective weed control. In rice-based cropping systems, implementation of CA is hampered due to practice of soil puddling for rice seedling transplanting. However, rice seedling transplanting in unpuddled soils, developed in Bangladesh, opens the possibility for CA adoption in other rice-growing regions. Further challenges lie with developing a supply chain for planters

and planting services. Commercialisation plans for scaling out the use of planters for CA involve initial demand creation among farmers and then support to LSP and manufacturers to develop profitable business models. High-level dialogue is required to create an enabling policy environment in which the private sector can promote CA and small-scale mechanisation so that benefits to farmers and the environment can be realised.

Keywords: *Commercialization, Fuel and labour saving, Planters, Policy, Soil organic carbon, Unpuddled rice transplanting*



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Development and Management of Dams under Conditions of Climate Change

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Dams provide us valuable services, such as hydropower, flood control, regulation of water supply, and recreation. When evaluating the desirability of building a new dam, expected benefits from its services need to be weighed against the likely social, economic, and environmental costs of building and managing the dam. The long-term sustainability of a dam's storage related functions may be contingent on factors that influence water and sediment flows into a reservoir and on appropriate management of sedimentation at the reservoir level. Climate change clearly has the potential to impact the demand for new dams. One can, for example, envision the need for more hydropower as the earth warms, and for more protection against floods as river flow variability increases. Interestingly, climate change can also play a significant role in determining the desired physical characteristics of new dams, such as reservoir capacity, and the preferred strategy for management of reservoir sedimentation at existing dams.

There is a growing literature on how climate change can influence river water and sediment flows, thereby requiring adaptation of watershed and reservoir level management practices. The direction and the extent of this influence depend on the climate change scenario under consideration as well as on site specific features. Given such variability in possible outcomes, policy makers and dam managers stand to benefit from research that provides a practical tool kit for assisting them with making decisions appropriate for their unique circumstances. One promising starting point in this regard is the RESCON (REServoir CONservation) model and associated computer program, developed in 2003 by a team of engineers and economists. The main objective of the program is to help determine a net present value maximizing sediment removal plan for any reservoir, taking as given all physical parameters (e.g., reservoir size and geometry, water inflow characteristics, average annual incoming sediment flow) and economic

parameters (e.g., prices and costs). Sediment accumulation is modeled as causing loss of storage capacity and related benefits. It can be prevented or slowed down with costly sediment removal. Results from the program include a ranking (in net present value terms) of sediment removal techniques, timings and levels of their utilization, and time of dam decommissioning (in case of complete loss of reservoir capacity).

The RESCON model has been used quite widely by dam managers around the world and is the basis of several case studies published in academic outlets. The model has also been extended recently to include options for reducing incoming sediment via watershed management practices and for evaluating economic consequences of dam level operations for downstream water users. Ongoing research is adapting the model to study the impact of climate change by making incoming water and sediment flows and water evaporation rate depend on climate variables. This modification gives rise to several research questions, of which the following three are at a relatively advanced stage of investigation. First, what would be the desirable sediment management strategy at a dam for a given climate change scenario? This question is approached using our extended RESCON model under deterministic assumptions regarding future values of precipitation and temperature. Second, what would be the impact on the timing of dam decommissioning if there is uncertainty in river flows and greater variability is expected under climate change? Answering this question entails use of stochastic dynamic programming in a version of the RESCON model that incorporates the risk of dam failure. And third, how would expected trends in river and sediment flows impact the desired size of a dam? This problem is formulated by adding reservoir capacity as a control variable to the modified (deterministic) RESCON model. Each of the above three adaptations of the RESCON model is applied to case study dams from Asia, Africa, and North America.



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Sustainability of Livestock Grazing Systems; a New Zealand Perspective

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Supply of milk and meat products derived from livestock animals is a nutritionally and economically important part of the global food system. How sustainable the production system from which highly nutritious livestock products are sourced, is becoming an increasingly important question. Livestock globally are produced from three broad production system types: confined-intensive, mixed crop-livestock, and open grazing. The following definition of a sustainable livestock grazing system – *generating economically-viable and nutritionally-rich livestock products without diminishing the supporting natural physical and social-cultural resources and ecosystem functioning* – is explored in a New Zealand context. A favourable oceanic climate and good soils allowing almost year round pasture growth, good transport infrastructure and trading links, and a clean-green environment perception, contributes fundamentally to NZ's strong position as a producer of premium meat, milk, and wool. NZ has diverse livestock grazing systems: dairy and beef cattle for milk powder, butter, and beef; sheep for meat (lamb) and wool; deer for meat (venison) and velvet. There are also emerging livestock systems of goat and sheep dairying. With a 130 year history of producing milk and meat products from livestock reared on grassland and pastures, NZ today exports 80% of all meat and milk produced to the outside world. The sustainability level of NZ's livestock grazing agroecosystems is explored and its current sustainability challenges discussed. An overview of current research in NZ pasture-based livestock agriculture systems is presented.



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Production and Water Use Efficiency of Simple and Diverse Pastures for Dairy Cow Grazing in Canterbury, New Zealand

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A two year study compared the herbage dry matter (DM) production and water use efficiency (WUE) of a simple perennial ryegrass/white clover pasture (S) with diverse pasture mixtures grown for the purpose of grazing by dairy cows. Diverse pastures contained the simple mix of perennial ryegrass/white clover along with additional legumes (red clover and lucerne, SL), herbs (chicory and plantain, SH), grasses (prairie grass and timothy, SG), herbs and legumes (SLH), or legumes, herbs and grasses (SLHG). Pastures were subjected to full and partial irrigation, with the partial irrigation treatment receiving no irrigation for a 2 month period from mid-summer to early autumn; 14 January 2011 to 10 March 2011 (Year 1) and 7 January to 16 March 2012 (Year 2). Neutron probe tubes were inserted to a soil depth of 2.5 m to measure soil moisture content. Averaged over two years, herbage DM production was greater ($P<0.05$) where additional legumes were added to mixtures than where additional herbs or grasses were added, or in the simple mixture (16.5, 16.1, 15.1, 14.5, 14.1, 13.6 t DM/ha for SLHG, SLH, SL, SH, S and SG, respectively). Pasture DM yield decline associated with partial irrigation compared to full irrigation was lowest ($P<0.05$) in SL (10%) and SLH (14%) and SLHG (15%) pastures than SG (19%) and S (26%) over the two year period. Greater pasture water use ($P<0.05$) occurred from mixtures containing additional legumes (SL, SLH and SLHG, 689 mm to 705 mm) than the mixture containing additional grasses (SG, 680 mm) or the simple mixture (S, 670 mm). However, the effect was relatively small (range 14 mm to 35 mm) and tightly linked to the summer period. In mixtures containing additional legumes (SL, SLH and SLHG), water was extracted from greater depths (0–2m) than the mixtures containing additional grasses or the simple mixture (SG and S, 0–1m). Mixtures with additional herbs (SH) extracted water to 0–1.5m soil depth.

WUE was greater ($P<0.05$) in the mixtures containing additional legumes and additional herbs (SL, SH, SLH and SLHG, 18.6 to 21.1 kg DM/ha/mm) than additional grasses (SG, 17.5 kg DM/ha/mm) or the simple mixtures (S, 18.3 kg DM/ha/mm). Results suggest that pasture mixtures containing tap rooted legumes and herbs use water more efficiently to produce herbage DM under the same soil moisture conditions than simple perennial ryegrass/white clover pasture.

Presentations

The Response of Growth, Yield and Antioxidant Content of *Aloe vera* L. Plant on a Combined doses of Fertilizers in Sandy Soil

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The study aims to explore the response of growth, yield and antioxidant content of *Aloe vera* plant in sandy soil, such as marginal land in need of application of different combined doses of fertilizers. The experiment was conducted in the districts of Bantul sandy soil particularly the region of Yogyakarta, Crop Production Laboratory in the Agriculture Faculty, Sarjanawiyata Tamansiswa University, and Research and Testing Integrated Laboratory, Gadjah Mada University. The research was a factorial experiment arranged in Randomized Completely Block Design with three replications. The first factor was doses of manure, namely 10, 20 and 30 tons per ha. The second factor was doses of urea fertilizer namely 0; 150; 300; 450 and 600 kg per ha. Variable of observations included the components of growth, yield and antioxidants content. Data were analyzed by analysis of variance followed by Duncan's Multiple Range Test of 5% significance level. As a conclusion, there was interaction between manure and urea fertilizer doses on all of variable observation. The highest growth rate and yield were obtained by the application 30 tons per ha of manure and 450 kg per ha of urea. However, the highest antioxidant content was obtained by the application of 20 tons per ha of manure and 300 kg per ha of urea.

