

**RESPONSE OF SOME NITROGEN FIXING TREE SEEDLINGS TO
RHIZOBIUM CROSS-INOCULATION**

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Six introduced and one native nitrogen fixing tree species were grown in a potted non-sterilized Inceptisol with: species-specific rhizobia strains; Rhizobium strain TAL 1145, a *Leucaena* isolate; Bradyrhizobium japonicum strain TAL 169, and without inoculation. Twelve weeks later, significant differences in dry matter yield, total N yield and nitrogen derived from the atmosphere (Ndfa) were obtained. Unlike earlier reports, *Acacia albida* and *Acacia Senegal* were better N₂ fixers than *Leucaena tephala*. Two species did not respond to any of the inoculation treatments and none responded to inoculation with TAL 169. In species belonging to one cross-inoculation group, TAL 1145 had similar Ndfa as those of species-specific rhizobia, implying that it is sufficient as the inoculum for this group.

Key words: Cross-inoculation, *Rhizobium* strains, reference crop, isotope dilution.

**USE OF PSEUDOSTEM TRAPS AND COEFFICIENT OF INFESTATION (PCI)
FOR ASSESSING BANANA INFESTATION AND DAMAGE BY
COSMOPOLITES SORDIDUS GERMAR**

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The banana weevil borer, *Cosmopolites sordidus* Germar (Coleoptera: Curculionidae), is a nocturnal pest and larvae tunnel into banana rhizomes. Infestation and damage are assessed mainly by pseudostem trapping of adults, and the determination of coefficient of infestation. Deficiencies of these methods were identified and field experiments and destructive sampling of bananas carried out to answer some of the questions raised. Variation in trapping conditions, such as trap length, placement, duration of trapping, and soil moisture conditions significantly influenced weevil catches in pseudostem traps. The relationship between external rhizome tunneling, indexed as Percent Coefficient of Infestation (PCI), and internal rhizome damage by *C. sordidus* varied among the banana types and with the parameters used to quantify damage. There was also a poor correlation between weevil trap catches and rhizome damage. For trap to be statistically comparable, trap size and trapping conditions should be defined and standardized. Proper use of the PCI requires that correlations between external tunneling and internal rhizome damage be established for a given banana type or cultivar.

Key words: *C. sordidus*, Curculionidae, pseudostem trapping, PCI.

**FACTORS INFLUENCING THE INCIDENCE OF THE BLACK BEAN APHID,
FABAE SCOP, ON COMMON BEANS INTERCROPPED WITH MAIZE**

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The incidence of the black bean aphid, *Aphis fabae* Scop. (Homoptera: Aphididae), and its colonization of common beans (*Phaseolus vulgaris* L.) grown as sole crop and as intercrops with maize (*Zea mays* L.) of varying growth stages was evaluated in the field and glasshouse. Modification of bean micro-climate and its effects on *A. fabae*, and the species range and abundance of coccinellid predators (Coleoptera: Coccinellidae) of the aphid were also assessed. Results showed that *A. fabae* infestation of beans was greatly [reduced when intercropped with older and taller maize plants. Larger maize plants interfered with aphid colonization of beans and only small proportions of beans were infested by the aphid. Shading by older maize plants significantly ($P < 0.01$) reduced the level of solar radiation reaching intercropped beans; this reduced the build-up of *A. fabae* populations. Intercropping also reduced the number and diversity of coccinellid predators on beans, contrary to the prediction based on the "enemies hypothesis". Reduced aphid incidence on intercrop beans was attributed to maize interference with aphid host finding behaviour and bean colonization and, to a lesser extent, to reduced build-up of *A. fabae* populations due to shading. The relationship between intercropping practices and pest control should be adequately studied before recommending

Key words: *Aphis fabae*, coccinellid predators, intercropping, beans, microclimate.

**STUDIES ON SEED TRANSMISSION OF *XANTHOMONAS CAMPESTRIS* PV
PHASEOLI IN COMMON BEANS IN UGANDA**

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Studies on the seed transmission of *Xanthomonas campestris* by *phaseoli* (XCP) that cause common and fuscous blight of beans were conducted in Uganda. Bean seed was the main source of primary inoculum. The population of XCP in farmers', commercial and research seeds averaged 10^5 - 10^9 colony forming units (cfu) per 100 seeds; the levels of seed infection were 0.3-16.1%. There was a positive correlation between seed symptoms and population of XCP per seed. However, where seed was either slightly diseased or symptomless, XCP did not decrease bean germination irrespective of population density. The minimum population of XCP required to initiate infection in the field was 10^2 cfu per seed while 0.2% seed infection level resulted in serious disease incidence. Research on the XCP tolerance level needs to be carried out using more bean genotypes and locations.

Key words: Bacterial blight, *Xanthomonas campestris* beans, seed infection.

**CHARACTERIZATION OF UGANDAN ISOLATES OF
EXSEROHILUM TURCICUM FROM MAIZE nK r**

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Four representative isolates *uxserohilum turcicum* from four major maize growing districts in Uganda were assessed with respect to their cultural variability and pathogenicity towards an isogenic maize series containing the *Hi* genes for resistance. Two other isolates, one from Zimbabwe and a race 2N isolate from Hawaii, USA, were included for comparative purposes. The isogenic line (H4460) without the *Ht* gene, developed typical necrotic susceptible lesion type following inoculation with all isolates, whilst H4460/fr1, H4460/ft2 and H4460///3 exhibited the resistant chlorotic lesion type. These results indicated that the Ugandan isolates comprised race 0. *In vitro* studies showed that radial growth rates differed significantly among the isolates, the Ugandan isolates tending to have higher temperature optima than the Zimbabwean one.

Key words: *Exserohilum turcicum*, northern leaf blight, race, Uganda.

MALE FERTILITY IN UGANDA BANANA GERM PLASM

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Identification of fertility levels in banana germplasm collection at Kabanyolo, Uganda, was conducted by dehiscing the anthers when using a glass rod. The study involved 151 accessions. The quantity of pollen grains was ranked 0-5; where 0 had no grains and 5 had abundant pollen grains. A correlation between pollen output and inflorescence characters revealed a positive relationship ($r = 0.69$, $P < 0.01$) to inflorescence diagnostic characters. A quantitative determination of pollen output per anther and viability based on starch test using the Heamocytometer method revealed that the amount of starch filled grains did not proportionally vary with the total pollen output. Pollen output varied from cultivar to cultivar. Most East African highland banana cultivars were found to have more pollen than, the recently introduced banana cultivars. A few highland banana cultivars were non-polleniferous. The results indicate potential of using various cultivars in hybridization and, anther and pollen. Sathiamoorthy *et al.* (1984) noted that seed set depends not only upon male parent but also and primarily on the fertility level of the female parent. Therefore, there is a need to evaluate female fertility of the East African high land banana germplasm

Keywords: Bananas, Heamocytometer, fertility, pollen

RELATIVE INFESTATION AND DAMAGE OF SOME PIGEONPEA CULTIVARS BY LEPIDOPTERAN POD BORERS IN UGANDA

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Infestation and damage of some pigeonpea (*Cajanus cajan* [L] Millsp.) cultivars by lepidopteran pod borers were evaluated on two cropping seasons during 1991 at the Makerere University Agricultural Research Institute, Kabanyolo. Significant ($P = 0.05$) cultivar differences were recorded in borer incidence and pod damage. Apio, the local cultivar, showed the highest infestation by *Helicoverpa armigera* (Hubner). ICPL 87104 had the greatest infestation by *Maruca testulalis* (Geyer), although in the second season it was not significantly higher than the rest. *Etiella zinckenella* (Treitschke) occurred in very low numbers, and cultivar differences were not significant ($P > 0.05$). Indexing larval counts to number of pods per plant showed that infestation pressure by both *H. armigera* and *M. testulalis* was not as different among cultivars as larval counts suggested. Pod damage was greatest on ICPL 87 and lowest on ICPL 87104. Since the pod index takes into consideration resources available to insects for shelter, feeding and oviposition, it is probably a more realistic measure, particularly in relationships of infestation and damage. Borer infestation suggests that resistance susceptibility factors to these pests are different. This area requires further research.

Key Words: Pigeonpea, pod borers, Uganda

EFFECT OF TEMPERATURE AND HOST GENOTYPE ON COMPONENTS OF RESISTANCE TO GROUNDNUT RUST¹

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The effects of temperature on incubation period, infection frequency, lesion diameter, leaf area damage, pustule rupture, and sporulation were quantified for six groundnut genotypes, representing rust-resistant and susceptible reactions using detached leaves. Rust developed on all groundnut genotypes at 10, 15, 20, 25 and 30°C but not at 35 and 40°C. Incubation period decreased with increase in temperature but in susceptible genotypes it again increased at 30°C. Infection frequencies were highest for susceptible genotypes at 20°C and for resistant genotypes at 30°C. Lesion diameters were smallest at 15°C but increased with the increase in temperature. Optimal temperature for lesion diameters was at 30°C for most genotypes. In susceptible genotypes, the optimal temperature for the leaf area damage occurred at 25°C. The optimal temperature for resistant genotypes was at 25 or 30°C. Nearly 100% pustules ruptured on susceptible genotypes at most temperatures. In resistant genotypes, the percentage of pustules ruptured was highest at 15°C but decreased at 20, 25, and 30°C with the exception of NC Ac 17090 at 30°C. Sporulation was highest on susceptible genotypes at 20 and 25°C. Resistant genotypes had high sporulation at 15 or 20°C but decreased at higher temperatures with the exception of NC Ac 17090. Resistant genotypes had longer incubation period, lower infection frequencies, smaller lesions, reduced number of ruptured pustules, and lower sporulation and leaf area damage than the susceptible genotypes. The differences between susceptible and resistant genotypes in some of the components were large only at certain temperatures.

Keywords: *Arachis hypogaea*, components of resistance, disease resistance, ground nut

**TESTING FOR A SUITABLE CULTURE MEDIUM FOR
MICROPROPAGATION OF EAST AFRICAN HIGHLAND BANANAS**

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A study was conducted to find a suitable culture medium for micro propagation of East African highland bananas (*Musa* spp.). Modified Eriksson (ER), Gamborg's B-S (B-S) and Murashige-Skoog (MS) media were tested with a roasting cultivar Gonja-Horn plantain (AAB), a dessert Bogoya-Gros Michel (AAA) and three East African highland cooking (AAA) cultivars Kibuzi, Mbwazirume and Namwezi for *in vitro* proliferation induction. The media were supplemented with 4.5 mg l⁻¹ Benzylaminopurine (BAP) and with or without 0.186 mg l⁻¹ Naphthalene acetic acid (NAA). Only ER and MS gave proliferation. AAB cultivar proliferated significantly more than the AAA which did not differ among themselves. The AAA cultivars precocious rooting in the absence and presence of 0.186 mg l⁻¹ NAA on ER and MS media with 4.5 mg l⁻¹ AP. However, the presence of auxin NAA significantly lowered shoot proliferation with concomitant significant induction of precocious rooting. This indicated a high level of endogenous auxin in these cultivars and, therefore, the unnecessary of exogenous auxin for their maximum *in vitro* proliferation. It was also found that ammoniacal nitrogen content determined the suitability of a culture medium thus making ER an alternative to the MS salts.

Key words: Auxin, bananas, culture medium, cytokinin, microproliferation.

**INFLUENCE OF SOME CROP PROTECTION MANAGEMENT PRACTICES
ON YIELD STABILITY OF COWPEAS**

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Thirty varieties of cowpeas (*Vigna unguiculata* L. Walp) were evaluated for their yield stability using two methods of field trials. One set of environments was created by using different crop protection management practices within one location. The second set was created by using different seasons and locations. The results of both methods revealed significant differences among environments, genotypes and genotype x environment interactions. Both methods showed that most of the varieties were stable with regression coefficients (b) not significantly different from unity, mean square deviations from regression (s^2_d) close to zero, high coefficients of determination (r^2) and high grain yields. It was concluded that where funds, time, co-operating scientists and competent field assistants are limiting the simulation of environments could be resorted to. Five varieties IT85F-1987, TVx 3236, IT82D-716, IT82D-522-1 and TVx 274-02 were selected, using the stability parameters of both methods and other desirable traits for further testing before eventual release to farmers.

Key words: Cowpeas, Crop Management Practices, yield stability

RANGE AND OCCURRENCE OF PIGEONPEA PESTS IN CENTRAL UGANDA

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A study was carried out at the Makerere University Agricultural Research Institute, Kabanyolo over four cropping seasons (1990-1992) to determine the range of pests attacking pigeonpeas (*Cajanus cajan* (L) Millsp.) in Uganda, and to assess their status depending on occurrence and nature of damage. Of the species identified, there were seven lepidopterans, two homopterans, three heteropterans and coleopterans, each, and one dipteran, hymenopteran, isopteran and thysanopteran insects and jassids (Homoptera), cowbugs (Heteroptera), leaf webbers and defoliators (Lepidoptera), leaf beetles (Coleoptera) and grasshoppers (Orthoptera). Seven identified species were new records on the crop in the country. The most commonly occurring species were *Aphis craccivora* (Koch), *Helicoverpa armigera* (Hub), *Maruca testulalis* (Geyer), *Etieta zinckenella* (Treitschke), *Melanagromyza chakosoma* Spencer, *Tanaostigmodes cajaninae* LaSalle and *Clavigralla* sp.

Key Words: Range and occurrence, pigeonpea pests, Uganda.

RELEVANCE OF UNIVERSITY-BASED RESEARCH TO LOCAL FARMING PROBLEMS: THE CASE OF MAKERERE UNIVERSITY AGRICULTURAL RESEARCH INSTITUTE

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The contribution of university-based agricultural research to solving local farming problems is a major area of debate in developing countries. A case study of Makerere University Agricultural Research Institute, Kabanyolo, Uganda, was done to ascertain the nature of research done at the Institute and to assess the Institute's impact on farming practices on surrounding areas. Most research programmes were found to cover commodities and problems that had a bearing on farming on the Institute's surroundings and the country at large. However, only a few of the research programmes had yielded technologies that could be applied to the farmers. Moreover, the few farmer-usable technologies available at the Institute were not widely adopted among the farmers studied. Most of the potential adopters were unaware of the existence of such technologies at the Institute. The Institute could increase the utility of its research to Ugandan farmers by conducting more adaptive research, strengthening its links with the agricultural research institutions outside the University, and establishing a formal programme for reaching out to farmers and extension workers. MUARIK should enhance its ability to generate farmer-usable technologies by encouraging some of its post-graduate students to conduct adaptive research rather than basic research. Part of the student research funds and efforts should be utilized to follow through on previous adaptive studies in order to develop farm level recommendations. MUARIK should be concerned about the transfer of its technologies to farmers. Transferred technologies need to be formalized and augmented. MUARIK should establish a formal outreach programme to foster, determine and evaluate the transfer of its technologies to extension workers and farmers from within and surroundings it and reach out to other audiences

Key words: Adoptive research, local farming problems University research, usable technologies

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TROPICAL INTERCROPPING SYSTEMS: WHAT IS THEIR FUTURE?

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This paper examines the relevance of a temperate region model in intercropping in the tropics and outlines the success of tropical intercropping systems in maintaining biodiversity and controlling pest populations. It then discusses the need for research to develop crop varieties for intercropping systems, which take into consideration planting and harvesting technologies.

Key words: temperate region model, biodiversity, pest population, crop varieties

**EFFECTS OF MULCHING MATERIALS ON THE GROWTH, DEVELOPMENT
AND YIELD OF WHITE YAM**

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Two similar experiments we described in which the effects of different mulching materials and staking on the growth, development and yield of white yam (*Dioscorea rotundata*) Minisetts were studied. One white yam cultivar TDR131 was used and the treatments were: black and white embossed polyethylene plastic (Visqueen 38mu) with either black or white surface up; light weight black polyethylene plastic; rice straw; staking but no mulch, and no staking and no mulch. Each experiment was laid out in a randomised complete; design with four replications. Polyethylene plastic mulch with white surface up was superior to all other treatments. Total dry matter per plant and total fresh tuber yield were all consistently higher in plants grown under the white surface polyethylene plastic mulch. In 1985, mean tuber size was more than 34% larger than in traditional staking system and nearly double the value obtained with no staking no mulch treatment. In 1986, mean tuber size was again larger with white surface plastic mulch but not significantly different from those of the staking and rice straw treatments. Plants in all treatments attained peak leaf area Mex (LAI) about 100 days after planting and those in the white surface plastic mulch maintained a higher LAI for most of the growing season. White surface polyethylene plastic mulch gave the larger Leaf Area Mex and the greater Leaf Area Duration, which ensured a high bulking rate over a comparatively longer period. It is suggested that under tropical conditions, farmers would obtain better seed yam yields through the use of white surface polyethylene plastic mulch.

Key words: *Minisetts*, *Mucuma*, Polyethylene plastic, seed yam, transplanting

**NORTHERN LEAF BLIGHT PROGRESS AND SPREAD FROM INFESTED
MAIZE RESIDUE**

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Local epidemics of northern leaf blight, incited by the fungus *Exserohilum turcicum* (Pass) Leonard & Suggs, usually originate from conidia on infested maize residue. The effect of four residue levels: 0,1,2, and 3 kg/2.25 m² on the progress and spread of northern leaf blight was monitored on a susceptible maize cultivar EV8429-SR. Final percentage leaf area blighted and area under disease progress curve were significantly ($P < 0.05$) higher in the residue infested plots compared to the residue-free plots. Disease severity decreased with increase in distance from the maize residue area, whereas the apparent infection rate remained relatively constant. Gradients of disease spread curves were significantly ($P < 0.01$) influenced by levels of maize residue and ranged from 0.2 to 1.6. The gradients flattened as the season progressed. Presence of lesions in residue-free plots indicated background contamination and/or disease spread from the residue-infested plots.

Key words: Apparent infection rate, disease, epidemics, *Exserohilum turcicum*, gradients, inocula, Uganda

**EVALUATION OF 80 COWPEA LINES FOR RESISTANCE TO SCAB,
*SPHACELOMASP***

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Eighty cowpea lines were evaluated in Uganda under natural disease pressure for resistance to *Sphaceloma* sp., the causal agent of cowpea scab, during the second (short) rains of 1991 and the first (long) and second rains of 1992. Scab severity (percent plant area affected) varied with season and averaged 32% in 1991, and 2 % and 24 % during the first and second rains of 1992, respectively. Cowpea lines were ranked as resistant, moderately resistant, and susceptible when percent plant area affected averaged <15, 15-30, and >30 in 1991; <15, 1.5-4.0, >4.0 in the first rains of 1992; and <15, 15-24, and >24 in the second rains of 1992. Overall, 25 lines were considered resistant, 20 moderately resistant and 35 susceptible. Lines that have shown some degree of resistance to sphaceloma could be used in cowpea improvement programme

Key words: AUDPC, disease rating, resistance, screening, *Vigna unguiculata*.

