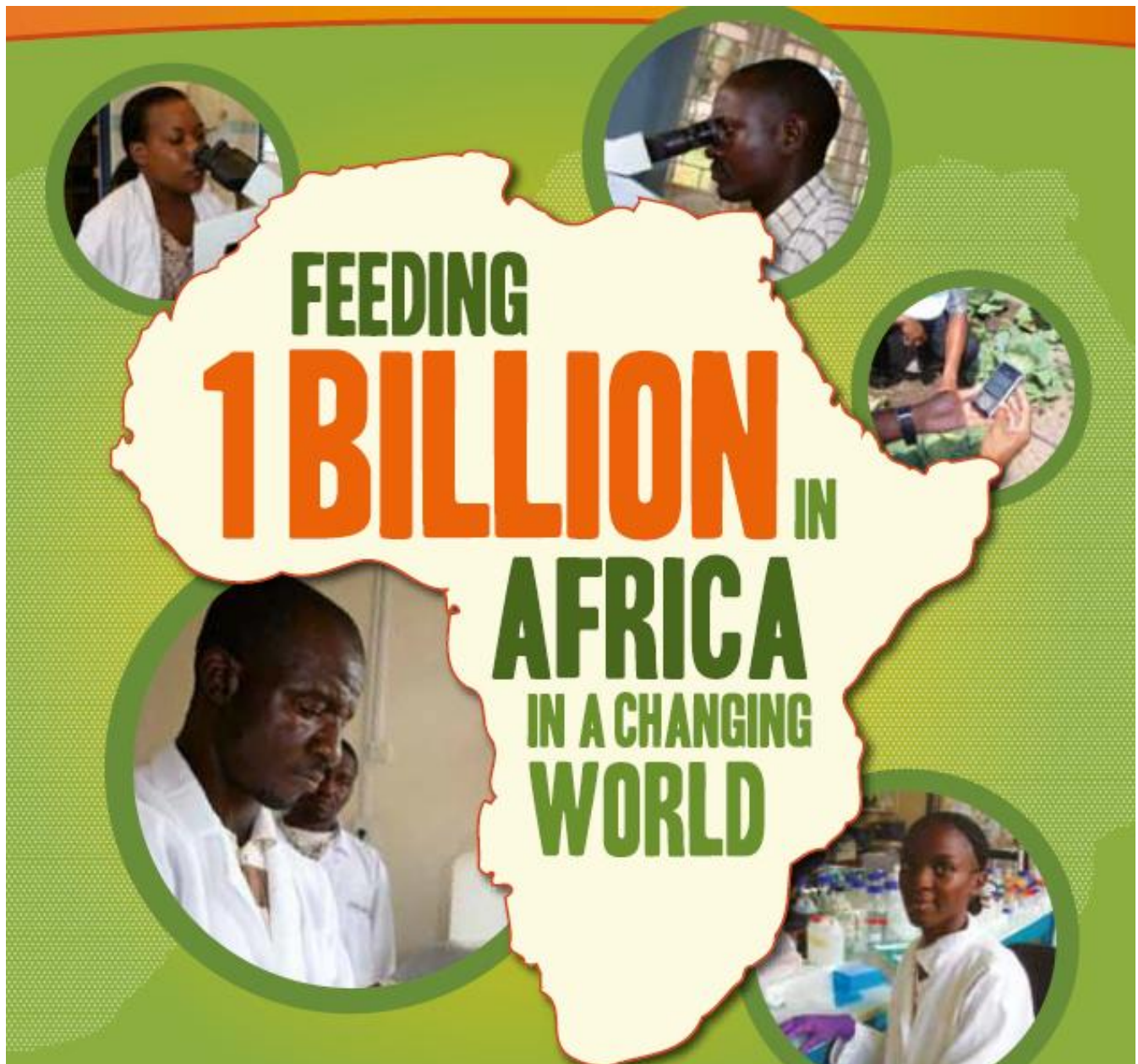


BOOK OF ABSTRACTS



FINALS OF THE 3rd AFRICA-WIDE WOMEN AND YOUNG PROFESSIONALS IN SCIENCE COMPETITIONS

15-16 July 2013

6th Africa Agriculture Science Week and FARA General Assembly
Accra, Ghana



INTERNATIONAL
FOUNDATION FOR
SCIENCE



NEPAD Planning and Coordinating Agency
Agence de Planification et de Coordination du NEPAD



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IMPROVEMENT OF TRADITIONAL CHURNER FOR EXTRACTION OF BUTTER IN ELKIRYAB, SUDAN

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Abstract

Traditional churning technology was developed and modified for butter production using participatory innovation development (PID). The objectives were: i) to analyse churning practice as a traditional and indigenous innovation technology; ii) to evaluate the physical effort made by women with respect to income generated; and iii) to develop an improved design of a local technology with higher performance. The research was carried out by a researcher, an innovator and an extensionist, called a PID triangle, and PID tools were used. Two areas of Sudan practising churning technology were selected and surveyed. There were two different churning devices used; *AlBukha* is a gourd and *ElSein* is made from goat leather. Milk preparation for processing in the two areas was almost the same. Matrix ranking was used as tool to prioritise and select one of the local innovations. The *ElSein* milk churning technology had higher priority for women in the village, for two reasons. Firstly, the technology was inherited from grandmothers and is habitually practiced. Secondly, it is an income generating activity. The design was developed successfully and accepted by the womens group. From preliminary, joint experimentation, it was found that the design was simple, required less effort by the women, and was portable and easy to clean. It gave a high extraction rate, converting 90-95% of the milk into butter in 15 minutes, compared with traditional churners, which gave the same amount in more than two hours.

Key words: Butter churner, Design development, Innovator, Participatory approaches.

