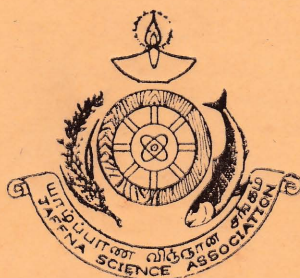


PROCEEDINGS OF JAFFNA SCIENCE ASSOCIATION

ABSTRACTS - 1998



SIXTH ANNUAL SESSION

03 - 05 JUNE 1998

JAFFNA, SRI LANKA

1998

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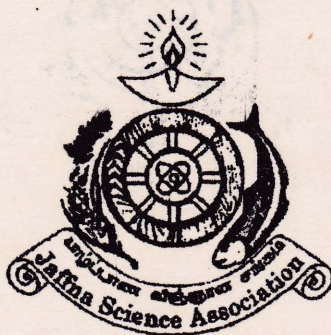
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**PROCEEDINGS
OF
JAFFNA SCIENCE ASSOCIATION**

ABSTRACTS 1998



**SIXTH ANNUAL SESSION
3 - 5 JUNE 98
JAFFNA, SRI LANKA.
1998**

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ABSTRACTS 1998



SIXTH ANNUAL SESSION
3 - 5 JUNE 98
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1998



This volume is a record of the proceedings of the Fourth Annual Session of the Jaffna Science Association. This contains the abstract of papers accepted for presentation at the sixth annual session of the Jaffna Science Association to be held at the University of Jaffna from 3 - 5 June, 1998. It contains twelve (12) abstracts in Pure Science, thirty seven (37) abstracts in Applied Science, two (2) abstracts in Medical Science and four (4) abstracts in Social Science.

I wish to thank the chairman of all sections for their assistance in getting these abstracts refereed in time for presentation at this annual session.

Mrs. R. Mahesan

Chief Editor

May 25, 1998



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Chief Editor

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A STUDY ON THE EFFECT OF NEEM SEED OIL ON GREEN GRAM SEEDS AGAINST *CALLOSOBRUCHUS CHINENSIS* (Coleoptera:Bruchidae)

Nithiyagowry Ratnasabapathy and Ganesalingam, V.K.
(Department of Zoology, University of Jaffna, Sri Lanka.)

Callosobruchus chinensis is one of the major pests of legume seeds such as green gram, black gram and ground nut. Such legumes in storage have to be prevented from insect attack. Protection should be afforded by botanicals which are effective, safe, non-persistent and cheap. The present study was undertaken to evaluate the effect of neem oil on egg laying, mortality and adult emergence in *C. chinensis*.

Five grams of infestation free green gram seeds were taken in the separate vials and mixed with neem oil of different quantities of 01, 03, 05 and 07 drops respectively (one drop = 0.0035 ml). Six hours after treatment, one pair of one day old, mated male and female *C.chinensis* from the laboratory culture were introduced into the petridish, closed with ventilated lids and left at $30\pm2^{\circ}$ C and 65-70 % relative humidity under laboratory condition in the dark. After seven days the total number of eggs laid, the egg mortality and the adults emerged were determined. Germination of green gram seeds was done in petridish containing soil under favourable environment. Five replicates were carried out and 25 readings were taken. In each replicate, control experiment was carried out simultaneously under the same conditions but with the seeds being mixed with water alone.

The results showed that there was a significant reduction in the number of eggs laid on the seeds mixed with different quantities of oil from untreated seeds ($P<0.05$). The use of only one drop was not effective. Significantly higher egg mortality was observed when treated with 03, 05 and 07 drops of neem oil than the untreated ones ($P<0.05$). The adult emergence was significantly reduced with neem oil treatment; and was completely ceased with 05 and 07 drops of oil. The developmental period from egg to adult was delayed by 1.2 days on treated seeds compared with those of untreated seeds. The weight of seed loss was significantly reduced from that of untreated ones ($P<0.05$) and there was no adverse effect on the germination of the treated seeds.

It was concluded that the protection of green gram seeds against *C.chinensis* appears to be effective when mixed with neem oil of 2.0 - 3.5 ml/Kg.

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ECOLOGICAL STUDIES OF INSECT COMMUNITIES IN THE NEERAVIADY, SIVANKOVIL AND PATRICKS PONDS OF JAFFNA PENINSULA, SRILANKA.

Chandrakanthy Rajendram

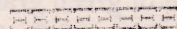
(Department of Zoology, University of Jaffna, Sri Lanka.)

It is generally accepted that benthic macroinvertebrates in ponds are of value as long term indicators of water quality and this fauna is also an important food for fish.

The aquatic insect communities in static environments of Jaffna peninsula in relation to their environmental conditions were studied. Three ponds situated in Nallur and Jaffna districts nearby to University of Jaffna were sampled monthly for two years from May 1990 to April 1992. The insects were collected by sweep net. Environmental conditions of the ponds such as temperature, pH, dissolved oxygen, free carbondioxide, bicarbonate, salinity, nitrate nitrogen, ammonium nitrogen and primary productivity were determined.

Altogether 23 species of insect belonging to 6 orders Hemiptera, Coleoptera, Odonata, Ephemeroptera, Trichoptera and Diptera were identified in these ponds. Of them the predatory back Swimmer *Anisops barbata* was dominant in Neeraviady and Sivankovil ponds but in Patricks pond it was the phytophagous mayfly nymph since the pond was full of vegetation.

From the analysis of simple and multiple correlation between the measured environmental factors and the entomofauna, it was found that the growth potential of aquatic insect populations however, depended on the concentration of dissolved gases, salts and alkalinity of the pond water. For example, in Patricks pond the predator species *Ranatra liliiformis* and Damselfly nymph showed a high positive correlation ($p < 0.01$) with the light penetration while the plankton feeder *Heleocoris bengalensis* and the scavenger beetle *Cercyonon aviarius* showed a high positive correlation ($p < 0.01$) with pH. In Sivankovil pond the scavenger bug *Micronecta punctata* and the predatory *Rhagodotarsus kraepelini* showed a high positive correlation ($p < 0.01$) with nitrate nitrogen content of the water.



THE DISTRIBUTION OF CALANOID COPEPODS (Copepoda : Crustacea) IN TWO PONDS IN JAFFNA PENINSULA.

Chandrakanthy Rajendram and Selvarajah, N.

(Department of Zoology, University of Jaffna.)

Calanoid copepods constitute an essential link in the food chain. They are also intermediate hosts for parasites of higher animals.

Some aspects of the distribution of calanoid copepods were studied in two freshwater ponds namely Nandavil and Sivankovil (Paravaikulam) in Jaffna peninsula. Monthly survey of calanoid population in relation to physico-chemical factors such as temperature, pH, dissolved gases, salinity and nitrogen content of the pond water was made for a period of two years from May 1990 to April 1992. Statistical analysis such as Duncan's Multiple Range Test, Spearman rank correlation and Multiple correlation tests were carried out to obtain the relationships between the density of copepods and physico-chemical factors.

A total of six different species were recorded in Nandavil pond and five species in Sivankovil pond. *Phyllodiaptomus annae*, *Rhinediaptomus indicus*, *Heliodiaptomus viduus* and *Neodiaptomus schmackeri* were recorded in both ponds, whereas *Allodiaptomus raoi* and *Zeylanodiaptomus papillopedes* were identified only in Nandavil pond and *Paradiaptomus greeni* in Sivankovil pond. *Phyllodiaptomus annae* was the most dominant in both ponds.

In Sivankovil pond the density of calanoid copepoda was significantly high ($P < 0.01$) during June 1991, and in Nandavil pond it was during August, 1991 (not significant). The analysis of multiple correlation coefficients revealed that the combined effect of physico-chemical factors of the pond water, has a great influence upon the abundance of calanoid copepoda.

Since the densities are high, fish may be cultured (Zooplankton feeders) in these ponds during the rainy season. Further study on the culturing of calanoid copepods will be useful.

ESTIMATION OF BASAL METABOLIC RATE IN JUVENILE *Penaeus Indicus*

Sivashanthini Kuganathan.

(Department of Zoology, University of Jaffna, Sri Lanka.)

