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Effect of different border crops and fertilizer regime on capsicum growth and yield

Student Name : Murugaiah Ramesh

Index No : 346

A study was undertaken in summer 2009 to assess the effect of different border crops and fertilizer regime on capsicum plant growth and yield at the Agricultural Research Station, Thirunelveli. The experiment was laid out in a split plot design, with four replicates. The experiment consisted of 12 treatment combinations, four different border crops (maize, chrysanthemum, sunflower, finger millet) and three different fertilizer levels (recommended level of inorganic fertilizer with organic fertilizer, ½ recommended level of inorganic fertilizer with organic fertilizer, and only organic fertilizer). Capsicum was planted with the recommended spacing of 30cm × 15cm. All other management practices were performed as per recommendation made by the Department of Agriculture. Plant height, plant canopy width, yield and the incidence of leaf curl complex were recorded. The results revealed that there was no significant difference in growth parameters in the border crop until 4th week after transplanting. But the growth parameters were significantly different with fertilizer level in all weeks after transplanting. Maximum yield was observed under the maize bordered with recommended level of inorganic and organic fertilizers. Minimum yield was observed under the treatment of finger millet border with organic fertilizer only. Among the sunflower and chrysanthemum border no significant difference was observed in the yield. Leaf curl complex incidence was not different among the fertilizer treatments. But highest level of leaf curl complex incidence was observed under the finger millet and minimum level in the maize border. The leaf curl incidence was not significantly different among the sunflower and chrysanthemum borders. Maize border crop with recommended level of organic and inorganic fertilizer treatment combination was an effective treatment to get good growth and yield performance with less leaf curl incidence in capsicum.

Keywords: Border crop, fertilizer regime, leaf curl complex, Yield

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Effect of different curing process on the production of bio food wrapper from the banana leaf

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Index No : 364

Usages of eco-friendly materials ensure the safety of the environment. Use of bio-wrappers for polythene is much appreciable in conserving the environment. In this view, an experiment was carried out in the laboratory of the Department of Agronomy, Faculty of Agriculture, University of Jaffna during November 2008 to March of 2009 to investigate the suitability of banana leaves as bio wrappers after curing by different treatments. An experiment was performed in three factor factorial experiment with five replicates. Well grown banana leaves at three different stages such as matured (4th leaf from top), partly matured (3rd from top), and immature (2nd leaf from top) leaf were trimmed and separated in to pieces (40 Cm x 40 Cm) excluding mid rib. Laminas of prepared sample leaves were washed thoroughly with clean water to remove dust and any inert particle deposited on leaves. Three treatments such as oven drying (T₁), steaming (T₂), hot water treatment (T₃) and no curing (T₄) were provided for each samples and these cured banana leaves were stored in two different storage conditions such as normal environmental and cold storage. During storage period quality parameters and durability of the leaves without losing its quality was recorded. It was found that sample treated with hot water treatment (T₃ – 100 °C for 3-5 min) and stored under cold storage condition performed well in quality up to 32 days and both varieties Kathali and Itharai showed equal storability. The leaves cured using hot water and stored under normal storage condition also performed well. But storage durability is lesser than cold storage. The sensory evaluation results also confirmed these results. But cold storage is expensive to practice by the farmers. Therefore it can be concluded that the banana leaves which curing in hot water can be used as bio wrappers for about one month stored under normal storage conditions.

Keywords: Curing, Bio food wrapper, Banana leaf

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Effect of planting geometry on the growth and yield performance of cabbage (*Brassica oleracea*) intercropped with tomato (*Lycopersiconesculantum*)

Student Name :PiramilaSubramanium

Index No : 365

Field experiment was conducted during the period of October 2008 to April 2009 to find the effect of planting geometry on the growth and yield performance of cabbage (*Brassica oleracea*) intercropped with tomato (*Lycopersiconesculantum*) at the Agricultural Research Station, Thirunelvely. Three different plant geometry were provided for cabbage and tomato such as three rows of cabbage with one row of tomato, two rows of cabbage with one row of tomato and two rows cabbage with two rows of tomato with four replicates in randomized complete block design. Cabbage was planted at spacing of 50 cm × 40 cm as main crop in all treatments and tomato was planted as intercrop in between cabbage rows in the spacing of 50cm × 120cm (T₁), 50cm × 120cm (T₂), and 50cm × 80cm (T₃). The yield and growth parameters of cabbage as well as tomato were recorded. The yield components of cabbage among different plant geometry were is significant, except average head height. Diamond back moth pest incidence percentage was significant and the highest percentage was observed in T₁ (Three rows of cabbage between 120 cm × 50 cm tomato rows). The three rows of cabbage between one rows of tomato (T₁) treatment gave significantly higher yield than other treatments. The yield components of tomato were not significant among treatments except for width and weight of fruits. Late blight disease incidences among treatments were significant and the highest incident was recorded in T₃ treatment(Two rows of cabbage with two rows of tomato). The highest LER of 1.63 and gross income were recorded in the treatment T₁(Three rows of cabbage with one row of tomato). Therefore, three rows of cabbage can be planted between rows of tomato at spacing 120 cm × 50 cm for better LER, to obtain higher gross income with less incidence of disease.

Keywords:Planting geometry, Cabbage, Intercropping, Planting spacing, Tomato

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Growth and yield response of maize (*Zea mays*) with different density of capsicum (*Capsicum annuum*)

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Index No : 367

Effect of planting patterns of capsicum in maize in an intercropping system was studied at the District Agricultural Training Centre (DATC), Thirunelvely, during November 2008 to March 2009. A survey was done and relevant data were collected in Vallikamam area during November 2008 to assess the effect of thrips attack on capsicum. Further, a field experiment was carried out with four treatments in randomized complete block design (RCBD) with three replicates. The same population of maize comprised 120cm × 30cm spaced single rows (T₁ and T₂) and 60cm × 45cm spaced double rows (T₃ and T₄) as a main crop, was maintained in all treatments, while capsicum were planted at a recommended spacing of 30 cm × 15 cm but inter row spacing and capsicum plant population varied with treatments. Capsicum was planted 20 days after planting of maize. Growth and yield parameters of maize and capsicum were recorded and analyzed. Capsicum variety, HYW is commonly grown at the surveyed area both in *Maha* and *Yala* season. Incidence of thrips during capsicum cultivation was higher in both seasons. 60% of the farmers followed recommended spacing of 30cm × 15cm. 50% of farmers sprayed chemical in three days interval and kept pre harvest interval as 3 days. The field experiment results were tested significance at $\alpha = 0.05$. Plant height and yield of the maize did not differ significantly among treatments. Plant height of capsicum among treatments was significantly differed. Fruit length was not significantly different among the treatments. Yield was significantly higher in T₂ than other treatments. Light intensity was also not significantly differed in all treatments. However, the interception of light was higher in treatments with two rows of maize (T₃ and T₄). Land equivalent ratio (LER) was significant among treatments and highest was recorded in T₂ (1.59). Net income was also higher in the treatment T₂. The percentage of plants attacked by thrips were significantly differed among different intercropping system compared with sole cropping. The lowest % was obtained in T₃ followed by T₂. Considering yield, profit and other quality parameters, three rows of capsicum with single rows of maize (T₂) can be recommended as a better spacing option for intercropping capsicum with maize at *Maha* in calcic red yellow latasol soil.

Keywords: Maize, Capsicum, Intercropping system, Land equivalent ratio

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Effect of plant population on growth and yield of chilli (*capsicum annum*L. Var.*Acuminatumfingeth*)

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Index No : 368

Chilli (*Capsicum annum*L.var.*acuminatumfingeth*) is one of the major cash crops in Sri Lanka. Normally Jaffna farmers get low yield (1-1.4 t/ha) from chilli cultivation, mainly due to low plant population and pest and diseases incidence. Thus, a study was undertaken at Agricultural Research station, Thirunelvely, during the period of January to May 2009 to get the optimum dry chilli yield from different plant population within short period. The treatments consisted of three spacings (60 cm × 45 cm, 45 cm × 45 cm and 30 cm × 45 cm) and two different numbers of plants per hill (2 plants per hill and 4 plants per hill) in a two factor factorial Randomized Complete Block Design (RCBD) with four replicates. The results showed that dry chilli yield and plant growth were influenced by plant population. It was found that the plant height was highest (66.24 cm) in high density planting (45 cm × 30 cm) but canopy width was high (53.25 cm) in low density planting (45 cm × 60 cm). Thrips damage and anthracnose disease were not significantly differed among the treatments. Pod weight and pod number per hill was numerically highest in 45 cm × 60cm spacing. Average pod length was not significantly differed among the spacing and number of plants per hill. Average dry pod yield (3.70 t/ha) gave the spacing of 45cm x 30cm with two plants per hill followed by 45cm x 30cm with four plant per hill (3.65 t/ha) and there was 44 % yield increase compare to the farmer practices spacing (45 cm × 60 cm with 4 plants/hill). Therefore, 45cm × 30 cm spacing with 2 plants per hill is more suitable for *Mahaseason* chilli cultivation in Jaffna district to obtain optimum dry chilli yield within short period.

Keywords:Chilli, Planting density, Chilli pests, Diseases

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Effect of *in situ* green manure on growth and yield of subsequent red onion cultivation.

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Index No : 369

Increase the organic matter content of the soil improves the soil fertility and reduces environmental hazards. A study was carried out to find out the effect of adding *in situ* green manures on the growth and yield of red onion. The research was carried out at Agricultural Research station, Thirunelvely during *Maha* season, from November 2008 to March 2009 in Calcic red latosol soil in RCBD with five treatments and four replicates. The treatments comprised four *in situ* crops and control. Each set of green manure was buried on the 65th day after seeding and their biomass were recorded as 22 t/ha for black gram, 18 ton/ha for green gram, 41 t/ha for cowpea and 27 t/ha for sunnhemp. Subsequent onion was cultivated in this field four weeks after burying green manure and yield of onion was recorded. Soil samples were collected before and after adding the green manures. The growth and yield parameters were recorded. All the results were statistically analyzed at $\alpha = 0.05$. The result revealed that the plant height and yield were significantly differed among treatment and highest were recorded in the onion grown after adding cowpea residues. The yield of cowpea green manure treatment was given 13.1 t/ha in onion and gave highest profit among the tested crop combinations. The added green manure not significantly improved the nitrogen content of the soil. But the highest nitrogen was recorded in the cowpea buried soil. The result revealed that the cowpea crop can be cultivated as *in situ* green manure for subsequent onion cultivation which improve the onion yield significantly and give an additional grain yield and thereby increase the profit and reduce the crop risk.

Keywords :Green manure, Red onion, Fertilizer, Soil nitrogen

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Growth and yield response of okra intercropped with different density of groundnut

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Index No : 388

A study was conducted at the Agricultural Research Station, Thirunelvely (Jaffna) during November 2008 to February 2009 to study the effect of okra intercropped with different density of groundnut. Three different spacing of groundnut were tested between okra rows with four replicates in randomized block design. The same population of okra was maintained in all the treatments as a main crop. Ground nut population varied among the treatments. Okra was planted in rows at 120cm×60cm and ground nut was planted as intercrop in between okra rows in the spacing of 60cm× 15cm (T₁), 45cm × 15cm (T₂), and 30cm ×15cm (T₃). Both seeds were planted in same day. The yield parameters and growth parameters of okra among the treatments are non-significant except number of fruits per plant. It was reduced when intercropped with four rows of ground nut (T₃). The ground nut yield was differed significantly. The three rows of ground nut between okra (T₂) treatment was given higher yield than other treatments. The highest Land Equivalent Ratio (LER) 1.41 also recorded in the T₂ treatment. Three rows of ground nut can be planted in between okra to obtain high productivity in okra, groundnut intercropping system.