AGRONOMIC PERFORMANCE OF EXTRA-EARLY MAIZE HYBRIDS UNDER STRESS AND NON-STRESS ENVIRONMENTS IN NIGERIA

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Abstract

The availability of extra-early maturing varieties has facilitated the expansion of maize production into the savannas of West and Central Africa (WCA). However, maize production and productivity in the sub-region is greatly constrained by low soil nitrogen, drought and infestation by *Striga hermonthica* (Del) Benth. The objective was to determine the yield performance and stability of selected extra-early hybrids under drought, artificial *Striga* infestation, and optimal growing environments. The performance of 120 extra-early hybrids plus an open-pollinated check were assessed in Nigeria under managed drought at Ikenne during the dry seasons of 2010 and 2011, artificial *Striga* infestation at Mokwa and Abuja, and optimal conditions at Mokwa and Ikenne during the growing seasons of 2010 and 2011. Under *Striga* infestation, grain yield of the hybrids ranged from 735 kg ha⁻¹ for TZEEI 99 x TZEEI 95 to 3200 kg ha⁻¹ for TZEEI 83 x TZEEI 79. Under drought, grain yield ranged from 128 kg ha⁻¹ for TZEEI 62 x TZEEI 63 to 1982 kg ha⁻¹ for TZEEI 71 x TZEEI 79. Under optimal conditions, yield ranged from 653 kg ha⁻¹ for TZEEI 102 x TZEEI 63 to 3781 kg ha⁻¹ for TZEEI 70 x TZEEI 79. The hybrids TZEEI 67 x TZEEI 63, TZEEI 71 x TZEEI 79 and TZEEI 81 x TZEEI 95 were identified as the highest yielding and most stable across the research environments. The hybrids identified can be grown in *Striga* endemic and/or drought prone zones for enhanced productivity in the sub-region. In conclusion, stable, high-yielding extra-early hybrids with drought tolerance at the flowering and grain filling periods and *Striga* resistance are available for the first time in the sub-region. The promotion of the release and commercialisation of these hybrids in WCA is in progress.

Key words: *Striga hermonthica*, Drought, Genotype main effect plus genotype x environment interaction (GGE) biplot, West and Central Africa (WCA), Yield stability, Grain yield.

FOOD SECURITY IN AFRICA: AN EFFECTIVE INNOVATIVE TECHNIQUE FOR COWPEA STORAGE

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Abstract

Cowpea is a staple food legume crop for many Africans, especially in the Sahel. The challenge of grain storage is a recurring issue, often raised by members of the cowpea value chain. Improving cowpea storage is a major goal to increase farmers' income, improve food security and reduce health risks associated with overuse and misuse of pesticides. The triple-bagging (triple layer) technology was developed and disseminated to farmers quickly and on a large scale. Laboratory results showed that cowpea bruchids could not further reproduce if the grain was stored in triple layer bags with liners of 80 microns. Extension efforts that started with a pilot program (100 villages) followed by full-scale activities (covering the whole country - more than 4,000 villages in 3 years) proved to be effective. The development of the supply chain with the involvement of manufacturers, distributors and vendors has improved the availability of the technology to the end-users including farmers, cowpea traders and consumers. These efforts have addressed three major challenges of cowpea storage: 1) availability and access to good storage material; 2) knowledge on how to use the technology and 3) reduction of post-harvest losses. Triple-bagging - with an adoption rate of 30% 2 years after the launch of activities, and women participation up to 40% - has improved the cowpea value chain, food security, and increased the income of farmers, including women. Cowpea has now been included in the National Food Security Consolidation Programme.

Keywords: Triple-bagging, Storage losses, Cowpea bruchids, Outreach, Supply chain.

CLIMATE CHANGE TECHNOLOGIES FOR IMPROVED LIVELIHOODS OF SMALLHOLDER CROP-LIVESTOCK FARMERS IN EASTERN AND CENTRAL AFRICA REGION

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Abstract

The productivity of smallholder crop-livestock production systems in Eastern and Central Africa is threatened by the adverse effects of climate change, with severe consequences for livestock feeds, water and household livelihoods. A project was implemented in Burundi, Kenya, Tanzania and Uganda during 2009-2011, to promote utilisation of drought-tolerant forages, rainwater harvesting, and use of soil fertility enhancements, as coping mechanisms against climate change shocks, especially in the dairy-vegetable production systems. Drought-tolerant forages evaluated and promoted included *Brachiaria* hybrid cv. Mulato (*Brachiaria*) and *Pennisetum purpureum*, intercropped with forage legumes. Livestock manures from the farms were utilised to replenish soil fertility for vegetable production. Rainwater was harvested for domestic and livestock uses and to drip irrigate a vegetable crop (cabbage), grown on plots amended with either goat, cattle or poultry manure. The project involved 280 smallholder dairy-vegetable growing farms, most of which had women as key players. The trials were laid out in a randomised complete block design, with three replications. This paper presents data for one site, namely Masaka in Uganda. From the study, introducing 0.5 ha of a mixture of *Brachiaria* and *Clitoria ternatea* on farms previously dependent on 0.5 ha of *P. purpureum* and *Centrosema pubescens* mixture, provided year-round feed supply to dairy cattle. Drought-tolerant forages and water harvesting technologies increased fodder availability (76%), water offered to animals (46.3%), milk yield (78.7%) and cash incomes (52.4%). Application of goat, cattle and poultry manure with drip irrigation significantly ($P<0.05$) increased cabbage yield by 9, 49 and 95% respectively. In conclusion, integrated management of climate change adaptation technologies in dairy-vegetable production systems improves food security and income. Relevant policies should be bolstered to enhance adoption of climate change coping technologies, as a strategy for improving livelihoods.

Key words: *Brachiaria*, Cabbage, Napier, *Clitoria*, *Centrosema*.