Young *Penaeus indicus* were allocated randomly to a small 21 experimental tank, reared in UV - irradiated fine filtered sea water and maintained at $28 \pm 1^\circ \text{C}$ and 34 ± 1 ppt salinity with continuous aeration. These experimental prawns were fed with fresh mussel mantle tissue and acclimatized to the experimental conditions for two weeks.

Acclimatized prawns were transferred into conical flasks individually to prevent cannibalism and starved for 24 hours. At the end of the fasting period, a measurement of oxygen consumption was made to determine the steady- state fasting rate which was assumed as the routine rate (Dall, 1986) or basal metabolic rate, the energy utilized by an organism at rest.

Oxygen consumption was measured using closed respirometry with a polarographic oxygen electrode and oxygen meter. The rate of oxygen consumption was computed and converted to energy utilization. At the end of each experimental run, the total length of each shrimp was measured with vernier calipers to the nearest 0.01mm and the relevant dry weight of the shrimps were estimated from the calibration curve of dry weight versus total length.

The data obtained for metabolic rates of starved *P. indicus* showed a significant positive correlation with dry weight of the animals and an exponent of 0.63 ± 0.007 . The weight exponent of young *P. indicus* (0.63) falls within the range of 0.6 - 1.0 for crustacea (Wolvercamp & Waterman, 1960). The exponent value also fits the theoretical assumption that respiration rate is proportional to the two thirds power of body weight (Bertalanffy, 1957).

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EFFECT OF THREE DIFFERENT DIETS ON THE ABSORPTION EFFICIENCY OF JUVENILE *Penaeus Indicus*

Sivashanthini Kuganathan

(Department of Zoology, University of Jaffna, Sri Lanka.)

Absorption efficiency of juvenile *Penaeus indicus* (2.5-5.0 Cm in total length) reared in UV- irradiated, fine filtered sea water, fed with fresh mussel mantle tissue (D1 - 55.19 % protein & 8.01 % ash) and two commercial pelleted diets (D2 - 58.81 % protein & 12. 73 % ash and D3 - 63.31 % protein & 16.02 % ash) was investigated at $28 \pm 1^{\circ}$ C and 34 ± 1 ppt salinity by both the gravimetric method (e.g. Crisp, 1971) and ratio method (Conover, 1966). Absorption efficiencies obtained for all three diets were significantly different from each other, in both instances.

Very high mean absorption efficiencies of 88.93% and 90.14% was obtained for *P.indicus* juveniles by gravimetric method and by ratio method respectively, when fed with low protein mussel mantle tissue. Mean absorption efficiencies of D2 and D3 obtained by gravimetric method were 75.86% and 78.12% and by ratio method were 73.21% and 76.62% respectively. Gut evacuation time in *P. indicus* was 7-9 hours with fresh mussel and 2 - 5 hours with pelleted diets.

The lower digestibility of pelleted diet proteins for *P. indicus* in the present experiment may be due to an enzymatic inability to attack the compacted protein. Low absorption efficiencies with pelleted diets can also be related to quicker gastric evacuation time. Eventhough the pelleted diets were just passed through the gut, the absorption efficiency in terms of energy were only 12.30% lower than that of mussel diet for D3 and 14% lower for D2. Therefore , these diets can be applicable as efficient diets for *P.indicus* in aquaculture.

From the present experiment, it is apparent that the *P.indicus* utilize, the low protein animal origin diet efficiently than artificial diets. This would suggest that when dietary protein become excessive an increasing amount may be wasted, either undigested or used unnecessarily as an energy source. Thus, to maximize the growth in an intensive culture of penaeids the diets should be formulated with optimal rate of absorbable nutrients.

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EFFECT OF FEEDING ON THE METABOLIC RATE OF FISHES AND SHELL FISHES - A SHORT REVIEW

Sivashanthini Kuganathan.

(Department of Zoology, University of Jaffna, Sri Lanka.)

After feeding, the rate of oxygen consumption of fishes and shell fishes increases to a peak and then slowly declines to the pre-feeding level. An increase in metabolic rate following the ingestion of food was demonstrated in homeothermic animals first by Laplace and Lavoisier and the phenomenon was termed the specific dynamic effect by Rubner (in Kleiber, 1961). This has subsequently been termed the specific dynamic action (SDA), the heat increment, the calorogenic effect of feeding and related to the energy requirement for ingestion, digestion and absorption of the feed.

Many factors have been shown to influence the magnitude and duration of post-prandial oxygen consumption and these include quantity and /or quality of ration and environmental temperature. Eventhough, the majority of eco-physiologists defined SDA as 'the cost of digestion and food processing' the information available in the literature is often contradictory and thus, lead to a starting point for further investigations of the SDA phenomenon. The animal nutritionists proposed a number of theories which implies that SDA includes numerous energy costs associated with ingestion, digestion, intestinal work, absorption, amino acid oxidation/ urea synthesis and protein synthesis/growth (Jobling, 1983).

In recent years, the SDA has been documented in a variety of fishes and invertebrates including crustaceans since SDA investigations have obvious implication for nutritionists and aquaculturists in formulating diets promoting optimum rate of growth.

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THE 885 meV LINE DEFECT IN CZOCHRALSKI SILICON

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and Lightowlers, E.C.

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Thermal treatment of Czochralski - Grown (CZ) silicon between 450°C-500°C produces many technologically important defects via oxygen precipitation. One of the important groups of defects are the electrically active 'thermal donor (TD)' complexes, which can have deleterious effects on device performance. Post annealing and/or changing the annealing time produces various defect complexes, which are thought to be related to the TDs. In this communication we report a new defect detected by photoluminescence spectroscopy with a zero - phonon line at 885 meV. This defect is produced in oxygen - rich, carbon- lean CZ silicon after a long annealing (>200 h) at 470°C. Photoluminescence spectroscopy coupled with perturbation techniques were used to study the defect. Uniaxial stress measurements were made at 4.2 K, with the samples immersed in liquid helium. The stress measurements were carried out on X-ray oriented 12 x 4 x 2 mm³ samples with long axis in a <001>, <111>, or <110> direction. Polarisation studies were carried out with the laser excitation normal to the back 12 x 4 mm² plane and the photoluminescence detected normal to the front 12 x 4 mm² plane. The Zeeman experiments were carried out with a magnetic field of up to 6 Tesla, applied in turn along three principal crystallographic directions in an Oxford Instruments drip feed cryostat fitted with a Helmholtz pair of super-conducting coils. The luminescence was excited by 514.5 nm Ar⁺ laser and the spectra were recorded either using a Nicolet 60SX or a Bomem DA8 Fourier transform spectrometer fitted with liquid N₂ cooled North coast germanium diode detector. Uniaxial stress measurements have shown that this line can be interpreted as electronic transition at a point defect with a monoclinic I symmetry. Magnetic field perturbation studies suggests that the transition is between singlet states.

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STUDIES ON THE EFFECTS ON OPTIC TENTACLE ABLATION ON DORSAL BODIES AND ACCESSORY ORGANS OF THE FEMALE REPRODUCTIVE SYSTEM OF *CRYPTOZONA BELANGERI* (DESHAYES) (MOLLUSCA: PULMONATA STYLOMMATOPHORA)

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(Department of Zoology, University of Jaffna, Sri Lanka.)

Cryptozона belangeri (Deshayes) is a common land pulmonata hermaphrodite snail. It was already known that the female reproductive system and male reproductive system are influenced by dorsal bodies and optic gland respectively. In the present studies attempts were taken to show the influence of removal of optic glands on dorsal bodies and accessory glands of the female reproductive system of this snail.

In this experiment, the optic glands of the optic tentacles were removed in mature and immature individuals of *C. belangeri* and allowed to live for five days and after this period dorsal bodies and accessory gland were dissected, fixed, embedded, sectioned and stained for histological studies. Ten replicates were carried out. Controls were conducted concurrently.

The results showed that the immature snails after optic tentacles were removed developed dorsal bodies, hermaphrodite glands and the accessory organs namely such as albumin gland of the female reproductive system, similar to those of the mature ones. However the mature ones develop these dorsal bodies and accessory organs normally.