Keywords : Okra, groundnut, spacing , Land Equivalent Ratio

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Varietal influences of cowpea at different spacing on weed abundance, growth and yield

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Index No : 389

The field experiment was conducted during *Maha* season to study the effect of plant population on weed abundance, growth and yield of cowpea varieties. Nine treatment combinations comprising three cowpea varieties (MI-35, Dhawala and Bombay) and three inter row spacing (22.5 cm, 30 cm and 45 cm) were tested in two factor factorial randomized complete block design (RCBD) with three replicates. The growth, weed and yield parameters of cowpea were recorded and analyzed at $\alpha = 0.05$. The yield was not significantly differed among varieties but the total dry matter of weed was significantly differed among different varieties. Among spacing the weed population, dry matter and yield differed significantly. The highest yield was recorded in Bombay variety at the spacing of 22.5cm \times 15 cm. The lowest weed dry matter was recorded in Bombay variety at narrow spacing (22.5 cm) in the early stage of crop growth. The highest weed population and weed dry matter were recorded in Dhawala variety. The yield was not significantly differed among varieties. However the highest graphical yield was observed in Bombay variety. So that the planting of Bombay variety at 22.5cm \times 15cm spacing is more suitable to control the weed competition and get better yield.

Keywords: Cowpea, Planting spacing, Weed abundance, Weed population

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Effect of the replacement of maize with graded level of finger millet (*Elucine coracana*) on the performance of broiler chicks

Student Name : Sumathini Visuvalingam

Index No : AG 360

The effect of the replacement of maize with graded levels of finger millet (*Eleusine coracana*) on the performance of broiler chicks was investigated using ninety- six day old broiler chicks in a Completely Randomized Design (CRD) experiment. Trial was carried out at agriculture extension office in Jaffna from November 2008 to March 2009. The basal diet 1, 2, 3 and 4 contained 0 % (T1), 25% (T2), 50% (T3) and 75% (T4) finger millet respectively at both starter and finisher phases. The chicks were randomly allotted to the dietary treatments giving twenty-four birds per treatment of three replicates with each replicate having eight broiler chicks. Chemical analysis revealed that finger millet contains 8.2% of crude protein. Data were collected on daily feed intake and weekly weight gain while Feed Conversion Efficiency (FCE) was calculated and mortality rate was recorded. The results showed that mean weekly feed intake was significantly ($p<0.05$) affected by the dietary treatments and age of the bird. Weight gain was significantly ($p<0.05$) affected by the dietary treatments and age of the bird. Age of the bird and treatments were significantly ($p<0.05$) influenced in Feed Conversion Efficiency (FCE) during the trial period. Mortality rate higher in starter period than finisher period and Treatment4 and treatment3 have lower mortality rate in two phases. Overall performances of chicks were poorer than expected performance. In conclusion, replacement of maize with finger millet in broiler ration enhanced performance at 75% (T4) inclusion of finger millet.

Key words: Maize, Finger millet, Broiler chicks

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Effect of partial replacement of fish meal with *Gliricidia* leaf meal on the performance of Broilers

Student Name : Thayarani Sriparaparan

Index No : AG 354

An experiment was conducted with 96 randomly selected day old broiler chicks at the Agricultural Research and Extension Office in Thirunelvely from February 2009 to March 2009. The aim of this study was to determine the effect of partial replacement of fish meal with *Gliricidia sepium* Leaf Meal (GLM) on the performance of the broiler chicks. Ninety-six randomly selected broiler chicks allotted to four dietary treatments where fish meal replaced at the levels of 0%, 5%, 10% and 15% with GLM in a Completely Randomized Design. Each treatment was replicated three times and each treatment constituted 24 chicks. Feeding and watering were provided *ad libitum*. Performance characteristics in terms of feed intake, body weight gain and feed conversion efficiency were monitored. Chemical analysis revealed that GLM contains 18.86% of crude protein. But overall performance of chicks was poorer than expected performance. Anyhow, Feed intake, body weight gain and feed conversion efficiency were significantly different ($P < 0.05$) among dietary treatments. Birds fed 5%, 10% and 15% GLM ration had the higher feed intake and weight gain, and better feed conversion efficiency than 0% GLM ration. It therefore appears that up to 15% GLM can be incorporated into broiler ration without any adverse effect.

Key words: Broiler chicks, *Gliricidia* leaf meal, Fish meal, *Ad-libitum*

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Effect of partial replacement of fish meal with Cassava leaf meal on the performance of Broilers

Student Name : Thangavelu Venkadesan

Index No : AG 386

A 42-day feeding trial involving 96, day old Bahira broilers was carried out in at completely randomized design to determine the feasibility of substituting fishmeal with cassava leaf meal in broiler ration. Feed intake, weight gain and feed conversion efficiency were evaluated in broilers fed experimental diets that prepared as fish meal was replaced by cassava leaf meal at proportion of 0%, 5%, and 20% level. Feed intake and body weight gain of birds of group of 10% leaf meal was significantly ($p < 0.05$) superior to the group of 0%, 5% and 20%. Feed conversion efficiency of birds of group 5% and 20% leaf meal superior to other groups. However, 10% cassava leaf meal level diet gave high final body weight. It is suggested that 10% inclusion of cassava leaf meal could be used in broiler starter and finisher ration without any deleterious effect.

Key words: Broiler ration, Cassava Leaf meal, Fish meal

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Effect of the substitution of *Leucaena leucocephala* leaf meal with fish meal on the performance of broiler chicks

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Index No : AG 375

Ipil Ipil leaf meal prepared from leaf lets and petioles contained (dry matter basis) 22.68 percent crude protein. These leaf meals were found to be a cheaper and rich source of protein. Leaves meal prepared from Ipil Ipil leaves in the method of water shocking for 24 hours, then shad drying for three days and then sun drying for five days after, which was incorporated in starter and finisher ration to an amount of 0 percent, 5 percent and 10 percent, 15 percent by weight separately as a substitute for fish meal. The starter ration was fed for a period of three weeks, followed by finisher ration from 3rd weeks until 6th weeks. The weight of individual chicks and group feed consumption were measured at weekly intervals, from the day old chick. The completely randomized design was used to analyze the treatment effects and Duncan mean separation method for identify the significant different between treatments. The results showed that there were significant ($P < 0.05$) difference between control (without Ipil Ipil leaf meal) and 10 percent Ipil Ipil leaf meal treatment with respect to weight gain(T3 higher than control).when the proportion of Ipil Ipil leaf meal was increased, the feed consumption was found to be decreased treatment 3 found to be lowest FC. Therefore, the feed conversion efficiency decreased with the increasing of Ipil Ipil leaf meal in starter and finisher.10%and 5%percent level of Ipil Ipil leaf meal from an economically valid substitute for fishmeal in starter and finisher ration without any deleterious effect to the chicks.

Key words: Broiler starter and finisher rations, Ipil ipil leaf meal, Fish meal

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Occurrence of red palm mite, (*Raoiella indica*) Hirst: a new pest of banana in Jaffna, Sri Lanka

Student Name: Thambippillai Kajanthan

Index No : AG 391

Occurrence of Red palm mite (RPM), *Raoiella indica* Hirst (Prostigmata: Tenuipalpidae) was observed first time in banana (*Musa* sp) grown in Jaffna, Sri Lanka. Since it was new to this region, this study was carried out to understand its biology, damaging pattern and its severity. All life stages; Egg, larva, protonymph, deutonymph, and adult were red. Mean development time required for various life stages such as incubation (6.1 ± 0.4 days), larva (active period; 3.24 ± 1.2 and quiescent period; 1.67 ± 0.9 days), protonymph (active: 3.5 ± 1.2 , quiescent: 2.5 ± 1.12 days), deutonymph (active: 3.5 ± 1.37 , quiescent: 2.9 ± 0.98 days) and adult longevity (female: 43.7 ± 4.6 , and male: 15.3 ± 4.6) were studied. Fecundity was 19.7 ± 1.8 eggs/female and egg hatchability was 88.2 ± 4.6 %. Coconut and arecanut were not infested in Jaffna yet. Damage severity of RPM on banana was high in *Kappal* (40.5 %), moderate in *Itharai* (35.5%), and low in *Kathali* (10.5%) cultivars, *Monthan* cultivar was found safe to the damage (1%) caused by RPM. Finding RPM colony in lower part of the leaf surface and yellowing of leaves were the symptoms associated with this pest. Poorly maintained banana was found infested easily. Mature banana leaves were highly affected. Infestation was high in 7th, 8th, and 9th leaves and percentage infestation was 66, 74, and 82, respectively. RPMs were evenly colonized in top, middle and bottom part of the leaves. Its population was high (148 mites/ cm^2) during the months of October and November, 2008. Larva and adult of *Stethorus* sp and *Amblysius* sp were identified as predators of this pest. Among these predators larvae of *Stethorus* sp was found effective. This is the first time report on the infestation of *R. indica* on banana in Jaffna peninsula to make the growers aware of the damage and to alert them from its spread and destruction.

Key words: Red palm mite, banana, damage, *Amblysius* sp, *Stethorus* sp

Supervisors: Dr. G. Mikunthan

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Potential of selected earthworms and their impact in organic agriculture

Student Name: Sithamparanathan Mayooran

Index No : AG 358

Earthworms are used to convert organic wastes into vermicompost and perhaps their exudates applied as vermiwash influenced the plant growth. Vermicomposting results in the bioconversion of the waste into two useful products; production of earthworm biomass and vermicompost. The growth and reproductive potential of *Eisenia foetida* and *Lampito mauritii* and their biodegradation efficiencies were evaluated using different animal manures (cow, sheep, pig, goat, poultry and rabbit manures) in combination with leaf litter of mango (*Mangifera indica*) at 1:1 ratio and culture materials of *L. mauritii* were prepared animals manures, leaf litter of mango and soil at 1:1:2 ratio. Individual weight gain of *E. foetida* was its maximum at 226.81 mg as well as quick biodegradation in sheep manure combination and 67.5 mg by *L. mauritii* and large number of juveniles (7.667) produced in pig manure combination. To *E. foetida* cow dung combination was the best to obtain maximum cocoons (31.33 cocoons/100g beddings/month) and juveniles (896.33/100 g beddings/month). Poultry and rabbit manure combinations had least response in the weight of *E. foetida* and *L. mauritii*, respectively. Biodegradation rate of both species was least in poultry manure. Cow dung recorded higher (98.88%) degradation rate with *L. Mauritii*. After 70% of biodegradation weight gain and adult population were reduced in culture materials. Though variations were recorded among the animal waste combination, all were supported the vermicomposting process. Impact of vermiwash was evaluated on biological production of plant (*Vigna radiata*) and pest management of *Capsicum annum*. Seedling growth was evaluated by using in different vermiwash (vermiwash IE (*E. foetida*)), vermiwash IL (*L. mauritii*), vermiwash IIE (*E. foetida*) and vermiwash IIL (*L. mauritii*). The vermiwash IIL was superior in the development of roots of seedling (12.39 cm mean root length, 20.2 cm mean number of roots) and dry matter production (31.32 mg/seedling) but vermiwash IE was high in seedling height (15.56 cm). Growth and yield of green gram (*V. radiata*) were evaluated by applying different fertilizer (basal fertilizer, rotten cow dung, vermicompost, vermiwash IIE, vermiwash IIL and fertilizer combination). The results revealed that fertilizer combination enhanced the growth parameters and yield. Application of vermiwash IIL and vermicompost were better than basal fertilizer. The management of thrips (*Scritothrips dorsalis*) in *C. annum* was evaluated by spraying water, vermiwash IE, vermiwash IL, vermiwash IIE and vermiwash IIL. Thrips population was reduced (3.75) after 7th day of application of vermiwash IIL. Thrips population was reduced after a day of application of vermiwash IIE (1.55) and vermiwash IL (1.25). Therefore, vermiwash IIL can be used to increase the plant production and for pest management. Thus *L. mauritii*

was the best to obtain vermiwash influencing the crop production and *E. foetida* was effective in vermicomposting to organic agriculture exploitation.