Keywords: *Aloe vera, antioxidant, manure, sandy soil, urea*

Effects of Spent Engine Oil on the Growth and Yield of Different Accessions of Tomato (*Solanum Lycopersicum* L.) as Influenced by Arbuscular Mycorrhizal Fungi and Poultry Manure

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Tomato (*Solanum lycopersicum* L.) is an edible, often red fruit of the night shade family Solanaceae, it may be consumed in diverse ways, including raw, as an ingredient in many dishes, salads and drinks across the world. Ecological and environmental factors challenge the cultivation of tomatoes especially in West African sub- region. This work examines the effects of spent engine oil on the growth and yield of different accessions of tomatoes as influenced by Arbuscular mycorrhizal fungi and poultry manure. The research which was carried out in the Botanical gardens of the department of Biology, Federal College of Education, Abeokuta, South western Nigeria, was laid out in a randomized complete block design in three replicates. Parameters measured were: leaf area, number of leaves, cumulative number of fruits and fruits weight. Data collected were analysed using analysis of variance (ANOVA) and Duncan Multiple Range Tests. Results showed that plants treated with Arbuscular mycorrhizal fungi had higher values for both growth and yield traits among all the accessions. Accession 6 i.e. NG/RM/JAN/10/001 responded very well to combined treatment of Arbuscular mycorrhizal fungi and spent engine oil (AMF+SEO). It can be suggested that Arbuscular mycorrhizal fungi has the ability to degrade oil in an oil polluted soils.

Keywords: *Arbuscular mycorrhizal fungi, Spent engine oil, Tomato, Yield and accession.*

Influence of Drip Fertigation on Growth and Yield of Aerobic Rice

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Rice is staple food crop for more than half of population. More than 50 per cent of the irrigation water in the world is used for rice. The traditional rice production system not only leads to water wastage but also causes destruction of soil aggregates and reduction in micro-pores and fertilizer use efficiency. The increasing scarcity of water threatens the sustainability of irrigated rice production systems. In this context, a study on the influence of drip fertigation (DF) on aerobic rice was conducted. Drip irrigation reduces deep percolation and evaporation and controls soil water status precisely within the crop root zone. A field experiment was conducted during *kharif* autumn 2014 and summer 2015 at the Zonal Agricultural Research Station, V.C. Farm, Mandya, Southern Dry Zone of Karnataka, India. The experiment was laid out in a randomized complete block design with ten treatments and three replications; three levels of irrigation, based on 100, 125 and 150 % cumulative pan evaporation (CPE) in combination with 75, 100 and 125 % recommended dose of fertilizer (RDF) and absolute control. The growth and yield components of aerobic rice differed significantly. Highest grain yield was recorded with irrigation @150 % CPE + DF 125 % RDF (49.63 q ha⁻¹) (LSD_{0.05}=1.82), plant height (97.20 cm), tillers (40.00), leaf area (3671.67 cm²), productive tillers (25.10), panicles m² (230.00), panicle length (23.53 cm), panicle weight (4.17 g hill⁻¹), total number of grains per panicle (110.50) and thousand grain weight (110.50 g). These greater agronomic performance indicators were attributed to greater continuous availability of water and nutrients in the root zone through drip fertigation resulted in higher cell division and cell enlargement in plants as well as higher uptake of nutrients. However, significantly lower grain yield (32.28 q ha⁻¹) was observed in irrigation @100 % CPE+ DF 75 % RDF. Application of 125 % recommended dose of fertilizer through drip fertigation and irrigation @ 150 % cumulative pan evaporation provided a continuous supply of nutrients and moisture at optimum level to the aerobic rice crop which resulted in better formation and translocation of assimilates from source to sink which lead to increased yield.

Keywords: Drip, Fertigation, Cumulative pan evaporation, Irrigation, Yield

Resistance to Spot Blotch of Wheat in Eastern Gangetic Plains of India

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Spot blotch (SB) caused by *Bipolaris sorokiniana* Sacc. In Sorok. Shoem is a serious biotic stress to wheat in warm and humid areas, particularly South Asia. The yield losses due to this disease are very significant. A study was conducted with more than 700 diverse genotypes of Indian and International origin against virulent strain of the pathogen under polyhouse and natural conditions to determine the resistant genotype, its characteristics symptoms and biochemical constituents associated with disease resistance. The genotypes were planted for the crop seasons, 2012-13, 2013-14 and 2014-15. Disease data was recorded based on lesion number and types, disease severity and disease response (chlorotic/non-chlorotic, sporulating/non-sporulating). The biochemical constituents of plants viz. Phenols, Peroxidase, Polyphenol oxidase and Super oxide dismutase were estimated and correlated with disease resistance. Results indicated that some genotypes of CIMMYT origin exhibited high level of disease resistance against the pathogen and symptoms were characterised as resistant (restricted spots without coalescing and dark brown to black pin head dots) to susceptible (fast spreading spots. Coalesce and immature drying of the leaves). A correlation was observed with POX, PPO and SOD activities with disease resistance. The resistant genotypes (<300 Area Under Disease Progress Curve, Early heading <65 days and higher yield > 4.5 t/ha) were selected for future breeding program.

Keywords: Wheat, Spot blotch disease, Resistant genotype, Biochemical constituents

Isolation and Characterization of Bacteriophages Specific to *Vibrio vulnificus*

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Vibrio vulnificus is a Gram-negative bacterium widely distributed in estuarine environments and associated with vibriosis. It is capable of causing invasive septicemia with high lethality rate in aquatic animals resulting in loss in the aquaculture industry. Antibiotics and other therapeutic agents have been used for prophylactic and therapeutic purposes. However, the success of these treatments is now compromised by the increase in antimicrobial resistance of *Vibrio* spp. Bacteriophage is the alternative natural strategic way as the biological control against vibriosis. Three hundred and twenty-five bacteriophages relatively specific to *V. vulnificus* strains were isolated from shellfish and shrimps. The ability of specific bacteriophage to inhibit *V. vulnificus* was investigated. Three bacteriophages completely inhibited 10 *V. vulnificus* clinical isolates, 2 *V. vulnificus* biotype 2, *V. parahaemolyticus* ATCC 17808, *V. alginolyticus* PSU 6 and *V. cholerae* PSU 966 O1. This study provides further application of alternative way as biological agent to control vibriosis for a better sustainable aquaculture industry.

Keywords: *Vibrio vulnificus*, Bacteriophage, Vibriosis, Biocontrol

Remediation of Soil Contaminated by Non-biodegradable Compound Using Continuous Microwave Irradiation and Hyperthermal Catalysts

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The objective of this study was to develop a remediation technique for soils contaminated with persistent organic compounds using microwave irradiation and hyperthermal catalysts. Phenanthrene, a representative polycyclic aromatic hydrocarbon, was selected as the target contaminant of this study, which is toxic and carcinogenic. Thermal remediation by microwave irradiation was employed to remediate the soil artificially contaminated with phenanthrene. Powdered activated carbon (PAC) and graphite were selected as the hyperthermal catalysts, because these materials were found to be very effective to elevate temperature when the microwave is irradiated. A lab-scale microwave irradiation system equipped with a continuous conveyor belt type soil supplier was fabricated and operated. The contaminated soil was mixed with each of hyperthermal catalysts at 9:1 (w/w). The soil moisture content was adjusted to 20% (w/w). The microwave irradiation system was operated at 800 kW of input power for 10 min of retention time. Phenanthrene was removed about 35% at the initial stage of mixing with hyperthermal catalysts, which were attributed to the sorption to the carbon-based hyperthermal catalysts. When microwave was irradiated along with PAC, the removal of PHE from the soil was insignificant. However, PHE was effectively removed when microwave was irradiated along with graphite (~100% removal rate). In the case of graphite, the temperature in the microwave system was increased to a level higher than the boiling point of PHE (340°C) whereas PAC was not able to elevate the temperature to this level. As a result, PHE was more effectively removed by thermal effect in the case of graphite, compared to the case of PAC. The results of this study provide useful information for the development of a new thermal remediation technique for the contaminated soils using microwave combined with hyperthermal catalysts.