RESPONSE OF *HYCLEUS APICICORNIS* TO VISUAL AND OLFACTORY CUES IN THE FIELD

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Abstract

The blister beetles, *Hycleus* species, are a challenge for seed production of *Desmodium* spp. by smallholder farmers in western Kenya. *Hycleus* spp. feed on floral parts and the developing seeds of *Desmodium* and other crops such as sweet potato, thereby affecting seed setting. The objective was to evaluate the effectiveness of the simple, prototype, water bucket traps to capture adults of *Hycleus* spp., which are easy to use and are affordable to the resource-poor farmers. Traps of two colours, sky-blue and grey, were used. The traps were either not lured or lured with phenylacetaldehyde (PA) or 2-phenylethanol (2PE) compounds that were previously found attractive to *H. apicicornis* in laboratory bioassays. The sky-blue prototype trap baited with PA captured the highest number of beetles and differed significantly from all other traps except the sky-blue, non-lured trap. These results show that non-lured sky-blue traps can be used for trapping studies, although addition of attractive compounds may enhance the trapping efficiency. The ability of such traps to control these beetles will result in increased seed production, which is crucial for the sustainability of push-pull pest-control systems, for the enhancement of maize and sorghum productivity. Further studies are needed to evaluate which plant volatiles are attractive to the *Hycleus* species for the development of efficient traps, either for monitoring purposes or for mass trapping.

Key words: Blister beetles, Lures, Semiochemicals, Sky-blue, Prototype traps.

MACROPROPAGATION TECHNIQUE TO PRODUCE HEALTHY AND COST-EFFECTIVE BANANA SEEDLINGS IN EASTERN AND CENTRAL KENYA

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Abstract

Banana (*Musa* spp.) is one of the most important food and cash crops in various parts of Kenya. Despite its importance, banana production faces major challenges including scarcity of high quality seedlings, and pests and diseases. Demand for pest-free, high quality planting materials has been on the increase. The study aimed at determining if a macropropagation technique can produce healthy banana seedlings. Naturally regenerated suckers that are preferred by farmers are more likely to carry pests and diseases, leading to reduced productivity and a short lifetime of new plantations. Tissue culture has been introduced, but its adoption has been low due to the high costs and skills involved. To address this constraint, macropropagation has been introduced as an alternative propagation technology. The technology can be implemented with little capital or skill. A survey was conducted to identify the important diseases and pests of bananas in eastern and central Kenya. Macropropagation nurseries were constructed at Kenyatta University and in farmers' fields representing different agro-ecological zones. Corms obtained in accordance with established quality assurance protocols were propagated in two cycles and the health of seedlings monitored. Pathogenicity tests were carried out to determine the importance of microorganisms isolated from the corms. Fusarium wilt and Sigatoka were recorded as the most important diseases with 66 and 50% incidence respectively, while nematodes and banana weevil were important pests, occurring at 21 and 17% incidence respectively. Endophytes were commonly isolated from the corms. Weevil infestation was found to be the major cause of rejection of farms for acquiring corms. An average of 98% and 100% healthy seedlings resulted from the first and second cycles of macropropagation. Production of healthy, low cost bananas from this project will benefit seed entrepreneurs and farmers.

Key words: Musa, Diseases, Pests, Planting material, Propagation.

PRODUCTION OF ROASTED BLAND BAMBARA GROUNDNUT FLOUR (*VOANDZEIA SUBTERRANEA*) AND ITS APPLICATION IN FORTIFICATION OF BISCUIT AND TOASTED CASSAVA GRANULES

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Abstract

Fortification of starchy staples with high-protein materials has been emphasised as an intervention strategy, due to prevalence of protein energy malnutrition related diseases in Nigeria and many other developing countries. This has necessitated research into development of high protein, readily available, cheap and acceptable flour from indigenous legumes that could be utilised in different food applications. The study aims at (i) producing protein rich, high quality roasted bambara groundnut (BGN) flour for enrichment of biscuits and garri, and (ii) determining the quality and acceptability of these products. BGN was roasted at 140°C for 20 minutes to improve its nutritional quality and sensory acceptability. Flour obtained was used to enrich biscuits and garri, at 10, 20, 30, 40 and 50% replacement levels. Quality of flour and products were evaluated using standard methods. Roasting significantly ($p<0.05$) increased in vitro protein digestibility from 67.4% to 81.29%, and trypsin inhibitor activity was reduced from 23.7 ITU/mg (raw) to 12.6 ITU/mg (roasted). Available lysine was slightly increased from 6.3g/16g N (raw) to 6.8g/16g N (roasted). BGN-fortified biscuits had significantly ($p<0.05$) higher crude protein (11.42-13.96%) values compared to the control (8.18%). There were no significant ($p>0.05$) differences between biscuits with 10-30% BGN flour and the control in taste, crumb colour, crust colour, flavour and overall quality. Fortified biscuits had significantly ($p<0.05$) higher lysine (40.7-57.7 mg/g protein) content than the control (21.1 mg/g protein); also methionine + cysteine, threonine, leucine, phenylalanine and tyrosine contents differed significantly. Fortification significantly increased the protein content of garri from 1.7% to 3.85-10.01%. There were no significant ($p>0.05$) differences in colour, taste, flavour, texture and overall acceptability between the control garri and 20% fortified garri, which had higher mean scores in all attributes. The essential amino acids of fortified garri (20-40%) and biscuits (20-50%) met the FAO/WHO recommended dietary allowance for school children and adults.

Key words: Legume, Nutritional quality, Enrichment, Biscuits, Garri, Acceptability, Malnutrition.