MECHANISMS OF DROUGHT TOLERANCE IN CASSAVA

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Experiments were conducted at IITA to evaluate the response of cassava (*Manihot esculenta* Crantz) to moisture deficits. In a potted experiment, four varieties (TMS 30572, TMS 91934, TMS 30555 and Odongbo) were evaluated under four watering regimes. Stress significantly reduced leaf area, tuber number and size, and total fresh tuber yield in all varieties. However, stress had the greatest effect on TMS 30555 and Odongbo. TMS 30572 and TMS 91934 had proportionately higher dry matter in the fibrous root system and maintained higher LAI under stress. In a field experiment, TMS 30572 and TMS 91934 similarly had higher dry matter in the fibrous root system and relatively higher LAI. TMS 30572 produced consistently lower diurnal stomatal conductance and transpiration rates during the dry season and higher values during the wet season but had the largest amount of stored water (shoot capacitance) during the wet season. TMS 91934 produced consistently higher diurnal stomatal conductance and transpiration rates during the dry season and had the largest amount of stored water during the dry season. It is concluded that the extent of fibrous root system and the maintenance of high LAI under drought stress are important characteristics of cassava genotypes tolerant to drought stress.

Key words: Capacitance, diurnal conductance, drought stress, LAI, *Manihot esculenta*, transpiration

EVALUATION OF POTATO GERMPLASM FOR WARM CLIMATE AT LOW ELEVATIONS IN UGANDA

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Several experiments on *Solanum* potato were conducted at 0.28° N to 33° N latitude and 1250 to 1300 m a.s.l. in Uganda. Selected genotypes and breeding lines representing a broad genetic base were grown during both long and short rainy seasons from 1989 to 1994 to study their growth and yield responses in a warm = genotypes differed significantly for all parameters measured except the number of stems.plant⁻¹. High yielding genotypes indicated ability of seed tubers to survive and emerge quickly under high soil temperatures and begin quick, early and balanced haulm growth with good leaf canopy. Leaf area index varied from 4 to 6 while harvest index ranged from 52.0 to 55.0%. Average fresh tuber weight both at harvesting, 67 days after planting, and at full maturity demonstrated that tuber development was faster high tuber yield. Conversely, lower yield in genotypes unadapted to the mid-altitude was related survival and gappy plant stand. The plants grew taller and developed smaller leaflets. Plant growth was undetermined which stimulated the production of small tubers. Genotypes CIP – 382171.4, CIP-381381.20, CIP-381379.9 and CIP-379706.34 (LT.9) were outstanding in their ability to produce relatively high yields with better average fresh tuber weight. Accessions CIP 800938 and CIP 720108, though having high glyco-alkaloid and high rate of pathological degeneration, respectively, are heat tolerant and high yielding and are potentially valuable for a breeding programme. All the high -types and Cruza were observed to have useful degrees of resistance to bacterial wilt. There was also strong evidence that genotypes CIP 382171.4 and CIP 381381.20 possess combined resistance to late blight bacterial wilt. Intensive research is needed on the agronomic and physiological problems j cultivation under stress conditions (heat and drought). Specific breeding strategy will resistances to both biotic and abiotic stresses associated with successful potato production in mid-altitude zones. More research is needed, with a board based germplasm pool, to identify high yielding genotypes with built in resistance to important diseases, particularly bacterial wilt, a major production constraint in mid-altitude zones. There is need of understanding agronomic and physiological aspects of growing potatoes in warm environment, crop cultural practices, and genotype-environment interactions to improve phytosynthetic efficiency.

Key words: Abiotic, bimodal, biotic glycoalkaloids, photosynthesis, *Solanum*, stress conditions

**BEAN IMPROVEMENT FOR LOW FERTILITY SOILS IN AFRICA
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Bean (*Phaseolus vulgaris*L.) production in Africa is constrained by edaphic stresses. A pan-African effort, Bean Improvement for Low Fertility in Africa (BILFA), was initiated in 1990 to screen beans for tolerance to several edaphic stresses. In the first cycle, 280 entries consisting primarily of promising or released materials from African bean breeding programmes, were evaluated for tolerance to low availabilities of soil N, P and K, and toxicities of Al and Mn. Several entries were identified as tolerant for each of the stresses but especially promising are: RWR 382, RAO 55, ACC433, XAN 76 and MMS 224 for low P tolerance; ICA Pijao and EMP 84 for low K tolerance; Muhinga, Ntekerabsilimu and 7/4 ACC for tolerance to Al toxicity; and MCM 5001 and XAN 76 for tolerance to Mn toxicity. Several varieties, including XAN 76, RAO55, and OBA 1 have performed well under a number of edaphic stresses. The Rwanda breeding programme appears to be a good source of materials for low N and high Mn tolerance. The Uganda breeding programme appears to be a relatively better source of low P tolerance materials. The Great Lakes Region is apparently the best source of tolerance to Al toxicity. Problems encountered during implementation of the BILFA are discussed. BILFA need more test through evaluation of more varieties in more locations, and farmers' reactions to the varieties.

Key words: *Phaseolus vulgaris* L., edaphic stress, Aluminium and Manganese toxicity

**CONTROL OF *DIGITARIA ABYSSINICA* (A. RICH) STAFF. WITH
GLYPHOSATE**

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Investigations were conducted in Uganda on the effect of glyphosate dose rate, timing of application, and the combination of glyphosate with cultural methods for the control of *Digitaria abyssinica* (A. Rich) Stapf. Results showed a dose rate of 1.5 kg a.e.ha⁻¹ to be optimum. Application with pre-plant tillage did not increase *D. abyssinica* control, but increased populations of other weeds and costs. Glyphosate efficacy was increased when preceded by slashing, burning or digging. At least one month was required between the cultural pre-treatments and spraying to allow new shoots to emerge. Glyphosate was most effective when applied to *D. abyssinica* shoots up to eight weeks after emergence. The optimum timing for spraying was between one and two months after cultural pre-treatment. Glyphosate applications considerably reduced labour requirement for preparation of *D. abyssinica* infested land. For farmers lacking access to herbicides, sprayers or information, lack of capital, research to develop other less costly methods of *D. abyssinica* control is needed

Key words: Glyphosate efficacy, Uganda, weed control.

**INFLUENCE OF SEED SIZE ON SEED AND SEEDLING CHARACTERISTICS
OF *CENTROSEMA PUBESCENS***

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Seed of centre of different sizes was produced from ungraded seed under three support systems; unstaked, staked and intercropped with cassava. The effect of seed size (as a result of production system) and planting depth on germination rate, germination percentage and seedling vigour were examined during laboratory and screen house experiments. Results showed slight but nonsignificant differences in seedling performance of 100 seeds weighing 3.0 and 2.9 g (from intercropped and staked centro, respectively), while seedling performance of above seeds was significantly ($P < 0.05$) higher than that of unstaked centro whose 100 seeds weighed 2.6 g. Positive associations between seedling performance and seed size were also observed. Production of centro seed from cassava supported or staked plants yielded larger seed size and better seedling performance compared to unstaked growth.

Key words: Germination, planting depth, seed dry weight, vigour.

**DIALLEL ANALYSIS FOR REACTION TO *EXSEROHILUM TURCICUM* OF
MAIZE CULTIVARS AND CROSSES**

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The effectiveness of a diallel cross in initiating recurrent selection as a breeding procedure for concentrating genes for resistance to *Exserohilum turcicum* (Pass) Leonard and Suggs was studied in maize single and double cross F₁ 's during the first rains of 1993. Resistance was expressed as reduced percentage leaf area blighted area under disease progress curve of percentage leaf area blighted (AUDPC-S) and lesion numbers (AUDPC-L), and apparent infection rate (r), indicating presence of rate-reducing resistance. General combining ability effects differed with the genotype, cross and disease indices, resistant cultivars giving the highest negative values, and the single cross giving higher negative values than their corresponding ¹ cross genotypes. High heritability values were obtained for both types of crosses, signifying the heritable nature of this polygenic resistance and the low level of resistance present in the parent cultivars.

Key words: Combining ability, diallel cross, disease progress, northern leaf blight, *Zea mays*

**INFLUENCE OF TIME OF INSECTICIDE APPLICATION ON CONTROL OF
INSECT PESTS OF COWPEA AND GRAIN YIELD OF COWPEA AT
MTWAPA, COASTAL PROVINCE OF KENYA**

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Grain yield of cowpea, the most important grain in the Coast Province of Kenya, is very low mainly because of insect pests attack. It is, however, not clear which growth development stages at which pest attack occurs lead to significant reduction in yields. Consequently, it is difficult to focus control strategies on a particular growth stage. A study was, therefore, conducted to determine the critical stage of cowpea growth at which insecticide application minimises grain yield loss due to pests. The results indicated that controlling flowering and podding pests resulted in 15 fold increase in cowpea grain yield. It is concluded that control efforts should be focused on flowering and podding pests. Further studies to determine the frequency of insecticide application and the type of insecticide should be initiated.

Key words: *Monica testulalis*, *Megalurothrips sjostedti*, *Ootheca* sp., Pod sucking bugs, *Vigna unguiculata*

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Field evaluation was made of the effect of the fungal pathogen, *Beauveria bassiana* (Bals.) Vuillemin (Isolate KB/91/3), and Dursban, Primicid and Furadan insecticides on the banana weevil, *Cosmopolites sordidus* German. When the treatments were combined with pseudostem trapping, population of the banana weevil declined sharply. In the first four weeks after application, *B. bassiana* did not cause significant mortality of the weevil, while high mortalities were recorded for the insecticides, particularly Dursban. Monitored over a longer period (2-5 months), however, all the treatments significantly ($P < 0.05$) suppressed weevil population compared to the control. *Beauveria bassiana* was more persistent than the chemical insecticides, particularly when used without pseudostem traps. It is suggested that comprehensive field trials be carried out to confirm the findings of this study. Extensive investigations should be carried out to establish and develop the demonstrated potential of the K3 isolate of *B. bassiana* against the banana weevil.

Key words: Biopesticides, banana borer, entomopathogens, pesticides

**INFLUENCE OF MOLYBDENUM AND COBALT FERTILISATION ON
SYMBIOTIC NITROGEN FIXATION INDICATORS IN AN OXISOL IN
UGANDA**

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Molybdenum (Mo) and cobalt (Co) are important micro-elements involved in biological N₂-fixation. Uganda has embarked on a campaign to increase the productivity of legume crops through utilisation of rhizobial inoculants, unfortunately, non-responsiveness is frequently encountered. Among the suspected causes are inadequacies of Mo and Co supply in the soil. A glasshouse study was, therefore, conducted with an Oxisol to examine this relationship. Treatments included provision of lime at 0 and 1.01 ha⁻¹, Mo at 0, 390 and 780 g ha⁻¹ and Co at 0, 454 and 907 g ha⁻¹. Soybean (*Glycine max* Merrill) cultivar NAM1 was the test crop. Cobalt application at a rate of 454 g ha⁻¹ resulted in the greatest nodulation and number of effective nodules per plant, as well as total N accumulation in the shoots. Liming depressed soil solution acidity by 0.2 pH units. A combination of lime (1.01 ha⁻¹) and Co (454 g ha⁻¹) increased nodulation and the number of effective nodules per plant, but masked cobalt's positive effect on total N accumulation in shoots. Liming alone did not affect the biological N fixation indicators considered in this study. Further research is necessary to compare these results generated under greenhouse conditions with field conditions and for different soils across the country, which are non-responsible to Rhizobial inoculum.

Key words: Biological nitrogen fixation, inoculation, liming, soybean

**SEASONAL FLUCTUATIONS AND DAMAGE OF LEPIDOPTERAN
STEMBORERS OF MAIZE IN A MAJOR AGROECOZONE OF UGANDA**

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The distribution and damage of stemborers of maize, *Chilo partellus* (Swinhoe), *Busseola fusca* (Fuller), *Eldana saccharina* Walker, and *Sesamia calamistis* Hampson, were studied in two locations in Uganda. The species composition of the stemborers was influenced by crop phenology. Distribution of stem borer larvae in the plant was similar at both locations. At 2-3 weeks after plant emergence (WAE), 100% of larvae recovered was from the funnel of the plant with the proportion decreasing as the stem elongated. *Busseola fusca* and *Chilo partellus* were more injurious as indicated by the extent of leaf and stem injury. *Sesamia calamistis* predominantly attacked the maize ears. This phenological relationship of variation in stemborer incidence and damage to crop phenology is crucial in devising management strategies of the pests. There is need to develop appropriate management strategies for stemborers of maize in Uganda based on their importance and behaviour on the crop.

Key words: *Busseola fusca*, *Chilo partellus*, *Sesamia calamistis*, *Eldana saccharina*, crop phenology, stem tunnelling, *Zea mays*

**INHERITANCE OF RACE-NON SPECIFIC RESISTANCE TO EXSEROHILUM
TURCICUM IN MAIZE SYNTHETIC POPULATION OhSIO**

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Progeny tests of resistant lines derived from maize (*Zea mays* L.) synthetic population OhSIO were conducted at one location during two years (1993-94) in Ohio (Guerne) and at two locations during one year (1993) in Uganda (Kabanyolo and Namulonge) to examine the inheritance of resistance to *Exserohilum turcicum*(*Pass.*), causal agent of northern leaf blight (NLB). Individual plants in single ear derived selfed progenies (S₁ and S_{1::2}) were inoculated in a controlled fashion (Guerne, Namulonge) or naturally infected (Kabanyolo). Host responses to infection were characterized by determining area under the disease progress curve (AUDPC), calculated from percent leaf area affected (PLAA) and lesion number counts, and lesion size. The majority of S₁ and S_{1::2} progenies had few lesions, low rates of disease development, and high levels of resistance, indicating that multiple factors govern expression of resistance. Of the progenies tested, S20-4, S30-5, S30-6 and S30-7 exhibited consistently high levels of resistance to NLB.

Key words: Breeding, maize, genetics, host resistances

**EFFICACY OF DIFFERENT INSECTICIDES FOR THE MANAGEMENT OF
STEMBORERS OF MAIZE IN UGANDA**

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Evaluation was made of the efficacy of commonly available insecticides for control of stemborers on maize. Insecticide application influenced the occurrence and extent of stemborer damage on maize. In the early stages of crop development, the lowest stemborer incidence was recorded on Furadan treated plots, although its efficacy decreased with time. Overall, Sevin treatments effected better control compared to other treatments. A well-timed granular application of Sevin could fit well in the integrated stemborer management system and reduce maize yield losses caused by these pests. Application of Sevin 2-3 weeks after plant emergence in maize whorl coupled with continuous monitoring of the borer populations together with adoption of practices that reduce pest population and damage to crops, could constitute an effective integrated pest management programme.

Key words: Chemicals, Lepidopteran stemborer, *Zea mays*

**MODELLING BANANA GROWTH AND SOIL ORGANIC MATTER
DYNAMICS WITH THE CENTURY MODEL**

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A major concern to food security in Uganda is banana yield reduction, a condition locally known as '*matoke* decline'. Computer simulation is one means of understanding the complex interactions between plants, organic matter dynamics and soil but require that much be quantified within systems before models may be applied. We have initialised the CENTURY model to simulate a banana re-establishment experiment in Mukono District, Uganda. The initialisation required assumptions concerning assimilate allocation patterns between shoots, roots and bunches. The complex pattern of grass fallow, burning, maize, chemical fertilisation and banana receiving different managements could be simulated using schedule routines of the model, but some adjustments were necessary to allow for perennial growth. Two separate harvest files were constructed to account for harvest of bunches and the removal of basal offshoots. At the first harvest (18 months after planting) the simulation of treatments receiving no inputs and that having 10t napier grass (*Pennisetum purpureum*) differed by 5.0 and 1.01 ha⁻¹ in total aboveground biomass (dw) and fresh bunch yield. After six years of harvest, average annual yields were 5.1, 6.1 and 7.61 ha⁻¹ in the control, livestock manure (10 t ha⁻¹ y⁻¹) and napier grass treatments, respectively. Simulated soil organic carbon content increased from 2.2% to 3.8% in the treatment receiving napier grass and harvest residues but increased only slightly in the complete control (2.5%). Model outputs suggest that a near 'steady-state' in banana biomass is achieved due to periodic senescence of mature pseudostems, bunch harvest and offshoots. Model outputs suggest that external organic inputs of 10t ha⁻¹ y⁻¹ influence banana productivity to a greater extent than the retention of banana residues. The Century model should be refined to banana based systems and long terms simulations run as means of pre-selecting technical feasible management interventions intended to counter the *matoke* decline syndrome.

Key words: Banana management, *matoke* decline, napier grass, organic inputs, soil organic carbon, Uganda

GENETICS OF RESISTANCE TO *SPHACELOMA* SCAB OF COWPEA

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Although scab caused by *Sphaceloma* sp. is a major disease of cowpea in tropical and sub-tropical areas, little is known about the genetics of resistance to the disease. This study investigated i) relative importance of general (G.C.A) and specific (S.C.A) combining ability effects in the inheritance of resistance to scab on foliage and pods; ii) heritability of the resistance to scab infections on leaves and pods; iii) the genetic relationship between resistance to foliar and pod infections; and iv) the direct and indirect effects of scab foliar and pod infections on seed yield and yield components of cowpea. Ten cowpea lines [39,46, Kvu 454, Kvu 175 -resistant; Iv 1658, Iv1075, 82, Kvu 530, SLA 59 - moderate resistance; and Era? -susceptible] were half-diallel crossed during the first season of 1996 at Kabanyolo, Uganda. The F₁ and F₂ seeds were field grown together with their parents during the second season of 1996 and during the first season of 1997, respectively. A randomised complete block design (RCBD) with three replications consisting of single row plots, 3 m long, spaced at 75 cm apart, were used for all trials. Scab infected cowpea residues were introduced between rows three weeks after emergence (WAE) to ensure uniform scab infection. Foliar and pod scab severities were scored independently basing on a scale of 1 (resistant) to 5 (susceptible). Diallel analysis was done according to Griffing's (1956) method 2 model 1. Both G.C.A and S.C.A effects were important for resistance to scab infection whether on the foliage or pods suggesting the importance of both additive and non-additive gene actions for scab resistance. However, high G.C.A:S.C.A ratios (37.2 and 35.8 for foliar and pod scab severities, respectively) indicated preponderance of additive genetic variance for each trait. The resistant parents were found good general combiners for resistance to scab infections. Broad-sense heritability estimates were high for both resistances to foliar (93.8 %) and to pod scab infections (97.0%). Narrow-sense heritability estimates were also high for both traits (79.8 % and 84.5 %, respectively). Correlation analysis revealed high phenotypic (0.983) and genotypic (0.949) correlation coefficients indicating a strong relationship between the two traits. Foliar scab severity exhibited a negative direct effect on yield, but also indirectly affected it through reduced pods per plant and pod length. Similarly, pod scab severity indirectly reduced yield through pods per plant and pod length. This suggested deleterious effects of scab disease directly on yield or indirectly through reduction in the number of pods per plant and pod length.