Although the optic gland was considered to influence the male reproductive system (Sukumaran and Sriramulu, 1977) and the female reproductive system is influenced by the endocrine gland, dorsal bodies (Krishnarajah, 1993) this study conclude that the optic gland of the optic tentacle has direct influence on dorsal bodies and the accessory gland of the female reproductive system in this snail.

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**PRINCIPAL COMPONENT ANALYSIS OF THE OPISTHAPTOR OF
Dactylogyrus Vastator NYBELIN, 1924
(A MONGENEAN GILL PARASITE)
REARED AT DIFFERENT TEMPERATURES.**

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Dactylogyrus vastator Nybelin, 1924 is a common, economically significant pathogenic monogenean gill parasite of European carp, *Cyprinus carpio* L. *D. vastator* attaches to the gills by means of an attachment organ, the opisthaptor, which carries two large hamuli, a connecting bar and fourteen marginal hooks.

Principal component analysis (PCA) is a multivariate analysis using morphometric data used to separate morphologically close species on the basis of considering all the measured variables simultaneously and loading for differences between the specimens. (Gibson, *et al.*, 1992). Principal component analysis was used to investigate the effects of temperature on sclerite measurements.

This study was carried out to assess the morphological variation or discrimination from the measured variables of *D. vastator* reared at three different water temperatures using PCA. The measured variables such as spike length of the hamuli, outer root length of the right hamuli, marginal spike length. It was shown that basic length of the hamuli and internal root length are the major factors which cluster more than 75.0% within the ellipse by which the population of the parasite reared at different temperature regimes can be discriminated. The length measurements cluster and fall within the ellipse, the ellipse of different temperatures can be separated off very clearly for the 12°C reared specimens than those reared at 14°C and 19°C.

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COMPOSITION AND SEASONAL VARIATION OF INVERTEBRATE MESOFAUNA AND THE EFFECT OF PHYSICAL, CHEMICAL FACTORS (IN A FRESH WATER POND.)

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The composition and seasonal dynamics of invertebrate mesofauna were investigated in the Pillaiyar Kovil pond in Jaffna Peninsula for a period of one year from November 1996 to October 1997. This pond was selected for the first time for this study. The physico-chemical factors of the pond water were also determined monthly at each survey.

The invertebrate mesofaunal community was rich as 25 species were identified. These included one annelid species, 16 insect species, 3 mollusc species, 2 species of crustacea and 3 species arachnida.

In terms of numerical abundance the insects, significantly ($P < 0.01$) dominated the community with 73.5% followed by molluscs 13.20%, crustacea 7.27%, arachnida 5.69% and annelida 0.27%.

Of the 25 species identified the total abundance of 8 species showed a high positive correlation ($P < 0.01$) with the volume of water which is high during the rainy season from November to December. The species richness was also high during this season.

Four species of mesofauna showed a positive correlation with light penetration of the pond water, but most of them showed a high ($P < 0.01$) negative correlation with salinity and dissolved carbondioxide content.

From this study it was found that the species composition and abundance of the total mesofauna reached the maximum during rainy season and minimum during dry season. (April - September).

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ASSESSMENT OF THE PROTEIN QUALITY OF SOYBEAN PRODUCTS

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Soyflour, tempeh, soymeat, thriposha, soy sausage, soy milk, soy ice cream and soy cutlet are the commonly consumed soy products in Sri Lanka. The effect of the processing techniques on the quality of these products is not known. Hence a systematic evaluation on the quality of these products was carried out using standard techniques.

Soyflour is a finely ground product processed from full-fat cotyledons or defatted flakes. Tempeh is produced in Sri Lanka by fermenting soybeans with *Rhizopus*. Soymilk can be processed from whole soybeans of full-fat soy flour. Thriposha is a cereal - based weaning food which contains 30% of soyflour, 70% of maize flour, 5% of non-fat dry milk, 0.8% of mineral and vitamin mixture etc. Sausages are prepared from partially defatted soyflour by an extrusion process. Soy ice cream is prepared from the soymilk in as much the same way as conventional dairy ice cream. Soy cutlets are prepared as the usual cutlets. Here, soy pulp is added as an ingredient along with potato, spices and salt.

The protein content of the products ranged from 8.51 % to 58.73 % for dried products and from 2.57% to 46.88% for fresh product. Soyflour had the highest protein content (58.73%) and soy ice cream had the lowest protein content (8.51%) under fresh conditions.

The amino acids aspartic acid and glutamic acid were found in highest amounts in all soy products (soy flour, thriposha, Nutra, soymeat, soy cutlet, soy sausage, tempeh and soy ice cream etc.). The sulfur containing amino acids, methionine and cystine were in least amounts in these soy products. Soy cutlet had the highest chemical score of 30% whereas tempeh and soy ice cream had the lowest chemical score of 14%. The amino acid composition of soy cutlet resembled that of soy flour. Regarding amino acid scores, all the soy products supply threonine at 100% or more of the requirement for adults. Lysine is supplied by soy flour at 100% or more of the requirement for adults. The sulfur containing amino acid requirement of pre- school children, school-age children and adults is poorly satisfied by all the soy products.

The in vitro digestibility values for thripasha and Nutra were higher compared to the other soy products. Tempeh which is a fermented product had a digestibility value of 88.81%.

The trypsin inhibitor (TI) content is high in soy sausage (3.072 mg TI/g sample) and low in Nutra (0.223 mg TI/g sample) among the eight soy products. The results of the regression analysis showed that there was a negative correlation (correlation coefficient = 0.85) between trypsin inhibitor contents in soy products and their in vitro digestibility values.

Feeding experiments with rates indicated that the replacement of the control diet (Prima feed:wheat flour = 1:5) with defatted soy flour (prima feed: defatted soy flour : wheat flour = 1:1:28) improved the weight gains of rats. From this experiment, the Protein efficiency ratios of 2.04 and 1.33 were obtained for soy diet and control diet respectively.

The factors determining protein quality showed variation among the soy products. The chemical scores and amino acid scores were low in soy products compared to soybean. Therefore, the processing conditions must be reassessed to obtain soy products of good protein quality.

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EFFECT OF FEEDING A FEW SELECTED VEGETABLES ON BLOOD CHOLESTEROL CONCENTRATION IN RATS.

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Ischaemic Heart Disease (IHD) is a major cause of mortality among the middle aged population in Sri Lanka, and hyperlipidaemia has been identified as a common risk factor involved. Since cholesterol and its esters have the greatest atherogenic potential, dietary and therapeutic agents capable of reducing serum cholesterol, especially in non-HDL lipoprotein fractions are of importance in the prevention of IHD. Because of the close connection between Cardiovascular disease and serum cholesterol, assessment of lipoproteins can be used in the calculation of cholesterol risk ratios.

To lower blood cholesterol, one could make use of foods containing high fiber content mainly Soluble Dietary fiber (SDF), protein and other dietary components like saponins, isoflavones and sitosterols.

An in-vivo study was undertaken to see the effect of vegetables on the serum cholesterol level of male Sprague Dawley rats. Five selected vegetables with high soluble fiber contents, viz. carrot, brinjal, snake gourd, bitter gourd and radish were investigated.

The test and control groups comprising 3 months old male Sprague Dawley rats of weight 170 to 200 g, in group of four were fed with 'Prima' broiler feed with and without an oven dried food article (25%) supplemented with cholesterol (1%) and cholic acid (0.2%). After 3 weeks average food intake was determined and the animals were bled following a 14 h fast, and sera were analysed for total and HDL cholesterol using Randox kits.

Bitter gourd fed group showed a slightly higher food intake than the other vegetable fed groups. But the difference between the food intake values is not significant.

The total and HDL cholesterol levels of the control group were 78.59 ± 7.55 and 35.17 ± 2.34 mg/dl respectively (Total : HDL=2.23). Test groups fed with carrot, brinjal, snake gourd and radish gave similar results as control group (Total : HDL=2.00-3.19). Bitter gourd fed group (Total : HDL=1.90) displayed a significant decrease in non-HDL serum cholesterol (26.62 ± 13.7 ; $P < 0.1$) and total cholesterol (54.51 ± 9.52 ; $P < 0.05$) levels, although the food intake was higher than that of other vegetables.