Key words: Vermicomposting, earthworm, vermin wash, *E. foetida*, *L. mauritii*

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Insect pests associated with neem, *Azadirachta indica* in Jaffna, Sri Lanka

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Index No : AG 345

In spite of remarkable spectrum of activity of neem, *Azadirachata indica* (Family: Meliaceae) against pests, does the tree itself not immune to them. Many insects such as ash weevils, tortricid moth, peacock moth, scale and thrips were found associated with this tree in Jaffna. This research was aimed to identify these insects and their damage. Further it is essential to have information on biology and alternate hosts of ash weevils, *Myloccerus* sp., which was found as heavy defoliators and their management using botanicals. The severity of infestation incurred by complex of adult *Myloccerus* sp. was assessed as high as 62.5% based on visual rating method in randomly selected neem trees. Adults of *Myloccerus* sp., the weevils, fed on leaves by nibbling from the margins and eating away small patches of leaf lamina and the whole tree looked alike sickly appearance. Adult of *Myloccerus* sp were small and had a dense covering of grayish to green with black cuticular marks. Female weevils laid eggs in clusters of 35.16 ± 7.13 on muslin cloth covered the rearing chamber. Fecundity of weevils was 237.5 ± 30.4 eggs. The mean incubation period of egg was 4.57 ± 0.53 days at $28.9 \pm 1^\circ\text{C}$. The percent hatchability of egg was 68.12 ± 11.15 at $28.9 \pm 1^\circ\text{C}$. The neonate grubs were small, creamy white with brown head, but just period to pupal formation they enlarged in size. They burrowed through the soil and fed on the rootlets of the *Vernonia cinerea*. The mean grub period was 50.6 ± 1.51 days at $29.1 \pm 1^\circ\text{C}$. Pupation was observed in an earthen brown coloured puparium. Mean pupal period was 7.83 ± 0.75 days at $29.1 \pm 1^\circ\text{C}$. Ash weevils had a wider host range extended to families of Meliaceae, Caricaceae, Amaranthaceae, Caesalpiniaceae, Malvaceae, Solanaceae and Asteraceae. Monocot weeds such as *Cyperus rotundus* and *Cyanodon* sp. were not preferred by *Myloccerus* sp. in the field. The extent of damage in neem, mahogany, papaw and a dicot weed, *Vernonia cinerea* was 1.22, 1.04, 0.88, and 3.81 percent/day/weevil, respectively. Dicot plants including medicinal herbs were tested for their repellency against *Myloccerus* sp. the results revealed that *Curcuma domestica*, *Pavetta indica*, *Coleus amboinicus*, *Allium cepa*, *Allium sativum*, *Annona squamosa*, *Zingiber officinale* were exhibited repellent properties against the adults. Among the botanicals, *C. domestica* and *C. amboinicus* were superior in reducing the pest population. Other botanicals were also found to be effective in managing the beetles when compared with control. The tip burning on the neem was assessed in 38 Grama Sevaka Division of Nallur Divisional Secretariat. The trees at Vannarpannai and Thirunelvey exhibited heavier tip burning compared to other surveyed areas. The cause for tip burning was investigated and a thrips, *Scirtothrips* species Hood was found associated in the tip of the neem branches.

The early stage of damage caused by the thrips led to the exudation of gummy substance followed by the burning of tips and young shoots.

Key words: Neem, repellent, botanicals, *Myloccerus* sp, weevils

Supervisors: Dr. G. Mikunthan

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Application of feasible and cheapest techniques to promote mushroom cultivation at rural areas

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Index No : AG 363

Cultivation of mushroom includes mother culture maintenance, spawn production and growing mushroom in beds. To simplify the techniques locally available cheapest substrates were tested for their suitability to serve as culture media. The substrates chosen were tubers of *Manihot esculenta*, *Dioscorea alata*, *Dioscorea bulbifera*, *Amorphophalus campanulatus* and bulbs of *D. alata*, *D. bulbifera*. Among the tested materials tubers of *D. alata* and *A. campanulatus* were the best alternatives to grow mushroom and to maintain mother culture as like potato dextrose agar. To avoid contamination in these substrates 6% H₂O₂ was used. Being a disinfectant, 6% H₂O₂ was found as a suitable alternative to avoid contaminants in the culture plates. Locally available substrates and simple microbial techniques were evaluated to opt an appropriate and cheapest method that can be easily practiced and rural areas to produce mushroom spawn. Substrates tested were maize, paddy, foxtail millet; finger millet, paddy husk and a combination of paddy husk + rice (1:1). Technique evaluated to avoid contaminants in the growing media were sterilizing in an autoclave, pasteurizing under pressure cooker, disinfecting with 3% H₂O₂ + pressure cooker. Results revealed that combination of 3% H₂O₂ + pressure cooker and finger millets as substrate was the best suited method which is applicable at house hold level.

Key words: Mushroom, substrates, *D. Alata*, mother culture, paddy

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Study of associated arthropod fauna, insecticidal and antibacterial properties of *Gymnema sylvestre* R.Br

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Index No : AG 387

This study was aim to assess the importance of *G. sylvestre*, identify the associated fauna and investigate its insecticidal and antimicrobial properties. A survey on diabetic patients revealed that 87.3% patients visiting medical clinic (MC) were using *G. sylvestre* and all visiting to Siddha Ayurvedic clinic (AC), in Jaffna during 2009 and no side effects were reported by any one of them. Leaves were eaten as raw by one fourth of patients and daily users were 14.5% and 30% in MC and AC, respectively. Survey on growers revealed that two third of the population propagated *G. sylvestre* using seedlings and 12% using stem cuttings. Associated caterpillars, aphid, worms and insects were also recorded in this study. 80% had awareness about its need but none were aware about the pests found in the leaves. The arthropods associated with *G. sylvestre* were studied at weekly intervals from an acre field having 1300 plants in Jaffna during 2008. 21 different fauna were identified. Among them 15 were phytophagous viz: 5 lepidopterans, *Euploea* sp, *Triumala* sp, *Hanncappsia* sp, *Orgyia* sp, *Micronia* sp, a bug, *Geocoris* sp, 3 beetles *Chrysomela* sp, *Epilachna* sp and snout beetle, Grasshopper, a Katydid *Neoconocephalus* sp, a mite species (Tarsonemidae), an aphid *Aphis nerii*, a thrips species (Thiripidae) and a mealy bug (Pseudococcidae), 5 predatory species, *Monochilus sexmaculates*, *Syrphus* sp, small green spider and a grab spider were found. Tarsonemid mite infestation caused the leaves to wither and shed subsequently and the damaged was assessed as 47.26%. Lepidopterans were associated with 72% of the sampled vines where as 52% plants were with sucking insects and 48% plants with leaf miners. This is the first report of fauna associated with *G. sylvestre* and it is expected to make awareness to the public, who consume raw leaves or any other form of it. Seven different formulations of *G. sylvestre* leaves were studied for their insecticidal effects on the stored product pests *Tribolium castaneum* and *Sitophilus oryzae*. Mortality was assessed after 24h, 72h, 7 days, 14 days and 21 days of exposure. All the tested extracts caused significant mortality and it increased with time intervals after application. Cumulative mortality and progeny suppression were higher in leave extract and leaf powder paste for *S. oryzae* and *T. castaneum*, respectively. Ethonolic was assessed by residual film assay and the mortality was 100% at 24h for *S. oryzae* and *T. castaneum* on 100mg and 300mg dosages, respectively. LD50 value for *S. oryzae* and *T. castaneum* was 25mg and 17.5mg, respectively. *In vitro* antibacterial studies on the aqueous extracts of *G. sylvestre* leaf powder (1:5) and gymnemagenin (1:10) revealed that the extracts showed inhibitory activity against the all tested medically important bacterial strains. Leaf powder extracts was found better in activity than gymnemagenin extract. Bacterial growth inhibition was found to be dose

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dependent. The range of the activity were in the order of *Shigella* > *Klebsiella* > *E. coli* > *Pseudomonas* > *Staphylococcus* > *Proteus* for leaf powder extract and *Klebsiella* followed by *Shigella*, *Proteus*, *E. coli*, *Staphylococcus* and *Pseudomonas* for gymnemagenin extract. These findings are much useful to guide the consumers of the *G. sylvestre* from consuming pests and their excreta together with leaves. Further the insecticidal and antibacterial properties of *G. sylvestre* would be much helpful for the effective use of this medicinal herb in medicine and agriculture.

Key words: *G. Sylvestre*, fauna, insecticidal, antimicrobial, *T. castaneum*

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Multiplication of effective microorganism's and it's application in household composting

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Index No : AG 395

In modern agriculture, prime important has been given to preserve the environment while producing enough food to sustain the livelihood of people. Composting of organic waste could be fastened by introducing Effective Microorganisms (EM). EM was introduced and multiplied by using culture media and there composting performance was analyzed. Field application efficiency of the compost produced from EM was tested on okra plants. Simultaneously, a field survey was carried out using structures questionnaire to assess the usage and performance of cement compost bins in house hold composting process. The results revealed that 61% of the beneficiaries obtained their compost in three months, among them 93.2% collected compost within three months. Most of the beneficiaries utilized organic waste materials as source for home composting. Composting process was shortening to one month by introducing EM technology. Fungi in the EM exhibited growth at pH 4.5 and Lactic acid bacteria growth was observed at pH 5.5. Proliferation of EM was best in the distillery spent wash (DSW) and Toddy, but DSW is locally available cost effective best media. Quick composting was recorded in the compost pit applied with EM. Cement compost bins performed well then the plastic compost bins. The performance of okra was satisfactory in the compost produced from the EM than the control in terms of growth rate and yield. Therefore, it can be concluded that the application of EM in the organic waste material has promoted the decomposition rate and physical properties of the compost. Thus, it could be a potential tool to foster organic farming globally.