Key words: Combining abilities, heritability, scab, *Sphaceloma*, *Vigna unguiculata*

EFFICIENCY OF NITROGEN ACQUISITION AND UTILISATION IN
COMMON BEAN IN UGANDA

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Inadequate nitrogen nutrition is a major constraint to the performance of common bean (*Phaseolus* L.) in sub-Saharan Africa. Twenty-six lines selected for good performance under N-limiting conditions were further evaluated at two locations in Uganda to determine the mechanisms allowing good performance under soil N-limiting conditions. Two non-nodulating lines were included whose mean yield was 44% more with N application. The test lines showed little response to applied N implying that all fixed significant amounts of N₂; N derived from the atmosphere was estimated to average 15 and 43% of plant N for two locations using the natural abundance ¹⁵N technique. Mean yield of test lines ranged from 810 to 1450 kg ha⁻¹ across two locations with N-limiting conditions. Characteristics contributing to good performance under N-limiting conditions varied with genotypes which were grouped into two clusters, with four out-lying genotypes, based on N acquisition and utilisation characteristics. Nitrogen utilisation efficiency in vegetative growth was not important to yield under N-limiting conditions. Increased N acquisition during podfill was important to the yield of some genotypes, and presumably compensated for less biomass and plant N at the beginning of podfill. Yield was positively related to biomass and plant N logical maturity (R9), but not to N utilisation efficiency in biomass production at R9. Efficient of N from the vegetative parts to the grain was important to growth under N-limiting, as was N utilisation efficiency in grain formation.

Key words: BILFA, low N tolerance, N-limiting conditions, *Phaseolus vulgaris*

**EFFECTS OF PRESERVATION METHOD AND STORAGE CONDITIONS ON
THE FLAVOUR AND COLOUR OF PASSION FRUIT JUICE**

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Sensory and headspace gas chromatography analyses were done to evaluate the changes in the flavour of pasteurised and chemically preserved passion fruit (*Passiflora edulis* Sims.) juices stored at -18,4-8 and 23°C over a 12 week period. The colour of the juices was monitored by a Minolta colorimeter. The flavour attributes, except acidity and sweetness intensity of pasteurised juice were inferior to the chemically preserved juice. Headspace chromatograms of pasteurised juice showed slight changes in the volatile compound profile. Pasteurised juice was darker, less red and yellow (L: 24.66, a: -3.88, b: 8.43) compared to the chemically preserved (L: 33.22, a: -4.95, b: 15.47) juice. With the exception of acidity and sweetness intensity, other flavour attributes were also found to be dependant on storage temperature and time. Hunter L value, was relatively stable with increased storage temperature and time, but the red and yellow hue, and Hunter a and b values respectively, were altered. Esters were positively correlated to flavour intensity, persistence of fruit flavour and overall impression of passion fruit juices. However, ethanol and ethyl acetate were positively correlated to off-flavour and presence of an after taste in the juices. These results show that passion fruit flavour attributes and colour are dependent on method of preservation, storage temperature and time. Passion fruit juice stored at -18°C had a superior flavour and colour irrespective of the preservation method and storage time.

Key words: Chromatography, flavour attributes, *Passiflora edulis* Sims., preservation method, storage temperature and time, volatile compounds

EFFECT OF PLANTING METHOD ON ESTABLISHMENT OF NAPIER GRASS VARIETIES

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Napier grass (*Pennisetum purpureum* Schum.) is extremely valuable in eastern Africa, but high biomass production is often limited by poor establishment. An experiment was carried out at Makerere University Agricultural Research Institute, Kabanyolo (MUARIK) to determine the effect of planting method on sprouting and survival of Napier cuttings for three varieties. Erect and prostrate planting methods were compared. During the period 10 to 52 days after planting, ILCA 16791 was superior in percentage sprouting; development of fully opened leaves and 10 to 15 cm long leaves, and consequently had the lowest percentage of plants failing to sprout. The erect planting method resulted in a slightly higher percentage of sprouted Napier cuttings, but, generally, planting method did not have a significant effect on sprouting, growth and plant survival. Survival varied significantly between seasons.

Key words: Burial, erect, Napier grass variety, planting method, sprouting, survival

**EFFECT OF SOLAR DRYING PERIOD OF BEANS ON SEED VIABILITY,
COOKING TIME AND INJURIOUSNESS OF *ACANTHOSCELIDES*
OBTECTUS SAY**

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The efficiency of solarisation using a low cost solar dryer, on control of *Acanthoscelides obtectus* Say (Coleoptera: Bruchidae) in sequentially artificially infested beans (*Phaseolus vulgaris* L.) was investigated. The effect of the heat treatment on seed viability and cooking time were also examined. Solarisation periods varied for 0, 1, 2,3,4,5 and 6 hours and the minimum and maximum temperatures achieved were 44 and 75.5 °C, respectively. The beans were then stored under ambient room conditions for 3 months. Relative cooking time was determined by the Mattson Drop Bar Method during which the beans were cooked to the half-cooked point. Seed viability was determined by planting the non- and solarised beans in moistened lake sand. There was no single adult emergence on the beans when exposed in the solar dryer for any duration beginning from 1 hour and above. The non-treated beans were severely damaged. Seed viability was adversely affected by solarisation resulting into 0 % emergence of beans treated for 2 hours and above; 35 % for 1 hour exposure and 90 % in the controls. The shortest cooking time was achieved in the non-solar exposed beans and the longest time was observed on beans exposed for more than 2 hours in the dryer. Solarisation is recommended for beans for consumption but not for seed, and exposure should not be for more than 2 hours in the dryer. Successful disinfection should be followed by strict store hygiene to avoid re-infection. Solarization of stored product should be repeated at least once a month during storage. The technology is recommended for beans for cooking. If the grains are destined for seed, ash, oils and tobacco can be applied for prolonged storage against insect pests. Solarization should go beyond 1-2 hrs; otherwise the cooking time of beans will be greatly extended

Key words: Bruchidae, germination, *Phaseolus vulgaris*, solarisation

REACTIONS OF *MUSA* GENOTYPES TO DROUGHT STRESS

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Experiments were conducted at Makerere University Research Institute Kabanyolo (MUARIK), Uganda to identify the factors enabling the plant resistance and adaptability to drought stress in banana. Six banana cultivars (AAA-EA); Sukalindizi (AB); French Plantain (AAB); Gros Michel (AAA); Lep Chang Kut (BBB) and AAAA) were subjected to 4.5 weeks of water stress during which soil moisture tension rose to over in potted experiments. Soil moisture tension of >400 (mbar) significantly ($P < 0.05$) reduced growth, green and leaf area, photosynthetic rate, stomatal conductance and sub-stomatal CO_2 concentration. Cultivar Sukalindizi recorded significantly ($P \leq 0.05$) lower transpiration rate and sub-stomatal CO_2 but high assimilation rate indicating adaptability and resistance to drought stress, while cultivar Lep Chang Kut showed significantly ($P \leq 0.05$) transpiration rate and sub-stomatal CO_2 concentration but low assimilation rate, leaf water retention capacity (44.5 %) and stomatal conductance indicating its sensitivity to drought stress. The results from Lep Chang Kut were contrary to the concept that *Musa balbisiana* containing genomes have drought stress resistance. *Gros Michel* (AAA) and FHI A-02 (AAAA) exhibited stress resistance by retaining a high green leaf area ($Y = -60.12x + 3261.5$ and $Y = -59.83x + 2558$, respectively) and intermediate leaf water retention capacity (50.7 and 55.3%, respectively). Cultivar French Plantain (AAB) also exhibited intermediate moisture retention capacities (57.9%) indicating intermediate sensitivity to drought stress. The East African Highland banana Nfuuka had the lowest retention capacity (28.0%), indicating its sensitivity to drought stress.

Key words: Banana, drought stress resistance, green leaf area, growth responses, stomatal conductance, transpiration rate

ESTIMATION OF BANANA YIELD BASED ON BUNCH PHENOLOGY

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Cooking bananas (*Musa* cv.) are the most important food crop in Uganda and considerable research attention is now focused on yield experienced in long-term banana production areas. Measurement of banana bunch weight using field scales is rapid and reliable, but not always possible during field monitoring because it requires that either farmers, possess and, reliably use scales or that researchers are present during the short interval between bunch harvest and marketing or consumption of bananas. Furthermore, occasional theft of banana bunches from field experiments pose serious sources of experimental error owing to the large mass of individual bunches and – relatively few banana plants per experimental plot. The phenology of 317 banana bunches of *Musa* cv. Mbwarzirume obtained from a three year-old field experiment at the Mukono District Farm Institute was used to construct two estimates of individual bunch volume. Crude cylindrical volume (CCV) is based on the distance upper and lower most hands (length) and the maximum bunch girth (circumference). Aggregate finger volume (AFV) is based on the mean length and maximum circumference of three banana fingers x mean number of fingers per hand x number of hands per bunch. Both volume estimates were expressed as litre bunch¹ and compared to individual banana bunch mass (kg bunch⁻¹) using linear regression procedures. Banana bunch mass varied from 0.9 to 15.9 kg and bunch volumes between 0.5 to 45.91. Both volume estimates yielded significant relationships with mass as a dependant variable where bunch (kg) = 0.56 + 0.33 CCV (r = 0.85) and bunch (kg) = 0.66 + 0.49 AFV (r = 0.94). These relationships were established across a range of management practices including ± retention of crop residues and ± addition of 10 t ha⁻¹ yr⁻¹ napier grass (*Pennisetum atropurpureum*) or cattle manure. Bunch mass varied from 4.11 to 8.28 kg in relation to management and these values were reflected in the slope values of CCV but not AFV, suggesting that AFV provides a more robust estimate, however, CCV is more easily obtained from non-destructive field measurements. Further studies are needed on the regression equations between bunch mass and estimates of bunch volume for other banana cultivars and genotypes.

Key words: Cattle manure, East Africa, *Musa*, *Pennisetum atropurpureum*, residue management, Uganda

**BIOPRODUCTIVITY AND DECOMPOSITION OF WATERHYACINTH IN
UGANDA**

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The biological invasion of the waterhyacinth (*Eichhornia crassipes* (Mart.) Solms) into lakes and rivers of East forced the implementation of mechanical harvesting around key harbours and dams, resulting in subsequent difficulties of waste disposal. Utilising these wastes assists in minimising the costs of waste management. Estimates of waterhyacinth biomass were made by randomly deploying 1 m² buoyant sampling frames across four sites on the Ugandan shores of Lake Victoria and determining the weight within the frame. Single plants ranging 0.3 - 0.9 kg were placed within similar buoyant frames and their productivity monitored over a period of 16 weeks in a sheltered bay at Bugiri and a pond at Kajjansi. Nutrient contents and mineralisation patterns of harvested waterhyacinth wastes were characterised. Whole chopped plants and tissues were separated into leaves, petioles and roots, placed into litter bags, deployed as surface mulch and recovered over 16 weeks. Fresh biomass at the four sites was between 300 and 610 tha⁻¹. Productivity ranged from 58 to 2281 ha⁻¹ yr⁻¹ resulting from rapid production of daughter plants (108 to 237 plants m² yr⁻¹). Decomposition of the waterhyacinth was rapid but with significant differences between plant tissues. Time to 50% decomposition of whole plants, leaves and roots was 21, 31 and 45 days, respectively. Waterhyacinth applied as surface mulch to fields may offer opportunity as an organic input to soils because of the relatively rich nutrient contents and rapid decay pattern but the large bulk of plants (92% water) may offset these advantages. At sites where the accumulation of waste mounds presents a problem, alternative handling procedures should be developed to accelerate waterhyacinth decay. Farmers should be advised to partially dry the material prior to routine field operations and that it is not economical to haul fresh hyacinth for long distances for use as a soil input. Waterhyacinth wastes must be transported with caution as much of its weedy invasion has resulted from movement by humans. Waterhyacinth waste disposal and these materials could be utilised to our advantage as soil inputs, particularly in combating banana yield decline. Although alternative uses of waterhyacinth for fibre, livestock feed, potting soil and biofuel have been reported it is premature to recommend one over another until economic comparisons are made.

Key words: Aquatic systems, decomposition, *Eichhornia crassipes*, productivity, surface mulch

PESTS AND DISEASES ON COWPEA IN UGANDA: EXPERIENCES FROM A DIAGNOSTIC SURVEY

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A diagnostic survey (DS) using a questionnaire covering 525 farm households was conducted in 1993/94 to determine the status of cowpea (*Vigna unguiculata* L. Walp) and its production constraints in Uganda. Subsequent on-farm assessments were made during the two rainy seasons of 1994 to verify and quantify the survey information. Additionally, on-station trials were conducted to address issues arising from the information. Insect pests, low plant population densities, poor weed management and labour bottlenecks are the most important constraints to cowpea production in Uganda. Insect pest damage, particularly by bruchids, is most important. Research to develop integrated pest management (IPM) strategies based on the finding of this study are in progress.

It is envisaged that future studies would examine economic thresholds of the economically important pests. They should also analyse socio-economic factors that affect cowpea farmers' production goals and practices and their reciprocal impact on adoption of alternate pest management strategies. Verification of the relationship among production goals, cultural and current pest management practices should, therefore, be explored to provide the contextual knowledge base for developing alternative pest management interventions. It is also necessary to study the effect of different cultural control practices on the population dynamics of major cowpea insect pests, their predators and damage to cowpeas. If pesticides are to be used, there is need to determine the most appropriate time and frequency of insecticide application in the control of cowpea pests, and to integrate these with cultural control. There is need to study the relative contributions to pest control of cowpea insect pest predators in major cowpea agroecological zones. There is need to increase the germplasm base and identify cultivars for the major cropping systems. In eastern Uganda, there is a need to select for market and home consumption: both spreading and non-spreading cultivars. For market, cowpea seed size and oil content appear important variables to consider. In the case of northern Uganda (West Nile) emphasis should be to identify high yielding and spreading cultivars for the cowpea+cassava and cowpea + sorghum cropping systems.

Key words: Farmer perception, integrated pest management, on-farm surveys, production costs, profitability, Uganda, *Vigna unguiculata*

**INTEGRATED MANAGEMENT OF MAJOR FIELD PESTS OF COWPEA IN
EASTERN UGANDA**

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This study, which was done on-farm and in phases, aimed at developing a farmer and environmentally friendly management package against major cowpea pests. The pests considered were *Aphis craccivora*, *Megalurothrips sjostedti*, *Maruca vitrata* and pod sucking bugs. One trial examined the potential of intercropping in the management of the major field pests of cowpea. Another trial studied the effect of seed dressing and host resistance on cowpea field pest infestation. The best treatments from these two trials were combined (integrated pest management) and tested together with a minimum foliar insecticide application. Intercropping cowpea and sorghum combined with carbofuran "seed dressing" and minimal insecticide spray application (spraying once at budding, flowering and at podding) increased grain yields (ca 1350 kg ha⁻¹) markedly compared to the unsprayed plots (ca 200 kg ha⁻¹), those receiving foliar insecticide spray (23 1000 kg ha⁻¹) or carbofuran seed dressing only (ca 400 kg ha⁻¹).

Key words: Grain yield, insecticide sprays, intercropping, seed dressing, *Vigna unguiculata*

**POPULATION DYNAMICS OF SELECTED COWPEA INSECT PESTS AS
INFLUENCED BY DIFFERENT MANAGEMENT PRACTICES IN EASTERN
UGANDA**

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Population dynamics of the cowpea aphid (*Aphis craccivora*), bud thrips (*Megalurothrips sjostedti*), legume pod borer (*Maruca vitrata*), and pod sucking bugs were studied at three sites in eastern Uganda. The management practice which combined early planting, close spacing and minimum insecticide application (spraying once at budding, flowering and podding stages) was the most effective in reducing all pest infestations followed by sole foliar sprays. Seed dressing reduced aphid infestation but increased infestations of thrips, Maruca and pod sucking bugs to levels even higher than in the control. In comparison to the control, intercropping reduced pest infestations of all the pests but was not as effective as the other control measures. Foliar sprays are only recommended for more important post budding pests. For vegetative pests (aphids), a chemical free component such as intercropping and other cultural practices can be used.

Key Words: Aphids, combined control measures, foliar sprays, intercropping, legume pod borer, pod sucking bugs, seed dressing, thrips

EFFECTS OF CASSAVA MOSAIC VIRUS DISEASE ON THE GROWTH AND YIELD OF CASSAVA - SOME HIGHLIGHTS FROM MAKERERE EXPERIMENTS

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A series of experiments is described in which the effects of cassava mosaic disease (CMD) on the growth and yield of cassava were evaluated. Four cassava varieties of differing resistance/susceptibility were used. These were Ebwanatereka (Susceptible local), Nase 2 (Moderately resistant/improved), SS4 and Migyera (Resistant/ improved). The results showed significant differences between varieties and their mixtures both in the incidence and the amount of disease that developed. Ebwanatereka had the highest CMD incidence while SS4 had the lowest. Varietal mixtures consistently and significantly decreased the incidence of CMD and the population of adult whiteflies compared to their corresponding pure stand treatments. Stage of infection significantly affected the yield of the susceptible variety, Ebwanatereka. The earlier the infection, the greater was the effect of CMD. However, the stage of infection did not appear important in the resistant varieties. Compensation occurred in all varieties although significantly more compensation was achieved in Ebwanatereka. The health status of the immediate neighbours significantly influenced the losses sustained. Application of NPK fertilizer significantly increased the incidence of CMD in Nase 2 and Migyera compared with the unfertilised treatments. However, little difference was apparent in Ebwanatereka which became almost totally infected in all treatments. Adult whitefly populations were increased significantly by the application of NPK in Nase 2 and Ebwanatereka, whereas no effect was observed in Migyera. The implications of these findings in the epidemiology and management of CMD and the scope for future research are discussed.