Keywords: *Continuous microwave irradiation, Non-biodegradable compound, Phenanthrene, Soil remediation*

Evaluation of a Water-saving Superabsorbent Polymer and Ascorbic Acid on In-vitro Propagated Saba Bananas (*Musa balbisiana*) Under Nursery Conditions

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Protecting the plants against drought stress and improving water conservation in soil through proper techniques are vital in the production of banana plantlets. Therefore in this study the effects of superabsorbent polymer (SAP) application and Ascorbic acid (AsA) spraying on in-vitro propagated Saba banana (*Musa balbisiana*) were evaluated for growth response at the Greenhouse, Isabela State University, Echague, Isabela using 96 meriplants at 4 meriplants per treatment combination with an average height of 5cm per meriplant. The study was laid out following the factorial experiment based on completely randomized design. Four factors of superabsorbent polymers (SAP), and two Ascorbic Acid (AsA) were studied with the following levels: four SAP concentrations of 0, 2g/kg soil, 4g/kg soil and 6g/kg soil, two treatments of non-application and application of AsA. Results showed that the application of SAP in soil and foliar spraying of plants with AsA led to significant increases ($p<0.05$) in plant height, pseudo-stem girth and total leaf area at 45 and 60 days after transplanting compared with the control plants. Furthermore, the results indicated that the interaction of Ascorbic Acid and Superabsorbent Polymers has significant effect on the plant height of Saba at 60 DAT with the treatments applied with AsA and SAP producing taller plants compared to non AsA applied plants. This study demonstrates that using SAP along with the foliar application of AsA enhanced the growth performance of in-vitro propagated Saba under nursery condition.

Keywords: *Superabsorbent Polymers, In-Vitro, Ascorbic Acid, Saba*

Investigating Effects of Different Biochars On Red Soil Properties and Nutritional Conditions

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Biochars with different origins produced under specific pyrolysis conditions have variable physicochemical properties, which may cause dissimilar effects on red soil properties. To examine this issue, a 180-day *ex situ* incubation was established. Five biochars (rice husk [RH], the wood of Japanese cedar [JC], palm kernel shell [PKS], and coal ash of two particle sizes [5-8 μm , SC; 15-30 μm , LC]) were added to red soil of Hapludults with/without compost to simulate agricultural use. Soil samples were collected at Days 0, 90 and 180 for analyses of pH, electrical conductivity (EC), organic carbon (OC), total nitrogen (N), Mehlich III extractable cations (*i.e.*, K, Ca, Mg, Fe, Mn, Cu and Zn), and phosphorus (P). The results showed that pH was dependent on the biochar added with/without compost as all pH values gradually decreased with natural decomposition. EC mainly reflected the size of the biochar's surface area, where soluble salts were adsorbed. The content of soil OC during the incubation was determined by the content of OC in the biochars due to biochar's resistance to microbial activity. LC had the highest total N and produced the highest soil total N. Thus, the increase in soil N after biochar application was determined by the original N in the biochar. Interestingly, low extractable P due to soil fixation by low pH seemed to be alleviated without compost. RH was a good source of extractable P and K, and PKS had the highest extractable Ca throughout the incubation with/without compost. Extractable Fe and Mn decreased with time, probably adsorbed by the biochars, but no specific trend was found. LC may be a good soil additive to prevent low Zn in crops, while SC may cause significant Cu adsorption. In conclusion, different biochars can be used to adjust the nutritional conditions of red soil via direct changes in its physiochemical properties and/or indirect influences on its microbial properties, which are also important factors in soil nutritional conditions.

Keywords: Soil additive, Fertiliser, Agricultural waste, Resource, Recycle.

Effects of Growing Media Substrates on Selected Vegetable Growth in Self-watering Container

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A study was conducted to compare the combination of media substrates on the growth performances of Amaranth (*Amaranthus tricolor*) and Chinese kale (*Brassica oleracea* var. alboglabra L.) in self-watering container called *GreenKit*. *GreenKit* is self-watering system developed specifically for growing the shallow rooted crops in home gardening. It is a specially design container which has three separate compartments; the water reservoir, the growing compartment and the capillary chamber. Water moves up from the water reservoir to the growing compartment through the capillary chamber which is filled with capillary particles by the capillary action. The growing media tested were combination of peat, perlite and vermiculite (1:1:1), peat, perlite, vermiculite and empty fruit bunches (1:1:1:1), peat, perlite, vermiculite and soil (1:1:1:3) and cocopeat with perlite (1:1). The experiment was laid out in a randomized complete block design with three replications. Seeds were direct seeded and plants were grown under greenhouse and fertilized with calcium nitrate, potassium nitrate, mono-potassium phosphate plus microelements – S, MgO, Mn, B, Zn, Cu, Mo, Fe. There was prepared solution, which was diluted with water in a ratio of 1: 100. The concentration of salts in the nutrient solution was EC 2.4–2.7, acidity – pH 5.5–5.8. Statistical analyses of the treatment responses were conducted by performing analysis of variance (ANOVA) using SAS statistical software and Least Significant Differences (LSD) was used for testing differences among means of the parameters. Chlorophyll content, shoot and root growth of Chinese kale were not affected by the media substrate combinations. Meanwhile, shoot growth and chlorophyll content of Amaranth on peat, perlite, vermiculite and empty fruit bunches (1:1:1:1) was significantly lower than other combination substrates. Results suggested that all media combinations tested in this study were able to support plant growth of both species.

Keywords: Growing media, Self-watering container, Peat, perlite, Vermiculite, Empty fruit bunches

**Searching Behaviour of the Egg Parasitoid, *Oligosita* sp.
(Hymenoptera: Trichogrammatidae) of the Rice Brown Planthopper,
*Nilaparvata lugens***

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Egg parasitoids can be used as biological control agents in agriculture to prevent any sudden outbreak of pest due to food web imbalances, reduce the occurrence of chemical resistance in pests and increase the production of safe organic crops. Recently, studies on the kairomones that may attract the egg parasitoids to locate the eggs of their hosts have drawn much attention. In the present study, we aimed to determine the egg searching behaviour response of the egg parasitoid, *Oligosita* sp. (Hymenoptera: Trichogrammatidae) of the rice brown planthopper, *Nilaparvata lugens* to uninfected healthy rice plants, *N. lugens*-damaged plants with and without adult *N. lugens*, eggs of *N. lugens* that have been isolated from the plants, plants with freshly laid eggs of *N. lugens*, and crushed eggs of *N. lugens* using the Y-tube olfactometer. Results showed that *Oligosita* sp. have no preference for uninfected healthy plants, and plants with adult *N. lugens*. A strong attraction towards the plants with freshly laid eggs of *N. lugens* was observed for the female *Oligosita* sp. However, female *Oligosita* sp. did not show much interest on the crushed or isolated fresh egg of *N. lugens*. It is likely that the oviposition-induced kairomone of the host plant or some unknown substances left by the female *N. lugens* during egg deposition play an important role in determining the egg searching behaviour of *Oligosita* species.

Keywords: *Egg parasitoid, Kairomone, Nilaparvata lugens, Oligosita, Rice plant, Searching behaviour*

Common Agricultural Policy as a Tool for Maintenance Traditional Agricultural Landscapes in Slovakia or other European Countries?

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The effects of Common Agricultural Policy (CAP) on landscapes was developing since the 80th of the last century. In order to implement protective measures, landscape value was one of the two criteria for "Environmentally Sensitive Areas' selection in rural development regulation (EEC/797/85). Relevant references have been more frequent in recent versions of agri-environmental measures, inclusive of specific mention of the landscape protection, historical characteristic of agricultural landscapes, High Nature Value (HNV) agricultural areas (EU/1257/99). The attention of this paper is drawn to the traditional agricultural landscapes (TAL) of Slovakia, which possess both natural and cultural value and is closely linked with HNV representing Type 2 - Farmland with a mosaic of low intensity agriculture and natural and structural elements. The measures for support of HNV farmland has not been effectively implemented in the Slovak Rural Development Program, therefore the aim of our study is to summarize knowledge about the HNV farmland support in other European countries and stimulate action for maintenance of TAL in Slovakia. The results of our analyses showed that measures to promote TAL and its structures have already been implemented in the Rural development program in countries like Ireland, Sweden, Portugal, Italy, Finland etc. The objectives and measures are defined as protection all features of historical and/or archaeological interest, supplementary measures for hedge plant/restore, wall restore, conservation of valuable nature and cultural historically valuable agricultural milieus with traces of old land use forms, preservation of landscape and of traditional features of agricultural land, preservation and re-establishment of the characteristic components of the traditional rural landscape etc. We propose that small patches of mosaic landscape should be recognized as HNV Type 2 farmland and integrated into national agricultural policy, as occurs in other EU countries. In addition to land use diversity, we consider the presence of forms of anthropogenic relief as very important. Although these areas are often excluded from the Land Parcel Identification System, they significantly contribute to landscape diversity, serve as habitats for many plant and animal species, and represent traditional features of agricultural land.