Key words: Effective microorganism, composting, bins, organic, fungi

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Potential of root-knot nematode, *Meloidogyne incognita* (Kofoid and White) existing in tomato based cropping system and its eco-friendly management

Student Name: Kandiah Pakeerathan

Index No : AG 383

Root-knot nematode, *Meloidogyne incognita* emerges as a threat to the tomato cultivation due to its gall forming ability in roots and subsequently causing wilting of plants. The nematode survives in suitable alternate hosts found in tomato based cropping system. This research is aimed to screen out tomato cultivars, to investigate the potential of *M. incognita* and its eco-friendly management by using different organic amendments. Six tomato cultivars such as Palaly, Roma, Shang thung, T-245, KC1 and Urumpirai cultivar were tested their resistance against *M. incognita*. Results showed that none of the six cultivars grown in Jaffna peninsula were resistant to *M. incognita*. The extent of galls in Urumpirai cultivar (41.5) was significantly ($p < 0.05$) different from rest of the varieties. Hence Urumpirai cultivar is moderately resistant to *M. incognita*. In the management of *M. incognita* different animal manures such as goat manure, vermicompost and poultry manure, and green leaf manures such as *Gliricidia maculata*, *Thespesia populnea*, *Calotropis gigantea*, *Azadiracta indica* and *Glycosmis pentaphylla* were used to evaluate the plant growth (height and biomass increment) and extent of galling in laboratory and field, respectively. Plant growth resulted in significant ($P < 0.05$) in application of goat manure (52.02 cm and 130.25 g) and vermicompost (57.52 cm and 109 g) in the laboratory. But extent of galling were significant in goat manure (10.75) and carbofuran (9). Similarly extent of galling (35.87), gall changing factor (0.41), yield (17.87 mt/ha) and plant growth (22.47 cm and 45.08 g) were highly significant in *G. maculata* compared to other treatments in field. The results confirmed that organic amendments stimulated plant growth, increased the productivity and reduced the nematode infestation. To understand the host range of *M. incognita* number of plants were tested. Results showed that cabbage, chilli, brinjal, tomato, okra, tobacco, green gram and *Amaranthus* sp were found susceptible to *M. incognita* and therefore, should be avoided as rotational crops in the nematode infected fields. The common weed, *Acalypha indica* in vegetable fields was also found susceptible to *Meloidogyne* sp. This dicotyledon weed should be removed from the field to restrict possible spreading of root-knot pathogen.

Key words: *Meloidogyne* sp, tomato, organic amendments, goat manure, vermicomposting

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Low cost production of *Trichoderma viride* and its potential to manage tomato wilt caused by *Sclerotium rolfsii*

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Index No : AG 355

Application of biological agents is given prime concern to manage plant pathogenic fungi and nematodes to strengthen the natural system. To facilitate the biological means of management understanding the interaction between antagonistic fungi with plant pathogenic fungi is essential. Further this mode of interaction could be applied into the field if the bio agents are mass produced in sufficient quantity using locally available cost effective materials. With this background this study attempted to explore the possibilities of developing simple hands-on techniques to produce potential antagonistic bio agent, *Trichoderma viride* by the farmers and to assess its antagonistic effect on wilt fungus, *Sclerotium rolfsii* in field grown tomato. Evaluating the effect of bio agents, *T. viride*, *Pseudomonas* spp with fungicide (Homai) and green manure (*Thespesia*) would help to select a suitable suppression of *S. rolfsii* causing wilt in field grown tomato. *T. viride* and Homai effectively suppressed the wilt disease by 84.4 and 81.2%, respectively in tomato. Application of *Pseudomonas* and green manure also was exhibited 75% and 71.9% disease suppression in tomato allowing 43.8% disease in control. The fungicide, Homai effectively controlled the sclerotia of *S. rolfsii* and comparatively similar response was also recorded while using *T. viride*. Characterization of sclerotia was done. The substrates tested were the waste materials of coconut after being used in the kitchen of every household in northern region. Being a solid substrate, coconut scrapings after milk extraction (CSAM) pasteurized in pressure cooker was yielded 1×10^9 spores/g. Pasteurizing in pressure cooker and sterilizing in autoclave did not exhibit any significant differences in the production of spores and were on par in restricting contaminants. Steaming and boiling of CSAM for an hour did not support the growth of *T. viride*. Similarly *T. viride* grown in coconut water mixed with 3% H_2O_2 alone yielded 1×10^9 spores/ml and was free from contamination. The results confirmed that the pasteurization was achieved with a household pressure cooker for the coconut scrapings used after milk extraction. These findings boost the large scale production of *T. viride* using the simple household waste with a simple pressure cooker at village level. The growth of *T. viride* was found complete in H_2O_2 treated coconut water without having any risk of contamination. The spore viability of CSAM and H_2O_2 treated coconut water were 60 and 14 days, respectively. This is an easy technique to produce the bio agent at any place without going for the usual sterilization process. The findings would helpful to the farmers to produce the bio agent, *T. viride* at village level at a cheaper rate. In addition, the kitchen wastes were often thrown out would be recycled to produce the bio agent, thus helping the environment clean by avoiding nuisance from being breeding site for flies and accumulation in drainage channels.

Key words: *T. viride*, CSAM, *S. Rolfsii*, sclerotia, contamination

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Some studies on the properties of unboiled & dried (*odiyal*) and boiled & dried (*Pulukkodial*) palmyrah (*Borassus flabellifer*) root tubers from different areas in Jaffna Peninsula

Student Name: Vjitha Vinayagamoorthi

Index No: AG 362

Palmyrah (*Borassus flabellifer*) is an ancient palm which provides several useful products. One of the aims of this study was to analyze the nutritional composition of *odiyal* and *plukkodiyal* flour from different areas of Jaffna. For this study *odiyal* and *plukkodiyal* from Delft, Kayts, Punnalaikadduvan, Arali and Kudathanai were selected. The mean moisture, ash, starch, fat, fibre and protein contents of *odiyal* from different areas were 15.54(±0.56), 1.46(±0.3), 74(±1.22), 1.6(±0.3), 2.1(±0.55) & 4.35(±0.66) % respectively and that of *plukkodiyal* 16.15(±0.9), 1.3(±0.26), 73.9(±1.9), 1.4(±0.1), 1.31(±0.57) & 4.8(±0.53) % respectively. *Odiyal* from Delft and *plukkodiyal* from Arali showed the lowest and highest contents of moisture respectively. The highest content of protein 5.42(±0.06) % was found in *plukkodiyal* from Kayts. Both ash & fat contents contributed a small proportion in the nutritional contents of *odiyal* and *plukkodiyal* flour. There were no obvious differences found in the starch content of both flours from different areas. The antimicrobial effects of the water and ether extracts of *odiyal* and *plukkodiyal* flour (1g/10mL) of different volumes (40, 60, 120 & 180 µL) from different areas on the growth of *P.aeruginosa*, *K. pneumonia*, *P.vulgaris*, *E.coli* & *S.dysenteriae* were studied. Since these organisms cause digestive disorders, aim of this analysis was to determine whether those disorders could be cured by having *odiyal* and *plukkodiyal* flour in the diet. Aqueous extracts of *odiyal* flour from different areas produced zones of inhibition at 4h of incubation and disappeared at 24h. No clear zone was produced for *odiyal* flour aqueous extracts below 180µL from different areas. Aqueous extract from Delft *odiyal* flour (180µL) produced the highest inhibitory zones against *P.aeruginosa*, *K. pneumonia*, *P.vulgaris*, *E.coli* & *S.dysenteriae*. Among the *plukkodiyal* flour, aqueous extracts of that from Delft produced the clear zone (0.7cm) against *S.dysenteriae*. Ether extracts of *odiyal* and *plukkodiyal* flour from different areas showed no inhibitory zones. The results of this analysis indicated that it is better to prepare extracts in water for future work instead of ether. Another aim of this study was to hydrolyze the starch in *odiyal* and *plukkodiyal* flour and fermenting to ethanol. At 70°C and at pH 5, commercial α-amylase, glucoamylase and their mixture hydrolyzed 9.56, 2.94 and 9.92% of *odiyal* flour suspension (16%, w/w). When the starch in *odiyal*, *plukkodiyal* flour and commercial starch suspensions (16%, w/w) were treated with glucoamylase at 70°C and at pH 5; 3, 12.5 and 73% were hydrolyzed respectively. But acid hydrolysis of *odiyal* and *plukkodiyal* flour (16%, w/w) produced 12% (w/w) reducing sugar. Hence the activity of glucoamylase was more inhibited than α-amylase by the substances in *odiyal* flour than that of *plukkodiyal* flour and acid

hydrolysis was not inhibited by the substances in *odiyal* and *plukkodiyal* flour. Also the substances in *odiyal* flour acid hydrolysate did not affect the growth of *Saccharomyces cerevisiae*. But its ability to produce alcohol was less compared to *plukkodiyal* flour hydrolysate. Since the commercial α -amylase and glucoamylase were inhibited by some active principles in palmyrah root it was decided to isolate the fungus which contaminated the *odiyal*. The contaminated *odiyal* contained *Aspergillus*, *Mucor*, *Fusarium* and *Rhizopus*. Since *Aspergillus* is well known for amylase production, *Aspergillus* was selected and it produced 128.8 μg glucose $\text{mL}^{-1} \text{min}^{-1}$ amylase activities at 30°C and at pH 4.0 in fungal medium. The enzyme was identified as α -amylase and not glucoamylase. The optimum temperature and pH for this fungal amylase were 60°C and 7.0 respectively. The fungal amylase hydrolyzed commercial starch, starch in *plukkodiyal* & *odiyal* (16%, w/w) to 12.5, 38.8 & 4% sugar respectively at 60°C and pH 7.0. Hence activity of fungal amylase was more effective on starch in *plukkodiyal* followed with commercial starch than *odiyal*. These preliminary studies indicated that the *plukkodiyal* & *odiyal* flour have no obvious differences in starch content and at high concentration the extracts of *plukkodiyal* & *odiyal* from Delft showed inhibitory effect on *S.dysenteriae*. The *odiyal* flour had some inhibitory substances against commercially obtained α -amylase and fungal glucoamylase, which could be reduced by the fungal amylase produced by the fungus which grows on *odiyal*. Further elaborate studies are needed to find the antibacterial substances and inhibitory substances of starch hydrolases.

Keywords : α -amylase , Glucoamylase, Palmyrah root tuber, Nutritional composition

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Effect of pre treatments on quality of cured ginger

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Index No: AG 350

Ginger is the rhizome of underground modified stem of the plant *Zingiber officinale*, a herbaceous perennial. Generally farmers used to cure fresh ginger using primitive practices inherited from ancient traditions resulting in poor quality cured ginger. This is because there is little information on ginger curing. There is the need to improve these traditional methods of curing for better quality and appearance of the cured ginger. This study was undertaken to find out the best combination of pre-treatment for curing of ginger without affecting the physico-chemical and sensory characters of the ginger. Initially the quality of cured ginger was evaluated by drying with different drying temperatures like 50°C, 60°C, 70°C and 80°C in oven. Then effect of CaO solution on quality of cured ginger was evaluated with different CaO% (1% and 2%) solution pre-treatment. The suitable thickness of ginger slices to produce good quality cured ginger was identified by using different thickness of ginger slices like 0.5cm, 1cm and 2cm. Then combined effect of CaO solution and thickness of ginger slices on quality of cured ginger was evaluated. Dry weight%, volatile oil%, oleoresin content, presence of terpenoids, microbial content and sensory characters like appearance, colour, flavour and overall acceptability of these 6 different combined pre-treatments were evaluated. Among the different drying temperature, quality of ginger dried at 60°C was better than other treatments. The quality of ginger soaked in 2% CaO solution was higher when compared to other treatment. Among the different thickness of ginger slices, quality of cured ginger samples produced with 0.5cm thickness ginger slices was better than other treatments. The dry weight% (12.163%) and oleoresin content(4.168g/100g of cured ginger) of the cured ginger were higher for the sample with combined pre-treatment of soaked in 2% CaO solution and sliced into 0.5cm thickness ginger slices than other treatments. Terpenoids which was responsible for the flavour of the ginger present in all cured samples. Microbial count (TPC) of all samples was 20-70 microbes/g of cured ginger after one month of storage period and this was not exceeds the maximum permissible level allowed for dehydrated ginger. According to the sensory evaluation test for appearance, colour, flavour and overall acceptability, sample that was soaked in 2% CaO solution and sliced into 0.5cm thickness was got the highest score than other samples. Sensory characters of this pre-treatment significantly differed from other pre-treatments ($P < 0.05$). Among the different pre-treatments combined pre-treatment of soaked in 2% CaO solution and sliced into 0.5cm thickness ginger slices was the best pre-treatment to produce good quality cured ginger without affecting the physico-chemical and sensory characters of the ginger.