These results show that bitter gourd has cholesterol lowering potential when compared to the other vegetables tested.

The cholesterol lowering effect may be due to the presence or absence of other dietary factors that influence cholesterol metabolism..

Therefore further work is necessary to identify the active agents with hypocholesterolaemic effect in bitter gourd and other vegetables.

INFLUENCE OF NITROGEN ON RATE OF GROWTH AND SHOOT POPULATION OF CLONE TRI 2024.

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A field investigation on the effect of different nitrogen levels 112, 224 and 336 Kg/ha/year in two climatic seasons (cool and dry / warm and wet) in tea was carried at Tea Research Institute, Talawakella. Application of 224 Kg showed significant effect on growth parameters than 112 Kg during the favorable warm and wet season. The response of nitrogen at 224 Kg level during cool and dry season was found to be low. This could be attributed to the soil moisture deficit during that season.

An increase in the level of N from 112 to 224 Kg/ha increased the total yield by 20%, shoot population by 19%, harvested shoot density by 22%, relative shoot extension rate by 6% and reduced the duration of shoot replacement cycle by 6 to 11 days. Nitrogen at the rate of 336 Kg/ha gave no extra increase in growth parameters from that of 224 Kg/ha. However, at all levels, N had no effect on time taken to unfurl two successive levels (phyllochron) and mean air temperature. The shoot population density and mean shoot dry weight are strongly but negatively correlated.

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--ADSORPTION AND DESORPTION ISOTHERMS OF RED DRIED CHILLIES

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A 'J' Shaped isotherm was obtained when red dried chillie was subjected to a range of temperatures (25°C to 40°C) and relative humidities (23% to 88%). Chilli had low adsorption capacity of moisture at low relative humidity and the moisture content was increased exponentially when the relative humidity was increased. Results revealed that low relative humidity (less than 67%) and high temperature (greater than 30°C) were suitable for a long term storage. Out of these two factors, the relative humidity determined the storage stability. Relative humidity of 88% and above were detrimental for long term storage.

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SOME OF THE BIOLOGICAL ASPECTS OF WOOD - ROT CAUSING FUNGI IN TEA BUSH.

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Wood-rot in tea bush is caused by two specific fungi called *Hypoxylon investiens* and *Tunstallia aculeata*. Mode of entry of the pathogens cultural requirements such as pH, growth media, temperatures and enzymes produced during their growth were studied at Tea Research Institute, Talawakella.

Both *Hypoxylon* and *Tunstallia* entered tea bush through their pruning cuts. These pathogens thrived well at a pH range of 4.2 to 6.0 where the plant extract had pH between 5.8 - 6.0. *Tunstallia* preferred Czapek Dox Agar (CDA) whereas *Hypoxylon* grew well on Potato Dextrose Agar (PDA) and Malt Extract Agar (MEA). Growth medium containing different proportions of N, P, K, Ca and Mg with fixed amount of C when tested showed no influence on growth rate of both fungi but higher levels of Ca increased the growth rate of *Hypoxylon*. Although both fungi thrived between 19° C - 31° C, *Hypoxylon* preferred 25° C whereas *Tunstallia* thrived well between 22° - 28° C. Both *Hypoxylon* and *Tunstallia* proved capable of producing wood decay enzymes such as phenoloxidase. Laccase, phosphates, esterase and peroxidase.

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SCREENING OF COCOA (*THEOBROMA CACAO L.*) CULTIVARS FOR RESISTANCE TO *PHYTOPHTHORA PALMIVORA* INCIDENCE

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Phytophthora Palmivora infection on cocoa is severe at high relative humidity and rainfall causing destruction of pod, stem, leaves and roots. Experiment was conducted at the Department of Export Agriculture, Matale to study the level of resistance of cocoa cultivars. *P. palmivora* was artificially inoculated from pod culture in the form of fragments and spore suspension on eight cultivars of cocoa to study the level of resistance to *P. palmivora* incidence. When wounded bark was inoculated with fragments of pod culture and leaves with spore suspension, rate of spread of lesion were found to be significantly different in different cultivars. Infection on unwounded bark inoculation is negligible in all cultivars. When infection was introduced through soil to roots there were no significant root decay but shoot of the seedlings were affected and showed significant difference in various cultivars.

In the artificial inoculation of *P. palmivora* on wounded bark, leaves and roots of cocoa, among the eight cultivars tested clone Amelanado (standed) showed most resistance to *P. palmivora* and selection of Amelanado A₁₀ and A₉ were found to be moderately resistance.

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STUDY OF SOME COMPONENTS OF AN INTEGRATED PEST MANAGEMENT SYSTEM OF SHOT-HOLE BORER (*Xyleborus fornicatus*) OF TEA IN SRI LANKA.

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Introduction of selected components of Integrated Pest Management in a study to control shot-hole borer (*Xyleborus fornicatus*) in tea bush at Tea Research Institute of Sri Lanka, Talawakelle consisting of application of tea bark volatiles, natural and synthetic insecticides and biological control agents such as entomopathogenic fungi showed that only tea bark volatiles had positive results. Tea bark volatiles examined consist a mixture of geraniol, phenyl acetaldehyde, methyl salicylate, t-2 hexanal and linalool. However geraniol alone gave equal attractancy to that above mixture. Natural Insecticides (Bioncern, Pestoneem and Multineem) artificial insecticides (Mosphilan and Javan) and biological control agents (*Paecilomyces fumoserosus*, *Beauveria bassiana* and *Metarhizium anisopliae*) were found to be ineffective. Pheromones were not tested, since *Xyleborus fornicatus* undergoes parthenogenesis. Hence geraniol could be introduced into a biochemical trap to control the famale shot-hole borers.

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THE RESPONSE OF MAURITIUS VARIETY PINEAPPLE TO CONTROLLED ATMOSPHERE STORAGE

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An experiment was carried out in controlled atmosphere condition to determine an ideal condition of storage for pineapple during export.

Pineapple when supplied for export takes normally minimum of 17 days in the ship at 10°C and about 2 days at ambient temperatures before it reaches the consumers. The Mauritius variety pineapple develop an endogenous brown spot (Black heart) in and around the core of the fruit when it reaches the consumers. High levels of free calcium and low levels of bound calcium were associated with high incidence of the black heart when storing Mauritius pineapple variety.

Different storage regimes for Mauritius pineapple when waxed and kept under various composition of controlled atmospheres of CO₂ and O₂ at 10°C did not completely alleviate the expression of Black heart disorder. However, waxed fruits stored in 6% CO₂ and 3% O₂ showed reduction (50%) in the severity of the disorder when compared to the fruits stored under unwaxed condition at 10°C. Whereas waxed treatment alone at 10°C when compared with waxed and stored under 6% CO₂ and 3% O₂ at 10°C resulted in no significant differences in the calcium content, but black heart severity score is marginally less for controlled atmosphere storage. Therefore waxing alone reduced the Black heart severity in Mauritius pineapple variety.

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EFFECTS OF HORMONAL APPLICATION AND MATURITY OF CUTTING ON ROOTING ABILITY OF COFFEE.

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Coffee is generally propagated by seeds. However, *Coffea canephora*, *Coffea excelsa* and *Coffea liberica* are self sterile, as such seedlings produced heterogeneous progenies. Therefore, vegetative propagation is inevitable to maintain genetic purity.

Two field experiments were separately conducted to ascertain the best stage of maturity of cuttings and then to study the effect of hormonal application on rooting ability of coffee varieties catimore and IMY.

The first experiment was carried out to find out , the ideal maturity stage of cuttings, for better and early rooting ability in coffee varieties of catimore and IMY.

The second experiment was conducted to study the effect of hormones of Indole Beutric Acid (IBA) and Naphathalene Acetic Acid (NAA) individually and in combination of 10 ppm and 100 ppm, under humid chamber.

In the first experiment, it was found that the maturity stage of cutting significantly determined the growth of the shoot and root in IMY variety only. It was also observed that the soft wood cuttings, with the presence of apical bud and semi-hard wood cuttings of the variety of IMY, produced better and longer roots than the hard wood cutting.