IMPROVEMENT OF PAPAYA PRODUCTIVITY FOR COMMERCIAL APPLICATION

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Abstract

Kenya was ranked 128th among 169 low-income countries in 2011, with vitamin A deficiency among children aged 6 to 11 months at 40.7%. Vitamin A deficiency (VAD) is a major cause of death among children under 5 years in sub-Saharan Africa. Papaya fruits are rich in vitamin A, and thus have potential for eliminating VAD in Kenya and other countries. Production of papaya has decreased in the recent past due to lack of improved varieties and devastating viral diseases. Papaya exists in three sex types: male, female and hermaphrodite. Prior to flowering, the seedlings look alike, making it impossible for farmers to plant the desired ratio of one male to nine females for optimal productivity. The objectives were to collect and characterise papaya germplasm, agronomic evaluation, tissue culture and value addition for fruits and seeds. Germplasm was collected from Coast, Nyanza, Western, Rift Valley, Eastern and Central provinces of Kenya. Morphological data on 60 accessions were submitted to neighbour joining cluster analysis. Seeds of 43 randomly selected accessions were evaluated for height, fruit yield and quality. Tissue culture was attempted, to develop protocols for mass propagation. Morphological characterisation revealed considerable diversity among 60 papaya accessions. Plant height at 100 days and yield were significantly different among papaya germplasm. An efficient protocol for meristem culture was developed. Papaya-based yoghurts were developed. Oil with high oleic acid content was extracted from papaya seeds and used to make soap and lotion. The diversity in morphological, agronomic and fruit characteristics among papaya accessions points to the possibility of obtaining desirable traits for varieties with superior productivity. Papaya has a lot of potential to improve the health and wealth of poor farming communities and contribute to the realisation of the Millennium Development Goals.

Key words: Papaya, Polygamous species, Morphological characterisation, Diversity, Propagation, Tissue culture, Agronomic evaluation.

VALORISATION OF POULTRY LITTER TO COMPOST: AN ASSESSMENT OF THE PATHOGEN REDUCTION POTENTIAL

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Abstract

The study serves to demonstrate the capacity of the composting process in transforming poultry litter into a safe product capable of replenishing the organic matter content of soils. The overall aim was to apply four measurable approaches to investigate composting-driven stabilisation. Total coliforms, fecal coliforms, *Escherichia coli* and fecal enterococci were systematically enumerated during a 110-day experiment. First, temperature elevation and volatile solids reduction were monitored to determine decomposition rate. The microbial indicators were then characterised via their respective rate equations using the Levenberg-Marquardt algorithm. Third, an exposure assessment investigated the exposure of root crops to enteric bacterial indicators at point of harvest. Fourth, the potential for *E. coli* regrowth in terms of the maximum specific growth rate (μ_{\max}) was parameterised. As a result of the findings generated, a mathematical relationship in relation to composting duration, decomposition rate and μ_{\max} was derived to determine the occurrence of *E. coli* regrowth. Thermophilic temperatures ($>55^{\circ}\text{C}$) were maintained in the windrows for >15 days. Log_{10} reductions of 6.98, -8.03 , -8.18 and -5.96 occurred in TC, FC, *E. coli* and FE concentrations respectively. TC, FC, EC and FE levels on root crops were reduced to very remote fractions of 0.190, 0.005, 1.2×10^{-3} and $1.3 \times 10^{-4} \text{ kg}^{-1}$ respectively. FE followed a first order decay rate while the other indicators decayed under a second order kinetics. μ_{\max} decreased significantly ($P<0.05$) from 2.18 h^{-1} (Week 0) to 0.95 h^{-1} (Week 15). The mathematical relationship indicated that regrowth may occur at the onset of the post-thermophilic/nascent second mesophilic phase. Two simple and low-technology strategies have been advocated to ensure the production of stabilised, pathogen-free compost, namely: timely adjustment of moisture content during the thermophilic phase and turning of compost piles. The findings of the research were disseminated to various stakeholders of the agricultural sector.

Key words: Poultry waste, Composting, Fecal bacterial indicators, Sanitisation, Exposure assessment, Regrowth, Low-cost process control strategies.

LABOUR-SAVING TOOLS FOR WOMEN: THE FORAGE CHOPPER FOR SMALLHOLDER DAIRY FARMERS IN UGANDA

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Abstract

Labour-saving tools have been advocated as critical to increasing production and improving the quality of life of rural Africans. They can be very useful in reducing household drudgery, especially during peak production seasons when labour requirements are high. However, the impact of these tools is usually not evaluated from a gender perspective, for the gender-related effects of social and technical change. The objective of this study was to evaluate the effectiveness of the forage chopper as a labour-saving device for women, and how existing gender relations influenced the nature, use and, ultimately, the impacts of the technology. The machine was developed with the assumption that it will save labour for rural women, giving them control over their own labour and freeing them for other income-generating activities. With a technographic approach, the study evaluated the introduced forage choppers in four dairying sub-counties of Masaka district and showed that: 1) forage choppers were redesigned and adjusted in their use; 2) use and effectiveness depends on social formation of households, community structure and support facilities; 3) the socio-technical dynamics of the forage chopper were not anticipated nor evaluated by the introducing agencies. The conclusion is that empowerment of women with labour-saving tools requires ‘design-in-the-wild’. The design process needs to be grounded and implemented within the reality on the ground, through interdisciplinary teams.

Key words: Drudgery, gender relations, technography, socio-technical change.

WOMEN IN SCIENCE DEVELOPMENT AND PROMOTION OF SUSTAINABLE SOIL AND WATER CONSERVATION TECHNOLOGIES IN SEMI-ARID AREAS OF KENYA: THE CASE OF VEGETATIVE MACRO CONTOUR LINE

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Abstract

Soil erosion is a major problem in semi-arid regions, often characterised by low and erratic rainfall and long dry periods. Increased cultivation in these fragile areas without effective conservation measures has worsened the situation, raising the need to develop management practices that are productive and sustainable. The objective was to evaluate farmer perceptions on soil erosion and runoff and soil and water conservation technologies, and by incorporating their views, develop farmer-friendly soil and water conservation technologies offering multiple benefits. This was done at Kathekakai Settlement Scheme, Machakos county, Kenya. Farmers' perceptions were evaluated through focus group discussions and farmer interviews. To determine effectiveness of the technology, a trial experiment involving three treatments: terraced, vegetative, macro contour line with maize mono crop and terrace ditch; un-terraced, vegetative, macro contour line with maize-dolikos intercrop; and terraced, vegetative, macro contour line with maize-dolikos intercrop and terrace ditch. Soil and plant samples were collected at three different slope positions – upper, middle and lower slope – on the terraced area. Percentage of soil moisture content was gravimetrically determined. Results indicated soil erosion as a major challenge, and that most farmers rely on advice from other farmers (65%) rather than experts (40%) to control runoff. Terraced treatments recorded higher soil moisture compared to un-terraced treatments. Upper and lower slope positions gave significantly ($P \leq 0.05$) higher soil moisture compared to middle positions. Taller plants and higher biomass yield were observed at upper and lower slope positions compared to middle slope positions. Results indicate the effectiveness of terrace ditches to conserve soil moisture, leading to increased land productivity and thus improving rural livelihoods. Therefore, the technology ought to be considered when advising on and implementing land management practices.