Keywords : Ginger, Curing, Physico-chemical, Sensory characters

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Preliminary studies to improve the ethanol production for wine making

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Index No: AG 350

Ethanol found in wine is the natural result of the yeast fermentation. Preliminary studies were carried out to optimize the conditions to increase the ethanol in red wine from locally available grapes. Since total sugar and protein contents are important determinants of ethanol production, the compositions of non peeled grapes extract (NPGE) and peeled grapes extract (PGE) were analyzed. NPGE had higher amount of total sugar [$86 (\pm 0.1)\text{gL}^{-1}$] and protein [$6.587 (\pm 0.2)\text{gL}^{-1}$] than PGE. Hence NPGE was selected for this study. Initially, *S.cerevisiae* (Baker's yeast) was grown at 30°C and pH 5.0, in a fermentation medium prepared from yeast extract (2.5gL^{-1}), bacteriological peptone (1.15gL^{-1}), $(\text{NH}_4)_2\text{HPO}_4$ (0.25gL^{-1}) and $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ (0.025gL^{-1}) (YPS medium) either glucose (10gL^{-1}) or sucrose (10gL^{-1}) were used as carbon sources. When glucose was replaced with the same concentration of sucrose (10gL^{-1} , Table sugar), the highest ethanol production of $4.25 (\pm 0.15)\text{gL}^{-1}$ was obtained and it was almost equal to that obtained in the medium in glucose. Hence sucrose available in the local market was used for further studies. Different concentrations of sucrose were used with the nutrients of YPS medium and the highest amount of ethanol [$45.4 (\pm 0.25)\text{gL}^{-1}$] was produced in the medium with 80gL^{-1} sucrose. Ethanol production was highest in 80gL^{-1} sucrose containing medium incubated at stationary state [$47.15 (\pm 0.25)\text{gL}^{-1}$]. When the ethanol production in NPGE was compared with that in PGE, higher amount was produced in NPGE [$39.6 (\pm 0.1)\text{gL}^{-1}$]. When the both media NPGE and PGE were supplemented with the nutrients of YPS medium except sucrose, higher ethanol [$51.075 (\pm 0.2)\text{gL}^{-1}$] was produced in NPGE supplemented with nutrients of YPS medium. Increase in $(\text{NH}_4)_2\text{HPO}_4$ concentration from 0.25gL^{-1} to 1.0gL^{-1} increased the ethanol production in NPGE supplemented with nutrients of YPS medium to 49.87gL^{-1} . When 1.0gL^{-1} of $(\text{NH}_4)_2\text{HPO}_4$ was used along with different concentrations of sucrose (80, 120, 160, 200 gL^{-1} and 240 gL^{-1}) highest ethanol production [$82.8 (\pm 0.125)\text{gL}^{-1}$] was obtained in the YPS medium with 240 gL^{-1} sucrose. With 240 gL^{-1} sucrose further increase in $(\text{NH}_4)_2\text{HPO}_4$ concentration to 2.0 gL^{-1} has increased the ethanol production to $86.25(\pm 1.0)\text{gL}^{-1}$. In the fed batch process, when the yeast was grown in NPGE supplemented with nutrients and at 22h the same amount of fresh medium was added, $83.95 (\pm 0.21)\text{gL}^{-1}$ ethanol was obtained. Half the volume of the spent medium was withdrawn from the same medium at 22h and supplemented with equal volume of fresh medium, the ethanol was obtained $81.7 (\pm 0.3)\text{gL}^{-1}$. The highest amount of ethanol [$88.0 (\pm 0.25)\text{gL}^{-1}$] was obtained when the spent medium (950mL) of NPGE supplemented with sucrose (160gL^{-1}), yeast extract (2.5gL^{-1}), bacteriological peptone (1.15gL^{-1}), $(\text{NH}_4)_2\text{HPO}_4$ (2.0gL^{-1}) and $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ (0.025gL^{-1}) and with the same fresh NPGE medium of 50mL (contained 120 gL^{-1} sucrose, 2.5gL^{-1} yeast extract, 1.15gL^{-1}

¹ bacteriological peptone, 2.0gL⁻¹ (NH₄)₂HPO₄ and 0.025gL⁻¹ MgSO₄.7H₂O). This study was able to improve the ethanol production from the sugar in red grapes by supplementing with sucrose and other nutrients from 39.6 to 88.0gL⁻¹. Addition of increased amounts of yeast extract, bacteriological peptone and MgSO₄.7H₂O did not improve the ethanol production. Future studies are to be carried out to improve the quality of the grapes fermented product. Further a better strain has to be selected for wine production rather than that of baker's yeast used in this study.

Keywords : Ethanol, Wine, Non peeled grapes extract (NPGE), Peeled grapes extract (PGE)

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Nitrate leaching in vegetable growing soil amended with *Gliricidia* in Vavuniya district and estimate the nitrate nitrogen in agro wells during growing season.

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Index No: AG 396

Nitrate contamination of ground water has become a serious problem in Northern part of Sri Lanka where intensified agriculture is being practiced. Intense use of mineral fertilizer, excess irrigation water and high permeability of soils has resulted in significant nitrate contamination in ground water. Undesirable effects of high nitrate intake on human health have been major concern. Modification of agricultural practices from inorganic to organic is one possible way to minimize the nitrate contamination in soil and ground water. *Gliricidia* (*Gliricidia sepium*) is one of the locally available green leaf manure. Incorporation of *Gliricidia* during vegetable growing season is one of the possible measures to reduce the nitrate leaching from agricultural land and improve the soil fertility which is an important parameter for crop production. On this background experiments were conducted in Reddish Brown Earth fertilized with urea and *Gliricidia*. A leaching column experiment with *Solanum melongena* was carried out to find the effect of different N sources on nitrate leaching, growth and yield parameters. Treatments were T₁(urea), T₂(*Gliricidia*), T₃(½ urea with ½ *Gliricidia*), and T₄ (1/4 urea with 3/4 *Gliricidia*). Complete randomized design was used with three replicates for both nitrate content in leachate and yield of the plant. Monthly agro well water samples were collected from twenty wells for a period of December to March 2009 and nitrate nitrogen, pH, and electrical conductivity were analyzed. Results of leaching column experiment showed that loss was highest (13.78mg) in urea treated column. Nitrate losses were 12.62 mg, 13.033 mg and 12.73 mg in *Gliricidia*, ½ urea with ½ *Gliricidia* and 1/4 urea with 3/4 *Gliricidia* respectively. There was no significant differences among treatments. Tallest plant was observed in *Gliricidia* treated column followed by urea , 1/4 urea with 3/4 *Gliricidia* and ½ urea with ½ *Gliricidia*. Maximum yield was obtained in ½ urea with ½ *Gliricidia* and minimum was in *Gliricidia*. However, no statically difference in yield among different N sources. The nitrate levels of studied agro-wells ranged from 6.2- 15.7 mg/l. results indicated that about 95% of the agro-wells polluted by nitrate, which was above safe level of 10 mg/l. pH and electrical conductivity of well water varied from 6.9-7.25 and 0.66-1.24mS/cm. However, these ranges were within permissible limit of Sri Lankan drinking water standards. Results indicate that *Gliricidia* and its combination with urea could give comparable yield to urea. However, nitrate leaching was not significantly reduced by *Gliricidia* treatments. As 95% of the surveyed wells had nitrate levels above permissible limits further research is essential to reduce leaching of nitrate in this soil.

Keywords : Leaching, Nitrate losses, *Gliricidia*, Urea

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Comparative study on low cost cool chamber and ambient storage for selected vegetables

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Index No: AG 397

This experiment was conducted at the District Agricultural Training Centre (DATC), Jaffna from November 2008 to May 2009 to find out a suitable method to reduce the present level of post harvest losses of vegetables during marketing in Jaffna district. A cool chamber was constructed using clay bricks, sand and cement. Its capacity is about 50 kg of vegetables. The aim was to find out the effective storage period of freshly harvested *Amaranthus spp.*, brinjal and carrot samples kept inside cool chamber and at ambient environment. These samples were kept packed with paper, banana petiole, perforated polythene and poly sack bag and without packing used as a control. This was to find out the suitable packing materials for storing fresh vegetables in cool chamber and at ambient. Maximum and minimum temperatures and relative humidity inside and outside of cool chamber were recorded for every hour during the day time (12 hours) for 5 days in December 2008 and in whole day (24 hours) for 5 days in May 2009. Changes in weight loss, colour, rotting, shrinkage percentage, total soluble sugar content, sensory characters and microbial count of the vegetables kept inside and outside the cool chamber were evaluated. The change in ascorbic acid content of *Amaranthus spp.* was also evaluated. Maximum and minimum temperature inside cool chamber was lower than at ambient environment by 3.3 to 6.3°C and by 3.7 to 5.7°C respectively during December. Similarly, maximum and minimum temperature inside cool chamber was lower than ambient environment by 1.5 to 6.1°C and by 3.2 to 3.8°C respectively in May. The average relative humidity inside the cool chamber was increase from the ambient environment by 13 to 23% and 12 to 25% in December and May respectively. Weight loss of all vegetables was significantly lower in cool chamber than at ambient ($p < 0.05$). Similarly colour change, rotting, shrinkage percentage and microbial count of all vegetables were significantly lower in cool chamber than at ambient ($p < 0.05$). Total soluble sugar content and sensory characters of all vegetables were significantly higher in cool chamber than at ambient ($p < 0.05$). Ascorbic acid content of *Amaranthus spp.* was significantly higher in cool chamber than at ambient ($p < 0.05$). Weight loss, colour change, rotting, shrinkage percentage, total soluble sugar content, sensory characters, microbial count and ascorbic acid content of selected vegetables differ significantly between different packing materials ($p < 0.05$). The shelf life was 3 days for the *Amaranthus spp.* samples packed with paper, banana petiole, perforated polythene, poly sack and without package and kept in cool chamber and it was only half a day at ambient. The shelf life of brinjal packed in paper, banana petiole, perforated polythene and poly sack and kept in cool chamber was 12 days and this was 3 days

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for the samples packed in paper, banana petiole, perforated polythene and poly sack and kept at ambient. The shelf life of carrot packed in paper, banana petiole and perforated polythene and kept in cool chamber was 12 days and this was 3 days for the samples packed in paper, banana petiole and perforated polythene and kept at ambient. Therefore, the cool chamber can work with very little energy and can retain the freshness of the vegetables for a considerable period. Banana petiole and paper wrapper were the more suitable, low cost and environmental friendly packaging materials for storage of *Amaranthus spp.*, brinjal and carrot in cool chamber as well as at ambient in Jaffna district.