Key words: *Bemisia tabaci*, CMD, leaf area index, Uganda

**INFLUENCE OF FARMER PRODUCTION GOALS ON COWPEA PEST
MANAGEMENT IN EASTERN UGANDA: IMPLICATIONS FOR
DEVELOPING
IPM PROGRAMMES**

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We investigated using a case study the influence of differing production goals on cowpea production and pest management practices. The cases (farmers) were characterised as commercial, dual purpose and subsistence depending on the primary goal of production. Production goal influenced cowpea acreage, varietal choice, seasonal planting, perception of problematic pests, and stage and frequency of pesticide application. Farmers preferred to use pesticides, as the primary method of pest control, because they insured a marketable crop, were associated with yield increases, permitted two season cropping, and reduced demand for labour at labour peaks during the cropping season. Pesticides were used by the majority of farmers in the area. The only limitations to pesticide use were local availability and cost. Besides the use of pesticides farmers had local knowledge on alternative methods for controlling pests such as early planting, variety choice, weeding, leaf picking and intercropping. Generally, farmers were unknowledgeable (or unformed) about cowpea diseases. Future research should seek to introduce resistant varieties; investigate efficacy, timing and rate of pesticide application; and, educate farmers regarding proper pesticide use and safety. Clearly, the findings of this study indicate a need for follow-up studies. Pesticide management research, including timing, application rate and efficacy of different pesticides should be emphasised along with the development of relatively simple action thresholds. The concept of field scouting has already been introduced to the farmers. However, this practice in combination with action thresholds needs to be disseminated to more growers. Strategies to control all the pests and diseases which attack cowpea in eastern Uganda may not be viable. Efforts must therefore focus on determining which pests are the most damaging and the critical stage(s) of plant growth at which damage occurs. For instance, farmers perceive aphids as the most important pest, however, other studies indicate that Maruca and thrips are the most important. Farmers are generally unaware of thrips and their damage. The germplasm base appears to be limited. Thus, the introduction and field testing of new genetic cultivars with resistance to pests and diseases should be considered. Currently, improved germplasm developed at the International Institute of Tropical Agriculture (IITA) are being field tested by Makerere University Cowpea Improvement Program. The existing sources of resistance should be fully exploited. As indicated by several farmers, the possibility that the land race, *Icirikukwai*, is resistant to

field and storage pests requires more investigation. The impact of certain agronomic practices on various pests needs to be evaluated. Practices such as early planting, plant spacing, earlier and multiple weeding, leaf harvesting and intercropping have demonstrated effects on lowering pest populations. All farmers in this study planted cowpea by broadcasting the seed by hand. As a result, field plant densities were uneven resulting in reduced land use efficiency, low yields and potentially providing a favourable habitat for pests and weeds. Farmers preferred to broadcast seed because this method of sowing was perceived to be faster and saved labour. Despite farmer reluctance to row plant cowpea, this practice should be introduced on a trial basis for several reasons. First, row planting will facilitate the evaluation of different plant densities on pests and disease occurrence. Higher plant populations are expected to reduce aphid infestations with a concomitant reduction in aphid-borne diseases. Second, row planting might reduce seed wastage that occurs with broadcasting and save farmers money. Third, row planting may facilitate easier weeding, a critical labour and yield constraint. Fourth, row planting may lead to higher per hectare yields. Farmers' lack a well-developed concept of natural enemies, pesticide resistance, and pesticide safety including handling and potential negative impacts on human health. This area warrants further investigations.

Key words: Pesticides, resistant varieties, *Vigna unguiculata*

SOIL FERTILITY MANAGEMENT IN THE BANANA-BASED AGRICULTURE OF CENTRAL UGANDA: FARMERS CONSTRAINTS AND OPINIONS

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Soil nutrient depletion is one of the root causes of declining food production in Uganda. Results of a study comprising a survey and group discussion with farmers in Mukono district, Uganda, revealed that farmers perceive continuous cropping and erosion as the main causes of soil fertility degradation. The most frequent resource input to mitigate the degradation was banana residue. Only 0.9% of the farmers use mineral fertiliser, applying it to annual crops (maize and beans) whose residue is transferred to banana. Farmers perceive manure, coffee husks, compost as best suited for effective soil fertility management but the relationships between farm size and use of cattle manure was significant and positive ($P < 0.001$), implying a need for much land if one is to utilise cattle manure. Utilisation of domestic compost was positively related with households headed by females ($P < 0.05$), implying that since they lack access to most resources and provide most of the agricultural labour, they resort to the more labour intensive but easily accessible domestic compost. Group membership shifted the predicted probability for adoption of coffee husks from non-adoption to adoption whereas access to credit facilities shifted the predicted probability to adopt chemical fertiliser from 0.06 to 0.99. Access to extension services was also significantly related to adoption of soil fertility management practice, particularly coffee husks. Provision of credit, information, inputs and involving farmers in the development activities appear to be major requisites for improved agricultural production in the area. It is recommended that farmers in the smallholder banana agriculture in Mukono district be availed with a variety of practices for soil fertility management to choose from because they have a diversity of resources at their disposal. Researchers, extension workers and farmers should interact to bridge the current knowledge gap and to develop technologies appropriate to the farmers' situation. There is need to provide farmers with information on land-use and manure management, as well as recommended crop husbandry practices. Extension methods such as tours should be used to enable farmers to learn from each other. There is also need to increase farmers' access to input and credit facilities.

Key words: Farmer opinions, Lake Victoria Basin, smallholder farmers, soil fertility

**PROSPECTS AND CONSTRAINTS OF FINGER MILLET PRODUCTION IN
EASTERN UGANDA**

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Finger millet (*Eleusine coracana* L.) is a major staple and cash crop in northern, eastern, western and southwestern Uganda. However, research on the crop has been limited. As such, a survey was conducted in eastern Uganda (Kumi, Pallisa and Kamuli districts) to establish the status of the crop, its production constraints and prospects for its development. A semi-structured questionnaire was administered to fifty households per district, during the period October-December, 1998. Land productivity has declined considerably in the study districts and low soil fertility is a major factor in this respect. Production of the crop is hampered by many constraints, the major ones being inadequate labour for weeding and harvesting, frequent drought, pests and diseases, and soil exhaustion. The region is highly dependent on oxen for land preparation. Finger millet production activities are generally gender neutral. The crop is grown almost exclusively once a year. Inter-cropping and crop rotation are common practices in finger millet production, and the role of finger millet as a cash crop is on the increase. Prospects for development of the crop lie in increasing yield through generation of labour-saving technologies, particularly for weeding and harvesting, and development of farmer-friendly packages for pests and disease management, drought mitigation and soil fertility management. A follow-up on-farm soil fertility management study was conducted to investigate the response of finger millet sown in rows or broadcasted, to various soil fertility management regimes. Row planting resulted in significantly ($P < 0.05$) better finger millet growth and yield than broadcasting. Combined application of P and N, or P and manure gave the highest yields. Application of N alone delayed flowering and physiological maturity of the crop by 1 and 2 weeks, respectively. There was no significant ($P < 0.05$) effect of planting pattern or fertiliser treatment on threshing percentage. Further studies on nutrient mineralization, and crop nutrient uptake during the growing season are required to predict the soil biological processes that regulate soil fertility and examine the nutrient use efficiency resulting from combination of organic and inorganic fertilisers. There is also need to develop manure management options that will minimize nutrient losses from kraal manure and enhance manure quality and, hence, increase crop productivity.

Key words: Drought, *Eleusine coracana*, gender, labour, manure, soil fertility, weeds

**DETERMINANTS AND IMPACT OF INTEGRATION OF FORAGE LEGUMES
IN CROP/LIVESTOCK SYSTEMS IN PERI-URBAN AREAS OF CENTRAL
UGANDA**

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Majority of the intensive smallholder crop/livestock systems in peri-urban areas of central Uganda are characterised by low productivity. This is probably due to several factors such as poor management and inadequate feeds in terms of quantity and quality. A study was therefore undertaken to ascertain determinants and impact of integration of forage legumes on productivity of the systems. Data were gathered using an interview schedule with 90 smallholder milk producers. An econometric model was then used to quantitatively evaluate socio-economic factors impacting on the integration of forage legumes. Findings show that integration is more likely to be practised by farmers who have less farmland and/or are close to milk and inputs markets. Farmers who integrate legumes into elephant grass (*Pennisetumpurpureuni*) obtain more herbage that remains greener into the dry season, due to the ability of legumes to fix nitrogen in the soil, compared to non-integrators. They spend less money on artificial insemination services and their animals have lower incidence of disease.

Key words: Eastern Africa, logistic regression model, livestock feed resources, milk producers, peri-urban agriculture

**EFFECT OF FERTILISER AND MULCHING ON BEAN INFESTATION AND
DAMAGE BY BEAN FLY**

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The damage caused by the bean fly (*Ophiomyia* sp.), which is the major insect pest of beans in Uganda, is more serious in poor soils and under drought conditions. There is, however, limited information on cause and effect. This study investigated the relationship between fertiliser and the influence of moisture conservation through mulching on bean fly infestation. Fertiliser application significantly increased bean fly oviposition per leaf, number of pupae per plant and plant mortality. Mulching also significantly reduced bean fly pupae density and bean plant mortality. Mulching increased soil moisture content and there was a significant negative relationship between soil moisture content and bean fly pupae density. The influence of fertiliser and mulching on bean fly damage is discussed based on nitrogen and water relationships in plant growth.

Key words: Moisture, nitrogen, pest infestation, *Ophiomyia* sp., *Phaseolus vulgaris*

**EFFECTS OF AUXIN/CYTOKESIN COMBINATIONS ON SHOOT
PROLIFERATION IN BANANA CULTIVARS**

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The effects of cytokinin/auxin interactions on *in vitro* shoot proliferation of bananas were investigated. Shoot-tips (3 mm), excised from *in vitro*-plantlets of Kibuzi (AAA-EA), Bwara (AAA-EA) and Ndiziwemiti (ABB) cultivars, were cultured on basal Murashige and Skoog modified medium (Talengera *et al.*, 1994) to determine the cytokinin/auxin combination and concentration that gives high shoot proliferation in the three cultivars. The modified medium was supplemented variously by equimolar concentrations of Benzylaminopurine (BAP)/ Indolebutyric acid (IBA): 16.8/1.0, 20.8/1.0, 24.8/1.0, 28.8/1.0, 16.8/1.2, 20.8/1.2, 24.8/1.2 and 28.8/1.2 μM . The above concentrations were also used in: Kinetin (KM)/ Naphthalene acetic acid (NAA), Thidiazuron (TDZ)/NAA, TDZ/IBA, Zeatin (ZN)/NAA and ZN/IBA. ZN/NAA and TDZ/NAA supplemented medium suppressed shoot proliferation rates in the three cultivars at all concentrations while BAP/IBA combinations induced more shoot proliferation in cultivar Ndiziwemiti than was previously observed on 20.8 μM BAP modified MS medium. Cultivars reacted differently to different BAP/IBA concentrations: Ndiziwemiti had its best proliferation rate of 4.6 at 16.8/1.2 μM ; Bwara, 8.5 at 24.8/1.0 μM ; and Kibuzi, 4.5 at 24.8/1.2 μM . Other proliferation rates, for Ndiziwemiti, included 2.8 at 24.8 μM BAP/1.0 μM NAA and 4 at 28.8 /1.0 μM IBA. In most cases higher proliferation rates were observed in cytokinin/auxin combinations in which a weak auxin (IBA) was included.

Key words: Auxins, cytokinins, *Musa* sp., shoot induction

**CULTURAL PRACTICES AND PRODUCTION CONSTRAINTS IN
SMALLHOLDER BANANA-BASED CROPPING SYSTEMS OF UGANDA'S
LAKE VICTORIA BASIN**

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Identification of environmentally-sound options for agricultural resource management is necessary to obtain food security for smallhold farming communities in Uganda. Qualitative and quantitative appraisals were conducted in Bukoto county, Masaka district to assess the socioeconomic and biophysical status of the banana and coffee farming system. Three main hypotheses were tested: the banana-coffee system is relatively static; the farmers production and socioecological goals are constrained by socioeconomic and biophysical factors; and that the system consists of interacting components. In order to test these hypotheses a participatory rural appraisal (PRA) was conducted, followed by a systematic land resource evaluation and structured household interviews. The study revealed significant changes in the system in terms of major activities, nature and status of resources and constraints encountered in pursuit of production goals. Although coffee is still an important cash crop and banana an important food crop, other income-generating activities (e.g. growing of beans, cassava and vegetables, brick-making, local retailing) have gained significant importance among farm households. In order of importance, coffee ranks first followed by beans and bananas, respectively. The notable loss in status by banana to the third position was attributed to several factors including nutrient depletion (*ettaka likadiye*), unreliable rainfall and increased infestation of pests and diseases. Over the years, low banana yields have been increasingly compensated by expansion of production area rather than unit productivity. There is a general consensus among the farmers that the soils are no longer productive due to continuous cultivation and soil erosion and this was confirmed by the notable decrement in soil quality. pH, CEC, P and K in top soil (0-20 cm) decreased from 5.1, 13.4 cmol kg⁻¹, 9.7 mg kg⁻¹ and 0.2 mg kg⁻¹ to 4.7, 6.09 cmol kg⁻¹, 1.38 mg kg⁻¹ and 0.07 mg kg⁻¹, respectively. The cause of continuous cultivation is a high population pressure that creates land fragmentation while soil erosion is attributed to persistent failure by farmers to adopt soil and water conservation practices. All the farmers visited were aware of the importance of soil and water conservation (mulching, contour bunds, diversion channels, soak pits and agroforestry) but were constrained by labour, time and insufficient supply of inputs (e.g., mulch materials). There must be soil fertility status improvement, erosion control, integrated pest management (IPM) and stabilisation of soil moisture status for sustainable agricultural productivity to meet the demands of the increasing population.

Key words: Agricultural intensification, coping mechanisms, soil credibility, soil erosion, soil and water conservation practices, PRAs

PERFORMANCE OF PIGEONPEA AND ITS FINGER MILLET AND SORGHUM INTER CROPS

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Field trials were conducted to determine the optimum plant population and spatial arrangement of finger millet/pigeonpea and sorghum/pigeonpea intercropping systems, identify the intercrop compatibility of finger millet and sorghum with short and medium-duration pigeonpea, and evaluate insecticide application strategies for the control of pod borers. Pod sucking bugs and podfly on pigeonpea. The experiments were conducted at Makerere University Agricultural Research Institute Kabanyolo (MURARIK) and Ngetta experimental station during the second rains season of 1997 and first rains season of 1998. Theoretical planting densities (2.1, 2.8, 4.2, 4.8, 5.6, 8.3, 11.1, and 16.7 plants m⁻²) for pigeonpea, (8.3, 11.1, 16.7, and 33.3 plants m⁻²) for finger millet and 5.6 plants m⁻² sorghum intercrops were studied using KAT 6018, ICPL 87091 and ICP 6927 pigeonpea varieties. *Pese 1* finger millet variety and *Seredo* sorghum variety. Spraying against major pigeonpea insect pests was carried out at negative stage to pod maturity, flower bud initiation to pod formation, and pod formation to pod maturity. In the pigeonpea finger millet intercrop system, optimal combinations in terms of higher land equivalent ratio (LER) values were given by 16.7 plants m⁻² of ICPL 87091 and 8.3 plants m⁻² of *Pese 1*, 4.2 plants m⁻² of KAT 60/8 and 33.3 plants m⁻² of *Pese 1*. Planting of pigeonpea and finger millet or pigeonpea and sorghum in a 2:2 row arrangement gave higher total LER values than in the other arrangements and thus, was found to be an optimal row arrangement. Spraying pigeonpea cultivars ICPL 87091 and KAT 6018 against major insect pests at flower bud initiation to pod formation and at pod formation to pod maturity, respectively, produced significantly (P<0.05) better yields than unsprayed and W; 1S more cost effective than the other spraying regimes.

Key words: *Cajanus rojan*, insect pest management, intercropping, plant density, spatial arrangement

**PRODUCTION AND EVALUATION OF PRECOOKED DEHYDRATED
UNRIPE BANANA SLICES**

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This study was aimed at developing a process for production of easy to prepare dehydrated banana slices. Steaming unripe bananas for 7 minutes followed by hand peel stripping, slicing and dehydration in air dryers produced slices with better dehydration properties than slices produced without steaming, even when the latter were dehydrated by freeze drying. No significant change in total aerobic counts or yeasts and moulds counts occurred in dehydrated banana slices packaged in 250 gauge polyethylene bags and stored at ambient temperature for 3 months. The slices were found to be high in starch (68.5%) and minerals. When shallow fried, the dehydrated banana slices were found to have acceptable flavor, appearance, taste and texture. Overall, they were considered acceptable by sensory panelists. The findings of this study indicate that steaming, in addition to easing peeling and reducing discoloration, improves rehydration and reduces cook loss. Steaming is a useful and inexpensive pretreatment for production of dehydrated starchy foods. Other methods such as extrusion cooking, which give products with good rehydration, require high investment. Since much of the food dehydration in developing countries is made on a small scale, inexpensive and technically uncomplicated techniques are most appropriate. Steaming meets these criteria.

Key words: *Musa* spp., dehydration, rehydration, pretreatments

INHERITANCE OF RESITANCE TO THE POD SHATTERING IN SOYBEAN

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Hybridisation of soybean between susceptible varieties AGS 292 and TGm 737P, and resistant varieties. Duiker. Gc81090-48, Roan and TGx 1448-2E, and intermediate varieties, Kabanyolo 1 and Samsoy 1, were carried out and the pods assessed for shattering using an oven set at 80°C for 12 hours. The phenotype of F1 populations was closer to the susceptible parents and the distribution of F2 populations was not discrete and could not fit Mendelian ratios. Based on a 1 - 3 scale, the distribution best fitted the 1:3:12 genetic model suggesting genetic control by classical dominant epistasis. The parent offspring regression, suggested a heritability estimate in the narrow sense of 0.79. The average number of segregating genes was 2.01 and 2.06 for F2 and F1 respective generations in six crosses, suggesting that the shattering trait in soybean is conditioned by 2 genes.

Key words: Epistasis, gene number. *Glycine max*, heritability. Progenies

**CHANGES IN WATER INFILTRATION ALONG A CATENA PRIOR TO
MECHANISED CLEARING OPERATIONS AND AFTER TWO CROPPING
SEASONS**

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Maintenance of water infiltration into sloped agricultural lands is an important mechanism for both moisture supply to crops and erosion control. Changes in water infiltration of a typic Kandiodult (Rhodie Nitisols) with a 21% slope were measured in the upper-, middle- and lower-backslope segments of 9 m by 40 m run-off plots located at Makerere University Agricultural Research Institute, Kabanyolo, Uganda. Cumulative infiltration was computed for the Green-Ampt, Philips, and Kostiakov models from infiltrometer measurements taken prior to mechanised land clearing and during maize (*Zea mays*) cropping. Kay *et al.* (1994) model was used to predict the time of 50% reduction in infiltration rate. The infiltration behaviour was best described by the Kostiakov model. Changes in infiltration rate were dependent on slope position with greatest alterations recorded on the upper and middle positions. Mean cumulative infiltration after 60 minutes was highest prior to land clearing with values of 150,97 and 97 cm for the upper-, middle- and lower-slope segments, respectively. The Kay *et al.* model predicted significant ($P < 0.05$) steady state infiltration decline on the middle and upper segments after the two cropping seasons with the bottom segment attaining an asymptotic infiltration rate of 20.4 cm h⁻¹. Further studies should be done to establish the long-term effects of different forms of tillage on the soil properties and processes in general to guide decisions for sustainable productivity management.

Key words: Catena, continuous cultivation, infiltration model, infiltration rate, Rhodic Nitisols, structure index

**THE INFLUENCE OF FARMER PERCEPTION ON PESTICIDE USAGE FOR
MANAGEMENT OF COWPEA FIELD PESTS IN EASTERN UGANDA**

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The insect pest complex infesting cowpea has made farmers in Uganda to increasingly use pesticides as the major means of pest control. A case study conducted in eastern Uganda revealed that: (a) pesticide usage depended on farmer production goal. (b) change from goal pesticide to another depended on perceived priority pests and crop growth stage, (c) pesticide use was more intense with the commercial category (i.e., farmers who cultivated cowpea primarily for income generation); subsistence cases relied on host resistance. These findings strongly indicate that pest management recommendations to farmers must take into account farmer perception and production goals. The importance of wearing protective clothing should be demonstrated to the farmers as well as informing them about the dangers and reduced cost effectiveness due to frequent pesticide application.