Key words: Soil and water conservation, Food security, Land productivity, Water harvesting, Terrace ditch.

DEVELOPING CAPACITY FOR FARMER-LED INTERVENTIONS IN MONITORING AND EVALUATION PROCESSES OF INTEGRATED SOIL FERTILITY MANAGEMENT IN EASTERN ZIMBABWE

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Abstract

Integrated soil fertility management (ISFM) technologies are knowledge intensive, presenting major challenges for adoption by smallholder farmers in sub-Saharan Africa. Development practitioners have postulated that participatory monitoring and evaluation can bridge the gap between scientific research and farmers' technological preferences. However, there is lack of empirical evidence to support this argument. To address this knowledge gap, a 2-year study was conducted in smallholder farming areas of eastern Zimbabwe to: i) jointly develop indicators and monitoring plans, for implementation and evaluation of ISFM technologies with farmers; and ii) to investigate farmers' evaluation criteria in comparing ISFM technologies. Participatory research methods that included focus group discussions and farmer meetings were employed to mobilise farmers for experimentation. Over two cropping seasons, farmer-prioritised ISFM technologies were tested and evaluated through field-based learning centres (LCs). Farmer indicators of ISFM use and non-use were used for monitoring and evaluation. These indicators were then categorised into either ISFM or agronomic parameters. Overall, the farmers' preference criteria for ISFM technologies were underpinned by prospects for multiple benefits, low costs of accessing a technology, its ready availability, and access to knowledge of its use. Criteria for ranking the technologies were influenced by gender and farmer resource endowment. Use of LCs showed the ability of farmers to consistently follow through their indicators in the monitoring and evaluation process. The clarity of farmers on what to look for in ISFM technology use provided scope for employing their criteria in assessing adoption. The study showed that capacity can be developed for farming communities to conduct monitoring and evaluation processes, providing them the opportunity to measure the success of new interventions, as well as identify possible areas for improvement. Farmer interactive platforms, such as LCs, can be useful in supporting stronger participation of farming communities in the evaluation of complex technologies.

Key words: Co-learning, Experimentation, Indicators, Learning centre, Participatory research approaches.

INTRODUCING HEAT-TOLERANT GENES INTO EXOTIC CHICKEN FOR IMPROVED EGG PRODUCTION UNDER HOT AND HUMID ENVIRONMENTS

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Abstract

Exotic layer breeds of poultry in Ghana do not perform to their full genetic potential due to the warm and humid environment, among other factors. A breeding programme was carried out with the aim of incorporating heat-tolerant genes into layers to make them more productive under such environments. Four different groups of Lohmann Brown layers with the naked-neck and frizzle traits were generated after four successive generations of backcrossing. A total of 360, 16-week old pullets (90 from each of the four groups) were assigned in a completely randomised design (CRD) experiment and kept for up to 72 weeks. Each treatment group had three replicates, each with 30 birds. The birds were kept in partitioned open-sided deep-litter pens (with 30 pullets in each compartment) and fed *ad libitum* with layer diets containing 18% crude protein and 2800 Kcal ME/kg. Results showed that Lohmann Brown layers with the naked-neck and frizzle traits were significantly ($P < 0.05$) superior in terms of age at sexual maturity, feed conversion ratio and egg weight compared with layers without these traits. Birds with a combination of the two traits laid at significantly higher rates than their counterparts with a single dose of the genes, which in turn also laid at a significantly higher rate than birds without any of the two traits. The results show that incorporating heat-tolerant genes into Lohmann Brown layers make them more adaptable to hot and humid environments. This is evidenced by increased egg production observed in the naked-neck and frizzled birds compared to their fully-feathered counterparts.

Key words: Lohmann Brown, Naked-neck, Frizzle, Fully-feathered, Sibs.

QTL MAPPING OF RESISTANCE TO ETHIOPIAN STEM RUST RACES OF *PUCCINIA GRAMINIS* F. SP. *TRITICI* INCLUDING UG99 AND STEM RUST RESISTANCE GENES IN DURUM WHEAT (*TRITICUM DURUM* DESF.)

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Abstract

As a result of a recent spread of the highly virulent race of *Puccinia graminis* f. sp. *tritici* (*Pgt*), Ug99 (TTKSK), stem rust is becoming a serious threat to wheat production in Ethiopia as well as in other countries in Eastern Africa. The objective of this study was to identify quantitative trait loci (QTL) regions conferring resistance to Ethiopian stem rust races of *Pgt*. A total of 95 recombinant inbred lines were evaluated for resistance to stem rust for three consecutive years at two locations in Ethiopia, and genotyped using 209 microsatellite markers. Using composite interval mapping, nine QTL regions conferring resistance to Ethiopian stem rust races of *Pgt*, including Ug99, were identified on chromosomes 1AL, 2AS, 3BS, 4BL, 5BL, 6AL 7A, 7AL and 7BL. The markers that are closely linked to these QTL could be used for marker-assisted selection for resistance to stem rust in durum wheat. Durum wheat varieties in Ethiopia are released for production without information on resistance genes against stem rust. As a result, genes responsible for resistance in these varieties are not known. To identify stem rust resistance (*Sr*) genes present in Ethiopian durum wheat varieties, 22 varieties released during 1966-2009 were haplotyped with 17 molecular markers linked with genes *Sr2*, *Sr13*, *Sr22* and *Sr35*. Most of the varieties showed haplotypes for *Sr13* and *Sr22*. This study is the first report on the identification of *Sr* genes in Ethiopian durum wheat varieties based on linked molecular markers. Thus it might help in the identification of varieties carrying resistant alleles that provide valuable genetic material for the development of new improved varieties in further breeding programmes. Hence, this study provides useful information for Ethiopian wheat breeders.