Keywords: *High Nature Value Farmland, Rural Development Program, Cultural value of rural landscape*

Evaluation of Different Method of Crop Establishment on Growth and Yield of Finger Millet under Irrigated Condition

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Finger millet [*Eleusine coracana* (L.) Gaertn.] plays an important role in both the dietary needs and incomes of many rural households in Eastern and Southern Africa and South Asia, and accounts for about 12% of the global millet area. In System of Ragi Intensification (SRI) method use of organics is one of the important component of the practices for enhancing soil health and productivity. However, their availability and cost may inhibit farmers from this practice. In order to standardize spacing and method of establishment a field experiment was conducted during *Kharif* 2013 and 2014 at Zonal Agricultural Research Station, V.C. Farm, Mandya, Southern Dry Zone of Karnataka on sandy loam soils with pH 6.65, O.C (0.32 g kg⁻¹), available nitrogen (242.73 kg ha⁻¹) available phosphorus (28.56 kg ha⁻¹) and available potassium (164.2 kg ha⁻¹). The experiment was laid out in a randomized block design with eight treatments viz., University of Agricultural Sciences, Bangalore package of practice, planting in ridges and furrows, square planting at 22.5cm, SRI method of transplanting at 22.5cm X 22.5cm, SRI method of transplanting at 30 cm X 30 cm, SRI method of sowing (sowing 1 to 2 seeds/hill), sowing through seed drill and drum seeding and replicated three times. Significantly taller plants (103.92 cm), total tillers (4.05 per hill) number of fingers (12.48) and finger length (11.50 cm) of ragi were observed in SRI method of transplanting at 30 cm X 30 cm followed by SRI method of transplanting at 22.5cmX22.5cm (97.92 cm, 3.20 per hill 12.2 and 11.00 respectively). Shorter plants (71.78 cm), less total tillers (1.87 per hill) less number of fingers (9.60) and less finger length (6.10 cm) were observed in drum seeding method. Both grain and straw yields of ragi differed significantly. SRI method of transplanting at 30 cm X 30 cm recorded significantly higher grain yield (4899 kg ha⁻¹), followed by SRI method of transplanting at 22.5cmX22.5cm (4707 kg ha⁻¹) whereas lowest grain yield was noticed in case of drum seeding method (3576 kg ha⁻¹), similarly SRI method of transplanting at 30 cm X 30 cm also recorded significantly higher straw yield (7477 kg ha⁻¹) followed by SRI method of transplanting at 22.5cmX22.5cm (7039 kg ha⁻¹). Thus, among the different ragi establishment methods SRI method of transplanting at 30 cm X 30 cm was more productive.

Keywords: Irrigation, System of Ragi Intensification, Yield, Drum seeding

Evaluation of ‘Self-watering’ Green Roof System on Establishment of Selected Tropical Ornamental Plants

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Green roof considered as a new garden concept in Malaysia where the plants and growing media taking place of grey Siemens at buildings’ roofs. There are several types of vegetative green roof system and one of these systems is the modular system. Modular system is more practical because it is easy to install, flexible and fully modular. However, the current systems available in the market are mostly designed for temperate regions and not compatible with Malaysia’s climate which received full sunshine and rain throughout the year. The plants used for green roof in Malaysia must be able to survive and grow well in minimum substrate depth with extreme weather condition, and this is the main challenge to develop a green roof in Malaysia. Therefore, a research has been done to study the suitable planting system and plants selection for green roof in tropics. A trial has been conducted to determine the suitable planting system for tropical green roof and also to determine the potential selected ornamental species to be planted on green roof. The trial was set up on the flat roof in Horticulture Research Centre, MARDI located in Serdang, Selangor, the central part of Peninsular Malaysia. Four tropical plants namely *Otacanthus caeruleus*, *Turnera ulmifolia*, *Vinca minor* and *Ruellia brittoniana* were used in this study. The treatments consisted of two green roof systems; ‘Conventional’ system and ‘Self-watering’ system with 5 cm substrate depth. ‘Conventional’ system and ‘Self-watering’ systems were made from acrylic material (each measures 615 x 430 x 160 mm). Lightweight growing media were used consisting peat moss, perlite and vermiculite in the ratio of 1:1:1. Supplementary watering for both treatments has done once a week and 8 liters of water for every planter box. Planter box with ‘Self-watering’ system promoted growth in majority of species. Besides that, in the ‘Self-watering’ system, most of the tested species performed very well with the high percentage of survival rate and have a better score in appearance scale compare to the other system. This research shows the potential of ‘self-watering’ planting system for green roof particularly for tropical ornamental plants. Beneficial output gathered from this study can be a good start for more depth research to be done on green roof planting technique and its vegetation.

Keywords: Drought, Rooftop garden, Landscape plants, Self-watering, Tropical region

***In Vitro* Plant Regeneration and Production of Secondary Metabolites from *Peperomia Pellucida* (L.)**

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Peperomia pellucida (L.) from piperaceae family is one of the most significant medicinal plants with great bioactive potential for the modern treatment due to known value in the traditional medicinal systems. The aims of this study were to develop an efficient standardized protocol for mass propagation through *in vitro* plant regeneration using plant growth regulators and to investigate the secondary metabolites of *P. pellucida*, as well as to test their antimicrobial activity. The internodal explants were cultured in Murashige and Skoog (MS) medium supplemented with different combinations of plant growth regulators to induce shoot. Successful elongated shoots were then separated to achieve adventitious root induction in MS medium with different concentrations of indole-3-butyric acid (IBA) and indole-3-acetic acid (IAA). Optimized root induction was detected (100%) in MS medium supplemented with IBA (2 mg/L) at 6th week. Rooted plantlets were successfully acclimatized to pot containing soil, sand and vermiculite (1:1:1) and maintained in tissue culture room (25°C ± 2°C) for three weeks. The percentage of plantlets surviving was 90% at greenhouse garden soil. Furthermore, secondary metabolites detection of *in vivo* and *in vitro* methanol and ethanol extraction were carried out and analyzed via GC-MS analysis before testing them for antimicrobial activity. The reproducible protocol of this study has potential for obtaining selected and standardized plant which are suitable for the exploitation in medicinal industrial sectors, apart from mass production of these species for commercialization purposes.

Keywords: *Medicinal plant, GC-MS, Plant growth regulators, Antimicrobial activity*

Saffron (*Crocus sativus* L.) Cultivation and Flowering in Malaysia

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Despite the expensive price of saffron which is around RM28, 000 - RM32, 000 per kg, Malaysia has to import a lot of this 'Red Gold' to fulfill the market demands. In this study, a potential *in vivo* cultivation technique for saffron under controlled room condition was established which could be an alternative method for mass propagation of saffron in non-temperate country. In addition, the effect of temperature on corm germination and the effect of substrates that may play important role in promoting saffron flowering and growth were investigated. In the current study, saffron corms were split into two different temperatures which were 23 °C and 10 °C. Four different substrates were then tested which were (1) black soil as control, (2) mixture of black soil and red soil, (3) mixture of black soil and vermicompost, and (4) mixture of black soil and vermiculite. Saffron corm germinated in 23 degrees could develop and grow successfully. Saffron plants grown in a mixture of black soil and vermicompost showed a significant increase in flower number and took less days to flower compared to the other substrates. In contrast, the presence of vermiculite increased leaf length and chlorophyll content as well as reduced leaf wilting even after 85 days being planted. Therefore, it is indispensable to know the suitable temperature and substrates, whereby healthier saffron plants can be grown, which will result in higher saffron quality. As far as is known, this is the first successful attempt of saffron cultivation in Malaysia till flowering stages and this works have great economic potential to be developed further.

Keywords: *Crocus sativus*, Corm germination, In vivo flowering, Propagation, Saffron

***In Vivo* and *In Vitro* Growth and Adaptations of *Clitoria ternatea* L. (Butterfly-Pea) and *Onobrychis viciifolia* Scop. (Sainfoin) in Malaysia**

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The tropical legume (*Clitoria ternatea* L.) and temperate legume (*Onobrychis viciifolia* Scop.) are grown as protein source for animal feed, particularly in organic farming. Through tissue culture technique, root explants obtained from 2-week-old aseptic seedling were cultured on MS media fortified with different combinations and concentrations of α -naphthaleneacetic acid (NAA), 6-benzyl aminopurine (BAP) and Adenine. The general growth performance of leaves, stems and roots were observed under different temperatures (18°C, 24°C and 30°C), both grown *in vivo* and *in vitro*. The acclimatization and adaptations of the regenerants were successfully monitored after 4 months in *in vitro* condition. Different survival rates were observed; *Clitoria ternatea* (90%) and *Onobrychis viciifolia* (75%). *Clitoria ternatea* managed to produce higher number of dark green leaves under low temperature (18°C and 24°C) as compared with *Onobrychis viciifolia*.