Key words: Local knowledge, pesticide efficacy, *Vigna unguiculat*, yield.

**AGRONOMIC PERFORMANCE OF TWELVE ELITE POTATO GENOTYPES
IN SOUTHWESTERN UGANDA**

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Twelve potato genotypes including two checks were evaluated for yield and resistance to late blight. Weekly assessments of late blight severity were done using a 1-9 CIP scale and percentage leaf area affected. In 1998A all genotypes yielded better than the local checks (Kisoro and Victoria) except for 391558.16 that yielded lower than Victoria. In 1998B only 4 genotypes (389685.2, 389698.12, 389584.33 and 391557.1) performed better than the local checks, while in 1999A only 3 genotypes performed better than the local checks. Better yields were recorded in 1999B, which ranged from 15.2 to 44.7 Mt ha⁻¹. The average yields for the genotypes in four seasons were 21.7, 16.2, 20.2 and 29.8 Mt ha⁻¹ respectively. All genotypes showed higher levels of resistance to late blight than Victoria (28.8 %), except 389484.20 in 1998B with AUDPC of 28.8 %. Field valuation at the two sites in 2000B generally showed a similar trend. The promising clones are undergoing multilocational trials in different parts of Uganda.

Key words: Genotype evaluation, late blight resistance, Kisoro, Victoria, Uganda

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Key words: Genotype evaluation, late blight resistance, Kisoro, Victoria, Uganda

**EFFECT OF INTERCROPPING MAIZE AND SOLANUM POTATO ON YIELD
OF THE COMPONENT CROPS IN CENTRAL UGANDA**

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Three potato (*Solanum tuberosum*) varieties and one maize variety were intercropped in six spatial arrangements, viz, sole crops, 2:1, 2:2, 1:1, 1:2 potato: maize row arrangements and one additive mixture. Intercropping influenced some growth parameters of potato but not of maize. For instance, the rate of potato stem extension and leaf formation rates were hastened by intercropping. Branching in potato influenced leaf area development, especially during the second season when the additive mixture supported the least leaf area. Potato yield differed significantly among the spatial arrangements with the highest yield in the sole crop followed closely by the 2: 1 and 2:2 potato: maize mixtures. However, these yield differences depended on potato variety, with Kisoro being the most responsive to changes in spatial arrangement. Assessment of biological efficiency of intercropping using the Land Equivalent Ratio (LER) method revealed that yield advantages increased slightly with increase in the proportion of potato in the mixtures. However, it was only the additive mixture with a significant overall LER of 1.58 indicating a 58.2% yield advantage for intercropping. The contribution of maize to total LER was greatest in the 1:2 and additive mixtures.

Key words: Biological efficiency, inter-cropping, land equivalent ratio, *Solanum tuberosum*, spatial arrangement, yield advantage.

**IMPACT OF DEFOLIA ON THE AGRONOMIC PERFORMANCE OF
SWEETPOTATO IN UGANDA**

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The sweetpotato butterfly, *Acraea acerata* Hew. (Lepidoptera: Nymphalidae) is known to extensively defoliate the sweetpotato crop, especially during the dry season, and this leads to significant foliage yield reductions. However, storage root yield losses due to the defoliation have not been adequately quantified. Artificial defoliation was undertaken at Namulonge in central Uganda, to estimate the effect of frequency and timing of defoliation on the agronomic performance of sweetpotato (*Ipomoea batatas*). Results showed that defoliation had no effect on shoot survival. Single quality defoliations had little effect on storage root yield but repeated defoliations significantly ($P < 0.05$) reduced root yield. The time at which defoliation was carried out did not have a significant effect on the yield. It is possible that the plants had sufficient time to recover when defoliated once and therefore were able to channel enough assimilates towards the roots. However, repeated defoliation may not have given the plants enough time after each regeneration, given the limited growth period of six months. Any recommendation for the control of *A. acerata* should therefore take into account these responses given the fact defoliation by the pest is usually less severe than was the case in this study. Any recommendation for *A. acerata* should therefore take into account these responses given in particularly the fact that defoliation by pest is usually less severe than was the case in this study. Agro-ecological variation was probably another critical factor that determined sweetpotato response to defoliation. Subsequent experiments should be carried out in higher altitude agro-ecologies where the sweetpotato butterfly is considered a serious problem.

Key words: *Acraea acerata*, *Ipomoea batatas*, shoot survival, sweetpotato butterfly

INTERACTIVE EFFECT OF NITROGEN AND POTASSIUM ON FLOWERING AND BERRY SET IN TRUE POTATO SEED MOTHER PLANTS

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Field experiments were conducted at Namulonge Agricultural and Animal Production Research Institute and kalengyere Research Station during 1995, 1996 and 1999 to assess effect of N and K on flowering, berry set and true potato (*solanum tuberosum*) seed yield. Three N (0, 120, 240 kg ha⁻¹) and K (0, 132.8 and 265.6 kg ha⁻¹) rates were applied to true potato seed potato mother plants of three potato genotypes, CIP 800212, CIP 381379.9 (Kisoro) and CIP 381403.1. There was significant (P=0.05) N x K interaction on flowering. Potassium rate of 266 kg ha⁻¹ increased this parameter more than any other treatment. Mother plants fed with 266 kg K ha⁻¹ produced 26 % more berries than the control (0 kg K ha⁻¹). Potassium also significantly (P=0.05) increased berry weight. Nitrogen application at 240 kg ha⁻¹, reduced berry production. In the hybrid seed obtained from 38 I 379.9 (Kisoro) X Rutuku at Kalengyere, K increased seed weight at low levels of N and depressed it at high N levels. Similarly, N increased true potato seed (TPS) weight of low levels of K and depressed it at high K levels. There was a negative interaction between N and K on this parameter. Number of seeds per berry ranged between 53.7 and 71.2 and was not significantly affected by N application during 1999. Potassium application significantly (P=0.05) increased number of seeds during the season. Nitrogen and K rates of 120 and 132.8 kg ha⁻¹, respectively, were most optimal in promotion of seed production. An inverse relationship between 100-seed weight and number of seeds per berry was observed.

Key words: Potato genotypes, *Solanum tuberosum*, true seed, Uganda

INTERACTIVE EFFECT OF NITROGEN AND POTASSIUM ON DRY MATTER AND NUTRIENT PARTITIONING IN TRUE POTATO SEED MOTHER PLANTS

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Field experiments were conducted at Namulonge Agricultural and Animal Production Research Institute and kalengyere Research Station in Uganda, during 1995-1996 and 1999, to assess the effect of N and K on dry matter yield and nutrient partitioning in true potato (*Solanum tuberosum*) seed (TPS) mother plants. Three N (0, 120, 240 kg ha⁻¹) and K (0, 132.8 and 265.6 kg ha⁻¹) rates were applied to mother plants of three potato genotypes, CIP 800212, CIP 381379.9 (Kisoro) and CIP 381403.1. Potassium application significantly ($P < 0.05$) depressed shoot dry matter yield in all the genotypes. Nitrogen application, however, had no significant effect on shoot dry matter yield although N x genotype interactions were significant ($P = 0.05$) on the parameter. Fresh tuber yield ranged from 21.0 to 37.5 t ha⁻¹, and was significantly ($P = 0.05$) increased by both N and K application. Leaf N concentration varied significantly ($P = 0.05$) among genotypes and K rates higher than 132.8 kg ha⁻¹ increased this parameter in potato genotype CIP 381403. High N and K rates also increased stem N concentration in this genotype. Nitrogen application significantly ($P = 0.05$) increased foliar Ca concentration. In genotype CIP 800212, K application depressed foliar Mg concentration in the absence of applied N. Leaf Mg concentration declined at K application rate less than 132.8 kg ha⁻¹. Potassium significantly ($P = 0.05$) increased leaf P concentration, while N depressed this parameter. Stem K concentrations varied significantly ($P = 0.05$) among the potato genotypes. Nitrogen application increased stem K concentration, while K reduced this parameter. There was significant N x K interaction on stem Mg concentration. Both N and K significantly ($P = 0.05$) increased berry P and Ca. Nitrogen and K were found to have a negative interaction on Ca, Mg, K, N and P concentrations in the leaves, stems and berries of TPS mother plants.

Key words: Nutrient antagonism, potato genotypes, *Solanum tuberosum*, tuber yield

SPECIES DIVERSITY AND ACTIVITY OF PARASITOIDS OF THE SWEETPOTATO BUTTERFLY, *ACRAEA ACERATA*, IN UGANDA

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The species range, activity and relative abundance of parasitoids attacking the sweetpotato butterfly, *Acraea acerata* Hew. (Lepidoptera: Nymphalidae) in Uganda was investigated. Samples of eggs and larvae of the sweetpotato butterfly were collected from some of the major sweetpotato growing districts of Uganda to identify the range of Parasitoids in the country. Monthly surveys to collect samples of caterpillars from selected sites were also carried out to evaluate percentage parasitism over time. The collected samples were reared in the laboratory for parasitoid emergence. Results showed that the sweetpotato butterfly is attacked by three larval Parasitoid species in Uganda, namely, *Meteorus* sp. (AKW), *Charops* sp. (AKW) and *Caricelia normula* Wyatt. No parasitoids emerged from eggs, indicating an absence of egg Parasitoids. *Charops* sp. was the most abundant parasitoid species at all sites, *Meteorus* sp. had moderate occurrence, while *C. normula* was the least abundant. Percentage parasitism was found to be rather low to afford significant control on its own. Nevertheless, long-term impact of parasitoids is important in moderating pest population dynamics. It is, therefore, important to conserve the native natural enemies by over use of insecticides. Further studies should focus on understanding the roles of pathogens in the occurrence of sweetpotato butterfly pest outbreaks.

Key words: *Acraea acerata*, biological control, *Caricelia normula*, *Charops* sp., natural enemies, percentage parasitism, parasitoids, Uganda.

**INFLUENCE OF SWEETPOTATO ROOTING CHARACTERISTICS ON
INFESTATION AND DAMAGE BY *CYLAS* SPP.**

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Studies were carried out in the field at Serere Agricultural and Animal Production Research Institute (SAARI), Eastern Uganda, to establish whether the existing sweetpotato germplasm in Uganda has cultivars resistant to the sweetpotato weevils, *Cylas* spp. The trials were conducted during the two growing seasons of 1997. Root size was the only sweetpotato rooting characteristic that significantly influenced tuber infestation ($P=0.009$) and damage ($P=0.049$). Root size was positively correlated to tuber infestation by *Cylas* spp. ($Y=0.0456x + 21.206$) and negatively correlated to damage by *Cylas* weevils ($Y=-0.027x + 29.684$). A laboratory study demonstrated the effect of temperature on oviposition, survival and development of *Cylas, puncticollis* (Boheman). The variety 'Tanzania' that was used as the susceptible check registered the highest weevil emergence under both wet and dry weather conditions while varieties 'Kasira' and 'Akere-Ikokolak' registered the least emergence of adult *C. puncticollis*. These results indicate that the latter two varieties possess considerable levels of resistance to sweetpotato weevils. Further investigations should be carried out on the factors that determine variation in the relative infestation of sweetpotato cultivars in the field. Systematic evaluation of the varieties that have shown some degree of antibiotic resistance to *C puncticollis* should be undertaken

Key words: Germplasm, resistance, sweetpotato evils, Uganda

**INFLUENCE OF SPATIAL ARRANGEMENTS IN MAIZE/SOLANUM
POTATO INTERCROPS ON INCIDENCE OF POTATO APHIDS AND LEAF
HOPPERS IN UGANDA**

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A study to investigate the effect of intercropping maize (*Zea mays* L.) and potato (*Solanum tuberosum* L.) on the incidence of potato aphids and leafhoppers was conducted at Namulonge in Uganda during the two growing seasons of 1995. Three potato varieties and one maize variety were intercropped in six spatial arrangements; sole crops, 2:1, 2:2, 1:1, 1:2 potato: maize row arrangements and one additive mixture. Aphids and leafhopper infestations in the different spatial arrangements were similar at early stages but differed significantly later probably because increase in maize height with time and the associated effects had negative effects on pest establishment. Least aphid and leafhopper infestation were observed in the additive mixture. There was no significant influence of spatial arrangement on tuber damage although that tendency was for more damage in plots with high potato concentration. High relative humidity negatively affected aphids but not leafhoppers.

Key words: Additive mixtures, *Myzus persicae*, relative humidity, *Solanum tuberosum*, *Zea mays*

EPIDEMIOLOGY AND POPULATION DYNAMICS OF PHYTOPHTHORA INFESTANTS IN SUB-SAHARAN AFRICA: PROGRESS AND CONSTRAINTS

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Global estimates of losses attributed to plant diseases are approximated at 24.8 million dollars of this amount 3,4 million dollars has been recorded for potato. Of the potato diseases, late blight (*Phytophthora infestans*) is the most significant constraint in tropical Africa. Variation in losses of potato caused by late blight have been documented in several countries, and has shown that yield losses can range from 30 to 75 % on susceptible varieties. In terms of disease cycle, the sources of primary inoculum have been adequately investigated, however, the continuous cropping of potato and tomato ensures inoculum presence year-around in tropical Africa. Data on the low incidence of tuber blight and the lack of evidence for potato seed-borne infection suggests that tuber blight is not a significant source of primary inoculum in the tropics. Population studies of *P. infestans* in Sub-Saharan Africa (SSA) have been conducted primarily on isolates from Uganda, Kenya and S. Africa. Mating type with A1 tester isolates coupled with DNA analysis revealed that the fungal isolates from Uganda, Kenya and S. Africa are of A1 mating type (US 1 clonal lineage). Variation and lack of consistency in oospore production (10 % selfing, 24 % mating, & 15 % non-oospore) have been detected among the isolates from Uganda and Kenya. Similarly, variability in metalaxyl sensitivity has been detected among those isolates. Fungicides and variety reaction studies conducted in Uganda, Kenya and Ethiopia suggests that significant late blight control can be achieved when the protectant fungicide, Dithane (a.i. mancozeb) is applied on a scheduled basis. On-farm research also indicates that three timely application of protectant fungicide alternated with systematic fungicide can be effective for late blight management. Result of *in-vitro* tuber blight development and host-specificity studies imply that isolates from potato are more virulent than isolates from tomato. Studies are underway to qualify general resistance of potato varieties as well as to the significant of fungal population deviations in the region. Decision support systems are in the process of being developed to optimize fungicide application and variety resistance for late blight management.

Key words: *Phytophthora infestans*, fungal population, fungicide sensitivity, epidemiology, yield loss, tropical Africa.

VARIABILITY IN POTATO LATE BLIGHT SEVERITY AND ITS EFFECT ON TUBER YIELD IN UGANDA

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Variability in severity of potato late blight and yield loss associated with the disease was studied in the major potato growing agro-ecologies of Uganda. Late blight incidence and severity varied significantly ($P < 0.05$) from district to district to season during the four surveys (2 years). Overall, the highest late blight severities were recorded in Kabale district (mean severity of 27.6%), followed by Mbale (21.8%), and Mbarara the least (8.7%). There was more disease during the month of December 1997, with mean severity of 40.2%, while the least severity was in May 1998 (10.8%). The highest severity was recorded on cultivar Victoria (62.1%), followed by W. Africa (61.8 %) Sangema (59.5%) and Maboni (48.2%). Rutuku and Musitamya recorded the least severities, less than 20 % during 1998/99. Overall, there was no significant correlation between late blight severity and yield of potatoes, likely because the yield loss assessment was done during a season of low late blight occurrence (season was dry).

Key words: *Phytophthora infestans*, *Solanum tuberosum*, varietal resistance, Uganda

IMPACT OF FUNGICIDE APPLICATION AND LATE BLIGHT DEVELOPMENT ON POTATO GROWTH PARAMETERS AND YIELD IN THE TROPICAL HIGHLANDS OF KENYA AND UGANDA

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The effects of fungicide application and late blight development on potato varieties with different levels of resistance to late blight were quantified in Kenya and Uganda during the 1999 cropping seasons. Experiments were laid out in a randomised complete block design with three replications in three sites, Loreto and Kabete in Kenya and Kalengyere Research Station in Uganda. At each experimental site, plots consisted of 4 m rows with plants spaced at 0.75m x 0.3 m. Treatments consisted of three potato varieties and four application intervals of Dithane *M-45* arranged in a factorial combination. Areas under disease progress curves (AUDPCs) were significantly lower in the sprayed plots than in the unsprayed plots. Disease levels were lower in plots with 7 days application interval and most severe in plots of 21 days spray interval. Yields were higher in the 7 days intervals and lower in the 14, 21-days intervals and in the unsprayed plots. Fresh tuber weights and dry tuber weights were higher in the sprayed plots and lower in the unsprayed plots, respectively. At Kabete, Kerr's Pink had the highest AUDPC value of 2139.3 and disease was least on Asante with an AUDPC value of 409.4. The corresponding AUDPC values for the control plots were 671.5, 945.6 and 2367.8 for Asante, Tigoni and Kerr's Pink, respectively. At Loreto, disease was also most severe on Kerr's Pink with an AUDPC value of 2076.3 and least severe on Tigoni that had an AUDPC value of 444.8. The corresponding AUDPC values for the control plots were 840.4, 1000.2 and 2740.0, for Tigoni, Asante and Kerr's Pink, respectively. The highest tuber yield of 41.3 t ha⁻¹ recorded at Kabete for Asante was significantly higher than yields of Kerr's Pink (22.0 t ha⁻¹) but was not different from the yields of Tigoni (39.9 t ha⁻¹). At Loreto, Tigoni had the highest yields of 34.6 t ha⁻¹ that was significantly different from that of Kerr's Pink (6.2 t ha⁻¹) in the sprayed plots. At Kalengyere, disease levels were significantly (P= 0.05) lower in the sprayed plots than in the control plots and disease severity was least on variety 'Rutuku (AUDPC value of 17.9) in 7 day spray interval. Tuber yields were significantly (P= 0.05) higher in the sprayed plots and highest tuber yield was recorded on variety Kabale (39.5 t ha⁻¹) in plots with 7 day spraying interval. Growers should be able to increase fungicide efficiency by adjusting the dosage of fungicide to complete the polygenic resistance of various varieties. There is need to

quantify the levels of general resistance in variable varieties to increase the efficiency of fungicide application. Further work is necessary to determine whether the same relationship would prevail if concentrations of the fungicide were varied rather than interval of application.