The result of the second experiment reveals, that the pre-treatment of the cuttings, with the combination of the two hormones IBA and NAA (1:1) at 10 ppm level found to be very effective than other treatments. This combination gave the best rooting percentage of 83.33%, while the sole application of NAA or IBA individually gave only 73.33% and 60% rooting percentage respectively.

Therefore, it could be concluded, that in both varieties semi - hard wood cuttings with a pre-treatment of IBA and NAA(1:1) at 10 ppm level gave the best result. Hence, this method could be recommended for the vegetative propagation of coffee.

Table 1.0 Effects of cutting on the length and the number of roots

Treatments	Time in Weeks							
Type of Cuttings	12th week				14th week			
	NP	NS	PRL	TL	NP	NS	PRL	TL
Immature cutting with the apical bud	a 0.05	a 3.83	a 2.25	a 7.58	a 1.00	a 15.0	b 4.37	ab 15.6
Semi hard wood	a 0.50	b 0.00	b 0.47	b 0.47	ab 0.50	ab 9.0	a 6.87	a 35.9
Hard wood	a 0.00	b 0.00	b 0.00	b 0.00	b 0.00	b 0.00	c 0.00	b 0.00
Variety								
IMY	a 0.67	a 2.56	a 1.81	a 1.35	a 1.00	a 16.8	a 7.46	a 34.4
Catimore	b 0.00	b 0.00	b 0.00	b 0.00	b 0.00	b 0.00	b 0.00	b 0.00

Table 2.0 The effect of hormones and its concentration in rooting percentage.

Treatments	Rooting percentage
<u>Hormones</u>	
IBA & NAA	83.33 ^a
IBA	60.00 ^c
NAA	73.33 ^b
Control (Double distilled water)	53.84 ^c
<u>Concentration</u>	
10 ppm	83.33 ^a
100 ppm	70.00 ^{ab}
0 ppm	27.77 ^b

The mean value with the same letters were not significant at α value 0.05 percentage.

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A STUDY ON INSECT PESTS OF VEGETABLE CROPS IN JAFFNA

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A study was made on insect survey during the three months period 1995, in five locations namely Thirunelveli, Kokuvil, Urupbirai, Irupalai I and Irupalai II in the vegetable crops such as brinjal, okra and tomato.

Green leaf hopper (*Empoasca fascialis*), whitefly (*Bemisia tabaci*), Epilachna beetle (*Epilachna* sp), mite (*Tetranychus cinnabarinus*) and shoot and fruit borer (*Leucinodes orbonalis*) were the commonest pests in brinjal in all five locations. The damage done by above pests were very high and loss crop was enormous. The population of other pests in brinjal was very low and their damage was not significant.

In okra, green leaf hopper (*Empoasca fascialis*), aphid (*Aphis gossypii*), mite (*Tetranychus cinnabarinus*) and red cotton bug (*Dysdercus koenigiileaves*) were important pests. The damage by these pests was very high in all locations.

In tomato Jassids (*Empoasca* sp), aphid (*Myzus persicae*), leaf minor (*Liriomyza bryoniase*) and fruit borer (*Heliothis* sp) were the foremost pests. The infestation by these pests were low compare to brinjal and okra.

Natural enemies, mostly the parasitoids and predators supposed to keep the pests under control were not available even in small numbers.

Majority of farmers in the fields under observation were adopting chemical methods to control the insect pests. However this does not appear to have any effective control.

It was observed that the pests build up in the field under study was due to various factors such as absence of suitable natural enemies, use of insecticides which not only kills the pests but also kills the natural enemies, movement of pests from neighbouring fields, cultivating the same species of vegetable crops continuously, lack of cultural practices and not keeping up proper sanitation in and around the field.

A STUDY ON SOME INSECT PESTS OF STORED PRODUCTS IN JAFFNA DISTRICT.

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In order to study the pests of stored product insects in Jaffna district, five food stores were selected and investigated for the pests on rice, wheat flour, green gram and dhal.

The rice weevil (*Sitophilus oryzae*) was the foremost pest on rice in all five stores examined. The damage done by this weevil was very high and the loss of food material as enormous. The population of other pests on rice was very low and their damage was not significant.

In wheat flour, the red flour beetle (*Tribolium castaneum*) was a dominant pest. The infestation by these beetles were very high in all store houses and the population was also increased with period.

In green gram the pulse beetle (*Callosobruchus chinensis*) was the foremost pest. The pest population increased in time. The Siamese grain beetle (*Lophacaterus pusillus*) was also found as the second important pest in green gram.

The rice weevil was a dominant pest in dhal. The infestation of these beetles was very high in one of the stores but negligible in other stores. Other pests were not significant.

It was observed that the insect infestation in these food materials was due to poor sanitation and improper maintenance. It is suggested that proper precautions have to be taken in this direction to minimize insect pest damage.

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CHARACTERISTICS OF ORGANIC FARMING PRACTISING AT BOWLANA, KANDY.

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Intensive Agricultural practices with the indiscriminate use of inorganic fertilizers and Agro-chemicals are often criticised for their adverse effects on the environment and also affecting the health of human beings. Recently, advantages of using organic techniques in the farming system are increasingly recognized by scientists, consumers and farmers worldwide for solving this crisis.

This study was conducted to evaluate the productivity and profitability of organic farming in comparison with inorganic farming carried out in Bowlana village located in Kandy district. Samples farmers in this village were interviewed for this study.

Organic farming system in this study area was introduced and promoted by an NGO (Gami Seva Sevana). This NGO supplies all inputs in subsidised price and also arranges market facilities for organic products.

This study reveals that the productivity of organic farming was less than that of inorganic farming but, profitability is high due to higher market price and consumer preference for organic products. For development of organic farming animal component (cattle) is important. Low cost of production in organic farming leads to farmers to obtain relief from credit problems. Some simple organic techniques for preventing or controlling pest and diseases and efficient utilization of some organic materials as fertilizers were identified during this study.

Creating co-operatives among farmers and giving publicity for organic products are found to be necessary to promote the organic farming in other parts of the country. Thus the success of organic farming system largely depend on generation of new sustainable technology, suitable to a particular structural set-up.

Adoption of organic farming practices seems to be gradual and systematic. Hence, it should be backed up sound research and development net-work, since farmers are the ultimate decision makers.

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EFFECT OF AMMONIUM NITROGEN ON SOIL FERTILITY AND SHOOT GROWTH OF CLONAL TEA.

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An investigation was carried out to study the effect of levels of ammonium nitrogen on soil fertility, growth and yield of Clonal tea (TRI 2024) currently in the fourth year of pruning cycle, in an ultisol, at Tea Research Institute, Talawakelle. The levels of Nitrogen were 112 Kg (N_1), 224 Kg (N_2) and 336 Kg (N_3) as Ammonium Sulphate in combination with 60 Kg P_2O_5 and 140 kg of K_2O /ha/year.

The results indicated that content of soil organic carbon and Nitrogen, Phosphorus, Potassium and Calcium of soil and plant nutrients were maximum at N_2 level of Nitrogen application when compared to N_1 and N_3 . The results of the growth measurements studies such as rate of photosynthesis and shoot extension and yield showed a similar trend to that observed for nutrient studies. The soil pH and Magnesium content of both soil and plant decreased progressively with increasing nitrogen levels. The results suggest that optimum level of nitrogen required for maximum production is 224 Kg Nitrogen/ha/year.

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THE EFFECT OF DIFFERENT PACKAGING MATERIALS AND STORAGE CONDITION ON SEED VIABILITY OF TOMATO AND CAPSICUM.

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Two laboratory experiments were conducted at the Faculty of Agriculture, Kilinochchi, to study the effect of different packaging materials and storage conditions on seed viability of tomato (wilt resistant and Roma) and one variety of Capsicum (Hungarian yellow waze) were tested using three packaging materials (Paper; Aluminum foil and Polythene); under different storage conditions. Viability of the seeds packed in paper bags and in aluminum foil was tested only under normal atmospheric storage condition, while seeds packed in polythene bags were tested for their viability under three storage conditions, viz. normal atmosphere, refrigeration and saw dust. Both experiment were carried out using RCB design and treatment were replicated three times.

After ascertaining the initial viability seeds were subjected to different treatments. Thereafter, they were tested for their viability at 15 days intervals for a period of 135 days.