Keywords: Legumes, *Clitoria ternatea*, *Onobrychis viciifolia*, NAA, BAP, Adenine

Cytochemical Study of Apoptosis on Human Colon Cancer Cells (HT29 and HCT116) Caused by Flavokawain B (FKB): Production of Plant Extracts Using Micropropagation Techniques

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Flavokawain B (FKB) is a natural chalcone isolated from the rhizomes of *Alpinia Mutica* (Zingiberaceae) or Kava plant. FKB has been reported to have significant anti-tumor activity on several carcinoma cell lines and considered as a promising agent for use as a novel chemotherapeutic agent. Indole-3-butyric acid (IBA) with range of 0.5-2 mg/ml, 6-Benzylaminopurine (BAP) with the range of 0.25-1.5 mg/ml was used to push the growth of the plant and Jasmonic acid with the range of 15-20 μ M/l were used to enhance the production of secondary metabolites (isoflavonoids) of the plant. HCT116 and HT29 (human colon cancer) cells were treated by Hexane extracts from in vitro plants. This study, explains the apoptosis caused by FKB by a variety of techniques, including biochemistry, flow cytometry (Cell membrane changes at early stage, Measuring DNA breaks at middle stage Go/G1 DNA content at late stage), and imaging (Chromatin condensation, DNA fragmentation and Nuclei shrinkage) which is defined based solely upon morphological criteria. The model cells used for the study were human colon cancer cells (HCT116 and HT29). Exposure of HCT and HT29 cells to FKB resulted in loss of cell viability, morphological changes and the externalization of phosphatidylserine and DNA fragmentation verified by flow cytometry analysis. FKB caused G2/S phase cell cycle arrest on both cell lines. Cell proliferation assay results after 72 hours (IC₅₀= 16.7-50.6 \pm 4.58 μ M from MTT assay) was significant enough to determine the apoptosis effect of FKB for this study.

Keywords: *Chalcone, Flavokawain B, Apoptosis, Anti-cancer activity, Colon cancer, Flow cytometry*

The Potential for an Agroecological Farming System Approach in Malaysia: Lessons Learned from System of Rice Intensification (SRI)

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The System of Rice Intensification (SRI) is an agroecological method of rice cultivation that addresses global food security in a sustainable way through practices that encourage the health of the whole plant and soil health. Reports on the potential of the SRI method in the Malaysian context is still limited. This study was designed to assess the impact of SRI from an agroecological perspective in Malaysia. For this purpose, the impacts of the SRI method on the economics, environmental and social perspectives were studied. The results showed that the high productivity obtained by the SRI farmers and field trials have proven the suitability of the SRI method for sustainable rice farming in Malaysia. SRI reduces the reliance on external inputs, improves the productivity of land and water, increase the microbiomes and insect diversity as well as increase rice yield. The low dependence on external inputs and emphasis on natural processes through SRI open avenues for farmers to produce and sell their rice under shorter supply chains and cater to consumer demand for quality and traceability.

Keywords: *System of Rice Intensification, Productivity, Agroecology, Malaysia*

***Centella asiatica* Biotechnology**

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Centella asiatica from family of Apiaceae is a stoloniferous perennial herb which traditionally be used in different parts of the world. It has a glabrous stem and long petiolated fleshy leaves rooting at the nodes. This plant has an undeniable importance in medical systems for its beneficial active constituents to be used for treatment of asthma, bronchitis, dropsy, elephantiasis, gastric catarrh, kidney troubles, leucorrhoea, skin disease and urethritis. Some of its bioactivities such as antibacterial, anti-feedent, anti-filarial, anti-stress, anti-tuberculosis activities, antioxidant, and wound healing properties have also been shown. In this paper, we are discussing some of the *in vitro* culturing and biotechnical techniques used for genetic transformation, microbial interactions, and micropropagation of *C. asiatica*. New biotechnological techniques such as microbial treatment for enhancing the production of beneficial compounds in *C. asiatica* were also reviewed in this report. As a conclusion, future research should be carried out to maximise *C. asiatica*'s production as the cultivation of this plant was viable through tissue culture with different types of techniques. The protocol incorporated with biotechnological applications such as genetic transformation have also unequivocally facilitated production of higher yields of target compounds. Therefore, future studies should also illuminate the biosynthetic pathways for valuable medicinal and nutritional compounds such as asiaticoside, madecassoside and related triterpenoids in this important Asian herb.

Keywords: *Centella asiatica*, *In vitro* culture, Biotechnological techniques, Microbial interactions

***In vitro* micropropagation of Red Clover (*Trifolium pretense* L.) – an Important Forage Crop**

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Tissue culture studies of a temperate forage crop, *Trifolium pratense* L. were investigated in the current project. *In vitro* regeneration of this species was successfully achieved in this study using nodal explants cultured on Murashige and Skoog (MS) media supplemented with different hormones at various concentrations and also on MS hormone free media as a control. Complete plant regeneration of *T. pratense* was best achieved when the nodal explants were cultured on MS media supplemented with 1.5 mg/l BAP and 0.5 mg/l IBA, with mean number of 6.05 ± 0.28 shoots per explant, and 100% of the explant samples produced shoots. On the other hand, the best root formation was obtained on MS media supplemented with 1.5 mg/l BAP and 0.75 mg/l IBA, with the mean number of 3.3 ± 0.21 roots per explant. However, the nodal explants cultured on MS hormone free medium failed to produce any shoots or roots. Callus formation was successfully obtained from nodal explants cultured on MS medium containing different types of plant hormones. MS medium supplemented with 1.5 mg/l BAP and 0.5 mg/l 2,4-D was the most responsive, whereby 100% of the explants managed to produce callus. Adaptation process to the natural environment or acclimatization, i.e. the transfer of *in vitro* grown plants to the *ex vitro* condition was successfully undertaken, with very high survival rates of plantlets (93.71 ± 4.64 %) when they were transferred to the combination of red soil and black soil with the ratio of 1:1.

Key words: *Trifolium pratense*, *In vitro*, Callus, Acclimatization

Assessing the Effect of the Subsidy Reform Plan on Supply and Demand of Sugar in Iran

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Sugar is such a strategic good which has a considerable share in consumer's food basket in Iran. The main objective of this research is to evaluate the proposed effects of one of the most recent policies called Subsidy Reform Plan, on supply and demand of this commodity in Iran. In this research, the issue of interest is whether the outcomes of this policy varies the patterns of consumer's purchasing power. It is also of interest to see the effect of main determinants of sugar supply and demand. To reach the aims of this research, we used time series sugar's production data from 1980 to 2010. The Simultaneous Equation Regression Model (SERM) with three-stage least square estimator (3 SLS) was used to reach the supply and demand equations. The results of the implementation of this policy were added to the model by deviation of the prices to CPI. The result shows that the main determinants of sugar supply are one year lag of sugar supply, expected price and the cultivation of sugar beet. The price elasticity of supply is 22 percent which shows the positive effect of price on sugar production. Moreover, the price elasticity of demand is 17 percent which shows the negative effect of price on sugar consumption. Also, the income elasticity of sugar shows a positive correlation of six percent. The outcome of this policy is a considerable decrease in sugar consumption while it can increase sugar beet cultivation. Earned income from this policy helps the producers to increase the cultivation. Therefore, reaching supply-demand market equilibrium helps the authorities to reduce the sugar import and control high amount of sugar consumption.

Keywords: *Supply, Demand, Elasticity, Subsidy perform plan, 3 SLS, SERM*

Derivation of New Empirical Formulas to Estimate Lag Time between Upstream and Downstream Stations in Tropical Humid Rivers

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Lag time (Lt) reflects the speed at which a river basin responds to rainfall events and is influenced by many hydrological parameters. Rainfall and stream flow are considered the main parameters affecting Lt, which are represented in this study by four variables, namely peak rainfall intensity (Rf), previous 48-hour rainfall (Rf48), peak stream flow (Sf) and previous 48-hour stream flow (Sf48). The main objective of this study is to derive new empirical formulas to estimate the Lt between rainfall upstream stations and downstream stations in tropical humid rivers. In derivation of empirical formulas, a new graphical hydrological approach to estimate the Lt has been developed based on the Lt definition and its results of 95 hydrological events have been employed in derivation of the empirical formulas. Linear and polynomial formulas have been derived, and the correlation coefficient between the observed Lt and estimated Lt is 0.52 and 0.63 respectively. The derived formulas significantly improve the Lt estimation process directly based on the rainfall and stream flow records without the need to full description of all parameters affecting Lt. The derived empirical formulas are applicable only for Selangor River basin but it could be modified to be applicable for other humid tropical rivers basin based on the results of Lt estimation by the graphical approach which is applicable for all humid tropical rivers. The derived empirical formulas are potential to be used in many future hydrological applications, especially those related to the surface water and river basin integrated management.