Key words: East Africa, fungicide, general resistance, growth parameters, late blight, yield

EFFECT OF SOIL AMENDMENTS ON BACTERIAL WILT INCIDENCE AND YIELD OF POTATOES IN SOUTHWESTERN UGANDA

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Abstract

Potato bacterial wilt caused by *Ralstonia solanacearum* is a major threat to potato production in Sub-Saharan Africa. It is believed that yield losses due to bacterial wilt increase with decreasing soil fertility. A soil amendment experiment was therefore conducted for 3 consecutive seasons, 1998A, 1998B and 1999A at Kachwekano (at an altitude of 2200 meters) in southwestern Uganda. Organic materials: *Sesbania sesban* (S) and *Leucaena diversifolia* (L) were applied in amounts sufficient to supply 100 kg N ha⁻¹ either singly or combined with P and PK added were NP and NPK from inorganic sources. The organic materials were incorporated into soil one week before planting, while the inorganic fertilisers were side-dressed at planting all at rates that would supply 100 kg ha⁻¹ of N, P and K. Nitrogen in the form of urea was split-applied at planting and one month after. Bacterial wilt incidence differed with treatments and seasons. Disease incidence was lowest with treatments NP and S+PK and highest with the control. Application of organic manures alone did not necessarily result in reduced wilt incidence except in a few cases. Both marketable and total tuber yields were consistently highest with S + PK and different significantly from the control in all seasons. A combined analysis over the three seasons showed that the treatment S + PK gave a significantly higher yield (20.8 ha⁻¹) than all other treatments, while the control yielded significantly lower (9.7 ha⁻¹) than the other treatments. *Sesbania* as an organic manure performed better than *Leucaena* and potassium was found to be a useful nutrient for crop performance. When K was applied with NP, LP and SP, it brought about marketable yield increases of 11, 23 and 37%, respectively. Generally, the rate of wilt development, expressed in wilt incidence per unit time, was highest at early stage of growth, thereafter, it declined and stabilized during much of the tuber bulking stage. The interaction between soil fertility and bacterial wilt incidence merits further studies in different environments. The study shows that a combine application of organic and inorganic soil amendments could be one of the components for the integrated control of BW to increase ware yields. It is however important to investigate whether same thing applies for seed potatoes as well. The availability of organic materials and the economic viability of soil amendments to increase potato production in areas that have wilt problem and the interaction between soil fertility and bacterial wilt incidence merit further studies in different environment.

Key words: Organic materials, inorganic fertilisers, polyphenols, ware yields, wilt incidence

POTENTIAL OF ORANGE AND YELLOW FLESHED SWEETPOTATO CULTIVARS FOR IMPROVING VITAMIN A NUTRITION IN CENTRAL UGANDA

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The potential of orange and yellow-fleshed sweetpotato cultivars as a dietary Source of Vitamin A in Mpigi and Luwero Districts of central Uganda was evaluated. On-farm agronomic performance, acceptability and β -carotene content of two orange (SPK004 and 316) and two yellow fleshed (Tanzania and 52) sweetpotato cultivars were determined and compared to the farmer's best local cultivars. There were significant differences in yield performance between cultivars with 52 yielding highest. Yields for TZ and SPK004 were comparable to those of best yielding *local* checks while 316 yielded lowest. Dry matter content of all the cultivars was above 30%. Overall, 52 were the most acceptable to farmers but children preferred SPK 004. β -carotene content of orange-fleshed cultivars was higher than that of yellow and white-fleshed cultivars. It was concluded that orange fleshed sweetpotato have highest potential for improving Vitamin A nutrition in the study area. In order to ensure fast adoption, there is need for nutritional education alongside provision of planting materials

Key words: β -carotene, *Ipomoea batatas*, sensory acceptability, Uganda, Vitamin A, malnutrition.

EFFECT OF MAIZE STOVER USED AS MULCH ON TERMITE DAMAGE TO MAIZE AND ACTIVITY OF PREDATORY ANTS

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We investigated the effect of different quantities of stover applied as mulch on damage to maize plants by termites (*Principally species of Microtennes, Macrotermes and Pseudacanthotermes*) and on the incidence of predatory ant species (*Lepisiota* sp. and *Myrmicaria* sp.) over two cropping seasons at Namulonge, Uganda. Termite damage to maize plants was significantly ($P < 0.05$) lower in mulched than in unmatched plots. Both ant activity and average yield of maize were higher in mulched than in unmatched plots. The quantity of stover applied correlated significantly ($P = 0.05$) and negatively with termite damage but positively with nesting of the predatory ants. The results are discussed in the context of integrated pest management (IPM) for termites in subsistence level maize cropping systems.

Key words: Mulching, termites, IPM, Uganda. *Zea- mays*

**GENDER CHARACTERISTICS OF RURAL FINANCIAL INSTITUTIONS IN
UGANDA**

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The objectives of this paper are to describe the types and socio-economic characteristics of rural financial institutions in Uganda and to describe gender differences between men and women in the use or non-use of these institutions (services). The paper first gives a brief description of the sample, and this is followed by background social, economic, and demographic characteristics of respondents. There then follows a discussion of the use or no-use of financial institutions by respondents, and respondents' perceptions about using financial services. Subsequently, there is a description of the characteristics of informal financial services such as borrowing, saving and deposit activities, and the characteristics of informal financial groups (IFOS). Finally, the implications of the findings are discussed. Of the total respondents interviewed (527), 66 percent were women. Only 11 and 15% of women and men had bank accounts. A higher proportion of rural men (57%) than women: (52%) borrowed from informal sources. The findings indicate that there is limited access to and low-level use of rural finances by both men and women. Most rural people tend to hold their savings in the form of non-monetary assets, but women tend to have greater ability and propensity to save than men. The policy makers should consider using informal financial intermediaries, as conduits for delivering badly needed financial services to rural people. In particular, IFGs should provide a viable vehicle for this purpose

Key words: Gender differences, rural financing, Uganda.

DETERMINATION OF FIELD YIELD LOSS AND EFFECT OF ENVIRONMENT ON POD SHATTERING IN SOYBEAN

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Pod shattering in soybean is a major production constraint causing high field yield losses in the tropic and sub-tropics. With regard to pod shattering, soybean varieties can be categorised as tolerant, intermediate or susceptible. Six soybean lines, Nam 2, TGx 448-2E, Duiker, Nam I, TGm 737P and Kabanyolo 1 were grown at three locations for three seasons (1997 - 1998) to determine field seed yield losses due to pod shattering and the effect of G X E interactions on shattering. Based on the number of shattered and unshattered pods, the amount of soybean seed yield lost in the field due to pod shattering was determined. Yield losses in susceptible and intermediate susceptible varieties ranged from 57 - 175 kg ha⁻¹ and 0 - 186 kg ha⁻¹, respectively depending on genotype, location, season and harvesting date. The resistant varieties did not shatter even when harvested after a delayed harvesting period of 2 days. Field yield loss due to pod shattering was estimated and such estimates are considered useful for breeding programmes when selecting varieties for resistance to shattering. We recommend that selection for resistance to pod shattering be carried out in several locations in different agro ecological zones over several seasons. This is particularly important for cultivars that are cultivated over wide geographical areas.

Key words: Genotype x environment interactions, *Glycine max*, susceptible varieties

**AN ASSESSMENT OF THE INTEGRATED PEST MANAGEMENT
COLLABORATIVE RESEARCH SUPPORT PROJECT'S (IPM CRSP)
ACTIVITIES IN UGANDA: IMPACT ON FARMERS' AWARENESS AND
KNOWLEDGE OF IPM SKILLS**

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The IPM CRSP (Integrated Pest Management Collaborative Research Support Program) has been applying a farmer participatory IPM strategy at on-farm research sites in eastern Uganda since 1995. Following five years of project implementation an evaluation of project impacts was conducted using a stratified random sample of 200 small-scale farmers. The main purpose of this study was to evaluate the impact of project (IPM CRSP) activities on IPM knowledge and awareness change using comparison groups composed of project participants and no participants. A summated ratings scale consisting of four attributes was developed to measure knowledge of IPM and individual indices were developed to measure crop specific pest management knowledge. Results indicate that more active participation increased knowledge of IPM skills and knowledge, provided preliminary support for the project's participatory research and extension approach. However, diffusion of knowledge was limited and project beneficiaries were slightly more socio-economically advantaged. Several recommendations are made for increasing the number of farmer participants and improving the evaluation process. Future assessments will examine the relationship between IPM knowledge and awareness change and adoption of pest management technologies.

Key words: Beneficiaries, diffusion, evaluation, on-farm, participatory approach

**THE PERSPECTIVE OF SWEETPOTATO CHLOROTIC STUNT VIRUS IN
SWEETPOTATO PRODUCTION IN AFRICA: A REVIEW**

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Sweetpotato chlorotic stunt virus (SPCSV) (*Crinivirus: Closteroviridae*) occurs in the main tropical regions of the World and is probably the most damaging pathogen of sweetpotato (*Ipomea batatas*). However, until recently, little research had been done on it. The methods of identification were inadequate and this led to synonymy. The virus is transmitted by the whitefly species, *Bemisia tabaci* and *Tria/eurades abutilonea*, in a semi-persistent fashion. At least two serotypes occur, one, first described from West Africa (SPCSV wA.), and the other first described from East Africa (SPCSV EA). Both serotypes have also been found in the Americas. Nucleotide sequencing has facilitated the process of distinguishing strains. The SPCSV may have originated along with sweetpotato in the Americas, but is perhaps more likely to have been a 'new encounter' for sweetpotato when it was introduced to Africa and elsewhere in the 'Old World'. It infects few plant species other than *Ipomoea* spp. The virions comprise long flexuous particles and the genome is RNA and bipartite. Geographically, isolated strains of SPCSV have been distinguished using serological- and nucleic acid-based methods. The virus synergises *Sweetpotato feathery mottle virus* (SPFMV) (*Potyvirus: Potyviridae*), leading to increased titres of this virus and the development of the severe disease sweetpotato virus disease (SPVD) in dually infected sweetpotato plants. Plants affected by SPVD following artificial or natural infection with SPCSV plus SPFMV have generally yielded c.60 -90% less than uninfected or unaffected controls in field trials; plants infected with SPCSV alone generally yielded c.30 - 80% less. However, in crops, compensatory growth by unaffected neighboring sweetpotato plants probably results in direct effects on overall crop yields being small, and the major effect of SPCSV in constraining the yields of sweetpotato is perhaps through preventing the cultivation of high yielding but SPVD-susceptible sweetpotato cultivars. Breeding resistant high-yielding varieties has been the main means of avoiding the deleterious effects of SPCSV. Although sweetpotato cultivars which have field resistance to SPCSV have been identified, no gene conferring immunity to SPCSV has been identified within sweetpotato or its close relatives. Cultivars non-indigenous to Africa seem particularly susceptible. Extreme resistance has been identified in certain wild *Ipomoea* spp. Recent epidemiological studies indicate that most spread of SPCSV is short distance, leading to interest in the use of phytosanitation measures to grow high-yielding but somewhat SPVD-susceptible cultivars. This paper comprises a review of research work done on SPCSV worldwide dating from 1939 to-date. Elucidating the mechanism (*Kryeija et al.*, 2000b) may provide novel means of controlling SPVD and may also provide additional

information of how viruses invade plants.

Key words: Africa, *Bemisia tabaci*, *Ipomoea batatas*, Sweetpotato feathery mottle virus

POTENTIAL IMPACT OF INTERCROPPING ON MAJOR COWPEA FIELD PESTS IN UGANDA

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Insect pests are perhaps the most important constraint to cowpea (*Vigna unguiculata* L. Walp) production. In Uganda, aphids, thrips, pod sucking bugs and pod borers are ubiquitous and very devastating, sometimes leading to total crop failure. On-farm studies were conducted at 3 sites in eastern Uganda for three consecutive seasons to evaluate the use of intercropping as a pest control strategy in cowpea. Two local cowpea cultivars, *Ebelat* (Erect) and */cirikukwai* (spreading) were grown as sole crops or intercropped with a local variety of greengram (*Vigna radiata*) or sorghum *Sorghum bicolor* cv. *Seredo*. Aphids and thrips populations were significantly reduced in the cowpea + sorghum intercrop but were higher in the cowpea + greengram intercrop. In contrast, pod borer and pod sucking bug infestations and their associated damage were significantly higher in the cowpea + sorghum intercrop than in the other cropping systems. These results contradict previous reports and indicate that (a) not all pests are controlled by intercropping, (b) to be effective, intercropping has to be part of a pest management system that involves other control strategies, and (c) choice of a cropping system for IPM should consider the pest profile. A management strategy that involves other control tactics to complement intercropping is needed. It should target the most important pest in the locality, taking into account the cropping system and seasonal fluctuation of the major pests.

Key words: Aphids, IPM, pod borers, pod sucking bugs, thrips, *Vigna unguiculata*

**GENOTYPE X ENVIRONMENT INTERACTION STUDIES ON YIELDS OF
SELECTED POTATO GENOTYPES IN UGANDA**

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High yielding potato (*Solanum tuberosum*) genotypes with good levels of resistance to late blight were identified at Kalengyere Research Station in southwestern Uganda. The yield stability of these genotypes, however, remains uncertain. For instance, the performance of these genotypes varied over 4 seasons of evaluation and when tested at Kachwekano site. Genotype x environment interaction study was therefore required to determine their adaptation in the different agroecologies where the genotypes would be grown. Five sites in Uganda at different elevations were selected for the study and these were Kalengyere (2450 masl), Bulegeni (1670 masl), Mbarara (1500 masl), Tororo (1250 masl) and Namulonge (1150 masl). The trials were conducted for three seasons: namely 2000 (A and B) and 2001 (C) being the first (A) and second (B) and third (C) seasons of the trials. Each location for a particular season was regarded as one environment. Genotypes 389484.20, 389685.2, 389698.12, 389584.22 and 389701.34 performed better than the other genotypes in all the five locations. The G x E analysis was done using Additive Main effects and Multiplicative Interaction (AMMI) and the biplot identified genotypes 389484.20, 391558.16, Victoria, 391558.5, 389584.22, Kisoro and 391558.13 as adapted to Bulegeni C, Mbarara B, Namulonge Band C and Tororo A, Band C. Genotypes 391558.11, 389685.2 and 391558.1 were adapted to Kalengyere A, Namulonge Band C and Tororo A, Band C were identified as similar environments basing on their responses. The similarities identified in the trial sites will be useful for future regional and international multilocal trial sites. The best genotypes identified in the study should be tested on-farm under farmers' practices. This is to assess their performance and compare the genotypes with the local cultivars. They could perhaps be grown under traditional cropping system so that farmers can select varieties that would satisfy their needs and expectations.

Key words: Adaptation, AMMI analysis, *Phytophthora infestans*, *Solanum tuberosum*, yield stability

**ASSESSMENT OF GENETIC VARIATION AMONG EAST AFRICAN
CERCOSPORA ZEA-MAYDIS POPULATIONS**

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Restriction Fragment length polymorphism (RFLP) and amplified Fragment length polymorphism (AFLP) analyses were used to study genetic diversity of *Cercospora zea-maydis* isolates collected from Uganda, Kenya and Rwanda. For comparative purposes, isolates from Zimbabwe and the United States of America (USA) were included. Phylogenetic analysis of AFLP data revealed two major clusters. One large cluster comprised of 75 African and US group II isolates and the second comprised cluster of 4 USA group I isolates. Similar groupings were observed with RFLP data. Analysis of molecular variation (AMOV A) based on AFLP data revealed a significant population structure between American and African populations (? $F_{st} = 0.07$). No population structure was detected, among African isolates (? $F_{st} = 0.01$), while a strong and significant structure was obtained between the two pathotypes (? $F_{st} = 0.19$). The AMOVA using RFLP data, showed absence of a population structure among African populations (? $F_{st} = 0.01$), and gene flow among African populations was high (49.5). These findings suggest that group II pathotype is predominant in East Africa and gene flow appears to be the fundamental evolutionary force accounting for the current genetic structure. A regional approach to abate epidemics is most suitable. Since gray leaf spot is endemic to most African countries and given that gene flow is the major evolutionary force active in *C. zea-maydis* populations a regional approach to debate epidemic is most suitable. In cereals host resistance is the economical way to control diseases and pests. As such, it is suggested that breeding programmes should preferably test lines at multi-regional locations to offset the pathogens' movement effects. Breeding programmes should also include rotation of varieties as a core of their activities to stem resistance breakdown resulting from any new fungal incursion.

Key words: AFLP, AMOVA, gene flow, isolates, FLP. *Zea mays*

INFLUENCE OF NPK FERTILISER ON POPULATIONS OF THE WHITEFLY VECTOR AND INCIDENCE OF CASSAVA MOSAIC VIRUS DISEASE

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The influence of NPK fertiliser on the symptoms and spread of cassava mosaic virus disease (CMD) and on populations of the whitefly vector (*Bemisia tabaci*) was investigated in Uganda using three cassava varieties: Migyera (CMD-resistant), Nase 2 (tolerant) and Ebwanatereka (highly susceptible) in 1995-96 and 1996-97 planting seasons. In each season NPK fertiliser significantly ($P < 0.05$) increased the incidence of CMD and led to earlier infection and spread of the disease for varieties Migyera and Nase 2 than in unfertilised control plots, whereas for variety Ebwanatereka no significant differences in infection and disease spread were observed for the control and plots that received NPK application. Adult whitefly populations per shoot were increased significantly ($P < 0.05$) by NPK fertiliser on Nase 2 and Ebwanatereka in 1995-96 and on Ebwanatereka in 1996-97, although the increases were not significantly different. Application of NPK fertiliser did not significantly influence the population of whiteflies on variety Migyera in either experiment. Similarly, NPK fertiliser application did not influence CMD symptom severity for all varieties in either season. These results indicate that NPK fertiliser application is not a satisfactory strategy for facilitating the control of CMD. The role of nitrogen, phosphorus and potassium in enhancing virus replication and inter-cellular movement merits investigation. Analysis of CMD-infected leaf tissues to determine the virus titre in the leaves from plants with and those without fertiliser would also be important in furthering an understanding of nutrient effects. These issues should be considered in future studies.