Key words: Ethiopia, Molecular markers, Marker assisted selection, Ug99, Wheat breeding.

LANDSCAPE-SCALE MANAGEMENT OF INVASIVE *CYMBOPOGON AFRONARDUS* (STAPF) IN THE RANGELANDS OF UGANDA

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Abstract

Cymbopogon afronardus is an invasive species which continues to spread over grazing areas of Uganda. Its magnitude and potential threat to rangeland ecosystems has not been established. Conversely, it can be harnessed positively to provide solutions for resource poor farmers and pastoralists in the form of a potential bio-herbicide. Thus the objective was to (i) determine the current acreage of *Cymbopogon* invasion in the rangelands, (ii) evaluate its landscape characteristics and the ecological impact on threatened vegetation, (iii) identify allelopathic properties of *Cymbopogon* oil extracts and their potential in bio herbicide/pesticide formulations. Remote sensing and GIS techniques were used to estimate its spatial distribution and habitat characteristics. Results showed that the land cover was 9,293.6 km², constituting 11% of the rangelands. It is topographically concentrated on north facing steep slopes and prefers open canopy savannah. Allelopathic properties of *Cymbopogon*'s oil extract on seed germination and growth of *Lolium perenne* and *Cyperus rotundus* were assessed to determine the weed's bio-herbicidal properties. At all doses, both *C. rotundus* and *L. perenne*'s germination percentage, germination index, root length and vigour index were significantly different from the control (water). *Cymbopogon* invasion can permanently change ecosystem structure and is likely to generate significant, negative economic consequences in the rangelands, but can be utilised as a potential bio-herbicide.

Key words: Cattle corridor, Ecology, Alien species, Volatile oils, Grasslands.

BIOTECHNOLOGY AT A CROSSROADS: AN EMPIRICAL ANALYSIS OF TISSUE CULTURE BANANA ADOPTION AND IMPACTS IN KENYA

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Abstract

Agricultural technologies offer a great premise for mass poverty alleviation in developing countries. A wide range of agricultural technologies are, indeed, readily available for potential uptake but the rate and scale of their adoption, especially in sub-Saharan Africa, have remained persistently low. The objective of this paper is to illustrate that, when robust analytical methods are applied, the problem of low adoption somewhat ceases to be intrinsic to the technology as such, but is rather connected with insufficient information dissemination and inadequate infrastructural frameworks in developing countries. Following a concrete example of tissue culture (TC) bananas as opposed to conventional suckers for Kenya's smallholder farmers, this study finds that TC adoption rates are significantly increased if there is uniform exposure to knowledge about the technology. Women farmers are even more likely to adopt TC if they have an equal chance to access TC knowledge. The study also finds that TC can increase banana yields by 7%, which can be further raised by up to 20% with access to irrigation water. On welfare outcomes, TC greatly contributes to household income and food security, especially among the more destitute households in the sample. Thus, the use of TC bananas illustrates that biotechnologies can indeed benefit smallholder farmers if the necessary informational and institutional pitfalls are addressed. From the technical viewpoint, the paper argues for methodological pluralism, to be able to empirically identify the most notable technology adoption constraints and the technology's impact on productivity and household welfare outcomes.

Key words: Biotechnology, Adoption, Tissue culture, Impact assessment, Welfare outcomes, Kenya.

RECOVERY OF URBAN SOLID WASTE IN LOMÉ: METHODOLOGICAL APPROACH TOWARDS SUSTAINABLE COMPOST PRODUCTION

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Abstract

Various forms of composting processes are aimed at producing high-quality compost. But most developing countries, unfortunately, often have no or too few pre-project implementation approaches so choices cannot be underpinned with appropriate information, which leads to errors. The aim of the project is to ensure the continuity of compost production in Lomé, in Togo. The composting sector tailored to local conditions was assessed from the production of waste in households to the agricultural reuse stage. The information derived about the source of compost over 2 years and 2 seasons represents not only the first database on the type of waste produced in Lomé but also a genuine decision-making tool for local officials. Non-governmental organisations' analysis of the pre-collecting process helped identify the most relevant performance indicators. The effectiveness and efficiency of the composting process has been maximised in terms of the compost's mass balance and quality. Open field finished product tests provided extremely rewarding findings with a view to improving soils and crops. Lastly, an informal, centralised sorting-composting platform (<20 t/day) model was recommended and rolled out in the light of achievements made.

Key words: Process, Continuity, Project, Pre-collecting, Sorting-composting.