Keywords: Surface water, Lag time, Empirical formulas, Hydrology, Water resources, Tropical Humid Rivers

Climate Change and Economics of Integrated Watershed Management with Sedimentation: Evidence from Blue Nile

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It is no doubt that there is a wide spread knowledge on a vulnerability of water resources to climate due to its characteristic. However, water has a unique and complex peculiarity to climate change which is challenging to analyze in terms of economics. In this regard, this paper attempts to address both issues in the context of a dynamic optimization model that maximizes social welfare by allowing for periodic sediment removal from a dam in a way that is responsive to changing climatic conditions and the needs of downstream users. The model is applied to the Blue Nile in Egypt and Ethiopia Highland. Furthermore, the Aswan High Dam was analysed due to its water storage from the Blue Nile. The dam provides substantial economic benefits to Egypt in terms of hydropower, irrigation, and flood control. However, the dam's storage capacity is being reduced over time due to sedimentation, and climate change is also likely to significant impact its future net benefits by altering evaporation and precipitation rates. The model computes effective storage capacity of a reservoir by considering sedimentation, evaporation, and precipitation rates simultaneously. Reservoir-level sediment removal is our control variable and this allows us to influence downstream agriculture productivity, which is also determined in part by climate change. Hydrologic data of the Aswan High Dam is obtained from the International River and Lake Network and regional agricultural data is obtained from the FAO. Climate change forecasting data for the Nile River Basin is simulated by IPPC RCP 4.0. Our simulation results indicate that, without climate change, optimal sediment control increases reservoir life indefinitely and social welfare by 36%, compared to the situation with no sediment control. With climate change that involves relatively high evaporation rates, however, optimum reservoir life is curtailed to 319 years and social welfare is reduced by 21%.

Keywords: *Climate Change, Optimal Control, Reservoir Sedimentation, Sustainability, Water Economics, Watershed Management*

Effects of Land Use on Aquatic Insect Communities in Liwagu River, Sabah: implication for Habitat Assessment

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The diversity of aquatic insect communities from three different type of land use (forested, agricultural and residential area) of Liwagu River, Sabah was used to investigate the relationship among aquatic insects with physico-chemical parameters and habitat quality assessment. Stream in forested area recorded higher species richness, abundance and proportion of sensitive aquatic insects taxa compared to the agricultural and residential area. Cluster analysis test strongly evidence that three different type of land use associated with abundance of aquatic insects. The results of the Canonical Correspondence Analysis (CCA) identified four groups of aquatic insect communities based on physico-chemical parameters and habitat quality assessment preferences. The physico-chemical parameters (DO, temperature, phosphate, nitrate and conductivity) in addition to habitat quality assessment (canopy cover, epifaunal substrate, bank stability, vegetative protection, riparian vegetation zone and total habitat assessment) were the most important factors that affect diversity of aquatic insect communities at Liwagu River, Sabah.

Keywords: *Biodiversity, Land Use, Physico-chemical parameters, Habitat Assessment*

Harnessing Science and Technology through the Development of a National Crop Monitoring and Forecasting System

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The climate variability and extreme events we are currently experiencing compel us to rethink our ways of doing. For the Philippine agriculture sector, one of the many ways to adapt to climate change and risks associated with it is to harness the power of science and technology. This paper presents our endeavor to develop a national crop monitoring and forecasting, and crop advisories system directed to improve responses of the agriculture sector to climate risks. We refer to this system as SARAI or Smarter Approaches to Reinvigorate Agriculture as an Industry in the Philippines. The system is anchored on an interdisciplinary approach which integrates the use of crop modelling, remote sensing (RS) and Geographic Information System (GIS), crop suitability and vulnerability, site specific nutrient and water management, and pest management. The system is expected to bring timely information on crop forecasts, crop suitability, updated crop vulnerability, pest, nutrient and water management to the major stakeholders such as the farmers, local government units, policy makers, academe, and private sector. The program is now training the regional agricultural officers of the Department of Agriculture (DA) on how to use the SARAI methodology, specifically the use of RS and GIS in near real-time monitoring of areas planted to rice and corn.

Keywords: *Crop Monitoring, Crop Forecasting, Crop Forecasting System, Geographic Information System (GIS), Remote Sensing (RS), Integrated Research Project*

Investigation of Biocenoses in “Yerevanyan Lich” Reservoir and the Hrazdan River in the Conditions of Algal Bloom

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Previous phytoplankton studies (2003–2006) in “Yerevanyan lich” reservoir constructed in the Hrazdan river canyon in the south-west of Yerevan city, Armenia showed that algal bloom in the reservoir during Summer periods occurred which allows to think that this phenomenon in the reservoir has continuous nature. Taking into consideration the possible environmental effects of reservoir algae bloom, aquatic organisms’ growth rates in “Yerevanyan lich” reservoir and the Hrazdan river were investigated. For this purpose, the hydrobiological (phyto–, bacterio–, zooplankton and benthic macroinvertebrates), –physical (water temperature) and –chemical (dissolved oxygen) investigations in “Yerevanyan lich” reservoir and the Hrazdan river were implemented before (April, 2015), at the beginning (June, 2015), middle (July, 2015) and end (August, 2015) of the period of expected reservoir algae bloom. Analyses were carried out by the standard methods accepted in hydrobiological, –physical and –chemical studies. The results of the study have confirmed the aforementioned opinion that algal bloom in “Yerevanyan lich” reservoir occurs every year in Summer period. The algal bloom registered in “Yerevanyan lich” reservoir in the Summer period of 2015 was on account of the rapid growth of the different groups of planktonic algae. Phytoplankton groups causing the algal bloom were shifted as follows: green algae → diatom algae → blue-green algae. The algal bloom in “Yerevanyan lich” reservoir created new environmental conditions which in turn caused changes in aquatic biological communities (phyto–, bacterio–, zooplankton and macrozoobenthos) in the reservoir and the Hrazdan river sites located in the downstream from the reservoir: the deterioration and disappearance of clean water indicator species; the improvement and appearance of biological species preferring organically polluted waters.

Keywords: Armenia, “Yerevanyan lich” reservoir, Hrazdan river, algal bloom, effects, hydrobionts

This work was made possible by the research grant № zoo-3906 from the Armenian National Science and Education Fund (ANSEF) based in New York, USA.

Discovery of Sri Lankan Relict Ant (Formicidae, Aneuretinae) and a Preliminary Ant Inventory of Indikada-Mukalana Forest Reserve in Colombo District, Sri Lanka

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The Sri Lankan Relict Ant, the sole extant species of Aneuretinae, *Aneuretus simoni* Emery, survives in several wet zone and intermediate zone forests in Sri Lanka. Nests of the species and associated ant fauna were surveyed for the first time in a forest in Colombo District, the Indikada-Mukalana Forest Reserve, using the quadrat method and worker ants were investigated simultaneously by the pitfall trapping in December, 2015. The frequency of nest occurrence in 40 quadrats, percentage nest abundance, mean nest density and, percentage frequency of occurrence of *A. simoni* and associated ant fauna in pitfall traps in two localities at 291 m and 159 m altitudes were investigated by laying 20 quadrats of 1 m x 1 m at two plots in each locality and counting the number of nests within each quadrat, and setting hundred pitfall traps at 4 m distance along eight transects laid at each locality and collecting them after six hours. Collected ants were preserved in the bottles filled with 70% ethanol and identified to the furthest possible taxonomic level at suitable magnifications using a low power stereo-microscope. Several environmental parameters at the two localities were also recorded. A preliminary inventory of ant fauna observed in the forest was also prepared. Nests of *A. simoni* were found only in the locality at 291 m of the forest and 18/ 40 frequency of nest occurrence in the quadrats, 9.7% of nest abundance and 0.18 m⁻² of mean nest density of *A. simoni* were observed at the locality. Nest density of *A. simoni* had the third rank among that of other species. Frequency of occurrence of the workers of the species in the pitfall traps in the lower and upper elevations was 2 % and 3 %, respectively. A lower nest density of the species than that observed in other forests was recorded during the current survey but Indikada-Mukalana Forest Reserve can be added to the list of its habitats. Eighteen genera and 21 species in Aneuretinae, Dolichoderinae, Formicinae, Myrmicinae and Ponerinae can be considered a preliminary ant inventory of the Forest Reserve.