Keywords : Cool chamber, Ambient environment, Packing materials, Effective storage

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Different sources of nitrogen in combination with locally available nitrification inhibitors on nitrogen in soil and plant

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Index No: AG 385

Experiments were carried out in Calcic red yellow latosols fertilized with urea, compost and poultry manure. A laboratory incubation study was conducted to find out the effect of different N sources with locally available potential nitrification inhibitor on ammonia volatilization, nitrification, microbial biomass and other properties of soil. Treatments were T₁ (urea), T₂ (compost), T₃ (poultry manure), T₄ (urea + *neem* leaf powder), T₅ (compost + *neem* leaf powder) and T₆ (poultry manure + *neem* leaf powder). A pot experiment with *Amaranthus* was also carried out to quantify NO₃⁻ leaching loss and NO₃⁻ accumulation in edible tissues for different treatments. Treatments used in pot experiment were T₁ (urea), T₂ (compost), T₃ (poultry manure), T₄ (urea + *neem* leaf powder), T₅ (compost + *neem* leaf powder), T₆ (poultry manure + *neem* leaf powder) and T₇ (urea + *Lantana camera* leaf powder). For both incubation experiment and pot experiment complete randomized design was used with three replicates. NO₃⁻ content of some selected vegetables from local market was also analyzed during study period to find whether they have nitrate risk or not. Results of incubation experiment with different N sources indicated that loss of ammonia volatilization was highest (18.39%) from T₃ (poultry manure) and lowest (15.4%) from T₅ (compost + *neem* leaf powder). Losses in other treatments were 18.22%, 17.11%, 16.74% and 16.15% from T₁ (urea), T₆ (poultry manure + *neem* leaf powder), T₄ (urea + *neem* leaf powder) and T₂ (compost) respectively. *Neem* leaf powder significantly reduced volatilization from all N sources. Lowest NO₃⁻ content and highest NH₄⁺ content observed in T₆ (poultry manure + *neem* leaf powder) treated soil after 2 weeks of incubation. Highest (2510µg/g) microbial biomass carbon measured in T₃ (poultry manure) and lowest (930µg/g) in T₁ (urea) on dry weight basis. Results of pot experiment showed that leaching loss was highest in urea treated pots. About 72.3%, 51.47% and 43.84% of reduction in leaching loss achieved by *neem* leaf powder with urea, compost and poultry manure respectively and 59% in urea with *Lantana camera* leaf powder. NO₃⁻ content of *Amaranthus* varied from 50.97 mg/Kg to 126.26 mg/Kg. Fertilization with compost and poultry manure significantly reduced NO₃⁻ accumulation in edible portion. None of the tested vegetable samples from market had nitrate risk. Results therefore indicate that, poultry manure and compost have potential in terms of reducing NO₃⁻ leaching loss, slow down nitrification, improve soil fertility parameters such as cation exchange capacity and microbial biomass carbon and reduce NO₃⁻ accumulation risk in edible tissues, compared to urea. Further, reduction in nitrate losses is also possible through incorporation of nitrification inhibitors with urea, poultry manure and compost.

Keywords : Nitrification inhibitors, NO₃⁻ leaching, *Neem* leaf powder, *Amaranthus*

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Adsorption, leaching and accumulation of Carbofuran in three different soil series of Jaffna peninsula

Student Name: Thushagini Kanthasamy

Index No: AG 399

A study was carried out to investigate the adsorption, leaching and accumulation of carbofuran in three soil series of Jaffna peninsula namely Chankanai, Inuvil and Navatkuli. For the adsorption study, soil samples were shaken with carbofuran having 625 μ g for 2 hours. Soil suspension analyzed for carbofuran. To fit the Freundlich isotherms of each soil, five different concentrations (1, 2, 3, 4, and 5ppm) of carbofuran were used. In the leaching study, samples from three soil series were packed into plastic columns. Soil columns were leached with 100 μ g carbofuran and leachate fractions were analyzed. Selected vegetables samples from market were analyzed for carbofuran. A pot experiment using *Amaranthus* was also carried out to analyze the carbofuran leaching and accumulation in plant sample. Three series soils were treated with formulated commercially available carbofuran. All the experiments were conducted in Complete Randomized Design (CRD) with four replicates. Adsorption of carbofuran was highest for Chankanai series and lowest for Navatkuli series. Percentage adsorption of carbofuran for Chankanai, Inuvil and Navatkuli soil series was 37.6, 19.2, and 5.6 respectively. There was a positive correlation between carbofuran adsorption and organic matter content. Among these three soils tested, K_{oc} (organic carbon normalized sorption coefficient) was highest (15.13) for Chankanai soil and lowest (2.71) for Inuvil soil. K_d ranged from 0.01 to 0.15 and K_{oc} ranged from 2.7 to 15.1ml/g. Leaching study revealed that leaching was highest (59.34 μ g) for Navatkuli soil, whereas, lowest for Chankanai soil. Leaching in Inuvil (40.3 μ g) and Chankanai (39.2 μ g) soils was more or less equal. Lowest leaching and highest adsorption was recorded for Chankanai soil. Likewise, Navatkuli soil showed highest leaching and lowest adsorption. Amongst all vegetables (carrot, *Amaranthus*, cabbage, brinjal, onion and potato) tested, highest (0.54 mg/100g) and lowest (0.008 mg/100g) carbofuran residue was detected in onion and potato respectively. None of the tested market vegetables had risk level of carbofuran residue when an adult consume less than 100g vegetable. In the pot experiment, highest carbofuran leaching was observed in Navatkuli series soil, whereas lowest leaching was observed in Chankanai series soil. Navatkuli soil significantly differed from rest of the soils; however, there was no significant difference between Inuvil and Chankani soils. Results of tissue analysis of *Amaranthus* from pot experiment revealed that highest and lowest carbofuran residue was observed in Inuvil and Chankanai soils respectively. Amount of residue in plant samples varied from 0.011-0.016 mg/100g. Thus, there is no chance of accumulating carbofuran at risk levels in *Amaranthus* when farmers apply recommended dosage in *Amaranthus*.

Keywords : Carbofuran , Leaching, Adsorption, *Amaranthus*

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Chemical and Microbial analysis of ice creams sold in Jaffna municipality area

Student Name : Bamithra Ponnampalam

Index No : AG 366

Everyone has the question about the quality of the ice cream produced in Jaffna peninsula. The greatest risk from microbes in ice cream is associated with consumption of ice cream that is contaminated with human and animal excreta, although other sources and route of exposure may also be significant. In this study attempts made to evaluate the quality of locally produced ice cream by chemical and microbial analysis. Ice creams from fifteen local industries were selected which include six large scale and nine small scale producers in Jaffna Municipality area including the places such as Jaffna town, Nallur, Thirunelvely, Kokuvil and Koiyaththottum. The study showed that there were variation in chemical compositions and microbial counts in ice cream samples obtained from different producers. The sugar contents of the ice cream samples were very high and varied from 21.3 g/100g to 29.2 g/100g with the mean of 25.6 (± 0.7) g/100g. All analyzed ice cream samples contained higher sugar content than the typical amount (15%). The protein content of ice cream samples varied from 1.5 to 3.9 g/100g. The fat contents of the ice cream were low and varied from 5.8 to 9.0 g/100g with the mean of 7 (± 0.8) g/100g. Only 13.3% of the ice creams were contained fat content above minimum permitted level (8%) by Bureau of Sri Lanka Standard. When ice cream samples were analyzed for microorganism, aerobic bacterial count in ice cream samples varied from 1.0×10^4 to 7.6×10^5 colony forming unit per gram (cfu/g). About 46.7% of the ice cream samples contained high amount of aerobic bacterial count than the acceptable standard level (5×10^4 cfu/g) by Sri Lanka Standard Institution. Among these 20% of ice cream samples contained extremely higher amount of aerobic bacterial count. All analyzed ice cream showed positive anaerobic. The anaerobic counts of the ice cream samples were varied from 8.5 to 22.2 cfu/g with the mean of 14.0 (± 4.4) cfu/g. All the analyzed ice cream samples were contaminated with coliform bacteria. Out of fifteen ice cream samples four (26.6%) contained faecal contamination. This was confirmed by analyzing the ice cream samples for *Escherichia coli* and four ice cream samples were contaminated. Among four ice cream samples one ice cream sample from large scale bacterial contamination producer and other three ice cream samples were from different small scale producers.

Keywords: Ice cream, Contamination, Chemical compositions, Microbial counts

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**DETERMINANTS OF ON-FARM AND OFF-FARM
PARTICIPATION DECISIONS IN THE THENMARADCHI FARM
HOUSEHOLDS**

Student Name: Abirami Rajadurai

Index No : AG 371

This research has taken effort to identify the determinants and quantify the effect of these determinants on the participation decision of the Thenmaradchi peasant farm women in both on-farm and non-farm activities. Thenmaradchi is one of the potential areas for agricultural production in Jaffna district. But, mostly the income from the farming tends to declining even below the subsistence level. The ground situation became worse due to the civil disturbances prevailed in near past. Nevertheless farming has been a major source of the household income, where labor force seem to be the only rich source those poor households' possess. But there exists a market for labor so that farm households are able to work in and hire out labor at a given market wage. Out of 1747 farm households in the study area 198 farm households were selected by using simple random sampling method. The data were collected by administering a structured questionnaire. The collected data were analyzed within the frame work of probit regression model. The estimated coefficient of women 'age manifested a positive influence over the possibility of their involvement in farming at 10% significant level. This implies that when woman's age is increases by one year, the probability of her decision to participate in the on-farm activities arises by 1.42%. Mean while the variable access to tarred road facility available to the village exerted a negative impact on the women's participation decision on on-farm work. The variable was found to be highly significant at 1% level, hence it can be concluded that, if there road facility is available to the village, the probability of the farm work participation of the women decreases by 0.01%. Same time access to the subsidy also influenced negatively on the on-farm working decision at 1% significant level. This implies that, if subsidy facility is available to the farm households, the probability of participating decision of women in the on-farm activities will decrease by 0.025%. It can be suggested that if the subsidy for farm input is available, the farm operators may be hire- in more labor and there is less requirement for the women to get involved in farm activities because in most instance peasant woman works at their own farm to substitute the hired labor with the intention of cutting down the cost of production. Paradoxically access to the tarred road positively

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influences on the probability of the peasant women's non-farm activities at 5% significant level. This implies that, if the tarred road facility is available, the probability of the non-farm work participation decision of the women will go up by 4.56%. Practically, it is true because when infrastructure facilities are available to the farm households that will expect to increase their mobility out of their farms. Therefore, it is explicit that, extending the labor market opportunities to the rural areas, well-constructed road facilities and regular public transportation facilities may be enhancing the non-farm labor participation decision of Thenmaradchi peasant women.

Key words: Peasant women, on-farm working decisions, non-farm working decisions, probit

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A SNAP SHOT OF COMMERCIAL DAIRY FARMERS IN JAFFNA DISTRICT

Student Name: Ganeshamoorthy Barthipan

Index No : AG 373

Protein plays a vital role in the formation of human diets. Protein deficiency has long been recognized for more than a century around the world. Dairy milk has been playing an important role in fulfilling the protein requirement of the people in Sri Lanka. But the Sri Lankan national dairy milk production is found to be far below the national requirement. Hence this research has taken attempt to identify the socio economic determinants of the commercial dairy milk producers and quantify the current technical efficiency status of the commercial dairy industry of Valikamam area located in the Jaffna district, Sri Lanka. The purposive random sampling consisted around 18 percent of total population. The primary data were collected by a structured questionnaire. The data were analyzed within the frame work of Cobb-Douglas production function and stochastic frontier production function by using the STATA 10 and FRONTIER 4.1. The results revealed that the capital investment, cost of concentrate feeds, cost of energy and availability of pasture are found to be significant and increase the milk production by 0.091, 0.163, 0.132 and 0.198 percents respectively. The hours of labors, herd size and health care cost manifested a significant negative impact and decrease the milk production by 0.139, 0.204 and 0.08 percents respectively. The mean technical efficiency of Valikamam dairy farmers was estimated to be 66 percent and this manifested that the Valikamam farmers still have room for the improvements.