ENHANCING PIG PRODUCTIVITY IN LAKE VICTORIA CRESCENT ZONE: THE EFFECT OF GENOTYPE AND POST-WEANING DIET

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Abstract

Pig production is one of the enterprises small-scale farmers can use to improve their labour efficiency and food security, increase income and alleviate protein malnutrition. This study aimed to determine the effect of genotype and diet on growth performance and carcass characteristics of pigs, so as to enhance those attributes. Diets were based on maize bran (MB) wheat bran (WB) and whole maize (WM). Cambrough (n=18, 12.0 kg) and Cambrough × Large White crossbred (n=18, 9.67 kg) pigs were grouped into six per pen balancing for breed, sex and weight and then randomly assigned to diets, replicated thrice and fed for 120 days. Data was collected on feed intake, weight gain, back fat thickness and body condition score (BCS). At 180 days of age, all male pigs were slaughtered to conduct carcass, tissue and sensory analysis. Diet and genotype influenced ($P<0.05$) weight gain, BCS, carcass composition, dressing percentage, chilling and drip loss, pH, latissimus dorsi (LD) muscle area, fat thickness and pork sensory quality. Weight gain/day was 360 g for WM, 420 g for MB, 390 g for WB, while hot carcasses weighed 46.87, 53.92 and 47.37 kg respectively. Pork of Cambrough pigs had less ($P<0.05$) fat thickness (4.8 mm) than crossbreds (7.7 mm) and had best ($P<0.05$) scores for sensory quality. The WB diet gave the best bet option for feeding pigs due to its low cost, and produced better pig performance and pork quality than maize-based diets, that are also economically unjustifiable. Cambrough pigs should become the breed of choice as they produce leaner pork, demanded by most consumers today. The diet and breed technologies should be promoted in all wheat producing and/or processing areas of the tropics and elsewhere.

Key words: Cambrough, Wheat brans, Growth response, Pork quality.

IMPROVING THE PRODUCTION OF TARO FLOUR FOR THE PREPARATION OF PASTE IN CAMEROON AND CHAD.

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Abstract

The taro sector in Cameroon involves crop production, and a well-established tuber marketing chain and restaurants specialising in the preparation of taro paste. In Chad this takes the form of farm production, processing into chips and flour, followed by the marketing process. The flour produced in Chad suffers from intense browning thus finds little favour with urban consumers, and there is no post-harvest technology available in Cameroon. As part of an approach based on cooperation and ensuring the continuity of work undertaken to produce and use taro flour to prepare the paste, this study had two key aims: 1) define the conditions governing the production of flour from the giant swamp taro (*Cyrtosperma merkusii*), a tuber used in Cameroon as a substitute for regular taro for preparing the paste, 2) studying the impact of the stage of maturity and the drying system on the physiochemical, textural and sensorial properties of Sosso taro (*Colocasia esculenta*) flour and paste in Chad. The findings showed a major variation in the composition of the flour according to the tuber's stage of maturity. *C. merkusii* has the advantage over *C. esculenta* of being a source of β -carotene, whose starch has highly specific techno-functional properties. An analysis of the principal components has shown a link between the composition of the tuber and the functional properties of the flour and the textural/sensorial properties of the taro paste. Training for farmer stakeholders in Chad has helped improve the quality of the flour being marketed. The innovation rolled out in Cameroon is now being exploited by student engineers.

Key words: Browning, Maturity, Drying, Sensorial, Techno-functional, Innovation, Stakeholders.

MARKER-ASSISTED SELECTION FOR IMPROVEMENT OF HIGH AND EARLY ROOT PRODUCTIVITY IN CASSAVA (*Manihot esculenta* CRANTZ)

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Abstract

Late root bulking is a major factor leading to rejection and abandoning of improved cassava genotypes in sub-Saharan Africa. Early bulking varieties shorten the growth period from planting to harvesting by 5 months or more. These varieties are suitable for environments with a short rainy season and reduced exposure to biotic and abiotic stresses leading to increased productivity. The objective was to use molecular markers to fast-track selection of early bulking and high root yield (EB-HY) cassava genotypes that will lead to early-maturing varieties. To improve cassava for early productivity, nine cassava populations were developed at NRCRI, Umudike, Nigeria. The progeny were evaluated for EB-HY at seedling, clonal, and preliminary yield trial stages at 7 months after planting (MAP). The progeny were genotyped at 542 Simple Sequence Repeat (SSR) marker loci using Bulk Segregant Analysis to identify markers associated with EB-HY in cassava. Thirty-two selected genotypes and two checks were evaluated for EB-HY at Umudike, Otobi and Ibadan at 7 MAP in randomised complete blocks with three replications. Collected data were subjected to statistical analyses. There were significant differences among the genotypes for all the variables at different evaluation stages. Nine SSR markers were closely associated ($r=0.3-0.5$; $p<0.05$) with EB-HY in six populations. Seven of the markers with regression coefficient of 0.2 or more are linked to major quantitative trait loci associated with EB-HY in cassava. Genotype plus genotype x environment biplot analysis identified different elite genotypes at different locations. The significant relationship ($r=1$) observed between fresh root yield (FRY) and dry root yield (DRY) suggests that DRY is highly a function of FRY. Therefore, a breeder may select with high accuracy for DRY in cassava using FRY data. The EB-HY cassava genotypes with higher fresh root yield than the checks across the three locations offer cassava growers high productivity in less than 12 months.

Key words: Late root bulking, Hybrid population, Simple sequence repeat markers, Mapping population, Quantitative trait loci, Bulk segregant analysis, Dry root yield.

POULTRY LITTER AS AN ALTERNATIVE FEED RESOURCE FOR BEEF CATTLE IN ERITREA

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Abstract

One of the prominent challenges that farmers face in developing countries such as Eritrea is maintaining a sustainable supply of animal feed. The overall objective of the current study was to evaluate poultry litter as an alternative feed for beef cattle. Litter from replacements, layers, and broiler birds were collected, sun dried and analysed for the contents of crude protein (CP), crude fiber (CF), ash, and fat. The CP content (%DM) for the replacement, layer and broiler litter was 21.15, 18.59 and 18.03, respectively, while the ash content for the corresponding litters was 14.54, 38.56 and 16.79, respectively. The litter was ensiled with leftover bread in plastic containers in a ratio of 2.5:3.0 for 21 days. The ensiling process resulted in a palatable and safe product with a higher CP content and wholesome appearance. Sixteen Barka cattle were used and divided into four groups and a 90-day feeding trial was conducted. The four treatments (T) consisted of: T₁) control diet with 30% wheat bran, T₂) 30% replacement litter, T₃) 30% layer litter and T₄) 30% broiler litter. Each treatment also consisted of 36.3% leftover bread, 30.3% taff straw, 2.4% fishmeal, and 1% salt. The feeding system was restricted and each group consumed all the feed that was available to them (7.44 kg of DM/cattle/day). Average body weight gains (ABG) for T₁, T₂, T₃ and T₄ were 1.093, 1.019, 0.673 and 0.966 kg/day, respectively. ABG for T₁, T₂ and T₄ were not significantly different ($P>0.05$), whereas the ABG of cattle fed on T₃ was significantly different ($P<0.05$) compared to the others. It can be concluded that wheat bran can be replaced by replacement and broiler litters. Furthermore, feeds containing poultry silage can reduce the cost of feed for farmers engaged in fattening of cattle.