No significant difference was observed in viability retention, between two varieties of tomato seeds packed in different packaging materials and stored under different conditions.

The percentage of viability of seeds stored under refrigeration was significantly higher than that of the seeds stored under normal atmospheric condition during the period from 60 to 135 days. However, even under normal atmospheric condition, the viability of seeds was found to be as 90% up to 135 days.

In the case of Capsicum, viability of the seeds stored under refrigeration was found to be 72% at the end of the experimental period (135 days), where as under normal atmospheric condition capsicum seeds started to rapidly lose its viability after one month and reached a viability percentage of 55% at the end of the experimental period (135 days). Among packaging materials tested, Aluminum foil and polythene were found to be significantly superior than paper bags.

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EFFECT OF FLOWER REMOVAL ON CANOPY DEVELOPMENT AND BERRY YIELD OF COFFEE.

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A field experiment was conducted to study the effect of initial flower removal on canopy development and berry yield of coffee. This was a long term field experiment in which flower removal treatments have been imposed from 18 months after field planting of catimor coffee variety.

Four treatments were carried out in this experiment.

- | | |
|----------------|--|
| T ₁ | No flower bud removal, allow to flower from the first year onwards (Control) |
| T ₂ | Flower bud removal up to first year and then allow flowering thereafter. |
| T ₃ | Flower bud removal up to second year and then allow flowering thereafter. |
| T ₄ | Flower bud removal up to third year and then allow flowering thereafter. |

Growth parameters such as plant height, canopy diameter, stem thickness, number of primary and secondary branches were recorded at monthly interval and soil moisture status were also observed with a Neutronprobe at weekly interval.

Canopy development parameters such as, plant height, canopy diameter, stem thickness, number of primary and secondary branches significantly increased in T₂, T₃ and T₄ treatments compared to T₁ (Control) treatment.

Among this parameters no significant differences observed in number of primary and number of secondary branches among T₂, T₃ and T₄ Treatments.

However plant height, canopy diameter and stem thickness were found to be significantly high in T₄ treatment, in which flowers were removed continuously for 3 years, and then plant allow to flower compared to T₂ and T₃ treatments.

Fresh Coffee berry yield collected from the first and second year reveals that removal of flower bud during first year increased the berry yield by 76l g./ Plant over the control.

Therefore it could be concluded that removal of flower bud during early stage help to develop canopy and there by increased the berry yield in catimor dwarf coffee.

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DESIGNING THE SYSTEM TO PROPEL THE AUTOMOBILE ENGINES BY USING BIO-GAS

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An experiment was carried out at the Department of Agricultural Engineering Faculty of Agriculture Kilinochchi to investigate the possibility of using raw bio-gas as supplementary energy source.

A feasible low cost dome type bio_gas production unit is available to obtain gas continuously. Three storage tanks (1, 2 and 3) were used for maintaining pressure. Then an specified purification unit was developed for water removal, H_2S and CO_2 removal and O_2 removal sections in which raw gas flowed through different chemicals such as silica jel, lime water, $CuSO_4$ and Pyrogallic acid. Again a series of bottles with lime water and $CuSO_4$ were used for the confirmation of absent of CO_2 , H_2S and H_2O in the purified gas. Thus, purified gas stored in a tank (4) in which a thin layer of oil poured on the water surface. Petrol Max.'s fuel tank and lorry tube with tyre were compressed with bio-gas by using air inflator. A regulatory valve controlled the pressure at 55 to 60 psi with reduction of each 5 psi at the point of delivery. Internal combustion spark ignition type four stroke single cylinder CG-125 old model motor bike was used as an application unit with little modification of carburetor.

It was found that 40 liters volumed 55 to 60 psi pressurised purified gas could be used to propel the application unit to the distance of 250 meters with pressure reduction of 5 psi. Mechanical failure was not interrupted and this system could be used extensively.

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DETERMINATION OF SUITABLE ENERGY REQUIREMENT AND OPTIMUM CONDITIONS FOR INDUSTRIALIZATION OF AERATED SOAKED PADDY PROCESS

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Parboiling means partial cooking of paddy to achieve an acceptable level of geletinization in order to increase head-rice in milling process. More than 60% of Sri Lankan consume parboiled rice as their prime source of energy. Consumers prefer to have parboiled rice which has shown as a growing demand in our country.

Parboiling consists of soaking, steaming, drying and tempering. More energy is being consumed in transitional method of parboiling. Reduction of energy consumption for this procedure helped effectively in modified parboiled unit which was designed in the Department of Agricultural Engineering, University of Peradeniya.

This study was conducted to identify energy requirement for the process using hot water boiling instead of steaming paddy. During the procedure all parameters regarding paddy-specific heat, bulk density, pressure drop, air flow rate and deep bed characteristics of parboiled paddy were analysed. Aerated soaking at 27°C for 42 hours, hot water treatment at 90°C for 60 minutes, drying at 53°C for 60 minutes and tempering at room temperature (27°C) for 48 hours were found as ideal for parboiling in industrial sector.

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WATER MANAGEMENT ON RICE CULTIVATION IN AKKARAYAN MAJOR IRRIGATION SCHEME.

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Recent research findings indicated that there is great potential to improve the performance of exiting irrigation systems in Asian rice growing regions. So Akkarayan major irrigation rice growing scheme was selected where water availability and efficient irrigation management are being identified as major problem. This could be attributed to the adverse climatic and soil and also associated with irrigation system design and tradition cultural practices.

The research was carried out during the Yala season in 1994. Water losses from tank conveyance system, crop evapotranspiration and wastages due to traditional cultural practices were measured by appropriate experiments. The total water consumption from the tank including tank losses were 1081.8 mm as theoretical value and 1379.8 mm as calculated value. Duty at the point of sluice was 1545.4 mm as theoretical value and duty at the point of farm was 2550.4 mm as calculated value. These calculated values were compared with the theoretical values. The highest water loss was found in conveyance system.

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STUDY ON WATER MANAGEMENT FOR RICE CULTIVATION IN KARIYALA NAGAPADUWAN SCHEME

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A field study was conducted to determine the irrigation requirement of rice cultivation during 1994 Yala season at Kariyala Nagapaduwan scheme and also to investigate the present status of tank irrigation system. Most of the settlers in this scheme had abandoned their allotments due to insufficient supply of water particularly during the dry season.

Water requirement for land preparation and crop evapotranspiration at various status, percolation and seepage losses and conveyance losses were measured experimentally. The total water consumed from the tank including water loss from tank as evaporation and seepage was 18.65 ft. Duty of 3½ months rice crop was 8.93 ft. In general the irrigation requirement varied from 4 to 6 ft. Seepage and percolation through unlined channels, leakage through defective control structures and wastage through improper water distribution and management lead to a relatively higher water requirement. The configuration of Kariyala Nagapaduwan tank has low volume/ area ratio leads large amount of evaporation and seepage with losses. The possible improvements to reduce water consumption at all three factors were discussed.

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SCORING METHOD ESTIMATION OF GENE FREQUENCIES OF BLOOD GROUPS -A-CASE STUDY

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Blood is an important material of any human beings for survival. Blood transfusion has become a common place treatment that the hazards of transfusion are frequently over looked. Hence finding the structure of ABO system in the Jaffna society is essential for further research. The system has three allelomorphic genes A, B and O. These genes give six genotypes which refers to the specific genes that carries. Although all the systems have given rise to transfusion difficulties the ABO system is of major importance and need to be known.

Altogether 84 University students who were studying in 1994 participated on a blood donation campaign at the Jaffna General Hospital. Their blood groups were recorded since every human being can be classified into one four blood groups O, A, B and AB. The classified observed frequency data were subjected to the statistical analysis known as scoring method estimation.

The maximum likelihood equations are usually complicated so that the solution cannot be obtained directly. A general method would be to assume trial solution and derive linear equations for small additive corrections. This process can be repeated until the corrections become negligible. A great mechanization is introduced by adopting the method known as the scoring system for obtaining the linear equations for the additive corrections. The score and informations for grouped data is described for the purpose of this research.