Keywords: *Ants, Forest Reserves, Quadrat method, Pitfall trapping, Mean nest density*

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***Usnea ciliifera* as a Potential Endemic Bioindicator of Climate Change in New Zealand**

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Lichens are mutualistic symbioses between fungi and photosynthetic algal and/or cyanobacterial partners. Lichens, especially epiphytic lichens, have been reported and used as bioindicators; mainly bioindicators of air pollution/quality such as sulphur dioxide and heavy metals. There are not many reports on application of lichens as biomonitors for climate change in comparison with using lichens as biomonitors of air pollution. Increasing the growth of some thermophilous lichen species such as *Candelaria concolor*, *Hyperphyscia adglutinata* and *Parmotrema perlatum* were reported to be linked to rising temperature. However, finding bioindicators with quantitative scale among the lichens species for biomonitoring of climate change is a critical parameter. Asexual reproduction system has been reported as the main reproduction system for most of the *Usnea* spp. However, apothecia, as the sexual reproductive structure, are commonly seen on *Usnea ciliifera* (an endemic New Zealand *Usnea* species) thalli. A potential relationship between season (winter and summer) and abundance of apothecia in *U. ciliifera* were observed in Craigieburn Forest Park, South Island, New Zealand during 2011-2014 which probably indicates the effect of temperature and moisture for the production of apothecia in this species. Similar temperature and moisture requirements were previously reported for production of apothecia in a few non-lichen forming species of fungi such as *Sclerotinia minor*, *S. sclerotiorum* and *S. trifoliorum*. The sensitivity of *U. ciliifera* to environmental changes was also shown through *in vitro* culturing method. Therefore, *U. ciliifera* is suggested as a potential bioindicator of climate change in New Zealand. However, further studies are needed before application of *U. ciliifera* in biomonitoring programs.

Keywords: *Usnea ciliifera*, Bioindicator, Climate change, Endemic, New Zealand

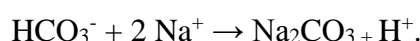
Carbon Dioxide Utilization for an Enhanced Biohydrogen Production of a Biomass Hydrolysate

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Bio-hydrogen (H₂) production in a thermophilic anaerobic bioreactor with carbon dioxide (CO₂) utilization at the headspace was investigated at different ratio of biomass substrate to microorganism (B/M). A 3-mL volume of 80% NaOH (m/v) solution was continuously hung at the headspace of the bioreactors to capture carbon dioxide. The utilization of CO₂ at its headspace, proved to enhance bioH₂ production. The highest cumulative biohydrogen yield (CHY) of 131.81±3.47 mL-H₂/gVS was measured at the ratio of 8.10 parts of biomass to 0.90 parts of acclimatized seed sludge (ASS), B/M 9, while 4.17 parts of similar biomass to 0.83 parts of ASS (B/M 5) had a biohydrogen production of 90.70±16.67 mL-H₂/gVS. The B/M of 6.125 parts of biomass to 0.875 parts of ASS (B/M 7) produced a CHY of 84.72±18.35 mL-H₂/gVS while the control bioreactors without CO₂ utilization (without and with biomass substrate) yielded a 0.06±0.035 mL-H₂/gVS and a 3.27±0.78 mL-H₂/gVS respectively. The mechanism of the biofermentation produced the reaction: C₆H₁₂O₆ + 4H₂O → 4H₂ + 2CH₃COO⁻ + 2HCO₃⁻ + 4H⁺ with two possible resulting reaction; acetogenesis of CO₂ with H₂ and hydrogenotrophic methanogenesis. These reactions consume hydrogen in the process to produce methane or acids. The presence of 80% (m/v) NaOH solution in the bioreactors, utilizes the CO₂ producing a hydrogen-rich region in space:



The highest average H₂ yield of 51.83 mL-H₂ after 49.1 hours with B/M 9 without methane was due to carbon dioxide utilization in the bioreactors.

A univariate ANOVA and Pair-wise Tukey HSD statistical analysis revealed that the CHY of B/M9 was significantly higher than the other B/Ms. The highest yield, 55.85 mL-H₂/gVS obtained with the bioreactor of B/M 9 was optimum for H₂ production. The results concluded that H₂ production is also enhanced by CO₂ utilization at the headspace.

Utilization of Nipa Palm Biomass for Ethanol Production by *Clostridium xylanolyticum*

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Bioethanol production from lignocellulosic materials like agricultural residues is increasingly gaining attention due to its low cost, domestic availability and environmental benefits. Nipa palm (*Nypa fruticans*) is one of coastal and mangrove species which are widely expanded in Asia. Nipa farming was suggested to be a promising land use in tropical coastal areas such as degraded lands and abandoned shrimp ponds. Apart from their traditional uses, nipa sap has been reported as potential feedstock for bioethanol production. In addition, nipa biomass especially fronds and leaves are abundant and have chemical composition similar to other energy crops. They could be potential raw materials to be used for biofuels. This work aimed to study the possibility to use nipa palm fronds as substrate for ethanol production by *Clostridium xylanolyticum*. The pretreatment of fronds (with and without leaves) using sodium hydroxide followed by hydrolysis with diluted sulfuric acid was performed in order to enhance fermentability. The hydrolyzates of untreated fronds and leaves were used for comparison. The results showed that without pretreatment step, the leaves and fronds hydrolyzates contained more sugar than that of the pretreated ones. Among them, the hydrolyzates derived from untreated fronds yielded the highest sugar of 11.43 g/L. The major sugars present were xylose and glucose, while arabinose, galactose and rhamnose were found at lower and varied contents in each hydrolyzates. Besides, the major degradation by-products from lignocellulosic materials such as furfural (21.43-38.30 mg/L), 5-hydroxymethylfurfural (132.40-223.50 mg/L) and phenols (10.30-53.30 mg/L) were detected. The fermentation of hydrolyzates derived from untreated fronds showed the maximum ethanol productivity of 0.073 g/L. Based on these results, the lignocellulosic biomass of nipa palm could be utilized for bioethanol production.

Keywords: Nipa palm fronds, Lignocellulosic biomass, Ethanol production, *C. xylanolyticum*

Estimation of Human Health Risk from Exposure to Mercury via Fish Consumption in West Peninsular Malaysia

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Fish contains long-chain polyunsaturated omega-3 fatty acids (PUFAs) that may reduce cholesterol levels and the incidence of stroke, heart disease and preterm delivery. Consumption of fish is the most common source of human exposure to mercury. This study reports mercury concentrations of 29 species of fish collected from selected landing ports and wholesale market of West Peninsular Malaysia. Median mercury concentrations in fish were 0.106 ± 0.128 µg/g wet weight (n=78). Demersal fish showed significantly higher mercury concentrations when compared with pelagic fish. Fish with higher trophic level, fish with body length of more than 20 cm and fish from Latidae, Scianidae and Lutjanidae families had elevated mercury concentrations. About 96% of the fish samples had very low to medium mercury concentrations (<0.150 – 0.350 µg/g wet weight) and 4% had high to very high mercury concentrations (>0.350 µg/g wet weight). Nonetheless, none of the fish samples exceeded the Malaysian Food Regulation and FAO/WHO Joint Expert Committee on Food Additives (JECFA) Guidelines of 0.5 µg/g mercury for fish and fishery products and 1.0 µg/g mercury for predatory fish. Bream, snapper, croaker, barramundi and tuna can be consumed between 2-5 servings a week to ensure that the Provisional Tolerable Weekly Intake (PTWI) of 1.6 µg/kg body weight of methyl mercury is not exceeded.

Keywords: *Heavy metals, Methyl mercury, Seafood, Provisional Tolerable Weekly Intake (PTWI), Malaysia*

Proximate Composition, Dietary Fiber Content, and Prebiotic Carbohydrates of Imported Hybrids and Local Pumpkin Varieties Grown in Sri Lanka

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Pumpkin (*Cucurbita maxima*) is one of the economically important vegetable in the world, while there are no conclusive reports on the proximate composition (PC), dietary fiber content (DF) and prebiotic carbohydrates (PR) of pumpkin from Sri Lanka. The pulp and seeds of two local pumpkin varieties (Villachchi, Moragollagama) and five imported hybrid varieties (Arjuna, Suprima, Abishek, Lara, Pragathi) were analyzed for PC, DF, and PR. Three mature fruits of each variety, grown during Yala season were used for analysis. Completely Randomized Design (CRD) was conducted and data were analysed by one way analysis of variance (ANOVA). The moisture of pulp of pumpkin varied from 90.01 to 95.81% fresh weight (FW), and ash, crude protein (CP), crude fat (CE), crude fiber (CF), nitrogen free extract (NFE) varied from 8.87 to 17.22%, 13.41 to 17.70%, 4.78 to 6.98%, 11.58 to 31.03%, and 22.41 to 53.81% dry matter (DM), respectively. Ash, and CF in Moragollagama variety was higher ($p < 0.05$) than other varieties. The moisture of pumpkin seeds varied from 32.27 to 38.86% FW and ash, CP, CE, CF, NFE varied from 3.86 to 4.83%, 27.94 to 29.32%, 34.63 to 42.04%, 27.59 to 31.50%, and 1.12 to 3.72% DM, respectively. Seeds of Suprima variety contained significantly higher CE content compared to the other varieties. Total DF content of pumpkin pulp were not varied ($p > 0.05$) among varieties. However, local varieties had higher ($p < 0.05$) soluble DF (11.75-12.21% DM) than hybrid varieties. Glucose, fructose, sucrose, sorbitol, mannitol, stachyose+raffinose, verbastose+kestose and nystose of pumpkin pulp varied 473 to 3441, 1020 to 4699, 300 to 2326, 44 to 230, 27 to 67, 19 to 176, 46 to 465, and 32 to 49 mg/100g DM, respectively. Arjuna variety showed significantly higher concentration of sucrose than the other varieties. Sorbitol, mannitol, and verbastose+kestose were highest in the pulp of Villachchi variety. In conclusion, this study revealed that local pumpkin varieties contain a considerable high nutritional value compared to imported hybrid varieties. Therefore, such local varieties could be introduced in breeding programmes to improve the nutritional quality of imported varieties.