Key words: Barka cattle, Leftover bread, Ensiling, Poultry litter, Wheat bran.

DEVELOPMENT OF DROUGHT TOLERANT TRANSGENIC BEAN LINES USING AN IMPROVED GENE TRANSFORMATION SYSTEM

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Abstract

Drought is the most devastating abiotic factor limiting plant growth and yield. Genetic improvement of beans to tolerate drought has been done using conventional breeding, however this is limited to genes within the species' own gene pool. In this research the objective was to develop a novel technique of genetic transformation of beans with genes that confer drought tolerance. In this technique the challenge of recalcitrance of the species towards *in vitro* regeneration due to excessive phenolic excreta was overcome. This was achieved by a hormonal balance of 2.51 mg L⁻¹ benzyladenine and 0.1 mg L⁻¹ of naphthalene acetic acid or indole-3-acetic acid which promoted robust multiple shoot regeneration. The addition of 30 mg L⁻¹ of silver nitrate further reduced the inhibitory effect of phenolic compounds. Gene delivery into explants is also a great challenge in bean transformation. In this research a comparison of the most efficient delivery method of transgenes into epicotyl shoot meristem was investigated using BiolisticTM bombardment and *Agrobacterium tumefaciens*. An observation was made that *Agrobacterium* system was more efficient. The system developed was tested for stable integration and expression of the barley (HVA1) gene, which confers drought tolerance. Significant tolerance of transformed plants versus wild type towards drought stress was observed after 21 days of withholding moisture with a corresponding increase in root length.

Key words: Genetic transformation, *Agrobacterium tumefaciens*, Biolistic Bombardment, *In vitro*, Beans, Drought.

ENVIRONMENTAL IMPACT MITIGATION THROUGH IMPLEMENTATION OF A SOLAR WATER HEATER IN TRADITIONAL BEER PROCESSING IN RURAL AREAS IN BURKINA FASO

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Abstract

In common with other income-generating activities in rural areas, the traditional beer processing sector is experiencing rapid growth. Traditional beer processing involves a series of steps: acquiring raw materials, malting, brewing, packing and sales. An environmental impact study carried out via a life cycle analysis (LCA) produced a global warming potential (GWP) of 21.56 g CO₂ eq per functional unit (FU) equal to 1 L of traditional beer, 3.33 L of water/FU, 0.15 kg of solid waste/FU versus 1.84 L of liquid waste/FU. The brewing subsystem accounted for 99.44% of the GWP, 59.70 of water consumption, 64.52 of solid waste, and 40% of liquid waste. The deployment of a solar water heater (SWH) would provide savings equal to 11% of the wood requirements, and 18% of the water requirements, plus a 10% cut in the workload. Based on the firewood savings, the payment of 200 CFA Francs into a local fund run by a producers' association will provide for the replacement of defective equipment. The cost of the SWH is a drawback: the cost to save 1 kg of wood is 25.85 CFA Francs compared with the actual cost of wood which is 5 CFA Francs/kg. Cheaper SWHs have been suggested to achieve a positive return on farmers' investment during the equipment's lifetime.

Key words: Solar water heater, Environmental impact, Traditional beer, Rural development, Burkina Faso.

EFFECT OF EGG YOLK IN SEMEN EXTENDER, PH AND COOLING METHODS ON CHILLED BOVINE SEMEN CHARACTERISTICS

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Abstract

Artificial insemination is solely dependent on frozen semen, since chilled semen has a short preservation duration. This study therefore sought to improve the preservation period of chilled semen. It evaluated the effect of five egg yolk concentrations (10%, 15%, 20%, 25% and 30%) in citrate semen extender, and different pH adjustments of the extender on the characteristics of chilled bovine semen. Similarly, four methods of semen cooling (cooling from 35°C to 5°C using a water bath, 35°C to 5°C without the water bath, 35°C to 20°C then to 5°C with water bath and 35°C to 20°C then to 5°C without water bath in the refrigerator) were tested. Daily, the post-thaw live cell concentration (LCC), and individual (IM) and progressive motilities (PM) were monitored using a light microscope and haemocytometer, with data grouped into three preservation periods: day 1 to 4, day 5 to 8 and day 9 to 12. Analyses showed that whatever the preservation period, the IM, PM and LCC at 10% egg yolk were significantly higher ($p < 0.05$) than those in other egg yolk concentrations. At 9 to 12 days of preservation, the IM ($15.42 \pm 06.90\%$), PM ($05.83 \pm 05.57\%$) and LCC ($01.83 \pm 01.47 \times 10^6/\text{ml}$) of the semen when cooled from 35°C to 20°C then to 5°C in the water bath were significantly higher ($p < 0.05$) when compared to all other cooling methods studied. The PM ($44.17 \pm 15.93\%$) and LCC ($18.75 \pm 03.68 \times 10^6/\text{ml}$) in the extender with unadjusted pH were significantly higher ($p < 0.05$) from day 5 to 8, as well as from 9 to 12 days ($12.00 \pm 11.83\%$ and $04.90 \pm 02.92 \times 10^6/\text{ml}$ respectively), compared to those of all other levels of adjusted pH. In conclusion, semen viability is prolonged for up to 12 days in an extender with unadjusted pH, containing 10% egg yolk and cooled through a water bath.

Key words: Artificial insemination, Meat, Milk, Motility, Live-cell concentration.