The observed frequencies 60,11,11 and 2 for the blood groups O, A, B and AB respectively were used. The Bernstein's estimates were obtained as trial solutions. The score and information were calculated and the corresponding differential equation were verified. The gene frequencies were finally estimated. The findings are 84% ,8% and 8% for the genes O, A and B respectively among the Jaffna University student community.

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MONOCHLOROACETIC ACID FOR IMPROVED ETHANOL PRODUCTION BY IMMOBILIZED YEAST CELLS

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Saccharomyces cerevisiae adsorbed on acid-washed glass beads produced 5.4g l^{-1} ethanol at 96h in batch process. Precoating the acid treated glass beads with gelatin (25g l^{-1}) before immobilization of the cells increased ethanol production to 26.3g l^{-1} at 72h. Cell leakage into the medium was decreased when the immobilized cells were cross-linked with increasing concentrations of glutaraldehyde ($0-100\text{g l}^{-1}$). Although monochloroacetic acid inhibited ethanol production and cell multiplication at concentrations greater than 0.1g l^{-1} , at a concentration of 0.01g l^{-1} it not only increased the ethanol production to 52.1g l^{-1} but also shortened the ethanol production time to 48h. In semi-continuous batch process with the feed containing 0.01g l^{-1} monochloroacetic acid, immobilized cells showed no significant change in ethanol-producing ability for 40 days when the immobilized cells were incubated with nutrient medium intermittently.

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CONTINUOUS BATCH SOLID STATE PRODUCTION AND EXTRACTION OF GLUCOAMYLASE IN LARGE SCALE

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For small scale cultivations of fungi, spore inoculum is generally used. Use of spore inoculum becomes difficult when large scale cultivations are carried out and mycelial inoculum becomes practically feasible. Thus the suitable age of the mycelial inoculum should be determined. In this work first the mycelial solid inocula of different ages of *Aspergillus niger* CFTRI 1105 were developed by inoculating the spores (6 days old, 2×10^7 spores g wet medium⁻¹) to solid medium (g kg⁻¹; soya meat powder, 300 and paddy husk, 690 and (ml kg⁻¹) mineral solution, 30 and tap water, 270; mineral solution contained ZnSO₄·7H₂O, 0.7g; FeSO₄·7H₂O, 0.7g and CuSO₄·5H₂O, 0.7g in 100 ml 2N HCl) and incubating for different periods at 30°C. Then different inocula at different ages were mixed to solid medium (10%, w/w). The optimum age of the inoculum was mixed and incubated. Maximum activity (271.5U DMM⁻¹; Dry Mouldy Medium) was obtained on 2nd day. From the above first batch mouldy medium, 100g was withdrawn at 24 h and inoculated to 1.0 kg fresh solid medium. Similarly another batch was carried out and the maximum glucoamylase produced in the second and third batches were 420.2 and 272 U g DMM⁻¹ (2nd day) respectively. To extract the enzyme, to the mouldy medium (1.0 kg, moisture content 60%) sterile distilled water (5.0l) was mixed either in one step or in two steps or in three steps or in counter current steps. The glucoamylase activity obtained in one step, two steps, three steps and counter current extraction method were 30.8, 42.7, 46.7 and 96.3 U ml⁻¹ respectively. Hence the counter current extraction method is most suitable to extract the glucoamylase from mouldy medium.

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CITRIC ACID PRODUCTION IN LIQUID SURFACE CULTURE BY RECYCLING *ASPERGILLUS NIGER* CM₁

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Cell recycling has advantages over batch process because in the former the biomass is conserved and thus the fermentation time is reduced. In this study *Aspergillus niger* CM₁ was cultivated at room temperature in a medium containing (gl⁻¹) NH₄NO₃, 0.75; KH₂PO₄, 0.5; MgSO₄.7H₂O, 0.1; peptone, 14; ZnSO₄.7H₂O, 0.1 x 10⁻³, ferrous ammonium sulphate, 0.1 x 10⁻³ and CuSO₄.5H₂O, 0.06 x 10⁻³ and (ml⁻¹) methanol, 30 and gingili oil, 2 at pH 5.2 in a conical flask by inoculating with mycelium (65 h old). Citric acid produced in the medium reached the peak (58.2gl⁻¹) at 8th day and the reducing sugar level decreased to 4.0 gl⁻¹. The spent medium was replaced with fresh medium and the cultivation was continued. In the second cycle maximum citric acid (28.2 gl⁻¹) was produced on the 5th day. Likewise the recycling of the biomass was continued for two more batches. Maximum citric acid produced in the 3rd and 4th cycle were 9 (2nd day) and 6.0 gl⁻¹ respectively. The citric acid produced in the 3rd and 4th cycles were 17 and 11% respectively of that produced in the 1st batch. Thus recycling of the biomass had decreased the time required for maximum citric acid production from 8 to 2 days while decreasing the citric acid productivity from 7.3 to 3.0 gl⁻¹d⁻¹.

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PREPARATION OF A SUBSTITUTE FOR NUTRIENT BROTH TO ACTIVATE *BACILLUS LICHENIFORMIS* 6346

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Fish (200 g) suspended in saline (1000 ml) was left at 30°C for 48 h. The extract (1000 ml) was mixed with pepsin (270×10^3 Units in 250 ml 0.5N HCl) and incubated at 30°C for 24 h (Fish extract hydrolysate.) The residue (150g) was pressure cooked with 6N HCl (400 ml) for 2 h and the extract was collected (Fish hydrolysate). Three activation media for *Bacillus licheniformis* 6346 were prepared by taking either the mixture of fish hydrolysate and fish extract hydrolysate (2.0 : 5.0, volume ratio, 20 ml) or fish extract hydrolysate (20 ml) or nutrient broth (20 ml, 25 g l^{-1}), 3.0 g l^{-1} soluble starch and 3.0 g l^{-1} , $(\text{NH}_4)_2\text{HPO}_4$. The activation media (20 ml) were inoculated with 2 loopsful of the bacteria and incubated at 42°C for 18 h. The activated bacteria (5.0 ml) was inoculated with 20 ml of the respective activation media and incubated for 5 h at 42°C to prepare the inocula. The different inocula (20 ml) were mixed to solid medium (80 g) (containing (g kg^{-1}) paddy husk, 300; rice flour, 10; soya flour, 32 and $(\text{NH}_4)_2\text{HPO}_4$, 6.4 and (ml kg^{-1}) gingili oil, 9.0; coconut oil, 3.0 and tap water, 440) and incubated at 42°C. At 4th day α -amylase activity obtained in the solid medium inoculated with the *B.licheniformis* containing inocula prepared by taking either the mixture of fish hydrolysate and fish extract or fish extract hydrolysate or nutrient broth in terms of glycine were 25.5, 0.37 and 0.88 mg ml^{-1} respectively. Then to a fixed amount of fish extract hydrolysate (13.6 mg amino acid) varying amount of fish hydrolysate (from 6.6 to 33.3 mg amino acid) was added to prepare the activation medium. Highest α -amylase activity ($1218 \text{ m mole g DBM}^{-1} \text{ min}^{-1}$) was obtained in the solid medium which was inoculated with the activation medium containing the fish extract hydrolysate: fish hydrolysate in the volume ratio of 4.0 : 10.0 (amino acid ratio of 1.0 : 2.5). Hence this media could be used as a substitute for nutrient broth.