Key words: *Bemisia tabaci*, disease progress, *Manihot esculentum*

RESPONDING TO THE SOYBEAN RUST EPIDEMIC IN SUB-SAHARAN AFRICA: A REVIEW

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Soybean rust (*Phakopsora pachyrhizi* Sydow), a major threat to soybean production, is a new pathogen on the African continent, where it is increasingly threatening soybean production. The fungus is highly variable, and this complicates most disease management strategies. Most research on soybean rust, its epidemiology and management has been in the Orient, and only limited work has been done in Africa. However, experiences in the Orient will be important for soybean rust researchers in Africa, who are currently combating the epidemic. This approach will be necessary to design and implement rust management strategies in the African countries already affected, and those as yet unaffected. Because there is little information on distribution, epidemiology, and management of soybean rust from Africa, this paper provides an overview on 1) soybean rust epidemiology, disease assessments and management, as experienced in the endemic areas, 2) the distribution of soybean rust in Africa, 3) on-going research activities in the African countries most affected, and 4) discusses priority research activities. This review is intended to stimulate future research activities, leading to a better understanding of the pathogen, its biology and ecology, and management. The disease is to stay, but we must minimize its disastrous effects on crops. In terms of control management experiences from Asia can in the mean time be replicated in Africa, as the disease is studied under our local conditions. Few issues need to be considered before implementation of these control strategies. Detailed studies on the epidemiology of soybean rust, in particular the influence of climate factors (rainfall patterns, temperature, humidity); alternative hosts; altitude; and cropping systems (crop rotation and intercropping), on soybean rust severity need to be explored. The cropping system in Africa is very complex and variable, and thus needs to be incorporated in soybean rust studies. Other management interventions (cultural practices, fungicide use, host plant resistance, and perhaps biological control) need to be addressed at both regional and national levels. A regional network to coordinate soybean rust research will be necessary to implement this research. This network should also monitor and initiate collaboration efforts with the necessary stakeholders, specially, with the soybean rust researchers in the endemic regions. It is necessary therefore that a critical mass of scientist be trained on soybean rust. Agriculture based universities within and outside Africa can provide appropriate training at masters and PhD level. Opportunities for exchanging informations should be forged through which soybean rust scientists in Africa can have a forum to exchange information and network

Key words: Control, epidemiology, *Phakopsora pachyrhizi*, yield losses

**SOMATIC EMBRYOGENESIS FROM IMMATURE MALE
INFLORESCENCES OF EAST AFRICAN HIGHLAND BANANA CV
' NAKYETENGU'**

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The East African highland bananas (*Musa* spp. cv. EA-AAA), the most important staple food in Uganda, are susceptible to a range of pests and diseases. This has been attributed to a narrow genetic base of this banana group and thus the need to create a wide genetic base through development of resistant cultivars. The use of genetic transformation (engineering) approach has been identified as a potential option that could be utilised to facilitate and/or enhance the process of developing resistance cultivars. The objective is to establish an *In vitro* regeneration system for East African (EA-AAA) highland bananas. Cell suspensions are the material of choice for genetic transformation because of their regeneration capacity through somatic embryogenesis. In this study, immature male flowers of cultivar 'Nakyatengu' were isolated and initiated on callus induction media designated M I, M2, M4, M6, M7 on petri-dishes. Cultures were placed under controlled light and temperature conditions and monitored for embryogenic callus formation. Embryogenic callus composed of somatic embryos was obtained on medium M I only, after a culture period of 3.5 to 4 months. Direct somatic embryo germination was achieved on embryo germination medium. Somatic embryo germination was recorded at a rate of 66.7%. Plant recovery was achieved on standard MS hormone free medium. all being normal plants with root and shoot at weaning. With regard to the pest and disease problems of the East African highland banana, these findings underscore the fact that somatic embryogenesis is essential in the development of an *In vitro* regeneration system and is a critical step for the development of resistant varieties through genetic transformation.

Key words: Cell suspensions, embryogenic callus, medium, regeneration, somatic embryos

EFFECTS OF DEFOLIATION ON GROWTH CHARACTERISTICS AND N, P, K CONTENT IN AN ALDER/MAIZE AGROFORESTRY SYSTEM

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The effects of defoliation on the growth characteristics and N, P, K content of potted alder (*Alnusacuminata*) and companion maize (*Zen mays*) grown outdoors in sole and mixed cropping were examined. *Alnus* seedlings were subjected to 0, 25, 50 and 75% repeated artificial defoliation. Defoliation reduced the height and diameter, and stem, leaf, root and nodule biomass in *Alnus*. *Alnus* showed higher, albeit mostly not significant ($P > 0.05$), growth performance in mixed culture than in sole culture. However, the biomass of *Alnus* nodules was significantly lower in mixed compared to sole culture. Defoliation increased *Alnus* N, P, K and nodule P and K concentrations, but decreased nodule N concentration and also significantly reduced both leaf and nodule total N, P, K content. In contrast, defoliation of *Alnus* increased the height, biomass and total N, P, K content in companion maize crop. The most severe defoliation treatment (75%) increased maize height by 57%, total biomass by 209%, and shoot total N, P, K by 209%, 238% and 208%, respectively compared to maize grown in association with non-defoliated trees. However, maize grown in sole culture showed significantly higher height, biomass and total shoot N, P, K content (than did maize intercropped with *Alnus*). Results of this study indicate that defoliation of *Alnus* may not only influence the performance of the species, but it may also have significant effects on the performance of associated plants with important bearing in nutrient cycling in agroforestry.

Key words: *Alnus acuminata*, companion crops, herbivory, nodulation, nutrient cycling

**A CRITICAL REVIEW OF THE FARMERS RESPONSE TO SOIL
CONSERVATION POLICIES IN UGANDA**

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To understand the relationship between public policy and local resource management, Makerere University Institute of Environment and Natural Resources (MUIENR), in conjunction with the World Resources Institute (WRI) conducted a policy study through local consultants in 1991. The study covered a wide range of natural resources, namely soils, forests, water, wetlands, fisheries and wildlife. The policies on natural resources and the intended impacts of these policies were made. Later, a field survey was done to determine what the farmers knew and were doing about these policies. Results of the study for the soil resource indicated the existence of a wide gap between the intended impacts of soil conservation policies, guidelines and legislation and what the farmers were practicing at the farm level. Many farmers were experiencing declines in soil productivity, which they attributed to declining fertility, droughts, pests and diseases, poor farming methods, and soil erosion. Soil erosion was evident on more than half of the farms visited. Bush/grass burning which was prohibited was still practiced by many farmers. Whereas some farmers were employing methods that could control erosion and restore productivity, there were many others who did not. The gap between the policy intentions and the actual impacts could be traced to weakness of, or absence of mechanisms for policy administration, legislation, communication of the law, a weakened non-effective agricultural extension service, and lack of government commitment to invest in soil conservation measures. The prospects, however, look bright. Government has taken initiatives to correct the above problems.

This year (1994), a National Environment Action Plan has been formulated. The plan has identified investment projects that specifically address issues of increasing productivity of soils. It is worthy noting that among these projects there are those that entail a very high degree of grassroots involvement in activities related to soil conservation. This should also build expertise in soil conservation at the local level, and arouse grassroots interest in the subject. The above measures in all, address the problems of soil conservation that emanated from scattered, sectoral policies and the absence of someone specifically responsible for soil conservation. Interest and expertise in the subject of soil conservation is being cultivated, and investments in soil productivity improvement that also involve the grassroots have been identified. The latter should also include an element of education and persuasion of farmers regarding sustainable soil management practices.

Key words: public policy, local resource management, soil productivity

**QUALITATIVE ASSESSMENT OF THE IMPACT OF SOIL EROSION ON THE
WATER RESOURCES IN UGANDA**

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The present water resources situation in Uganda with respect to sediment loads and siltation, and in relation to land use practice, is virtually unknown due to lack of quantitative data. Information on the detrimental impact of soil erosion on water bodies is qualitative. Our experience during a study tour of a number of districts in the southern part of the country suggested that this information often was an overstatement of the extent of soil erosion as well as its impact, representing people's perceptions of these problems. The study area was divided into regions of very high to low erosion potential based on scores of physical characteristics and land management practices. This can only serve as a precursor to generating quantitative data through appropriate assessment methods in order to determine the extent and causes of soil erosion and its impact on the water resources.

Financial and logistical support will be needed to implement appropriate soil and water management programmes. The integration of the physical and socio economic data is a multi-disciplinary effort. We noted poor cross-sectoral collaboration and lack of awareness among officers of different disciplines of soil conservation measures and the negative effects of soil erosion on water resources. The messages passed on to farmers were sometimes contradictory as a result of skewed training in relation to the subject. Proper management of water resources needs to be coordinated with land management planning, perhaps through committees of technical staff from the relevant disciplines. Soil erosion features were observed during this study but with limited attempts at controlling the erosion. The implication is that there are consequent negative impacts on the water resources, the most notable being siltation. To estimate the magnitude of the impact requires that quantitative data be generated. Until then, however, a multi discipline effort should be initiated to implement soil and water conservation strategies based on the available information.

Key words: soil conservation, water resources

**A COMMON APPROACH TO INCREASED AGRICULTURAL PRODUCTION
AND FORESTRY ACTIVITIES TO MINIMISE SOIL DEGRADATION: AN
OVERVIEW**

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The dynamics of land husbandry to enhance social welfare through increased agricultural production can take various forms. One of these is the delicate balance between soils and trees/forests, which presents numerous land management challenges as well as several opportunities and potentials to exploit. For instance, deforestation, which is part of a broader problem or land management, is one of the processes that lead to soil degradation. Forests and trees exert enormous influences on soil and land quality through such systems as agro forestry. Most of these relationships are beneficial through soil fertility enhancement, nutrient recycling, and microhabitat regulation and improvement and general soil conservation. Unfortunately, some of these interactions can be counter productive as they cause various biotechnically, physically and ecologically unfavourable conditions in the agroecosystem. However, in this latter case forestry practices in terms or silvicultural operations, species choice, protection and even harvesting regimes and technologies were poor. Agriculture is an environment management strategy, which depends on soil. Soil evolves and changes overtime through pedogenetic processes like leaching and erosion. These changes can be slow in relatively undisturbed natural vegetation and raster in areas explored by man for agriculture. Soil degradation can be attributed to a complex or cause-direct relationships. The intricate problems or development, environmental conservation, sustainable agricultural production, poverty and population growth have a very strong influence on soil degradation. The quest for development shall continue to exert pressure on the environment, therefore sound management of soil, crop, animal, engineering, forestry and social science principles and practices are crucial in increasing agricultural production and minimising soil degradation.

Key words: land husbandry, social welfare, soil fertility enhancement, nutrient recycling, microhabitat regulation, soil conservation

**CAN COMPOSTED AGRICULTURAL RESIDUES BE USED FOR
IMPROVING SOIL FERTILITY**

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A field study was conducted at Makerere University Rural Agricultural Research Institute Kabanyolo (MUARIK) during the period September 1993 - January 1994 to evaluate the potential of composted agricultural residues in improving crop production. Treatments applied were: control, compost manure 6.2 t ha⁻¹ and 12.4 t ha⁻¹ NPK (25:5:5) at 60 Kg ha⁻¹ and 120 kg ha⁻¹, and 6.2 t ha⁻¹ compost manure applied together with 60 kg ha⁻¹ NPK. Each treatment was repeated three times and arranged in a randomized complete block (RCD) design. Maize variety IITA Population 29 was planted as a test crop. Maize plants were sampled at 35 and 70 days after planting to determine the respective leaf area indices and at silking for nutrient content. At maturity, grain yields and dry matter yields of maize were measured. Maize did not significantly respond to separate applications of compost manures or NPK. The combined application of compost manure and NPK gave significant responses ($P < 0.05$) in terms of LAI₂ (9.14), % leaf nitrogen content (4.27), grain yields (3459 kg ha⁻¹) and dry matter yield (8830 kg ha⁻¹). The significant responses of maize were attributed to improved soil physical, chemical and biological conditions due to compost manure component; Increased amounts of nutrient due to mineralization of compost manure as influenced by NPK, and retention of Inorganic nutrients against losses.

Key words: Compost manure, composted agricultural residues, mineralization.

**THE DILEMMA OF POTASSIUM MANAGEMENT FOR BANANA
PRODUCTION IN HEAVY SOILS**

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High banana yields are obtained when potassium is supplied in large quantities. Paradoxically, potassium has dispersive effects on soils and often leads to soil compaction. An experiment was conducted at Makerere University Agricultural Institute, Kabanyolo to investigate the effects of potassium on banana yield and soil properties. Potassium was applied at 0, 25, 50, 100 and 200 kg K h¹, and used variety "Namwezi, type AAA" as test crop. The highest level of potassium did not give the highest banana yields initially' until after three years. Soil analytical data showed that bulk density had increased, infiltration rates and faunal biomass had decreased; all being evidence or deteriorated soil physical parameters. It is therefore, suggested that application of potassium to heavy soils should be accompanied by an addition of organic matter to minimize the dispersive effects of the element.

However, further addition of potassium (200 kg ha⁻¹) resulted in reduced faunal biomass. The initial increase in faunal biomass could be due to improved nourishment while its reduction at higher potassium levels was attributed to the detrimental salt effects of potassium. Incorporating organic matter may reduce salt effects due to elevated potassium levels. Ochwoh and Zake (1982) observed increased CEC in soils where organic matter was applied. Soils with high CEC retain K ions thereby reducing its concentration in the soil solution. Consequently, soil fauna populations are increased. In conclusion, supply of potassium to bananas in heavy soils requires a comprehensive understanding of its effects in soils. To avoid deleterious effects associated with K application, combined application with a carrier would be necessary. This research, therefore recommends application of potassium together with organic materials.

Key words: Dispersive effects, soil compaction, faunal biomass.

THE EFFECT OF DIFFERENT MULCHING MATERIALS ON SOIL PROPERTIES AND ON BANANA PRODUCTIVITY IN UGANDA

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The practice or crop mulching is used to suppress weeds, preserve soil moisture, protect soil from erosion and to provide nutrients to the soil. In Uganda different types of mulches are used in banana production. A study was therefore carried out at Makerere University Agricultural Research Institute Kabanyolo (MUARIK) to investigate the effect of mulching on field of bananas and on soil physical, chemical and biological properties. The main objective of this trial was to compare the various mulching options used by farmers. Five treatments using tall grass, soybean residue, maize stock residue, green conf plants (inoculated mucuna with 60 plus kg K ha⁻¹ and 50 kg P ha.1) and R control with no mulch were set up in a randomized complete block design with three replications. The mulch thickness was 10 cm used by progressive farmers. After a two-year period maize stover gave significantly higher yields than other mulches and live mulch was the least. It was concluded that the type of mulch, which released reasonable amounts of nutrients and at the same time improved soil physical properties was the best in maintaining soil fertility and high of banana yields.

The economic evaluation of the treatments will be done as the experiment continues. Presently it is recommended that in a banana-maize cropping system maize stover may improve banana yields as long as steps are taken to sustain the productivity of maize by using chemical fertilizers.

Key words: Crop mulching, soil properties, mulching options.

**SAMPLING CRITERIA FOR CHARACTERIZATION OF SPATIALLY
VARIABLE SOILS**

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Perhaps the lack of significant impact of soil and water conservation measures in mitigating the problems of agricultural resource degradation is due to inadequate sampling schemes used. The wide variability in soil properties is discussed and examples of analysis of the spatial structure of heterogeneous field data using variogram function provided as the sampling criteria.

Naturally, soils are heterogeneous and may exhibit wide point-to-point variability. A detailed soil survey preceded by preliminary sampling and analysis of the spatial structure of data may reduce sampling and analysis costs and yet increase the effectiveness in controlling soil degradation.

Scientists have a challenge to carefully evaluate the systematic and random variability in watershed properties in order to decompose the variogram function into its components.

Key words: Sampling schemes, soil heterogeneity, variability, variogram, soil degradation.

***FICUS NATALENSIS* IN BANANA PLANTATIONS: AN OVER VIEW OF
RESEARCH NEEDS**

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Bananas are an important staple crop in many parts of East Africa. Scientists and farmers have reported that a few trees including *Ficus natalensis* have a positive effect on banana production but the mechanisms of the beneficial effects are not clearly known. They are suspected to be related to soil fertility in banana plantation as a result of litterfall and build-up of soil organic matter. Studies are needed to quantify litterfall under *Ficus* canopies and to determine nutrient status when the tree is associated with bananas. Other microclimatic effects include improved soil moisture (on tent and temperature moderation. All these aspects need experimental verification. Besides, it is likely that *Ficus* density in banana plantation may be below the optimum as a result of its being cut down. Studies are needed to determine the optimum *Ficus* density in banana plantations so that its beneficial effects could be maximized without promoting below ground competition or shading. The above aspects of the *Ficus natalensis* agro forestry system are discussed in the paper and suggested the necessary research.

Key words: Soil organic matter, microclimatic effects, below ground competition, banana intercrops, shading, agroforestry.

**ENHANCING FARMERS EFFORTS TO COMBAT SOIL DEGRADATION:
A CHALLENGE TO SOIL SCIENCE TECHNOLOGY**

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Proper land use and management have occupied the minds of agriculturalists, government and non-government organizations concerned with agricultural production for many decades. Although soil loss and its amelioration are topics for soil scientists, soil degradation is continuing at an alarming rate and needs immediate attention. This paper discusses soil degradation (causes, agents and remedies) the extent of farmers' efforts to combat it, the desire of enhancement of farmers' efforts and how the latter poses a challenge to Soil Science Technology. Proper land use and maintenance of soil fertility for sustained productivity in an agricultural country like Uganda is very vital. However, this is not the case in Uganda today. Cooperative efforts must be sought to combat soil degradation. It is a battle that poses a challenge to soil scientists and others concerned with agricultural production

Key words: Land use, soil fertility, sustained agricultural productivity, Uganda.

**CHANGES IN SOIL PHOSPHORUS FRACTIONS DURING LABORATORY
INCUBATION WITH PHOSPHATE ROCK**

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A laboratory experiment was set up to determine the reactivity of Busumbu phosphate rock (PR) in selected acid soils of Uganda. Twenty grams of air-dry soil samples from Mukono (pH 6.0), Lugazi (5.2) and Kabale (4.2) were incubated with raw and demagnetized forms of Busumbu PR, and single super phosphate (SSP) applied at standard phosphate requirements (SPR) and field capacity of each soil for 10 weeks at 22°C. Incubated samples were retrieved after 1, 3, 6 and 10 weeks of incubation, air-dried and subjected to Bray I and modified sequential P extraction. Bray I extractable P in SSP treated soils was significantly higher ($P < 0.001$) than the control and nearly tripled those treated with PR. Demagnetized PR only occasionally resulted in earlier release of Bray I P in Mukono and Lugazi soils but it did not differ from the raw PR. The trends in increases in soil P fractions was NaHCO_3 Pi > NaOH Pi > HCl Pi > Residual P in SSP treated soils and ranged between 300-640% for the labile Pi fractions and 16-81% for recalcitrant fractions. The PR treatments had no specific trend across the soils in increasing soil P fractions but added more to the recalcitrant P (90-163%) than the labile Pi fractions (36-90%). The reactivity and hence, agronomic effectiveness of the PR in the short-term is, therefore, likely to be likely in the tested acid soils.

Key words: Labile P fraction, Recalcitrant P, reactivity, acid soils.

**BEAN RESPONSE TO NITROGEN, PHOSPHORUS AND RHIZOBIA IN
CENTRAL UGANDA**

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Among the critical bottlenecks to the productivity of Uganda's soils, especially Oxisols is nitrogen and phosphorus deficiency. Unfortunately, reliable quantitative assessment of the contribution of applied N and P to crop yields is yet to be done. A pot experiment was conducted at Makerere University Botanical Garden to determine the response of beans (*Phaseolus vulgaris*) to N, P and Rhizobial (*Rhizobia phaseoli*) inoculation using a clay loam soil from Makerere University Agricultural Institute Kabanyolo (MUARIK). Treatments consisted of N at 0, 20 and 40 kg ha⁻¹; rhizobia inoculation; and P at 0, 10 and 20 kg ha⁻¹. Except for rhizobia inoculation, the treatments were applied factorially in a completely randomised design with three replications. Application of each of these nutrients singly had no significant effect on plant height at 4 weeks after planting (WAP), total leaf area per plant (TLA) at 6WAP, shoot dry weight and plant nutrient content at 50% flowering. Nitrogen applied alone significantly ($P < 0.05$) increased TLA per plant and shoot N content. Total shoot P content responded significantly ($P < 0.05$) to P irrespective of N addition. Rhizobial inoculation had no significant advantage over the control except in the presence of P. However, plant height at 6WAP, the number of leaves per bean plant at 4 and 6WAP and number of nodules per bean plant at 50% flowering were not significantly ($P < 0.05$) affected by the treatments.