Key words: Technical efficiency, stochastic frontier production approach, Dairy industry, Jaffna

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IMPACT OF TRADE POLICY CHANGE ON SRI LANKAN APPAREL EXPORTS

Student Name: Shanmuganathan Jeyasanthan

Index No : AG 380

Prominent growth in the apparel sector led to the profound transformation of the Sri Lankan economy. Sri Lankan exports around sixty percent of its apparel products to US and its apparel export to US contributes a fairly sizable portion of Sri Lanka's foreign exchange earnings. The termination of MFA quota by the end of year 2004 offers a wide range of openings and simultaneously increased the competition among countries. Primary aim of this research is to quantify the impact of the elimination of MFA quota on Sri Lankan apparel export category HS 6104. Moreover it has taken effort to estimate the import demand elasticities of HS 6104 in the US import market. The secondary data were collected from the US department of statistics and the analyses were carried out within the frame work linearized almost ideal demand system. The results suggested that the phase out of MFA quota provided an opportunity to Sri Lankan apparel exports to US. The negative sign of the own price coefficient stands as an evidence of consistency with the demand theory. The estimated uncompensated own price elasticity of -1.142 suggested that the revenue of Sri Lankan apparel sector can be increased by reducing the unit price of the export clothing. The resulted expenditure elasticity of 1.6264 suggested that the American consumers have a higher preference to the Sri Lankan clothing than Chinese, Indian and Bangladesh clothing. From all these results, this research propose for further quality improvement, vertical integration and a reduction in the cost of production as the key issues to Sri Lanka to be a successful exporter.

Key words: Sri Lanka, Apparel, Quota, Linearized AIDS.

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ADOPTION BEHAVIOUR OF CHILLI CULTIVATORS IN THENMARADCHCHI OF THE JAFFNA DISTRICT

Student Name : Kalaivani Karthigesu

Index No : AG 393

Even though chilli as one of the predominant cash crop said to be bringing more income to the farmers, the majority of the farm house holds are still not fully adopted to the chilli cultivation. The overall objective of this study is to find the degree of adoption of chilli cultivation and the determinant factors of the adoption of chilli cultivation farmers of Thenmaradchy located in Jaffna district. The samples were selected by using stratified purposive random sampling method. The sampled population represented around 16 percent of the total chilli cultivators in Thenmaradchchi area. Pretested structured questionnaire was administrated to collect the data from the chilli cultivators. The pair wise correlation between adoption of chilli and other individual variables such as farmers' education level, farmers' knowledge, age of the farmer, experience of farmer, farm size, market distance from farm land, capital availability and dummy variable of A.I range. The association between the adoption of chilli cultivation and the determinants were analyzed within the frame work of Tobit qualitative regression model. The results revealed that in pair wise correlation significant relationships were found between education level and knowledge, education level and adoption, knowledge and adoption, age and knowledge and experience and adoption. In Tobit qualitative regression model adoption showed significant relationships with education level, farm size, market distance from farm land and capital availability each.

Keywords:Chili cultivators, Adoption behavior, Scoring, Tobit, Thenmaradchchi

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Economics of Poultry Production Units in Jaffna District

Student Name: Bradhusa Kathiramalaiaperinpan

Index No : AG 374

This research has taken effort to study the economics of the poultry production units located in Jaffna district of Sri Lanka. The research considered the socio-economic determinants, rationality of poultry farmers, return to scale, resource use efficiency and elasticity as the key economic indications of the poultry production units. The purposive random sampling method was adopted. The selected sample represented around 20 percentage of the total population. The primary data were collected by administrating a structured questionnaire. The model assumed Cobb-Douglas production function and analysis was conducted by using the STATA 10. The analysis identified the feed as the major determinant factor and it increased the production by 0.6784 in layer. The total cost of vaccine and medicine, educational level and age of the farmer are found to be positively correlated with the production by 0.2, 0.0747, 0.3369 and 0.02 respectively. Further the results revealed that, even though the layer farmers are seems to be operating their plants rationally, but further analysis of the individual resource use efficiencies manifested the irrational behaviour of the farmers. This implies that in most instances the farmers found to be either over utilizing or underutilizing the resources in the production process. The estimates of the production function indicated that the total cost of vaccine and total quantity of feed were the major important factors in layer production. It is evident that amount of labour used in layer production is exceeding the optimum level. While the estimates of the returns to scale of the total model obtained indicates that layer production is in the rational stage of production function.

Key words: Poultry production units, Cobb- Douglas production function, Elasticity, Efficiency

Supervisor: Mr.K.Umashankar, Department of Agricultural Economics, Faculty of Agriculture, University of Jaffna, Sri Lanka

Agricultural information system in urumpirai division

Student Name:Balasubramaniam Jeyanthan

Index No:AG390

Traditional agricultural information system (AIS) has many short comings. It is paper based information and has minimum details. As a result, this study was carried out to establish computer based AIS. This new system is more dynamic and authentic one than traditional system. Urumpirai AI division was selected for this study because of its agricultural potential and availability of secondary data. Cadastral level map of this division was created with quickbird satellite images and regional soil map was created to show the soil variability. Arc view GIS 3.2a, software was used for data input, analysis, data base management and visualization of AIS. Among the 14 GramaNiladari (GN) divisions in this study area, cadastral level data were collected from five GN divisions including J/263, J/264, J/265, J/269 and J/270. Field level information was collected by questionnaire. Physical information such as, pH, electrical conductivity (EC) and total dissolved solids (TDS) was measured from selected pockets in entire study area and converted into cadastral level by point interpolation analysis and ensured reliability of 90%. Primary as well as secondary data were used to create (AIS). This AIS is most useful to farmers, agriculture related government and nongovernmental organizations to take the decision and offers all of information about agriculture in cadastral level. According to this study, capital was major (60%) influential factor in decision making process of farming and 12% of farms were headed by female farmers and 5114 farming families engaged in agriculture. Meanwhile, 44% of land was used in farming activities from 3809 ha of total extend. 450.2ha land was used for paddy cultivation during 2008 *Maha* season. Vegetables were cultivated throughout the year with crop-climate synchronization. Land used changes and sever land fragmentation were observed. In fact, Thirunelwaly was the major market for 65% of farmers. Totally 403 farming families were capitalized by bank of Ceylon, koppay and Chunnagam branches. According to this study, computerized AIS is the better way to give both micro and macro level information about agriculture and agricultural infrastructure facilities to all uses. Therefore, future studies should be conducted to all AI divisions to create complete AIS in Jaffna peninsula.

Keywords: Agricultural information system, Urumpirai, Division

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Geochemical classification of groundwater of limestone aquifer

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Index No:AG348

Geochemical classification of groundwater has useful application in agriculture, ecology and human health investigations. It is important for the development of civilization and to destabilized data base for planning future water resources development. The hydro geochemical study reveals quality of water that is suitable for drinking and agriculture. Presence of excessive quantities of sodium and chloride in groundwater is one of the major drawbacks in agriculture sector. The aim of study was to present the detailed chemical phases of groundwater of limestone aquifer. The chemical quality of groundwater is related to geology of the area. pH, EC, major cations; Na⁺, Ca⁺⁺, Mg⁺⁺, K⁺ and Fe⁺⁺ and major anions; Cl⁻, SO₄⁻⁻, HCO₃⁻, CO₃[—]and NO₃⁻ were determined for water supply wells from October 2008 to April 2009 and for other wells from January to March 2009 based on Sri Lankan standard. Irrigation water quality was determined based on EC, Na%, SAR and RSC. Saturation index values were calculated by both manually using PHREEQC package. The results of these analyses were plotted on piper and stiff diagrams. Water samples were grouped in to two major types, namely calcium and sodium type. The result revealed that Chunnakam, Nillavari, Allipiddy, Pokkanai, KKS and Vallipuiram water samples were grouped into Ca-HCO₃⁻ type, the wells at Valveddithurai, Puthtur, Velanai and Karinagar two and three samples were grouped in to Ca-NDA type while well at Kainagaer one was grouped in to Ca-Cl type. NaHCO₃⁻ type water present in aquifers at Thellipalai, Varani, Iyaththali, Thirunelvely, Kondavil, Jaffna, Manduvil, Vidaththaipalli and Kaithadi west. Na-Cl type free-dominantly found in areas of Karaveddy, Naranthanai, Arali, Vaddukodai, Nallur two Aryalai, Colubuthurai and Kaithadi North while Na-NDA type water present at Nallur two and Chavakachcheri. NaCl type water always consist higher TDS than other type of waters. Cl⁻ subtype have significant amount of SO₄²⁻ ions than other subtypes. CaHCO₃⁻ and Na-HCO₃⁻ types water are suitable for drinking purpose in continuous use. CaHCO₃⁻ type water is best for irrigation, permissible to doubtful waterfalls in Ca-NDA, CaCl₂, Na-HCO₃⁻, Na-NDA type water while Na-Cl type water are not suitable for irrigation. In Jaffna peninsula, calcite aragonites are predominantly found while dollomite also present in some parts of Jaffna peninsula and there are no any minerals of gypsem and halite. Karainagar one, Karaveddy, Naranthanai, Vaddukodai, Columbuthurai severely contaminated with sea water. Since PHREEQC coincide with manual, PHREEQC is suitable for limestone aquifer for the estimation of chemical parameters.

Keywords: Geochemical classification, Groundwater, Limestone aquifer

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Performance of okra (*Abelmoshus esculentus*) under drip irrigation system in red yellowlatosol

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Index No:AG349

In adequacy of water is one of the most prominent environmental constrains for agricultural production in dry and intermediate climatic zones of Sri Lanka though the majority of the soils of the zones are at acceptable fertility levels. Over usage of irrigation water can lead not only to shortage of water but also to the determination of crop yields and soil. Uniformity of the water distribution is an essential component of the drip irrigation system for effective irrigation. Hence the objectives of the of the study were selected as evaluation of irrigation scheduling parameters, field capacity and infiltration rate of calcic red yellow latosol, vertical and horizontal movement of water within the soil profile and the crop response parameters for the drip irrigation system. Measurement of discharge rate of a nozzle is important because application rate of an emitter should always be less than the infiltration rate of the soil. Preliminary investigation of all above mentioned parameters were promised our local conditions. Standard methods were followed for the investigation of irrigation scheduling parameters. Performance of drip system shows 91.86% of Christiansen's uniformity, 75.4% of emission uniformity coefficient and the statistical uniformity of 90.52% christiansen's uniformity and statistical uniformity were above the recommended value for the drip system. But, the emission uniformity coefficient was below the recommended level which reflects the water shortage at some emitters resulting water stress to the plants. The field capacity and infiltration rate were estimated as 20.56% in gravimetric basis and 330 mm/hr respectively. The estimated discharge rate was 3.258 L/hr at pressure of 0.5 kg/cm². Vertical and horizontal movements of water in 30 min interval were 24.18 and 28 cm respectively. Okra responded well for the drip irrigation system than the basin irrigation. Higher plant height and growth rate were recorded in the plants, under drip irrigation than the plants under basin irrigation. Root density and flowering index were also perfect in the plants under drip than in basin. Water saving is much higher in drip system than basin. The water saving range is 82.43% and 64.86% for 15 min and 30 min duration in drip irrigation respectively compared to control. The yield obtained for one meter squareland area for the duration of 15 min with mulch, duration of 30 min with mulch, duration of 30 min without mulch and C was 1.39, 1.37, 1.35, 1.33 and 1.08 kg respectively. There were no significant differences in yield due to mulching. The drip system promoted the crop growth, root development, flowering index and less weed population with minimum usage of water. Therefore drip irrigation system with daily 15 min irrigation duration for okra could be introduced with the intention of saving groundwater resource for the future use. Designed kit bucket system could be introduced to promote home gardening with least water wastage for okra.