Keywords: Pumpkin, Pulp, Seeds, Proximate composition, Dietary fiber, Prebiotic carbohydrates

***In vivo* Evaluation of the Prebiotic Effect of Pumpkin (*Cucurbita maxima*)**

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Intake of diet containing prebiotic compounds is a major tool to manipulate gut microbiota. Pumpkin contains considerable amounts of potential prebiotic components. The present study was carried out to investigate the prebiotic effect of pumpkin *in vivo* using the pig (*Sus scrofa domesticus*) as a model animal. Ten weeks old, sixteen pigs from four crossbred litters were housed individually for the feeding experiment (n=4). Pigs were assigned to four different diets as pig fattener diet (PPF), pig fattener diet supplemented with probiotic (PSP), pig fattener diet partly replaced with pumpkin powder (100 g/kg) (PRP), and pig fattener diet partly replaced with pumpkin powder (100 g/kg) supplemented with probiotic (PPP). Freeze dried *Bifidobacterium animalis* Subsp. *lactis* (500 mg/d) and *Lactobacillus acidophilus* (500 mg/d) were used as probiotic organisms. At the end of the feeding period fecal microflora composition, fecal pH, and growth performances were determined. Fecal lactic acid bacteria (LAB) and bifidobacteria (BB) counts were higher (P<0.05) in PSP, PRP, and PPP fed groups than those fed with PPF. The highest LAB and BB counts were found in the pigs fed with PPP diet. The fecal coliform counts in PRP and PPP fed pigs were significantly lower (P<0.05) than counts of PPF fed pigs. The lowest counts of coliform were observed in pigs fed with PPP diet. Neither fecal pH nor body weight gain was affected by the diet. The current study revealed that incorporation of pumpkin into swine diet has promoted the fecal excretion of beneficial microorganisms (LAB and BB) indicating the prebiotic effect of pumpkin.

Keywords: Pumpkin, Pig, Prebiotic, Probiotic, Lactic acid bacteria, Bifidobacteria

Antimicrobial Activity of Peptides Extracted from White Cheese Produced by Probiotic Bacteria

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In this research, White cheese was produced using probiotic bacterial strains (with a combination of *Lactococcus lactis* subsp. *lactis* + *Lactococcus lactis* subsp. *cremoris* (control), *L. lactis* + *L. cremoris* + *B. bifidum* DSMZ 20456 and *L. lactis* + *L. cremoris* + *L. acidophilus* DSMZ 20079). Cheese samples in brine and vacuum package were ripened for 120 days. During ripening period, water soluble extracts of the cheese samples were obtained and antimicrobial activities of peptides on 2th, 60th and 120th days of ripening were investigated. For this purpose, *Escherichia coli* BC 402, *Salmonella* Typhimurium RSSK 95091, *Staphylococcus aureus* ATCC 29213 and *B. cereus* BC 6230 was used as pathogen microorganism. It was determined that peptide extracts did not show inhibitory activity against *Escherichia coli* BC 402, *Salmonella* Typhimurium RSSK 95091 and *Staphylococcus aureus* ATCC 29213, in contrast bacterium growth was stimulated, but this stimulation gradually decreased with the progressing ripening time. However, peptides were found to show inhibition on all days of ripening against *B. cereus* BC 6230 and to increase inhibition with the progression of ripening period.

Keywords: White cheese, Probiotic bacteria, Antimicrobial activity, Food safety

Utilization of Banana (*Musa brachycarpa*) Corm as a Source of Phenolic Compounds on Synbiotic Yoghurt

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This research was aimed to determine the potential of banana corm as a source of phenolic compounds through synbiotic yoghurt fermentation thus reduced pollution load. The phenolic compounds analyzed including total tannins and phenols, it was also studied the antioxidant activity. This research was done experimentally and the data was analyzed descriptively. The extraction of banana corm flour produces the most high tannins and phenols, which were 0.404% and 1.95%, respectively. The antioxidant activity measured as IC₅₀ was 271.7 ppm, it is categorized as weak compared to vitamin C standard (IC₅₀ vitamin C standard = 160 ppm). Furthermore, 1% of banana corm flour was used to fortify synbiotic yoghurt. Result showed that 1% fortification of banana corm flour decreased the total tannins to 0.21% and increased the total phenols to 3.98%. It was also increased the IC₅₀ value of antioxidant activity to 115.6 ppm. The antioxidants activity neutralizes the free radicals which prevents a variety of chronic degenerative diseases. The use of 1% banana corm flour fortification on synbiotic yoghurt, certainly affects the decreasing of pollution load.

Keywords: *Banana Corm, Pollution Load, Phenolic Compounds, Synbiotic Yoghurt*

Production of Date Juice Infused with Natural Antioxidants from Qatari Herbs

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At a universal level, the date palm and aromatic plant industry needs to find suitable production methods to give added-value to their products. This study was under-taken to utilize Qatari raw materials in the production of date palm juice high in antioxidants. Antioxidants were extracted from five Qatari herbs: *Caspian manna*, *Tetraena mongolica*, *Capparis spinosa*, *Ziziphus vulgaris* and *Lycium shawii*. The date juice was extracted from Qatari dates (*Phoenix dactylifera*) and was infused with the polyphenolic extracts from the 5 different Qatari herbs. The antioxidant containing the highest antioxidant activity and was within the acceptable range was included in the sensory evaluation. The phenolic content for *Lycium shawii*, *Alhagi maurorum*, *Ziziphus vulgaris*, *Capparis spinosa* and *Tetraena mongolica* was 4294 ppm, 3843 ppm, 804.59 ppm, 189.14 ppm and 226 ppm respectively, whereas their antioxidant capacity of was 6.21 %, 45.27 %, 69.81 %, 2.96 % and 8.63 % respectively. The highest antioxidant capacity was found in *Ziziphus vulgaris* 69.8 % and the highest phenolic content was found in *Lycium shawii* 4294 ppm. *Alhagi maurorum*, *Tetraena mongolica* and *Lycium shawii* showed good results in terms of taste and aroma however, *Ziziphus vulgaris* exhibited bitter flavor. *Alhagi maurorum* antioxidant extract was used to be added to the date juice due to its high phenolic content, high antioxidant capacity, good taste and aroma. Qatari herbs tested in this study have the potential to be used as antioxidant functional ingredients.

Keywords: *Qatar, Dates, Herbs, Antioxidants*

Growing Safflower (*Carthamus tinctorius* L.) for Food and Green Energy in Dry Areas, Performed in Turkey

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Chairmen of Safflower Society

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Safflower is an important oilseed plant and production of it has been increased. It has been grown in 782000 ha areas and produced 647000 tons seeds in 2013 in all over the world. In the last 10 years, production of safflower has been increased and raised to 76000 tons in 2014, while it was only 18 tons in 2000. Safflower has a lot of advantages compared to the other oilseed plants such as easy and cheap cultivation, drought resistant, suitable for mechanized drilling and harvesting, containing high Conjugated Linoleic Acids (CLA), and special of the country high government defenses. Turkey has 5 million fallow areas because of very limited rain. As safflower is drought resistant, we built up a project by safflower production in all those drylands and we succeeded. Safflower is not only an oilseed crop, at the same time carthamin which is obtained from safflower flowers, an important substance as a natural dye raw material. Safflower seeds are widely used in India production of an edible oil called 'sweet oil' processing it with the other oil plants such as peanut and etc. or by itself as pure safflower. Safflower abilities such as well adaptation to dryland, high cold-tolerance, and resistant to salinity are noteworthy. Seeds of safflower contain %25 to %40 oil. Unsaturated fatty acids are the vast majority of the safflower oil. Safflower oil contains an average of %78 omega-6 and teems with tocopherols. Safflower oil is use for treatment of arteriosclerosis and lowering cholesterol level. Safflower oil is also a healthy product which is used in skin care products, and flowers known as saffron are envisaged to consume as herbal tea and have strong antioxidant effects. In this study, it will be explained how we increased safflower production in Turkey, and where and how it is used in the Country's national project.

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