Key words: Bean response, nitrogen, phosphorus, and rhizobia.

LIMITING NUTRIENTS TO BEANS AND MAIZE INTERCROPPED WITH BANANAS

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The decline in the productivity of tile banana-based cropping system has to a great extent been attributed to the decrease in soil fertility. Yields of the basic intercrops within the system have dropped due to the depletion of nutrients from the system through the continued crop harvests. An experiment to determine the limiting nutrients of maize and beans, which are the major intercrops in the banana-based system, was conducted on seven farmers' fields in Mukono district and two research stations. Each field received 5 treatments being N, P, K, NPK, and a control. Nutrients were applied at an element rate of 100 kg ha⁻¹ to successive crops of maize and beans. For both crops, fertilizer treatments resulted in significantly higher yields than the control. Yield from P and NPK treatments were similar and superior to those of N and K treatments, implying that P was the most important primary nutrient to these intercrops.

Key words: Soil fertility, fertilizers, maize, beans, intercrops, banana-based cropping system.

**EFFECT OF FARM YARD MANURE ON THE GROWTH OF ONION (*ALLIUM
CEPA*)**

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In Uganda the world and at large, research and use of organic animal manures are on going. This is because of the easy accessibility of these manures by the farmers. In addition, they are also cost effective in the farmer's situation compared to artificial fertilizers. There is also a high and increasing demand for onions, as they are consumed by people of all nationalities. The trade of dehydrated onions is expanding. The food industry in Uganda has sprung up and indeed many people include onions in their fields. However, the productivity of this crop has been low. This is attributed mainly to the decline in soil fertility. An experiment was set up at Makerere University Agricultural

Key words: Poultry, Uganda, cow and goat manure.

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**ADVANCES IN SOIL MANAGEMENT FOR THE COFFEE/BANANA
FARMING SYSTEM IN UGANDA.**

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This review paper summarizes the past soil management in the production of coffee and bananas citing the problems that have lead to the current low production crops. It then points out the recent promising highlights and finally gives hypotheses which appropriate research into improved productivity when these crops are grown individually and in combination.

Key words: Musa sp. Soil and water conservation.

**INCREASE OF CROP YIELDS BY BENEFICIAL ORGANISMS: A CASE OF
RHIZOBIA USE IN UGANDA**

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Legume production in Uganda has been increasing since 1980 in terms of National total hectarage. However, yields per hectare have remained very low. This is highly attributed to the facts that the legumes are grown on soils, which are poor in nitrogen and lack effective Rhizobia strains, which could fix elemental nitrogen for the legume. Further more, most farmers cannot afford the use of nitrogenous fertilizers. Rhizobia inoculants are produced within the country and sold to farmers at affordable prices. Therefore, this farmer-participatory research aimed at assessing the use of inoculants to improve legume yields. Trials were conducted at Makerere University Agricultural Research Institute Kabanyolo (MUARIK), Namulonge Agricultural and Animal production Research Institute (NAARI), Ngeta District Farm Institute and Mubende District. Inoculated seed and un-inoculated soybean seed were planted and grain yields were assessed. Results showed significant (pro.05) yield increases at all sites and percentage increases ranged between 40% and 70%. The economic analysis indicated that cash constrained farmers can economically raise soybean crop using elite rhizobia strains.

Key words: Rhizobia strains, Nitrogen, legume yields.

**NATURE EFFECTS ON SURVIVAL OF BRADYRHIZOBIA AND
NODULATION OF SOYBEAN (*GLYCINE MAX*)**

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Inoculating legume seed with *Rhizobium* or *Bradyrhizobium*, species is a recommended agricultural practice aimed at ensuring the presence of adequate and efficient strains in the host rhizosphere. However, such seed is often exposed to unfavorable conditions such as extremes of temperature. Thus, survival and symbiotic effectiveness of *Bradyrhizobium japonicum* TAL 102 inoculated onto soybean seed (*Glycine max*) and exposed to 28 and 35 ° C was studied in the laboratory and greenhouse. Sucrose and gum arabica were used as stickers, water as control. *Bradyrhizobium* drastically decreased within 36 h but later the rate was slow as reflected by the forming units (cfus). Gum arabica offered greater protection to the nodule bacteria than sucrose or water. Nodule numbers and nitrogenase activity reflected by the number of pink nodules were better for seed stored at 6 than either at 28 or 35 ° C. Furthermore, delaying planting by 4 days significantly depressed nodulation. The results re-emphasized the need for protecting inoculated seed from ambient conditions and prompt planting. Use of sucrose or gum arabica may offer some level of protection.

Key words: *Bradyrhizobium japonicum*, temperature, nodulation, nitrogenase, Gum arabic.

**SOIL LOSS AND RUNOFF FROM AGRICULTURAL LAND USE SYSTEMS IN
THE SANGO BAY MICRO-CATCHMENT OF THE LAKE VICTORIA**

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Soil degradation by water erosion is recognized to be a major agricultural and environmental problem in the Lake Victoria crescent. Unfortunately, there is paucity of quantitative data on the magnitude, rates and severity of runoff and soil loss. Such data set is required for the identification, selection and recommendation of appropriate land use management practices and policies. In this study runoff and soil loss was quantified from banana, coffee, annual crops and degraded pastures/rangelands. The experiment was conducted on 13 runoff plots of 10 by 15 m. Each treatment was replicated three times, except banana. The soils of the study area are Petroplinthic plinthosols and Hyperskeletal leptosols at the summit, shoulder and upper backslopes of the flat-topped ridges and round-topped hills, and Haplic luvisols on footslopes. Preliminary results indicate that both soil loss and runoff are very high and pose a great threat to the sustainability of resources in the area. Soil loss ranged between 27 and 126 t ha⁻¹ yr⁻¹, while runoff ranged between 49.8 (for banana) and 1989.6 m³ ha⁻¹ yr⁻¹ (for pastures). Though non significant under difference (P<0.05) was detected between annual soil loss under different land use systems, runoff from pasture was significantly higher than that of banana and coffee systems, while annuals generated more runoff than banana.

Key words: Pollution, sustainability, farming systems, land use.

**VALUATION OF THE SOIL PHYSICAL ENVIRONMENT EFFECTS ON
CYANIDE LEVELS AND YIELD OF CASSAVA, (*MANIHOT ESCULENTA*
CRANTZ)**

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Cassava, (*Manihot esculenta*) is the most widely grown in many tropical areas having diverse soil and climatic conditions. In Uganda, it is one of the staple foods. While yields are not grossly affected by stress environment as water, potassium, K and P deficits, these factors enhance accumulations of cyanogenic glucosides that generate hydrogen cyanide (cyanogenic potential, CNp). This problem reduces its acceptability as a human or animal food. The experiment carried out in Kawanda Agricultural Research Institute investigated the impact of planting practices on CNp and overall yield of cassava by evaluating the influence of soil water regimes to CNp and eventual tuber yield of cassava planted on ridges, 'fats' and mounds. Root circumference was not significant all soil treatments and this was due to light soil that unlikely compacted. On the other hand in the first growing period, root length of both cassava genotypes was significantly high ($P < 0.05$) on soil ridges at 12 MAP. This was attributed to low soil resistance to root elongation. There was significant increase of tuber yield on ridges in the first growing period because of sufficient soil moisture reserved in furrows. However, in the second growing period this effect was counteracted by higher amount of rainfall received. A soil treatment on CNp was significant ($P < 0.05$). This was attributed to high rainfall that was uniformly distributed throughout the growing periods leading to favorable soil moisture regimes for cassava growth. Further, both soil K and available P that reduce CNp in cassava were generally well above the critical level for most plants. However, CNp decreased significantly ($P < 0.05$) to almost 50% from 6 to 12 MAP

Keywords: physical environment, planting practice, cyanide, yield.

**USE OF REMOTE SENSING MATERIALS FOR PARTICIPATORY LAND
RESOURCES MAPPING**

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Evaluation of the use of remote sensing materials in participatory land resources mapping was done in Katakwi district of Uganda. Topographic maps and aerial photos considered in this study. An enlarged aerial graph was found to be an appropriate technology that can be used by farmers while drawing the resource within a participatory framework. The aerial photo should not be smaller than 1:16,000 or larger than 10,000.

Key words: Aerial photographs, topographic maps

**EFFECT OF RELIEF ON SOILS AND LAND USE OF A SELECTED
MICROCATCHMENT OF THE LAKE VICTORIA BASIN**

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A semi-detailed soil survey at 1:50,000 scale was carried out in an area of approximately 30 km² in Kabonera microcatchment of the Lake Victoria basin. The soils have developed mainly from sedimentary rocks (quartz) and occur in four main physiographic units: summits, backslopes, footslopes and valleys/vales. The soils of the summits and the backslopes are mainly *Petroferic Luvisols* (used mainly for grazing and settlements) and those of the foot slopes are moderately deep to very deep *Chromic Luvisols* (where most of the farming takes place) and those of the valleys/vales are *Mollic Gleysols* (used for grazing and agriculture). The soils show diverse physical and chemical properties. They range from well to poorly drained and very shallow deep, dark reddish brown (2.5YR 4/6) to brownish black (10YR 3/2), sandy clay to clay. Top soil organic carbon lies between 0.23 and 4.2 percent, cation exchange capacity (CEC) is between 1.22 to 6.09 cmolkg⁻¹. Soil pH in both topsoils and subsoils varies slightly from acid neutral (4.4 to 7.6). The moisture regime is udic acid (i.e. means annual rainfall of 1218 mm) while the temperature regime is isohyperthermic. The soils are generally low in fertility but with a reasonable moisture storage capacity.

Key words: Summit, backslope, footslope, valley, *Petroferic Luvisols*, *Chromic Luvisols*.

**POTENTIAL FOR COMBINING SCIENTIFIC AND INDIGENOUS
KNOWLEDGE FOR LAND PRODUCTIVITY IMPROVEMENT**

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Although there is a growing recognition of the value of farmers' indigenous knowledge-
IK (e.g. resources, their problems and constraints to production and coping strategies),
little is documented on how it can potentially be exploited in conjunction with scientific
knowledge (SK) to improve land productivity. This paper highlights the potential of
combining scientific and indigenous knowledge for soil and water management based on
experiences from Wera and Toromas sub- counties in Katakwi District, Uganda. Farmers'
knowledge and perceptions of soils were explored using diagnostic participatory rural
appraisal (PRA) tools such as mapping, rankings and transect walks. The identified soil
units were then geo-referenced using the GPS, sampled and analyzed and the hydraulic
and infiltration tests were done to establish the hydrological properties of the soil units.
The results from IK were combined with SK in the field during participatory on- farm
research and off field using the geographic information system (GIS). Results revealed
that farmers' knowledge of their soils is a valuable and useful resource and can be
successfully used, preferably in combination with science based knowledge for planning
on-farm and other agricultural research and/or for transfer of land productivity
improvement technologies to other areas. The combination of IK and SK has a high
potential utility in adoption and subsequent adaptation of test technologies by local
farmers. However, in utilizing the combined sets of knowledge for technology transfer,
particular attention must be paid to differences in farmers' perceptions of their soils over
time and across locations. For example, the farmers in Toroma categorized their soils into
more defined groups than Wera by using adjectives such as nairionon (black), nainyalit
(mixed), nakwangan (white). The differences over time can be attributed to knowledge
build up over time. However, it is not yet clear whether the differences in defining soil

categories across locations was due to differences in their perceptions or was related to differences in methodology used in both sites.

Key words: Participatory rural appraisal, GIS, Uganda.

**ECONOMIC CONTEXT OF SOIL PRODUCTIVITY IMPROVEMENT
PRACTICES FOR SUSTAINABLE BANANA PRODUCTION IN THE RED
SOILS OF IN UGANDA**

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In the 1991-96 period of integrative field trials to evaluate complementary approaches to soil productivity management at the Makerere University agricultural search Institute (MUARIK), the need to use easily available organic matter (OM) carriers and potassium fertilizers to improve soil biophysical and nutrient properties, and increase banana yields, was demonstrated. However, given the lengthy response lags to investment OM-carriers, the high cost of inorganic fertilizers and liquidity problems that could not be easily relieved credit facilities in Uganda, this component of the study sought to assess the profitability of the various soil improvement options using stochastic procedures based on multi-year gross margin analysis. The economic evaluation indicated that it was irrational to produce bananas, in the red soils of Uganda, without using external input (organic or inorganic). On the other hand, it was not cost effective to use slow-decomposing OM carriers collected from a long distance. This result supported the key hypothesis that there was need to rationalize soil amendment and management practices. Taking into account the biophysical and nutrient status of the soil as well as the input/output economics. The most viable alternative for a time rich and cash-poor farmer would be to produce bananas using locally available soil be to produce bananas using locally available soil external inputs such as crop residues and farmyard manure and possibly plus an optimal dose of inorganic fertilizer.

Key words: Organic and fertilizer inputs, input/output

**FARMER SELECTION OF BIO -PHYSICAL DIVERSITY FOR
AGRICULTURAL LAND USES IN DISSECTED HIGHLAND PLATEAUS OF
MBARARA, UGANDA**

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Dissected Highland plateaus of Mbarara district are found in Isingiro and Rwampara counties. They are characterised by high altitude ranges of 1300 - 1800 m above sea level, with steeply sloping hills and ridges, V and U-shaped valleys, and rapid increase in human populations. Such land resources are considered fragile as far as agricultural land use is concerned. Farmers in this area are capable of selecting and manipulating the biophysical conditions of land to meet their increasing needs for food and cash. This work, done in Bugamba, Mwizi, Birere and Kabingo sub counties of Mbarara district aimed at assessing biophysical diversity of the area and indigenous knowledge on utilizing it for crop production. The participatory approaches of community workshops and walk transects were employed.

Results indicated that communities are knowledgeable of and able to classify the variability in the landscape types of their area as Hilltops and Shoulders (Ebibungo), Backslopes (Obushozi/Obushurno), Foot slopes (Hansi ye' mishozi) Ravines (obuhanga), plains (empita) and Valleys (Empanga). They were able to match the soils with landscape types. Farmers were found to effectively selected among these diversities and to utilize them appropriately for crop and livestock production. They grow most of the annual crops on hilltops, perennials (bananas and coffee) on foot slopes and valleys and they keep most of the backslopes and plains for grazing livestock. However where there is shortage of land because of increased population, especially in Mwizi, farmers have attempted growing all the crop diversity and other land uses on all landscape types even on very steep (slope gradient 30 70%) backslopes. This enriches the agro diversity of the region.

Key words: Agrodiversity, Indigenous knowledge, coping strategies, landscape types, farmers' soil classification

**SOCIO-ECONOMIC FACTORS INFLUENCING ADOPTION OF SOIL AND
WATER CONSERVATION AND BIODIVERSITY CONSERVATION
STRATEGIES IN SOUTHWESTERN UGANDA**

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There is increasing interest in environmental conservation in Uganda. The interest has been mainly centered on soil and water conservation and more recently, biodiversity conservation as well. However, empirical studies show that efforts to conserve soil, water and biodiversity at farmers, el are still inadequate. This paper, which is a result of farmer participatory appraisal, presents the socioeconomic factors responsible for the sluggish adoption of oil, water and biodiversity conservation. Among the factors identified as the most important determinants of oil, water and biodiversity conservation at farm level are type of land use tradition terrain, perceived severity of the problem, intensity of extension efforts (Government and NGOs), farmers influences, market forces, importance of the crop to the farmer, gender interest in crop and control over the crop on the land, household power distribution, and availability of labour and other resources.

Key words: Adoption Tradition, Extension, Technology, Reconnaissance, Transect, NGO

**RESEARCH NEEDS AND CHALLENGES FOR SUSTAINABLE NAPIER
GRASS (*PENNISETUM PURPUREUM*) PRODUCTION**

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Napier grass is indispensable in livestock production and sustainable management options are necessary. This means managing the forage to provide high yield on a long-term basis and to ensure that a large amount of quality forage is available for use when fodder is needed most. Thus the optimum date for cutting Napier so that sufficient amounts would be available for use in the two dry seasons in parts of East Africa, needs to be determined. Similarly, since Napier is a heavy feeder, research is also needed to determine the best time of application of fertilizer or manures, so that the Napier biomass can be readily available when it is needed most. Timely application of fertilizer would also reduce leaching losses. Despite the fact that use of inorganic fertilizer could prolong the productivity of Napier grass, this is not sustainable for most farmers in East Africa, making it necessary to seek for cheaper ways. This would be achieved through use of organic manures including farmyard manure (FYM) in the home gardens, even on "Lunyu soils" where Napier productivity can decline dramatically after only one year. However, FYM is likely to be restricted by the poor quality with respect to nutrient composition and its bulky nature. The use of coffee husks and ash with a view to prolonging the productivity of Napier plots needs examination with specific reference to amounts and method of application for optimum benefits. Recently however, use of coffee husks in coffee plots has been discouraged in an effort to reduce spread of the coffee wilt disease. This is likely to affect use of manure, which is usually available at a small fee in coffee-producing areas. Intercropping with forage legumes, such as *Centrosema* sp. and *Desmodium* sp., sometimes improves Napier yield. However, it is not clearly known for how long soil productivity is enhanced. Moreover, the legumes may add N but compete for other nutrients, which could jeopardize long-term soil productivity. Further, the time of interplanting and spacing of the legumes between Napier rows seems not to have been studied. Periodic deep tillage in Napier plots could also prolong Napier productivity better than shallow cultivation or slashing of the weeds at harvest time. However, deep tillage in Napier plots would pose a practical difficulty when the Napier is intercropped with the above legumes since these would be uprooted. Even mere shallow cultivation with a hand-hoe would require the legumes to be planted in rows rather than being broadcast between Napier rows. This would facilitate weeding the plots. Interplanting the perennial legumes only within the Napier rows, perhaps, could avoid the above problem since it allows deep tillage between the Napier rows and shallow weeding or even hand pulling of weeds within the Napier rows. This practice would also facilitate ploughing-in of FYM between the Napier rows.

Key words: Elephant grass, coffee husks, legumes, farmyard manure

THE EFFECTS OF *RHIZOBIUM* INOCULANT ON THE NODULATION AND YIELD OF GROUNDNUT (VARIETY ROXO 531) IN UGANDA

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The field experiments were conducted at Senge farm, Kampala, to investigate the effects of commercial *Rhizobium* inoculants on the nodulation and yield of groundnuts, variety Roxo 531. The trials were run on ferrallitic soil during the second rains of 1974 and first rains of 1975. Nodulation, dry matter production and nitrogen content of the shoots were not influenced by inoculation. Native rhizobium was thought to be competitive. However, inoculation with *Rhizobium* strains from West Virginia, U.S.A. significantly increased yield of unshelled groundnut from 710 kg/ha for the uninoculated treatments to 766 kg/ha at 5% level of probability in the first trial but depressed yields in the second trial.

Key words: commercial *Rhizobium*, native *Rhizobium*, Senge, West Virginia