Keywords: Performance, Okra, Drip irrigation system

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Studies on stabilization of rice bran and incorporation of it into a rusk

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Index No:AG356

Rice bran is an under-utilized by product of the rice milling industries. It has many unparalleled nutritional and medicinal properties that make it unique. But, because of its tendency of getting rancid easily after its production, it becomes unsuitable for human consumption. If it is properly sterilized through some means without destroying its beneficial properties, it will prove to be a breakthrough in many spheres of life. The method should be cost- effective and applicable to the grass roots and all walks of life. In Sri Lanka, successful incorporation of rice bran in to food products have not gone beyond 10 % according to the research carried out at Industrial Technology Institute (ITI). The objectives of the study were to find out a proper method of stabilization of rice bran soon after it is produced in a cost effective manner and evaluation of the highest level of incorporation in a rusk to give good sensory characters. The rice bran was obtained by dehusking and polishing of the paddy obtained from Gampaha area and also from, Kamala mills, Mallabe. The bran was treated with steam generated from boiling water in a steamer for 20 minutes; parboiled paddy was also used for the evaluation of success of stabilization. In addition, the bran obtained from Kamala mills was treated with steam for one hour in a steamer. The success of the stabilization was evaluated by determining the FFA (free fatty acids levels) which is an indication of stabilization. Furthermore, another part of the bran obtained from Kamala mills was extruded using the twin screw extruder with 20% and 40% of moisture content. They were divided into two parts and were kept at room temperature and incubator. The shelf life of the sample was analyzed by free fatty acids (FFA) method. Some of the bran stabilized by steaming for one hour was used for the development of rice bran incorporated rusk at 20, 25, 30 and 35 %. Twenty percent incorporation was observed to be the best one in the sensory evaluation by the trained panel at the industrial technology institute. Stabilizing the bran using steam for one hour prove to be successful. The bran can be successfully incorporated at 20 or 25% without any hesitation into food products.

Key words: Rice bran, Incorporation, Stabilization, Kamalamill, ITI

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The performance of sprinkler irrigation on cabbage (*brassica oleracea*) cultivation in Jaffna peninsula

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Index No:AG370

High efficiency irrigation systems are very important for water scarcity areas. Jaffna farmers do not have any recommended irrigation intervals and irrigation duration to cabbage under sprinkler irrigation. With the objective of estimating irrigation intervals and duration of cabbage, a field trial was carried out with sprinkler irrigation to see the performance of yield. The research was conducted during the period of 26th December 2008 to 19th April 2009 in DATC, Thirunelvely, Jaffna. The field possess the main soil type of Calcic Red Yellow Latasol and located under DL₃ region. Meteorological data were obtained from Meteorological station, Thirunelvely. ET_o was calculated from modified Penmon formula. Seasonal water requirement for cabbage was estimated by selecting suitable crop coefficient for four growth stages. Discharge rate of nozzles, diameter of nozzle, wetted area of the system, radius of the wetted area covered by the sprinkler, operating pressure at the sprinkler nozzles, drop break coefficient of the sprinkler and index for jet break up were calculated to evaluate the sprinkler system. Ten treatments were carried out including farmer's practices, morning sprinkler irrigation 15 and 25 minutes and morning and evening sprinkler irrigation 15 and 25 minutes with two varieties analyzed by 2 factorial randomized block complete design. The measurements were taken from randomly selected forty eight samples to analyse yield and quality parameters. The weather parameters; wind, rainfall, RH, temperature, all varied throughout the study period. Total rainfall of 356.9 mm was occurred. Average wind velocity was 4.56 km/h. Since the value of wind velocity had been less than 10 km/h, there was no significant in uniformity coefficient of sprinkler irrigation. Average discharge rate of experimental nozzles was 0.1467 lit/sec. The depth of water application in 15 minutes sprinkler irrigation was 8.252 mm, 13.753 mm of water in 25 minutes sprinkler irrigation and 30.957 mm of water in ridge and furrow irrigation systems. 15 minutes sprinkler irrigation with green coronet variety field recorded highest yield of 4.53 kg/m². 15 minutes sprinkler irrigation with K – Y cross variety field recorded lowest yield of 3.94 kg/m². Mean head weight was not significantly different within sprinkler irrigation treatments. But, Morning sprinkler irrigation was statistically not significant from morning and evening sprinkler irrigation and these two treatments were statistically significant from ridge and furrow irrigation for two varieties. Finally 15 minutes sprinkler irrigation was selected as best treatment and followed by 25 minutes sprinkler irrigation since 15 minutes sprinkler irrigation water application is lower

than other treatments. So this treatment economically best. Green coronet variety more response to sprinkler irrigation than K – Y cross variety.

Keywords: Performance, Sprinkler irrigation, Cabbage

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Effective utilization of municipal solid waste in an eco-friendly manner

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Index No:AG353

The present solid waste disposal models in Jaffna peninsula are a major impediment to the public health and environment quality. Therefore, a concept was developed to mix the Jaffna Municipal Solid Waste (JMSW) with the Toddy Distillery Spent Wash (TDSW) produced from Thiccam and Navalli distilleries. Composing of Municipal Solid Waste (MSW) is one of the eco-friendly waste management systems. In this study, composition of MSW was determined by taking random samples from collecting points located within Jaffna Municipal council limit and the manual separation was practiced. Pit method of composting at the field level and bin method at lab scale were followed with same treatment scheduling. The experiment was conducted in completely randomized design (CRD) with three replicates at field level. Based on spraying interval, treatment scheduling was T1, T2, T3, T4 and C that was once/week, once/two week, once/three week, once/month and without spraying of TDSW respectively. In addition to this, an enclosed centrally aerated compost digester with water circulation unit was designed to promote the concept of home composting. pH, temperature, moisture content, total and available nitrogen, both in the pit and bin samples, were analyzed by standard methods. Designed bin was evaluated by fitting the standard temperature model. The organic fraction in the JMSW was about 79%. The total nitrogen and available nitrogen in the samples obtained from T1, T2, T3, T4 and C in both pit and bin method were higher for T1 than all other treatments. There was significant difference in both total and available nitrogen for pit and bin samples obtained at the maturity time. The final pH of the TDSW treated compost was in the range of 7.5 to 7.8. There was no significant difference in the final pH of the compost from treatments compared to control. Moisture content was kept in the range between 50-70%. Temperature profile was higher in T1 that was 43°C than all other treatments for bin composting. The maximum oxygen consumption rate for the first 10 days of composting process for the designed centrally aerated compost digester was 5.11 mg/hr/g of solid waste but that was 3.89 mg/hr/g of solid waste for peripherally aerated compost bin. Quick composting, due to higher decomposition rate, within 35days, was recorded in the enclosed compost digester, is suitable for the household waste management. MSW management and household waste management are advisable to keep our city clean by minimizing the hazardous effects due to the improper disposal of the solids waste.

Agricultural Engineering

Keywords: Effective utilization, Municipal solid waste, Eco-friendly manner

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Design improvement by hot air recirculation for solar dehydrated brown lime to black lime production

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Index No: AG384

Food technology in Sri Lanka is at a dire need of significant developments strong enough to make a difference rich with a wide variety of fruits and vegetables. There is a massive surplus of the production of lime during the seasons. But, it is perishable in nature. Therefore, proper post-harvest handling and preservations are essential. Dehydration of whole lime has a potential demand as an export commodity. Therefore, a research has initiated in the dehydration of whole lime and its value added by products. Black lime production needs high energy and cost. This study evaluates methods of improvements in energy utilization and reduction of energy cost in drying. Newly design drier by hot air recirculation after reheating externally was evaluated for efficiency with and without air re-circulation. Performance in terms of energy utilization and energy cost for both with and without hot air re-circulation was evaluated. Results showed that hot air re-circulating drier has an average thermal efficiency of 35% and cost effectiveness of 32% compared to drier without hot air re-circulation. Further better temperature and humidity control, and thermal insulation were also observed. The new dryer with improved design and better energy efficiency was found to produce good quality dehydrated black lime according to the market demand. Comparison study on converting of fresh lime to black in three different temperatures using the hot air oven showed that the best temperature range for dehydration of whole lime was 130°C to 160°C. The lowest drying duration was taken by the sample dehydrated at 160°C and external appearance (quality) lost using low temperature and high duration. Previous study on biomass rack dryer showed that the maintaining of temperature between 130°C to 160°C and improving drying efficiency was necessary to obtain the market quality. Dehydrated black lime has moisture of 5-6%, water activity below 0.5%, acidity nearly 20-25% and colour of 25-27 lightness. The newly design hot air re-circulated electric batch type drum dryer has shown high efficiency in dehydration and this increasing efficiency can be applied to the biomass dryer for process commercialization.

Keywords: Design, Hot air, Recirculation, brown lime, black lime

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Design and evaluation of an extruder for mushroom sausage

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Index No: AG357

Mushroom is an important food item. There is great demand for edible mushroom for its flavor and nutrient content. It can be processed into products like sausage, burger, chow, cutlets and pizzas. Normally sausages are made from ground meat and are stuffed into casing. In Mushroom sausage, since it could be used as a vegetarian food, preferably casing should be non-animal origin. Eventhough the casing is made of plastic cellulose, they need to be removed before serving since they are not edible. Also it will be an additional cost. Therefore, the production of vegetarian sausage without a casing is preferred. This study was conducted to design an extruder to produce the mushroom sausage and to evaluate the extrusion performance at different operating conditions. Properties of the material (mushroom sausage mixture), such as density ($1.14 \times 10^{-3} \text{ kg/m}^3$), firmness (3.1kp), moisture content 63.64%) and particle size distribution were determined. Knowledge of material characteristics is important in the determination of design parameters. Design parameters like pitch angle (78°), normal pressure due to the bulk solid on the shaft (92.66 Nm^{-2}), total torque (73.96Nm), required power (0.102kW) and the expected throughput at different filling efficiency were calculated by using proper mathematical formulae and some parameters were assumed to suit the requirements (diameter of sausage, length of shaft, pitch length, barrel diameter, die lance length, inner radius of shaft, screw thickness, radial clearance and number of screw flight). According to the calculated and assumed design parameters, the drawings for the full equipment and its components were prepared with Auto CAD package. Materials required to fabricate each component were selected based on the hygiene and food safety and quantities were estimated by using machine drawings. Model machine was fabricated. Test trials were done using a pilot extruder to determine optimum screw speed (150 rpm) to obtain the maximum throughput of 20-25 kg/h with the power consumption of 220 W. Two factors which influence the response variable. Moisture content and particle size of the mixture play an important role on the throughout and power. There was no evidence for the mutual effect of moisture content and particle size. The test trials revealed that the moisture content of 50-60% is ideal for this extrusion process. The performance tests showed that the extruder could achieve most of the attributes required by the product.

Keywords: Design, Evaluation, Extruder, Mushroom sausage

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