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PREPARATION OF AN ACTIVATION MEDIUM FOR *Bacillus Licheniformis* 6346

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Different imported media are used for the activation of bacteria from stock cultures. Due to the present crisis availability of these media is limited. Thus alternatives for nutrient broth were studied. The activation media for *Bacillus licheniformis* 6346 were prepared by taking either beef extract (20 ml) or nutrient broth (20ml, 25 g l⁻¹) and soluble starch (3.0 g l⁻¹). The activation media (20ml) were inoculated with two loopsful of *B.licheniformis* from stock culture and incubated at 42°C for 19 h. These were (5 ml) again mixed to 20 ml of the respective activation media and incubated at 42°C for 5 h to prepare the inoculum. Different inocula (20 ml) were added to solid medium (80 g) and incubated at 42°C. Solid medium contained (g Kg⁻¹) paddy husk, 300; rice flour, 10; soya, 32 and (NH₄)₂ HPO₄, 6.4 and (ml kg⁻¹) gingili oil, 9.0; coconut oil, 3.0 and tap water, 440. At 4th day the α -amylase activity obtained in solid medium inoculated with *B. licheniformis* in different activation media prepared from beef extract, soya bean powder extract, fish extract and nutrient broth were 430, 779, 1180 and 1221 μ mole g DBM⁻¹ min⁻¹ respectively. Then fish extract activation medium was supplemented with 0.0, 1.0 and 3.0 g l⁻¹ (NH₄)₂ HPO₄, maximum α - amylase produced at 4th day were 1180, 1312 and 1426 μ mole g DBM⁻¹ min⁻¹ respectively. When fish extract activation medium was supplemented with 3.0 g l⁻¹ (NH₄)₂ HPO₄ and 1.0 g l⁻¹ yeast extract, maximum α-amylase activity obtained in the solid medium was 887 μ mole g DBM⁻¹ min⁻¹, while when the control activation medium, which does not contain yeast extract, was inoculated to solid medium, maximum α -amylase activity (1246 μ mole g DBM⁻¹ min⁻¹) was obtained at 4th day. Hence fish extract supplemented with 3.0 g l⁻¹ (NH₄)₂ HPO₄ and 3.0 g l⁻¹ soluble starch can be used to activate *B.licheniformis*.

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SELECTION OF A CARBON SOURCE AND FED BATCH PROCESS FOR CITRIC ACID PRODUCTION BY *ASPERGILLUS NIGER*

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Use of a locally available cheap carbon source, sucrose in palmyrah fruit pulp extract (PFP extract I) to produce citric acid was investigated. In addition sugars in partially purified PFP extracts such as pectin removed with CaO (PFP extract II), pectin removed with propan-2-ol (PFP extract III), rice flour hydrolysate (obtained by simultaneous liquefaction and saccharification, RFH) were used as carbon sources. Commercially available glucose and sucrose were used as controls. The fermentation medium contained (gl^{-1}) sugar, 80, NH_4NO_3 , 0.75; KH_2PO_4 , 0.5; $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, 0.1; peptone, 14.0; $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$, 0.1×10^{-3} , ferrous ammonium sulphate, 0.1×10^{-3} and $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, 0.6×10^{-3} and (ml l^{-1}) methanol, 30 and gingili oil, 2.0. *Aspergillus niger* was grown in the fermentation medium by surface culture at pH 5.2 and 30°C . When PFP extract I, PFP extract II and PFP extract III were used as carbon sources 6.5gl^{-1} (6th day), 6.0gl^{-1} (7th day) and 2.3gl^{-1} (7th day) citric acid was produced respectively. But when rice flour hydrolysate (RFH), glucose and sucrose were used as carbon sources 32.7, 27.4 and 16.9gl^{-1} citric acid was produced respectively on the 6th day. The results indicated that sugars in rice flour hydrolysate was the best carbon source for citric acid production. The sugars in rice flour hydrolysate was used as carbon source for the fed batch citric acid production while glucose containing medium was used as the control. This process was continued for 14 days in 4 cycles.

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CALCIUM ALGINATE ENTRAPPED LACTOBACILLUS CASEI FOR CONTINUOUS LACTIC ACID PRODUCTION

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When *Lactobacillus casei* was grown in nutrient medium (medium contained g l^{-1} ; glucose 150; yeast extract, 10; K_2HPO_4 , 0.5; KH_2PO_4 , 0.5 and sodium citrate, 1.0 and salt solution 1.0 ml; salt solution contained g l^{-1} ; $\text{MgSO}_4\cdot\text{H}_2\text{O}$, 50.0; $\text{MnSO}_4\cdot\text{H}_2\text{O}$, 3.1; $\text{FeSO}_4\cdot 7\text{H}_2\text{O}$, 2.0 and ascorbic acid 5.0) at 42°C and pH 6.5, maximum lactic acid (140.2 g l^{-1}) was produced at 38 h. Cells harvested in log phase (18 h) were entrapped in calcium alginate (10 g l^{-1}). When the beads were packed in a thermostated (42°C) column ($20 \times 2 \text{ cm}$), optimum flow for maximum lactic acid yield (74%) was 18 ml h^{-1} . At this flow rate productivity obtained was 21.2 g l^{-1} . With increase in the flow rate, viable cells in the beads were decreased. However cell number was more than that present initially. When different concentrations of glucose in the range of 50 to 250 g l^{-1} was passed at 18 ml h^{-1} , maximum lactic acid yield (81.6%) was obtained at the glucose concentration of 125 g l^{-1} . With an increase in glucose concentration from 50 to 100 g l^{-1} , viable cells in the beads were increased and further increase in glucose concentration in the feed decreased the viable cell number in the beads. When the nutrient medium containing 125 g l^{-1} glucose was passed continuously, steady state was observed after 3 days and continued for 17 days.

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SEPARATION OF ACID SOLUBLE PECTIN FROM PALMYRAH FRUIT PULP

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Pectin is used not only as a food additive due to its gelling properties but also to reduce the serum cholesterol level. Pectin is generally separated from fruits like that of Citrus species. In Sri Lanka pectin is not isolated but imported. Hence a study was made to separate pectin from locally available cheap fruits such as palmyrah fruit. Palmyrah fruit pulp (0.57kg) was manually extracted (0.57 kg l^{-1}) with distilled water (430 ml). The pH of the extracted pulp was changed from 4.8 to 1.3 by adding con. HCL (5.1 ml, sp. gravity 1.18) and the temperature was maintained at 60°C for 30 min. The hot content with acid soluble pectin was strained through a double layer muslin cloth. The extract (740 ml) was centrifuged (4000 rpm) for 10 min and the supernatant was left at room temperature for 48h. The dielectric constant of the extract was changed by mixing with propan-2-ol (50%,v/v) and the acid soluble pectin in the clear supernatant (730 ml) was gelated. The gel formed was washed by resuspending in distilled water (420 ml) and propan-2-ol (775 ml) and left for 1h at room temperature. The pectin gel separated was dried in air (20 min), oven (45°C , 30 min) and finally in a dessicator to attain constant weight. From 0.57 g of pulp 0.1 kg of acid soluble pectin was extracted.

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UV AND CHEMICAL INDUCED MUTATIONS FOR INCREASED CITRIC ACID PRODUCTIVITY BY *ASPERGILLUS NIGER* P₁

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Production of citric acid is entirely a microbe oriented process. *Aspergillus niger* excretes citric acid (primary metabolite) in trace amount. Thus mutants are used for commercial citric acid production. In this study, citric acid producing *A. niger* was isolated from natural source and multiple mutation was carried out by different methods. Among *A. niger* from different sources (such as decaying lime, laboratory waste and kitchen waste), *A. niger* P₁ from decaying lime was selected. When the fungus was cultivated in surface culture in liquid medium [containing (g l⁻¹) NH₄NO₃, 0.75; KH₂PO₄, 0.5; MgSO₄.7H₂O, 0.1; peptone, 14.0; ZnSO₄.7H₂O, 0.1x10⁻³, ferrous ammonium sulphate, 0.1x10⁻³ and CuSO₄.5H₂O; 0.06x10⁻³] citric acid productivity obtained at room temperature was 0.27g l⁻¹ d⁻¹. From the spores (6 days old) of parent *A. niger* P₁, natural mutants were selected based on high Acid Unitage value (AU=Diameter of acid zone/Diameter of a colony) produced in bromocrasol green indicator bacteriological agar plates. Among 2 natural mutants selected *A. niger* P₂ was confirmed as the best citric acid producer. The citric acid productivity of this mutant was 0.49 g l⁻¹ d⁻¹, ie. two time increase in citric acid productivity was obtained. The spores of *A. niger* P₂ was mutated by UV-irradiation (254nm, 10min, 6.0cm from the UV source). Among the mutants, *A. niger* UV₁ showed highest citric acid productivity (1.21g l⁻¹ d⁻¹) and this achieved to 2.5 folds productivity. This productivity was increased further to 3.21g l⁻¹ d⁻¹ by supplementing the medium with 30g l⁻¹ methanol and 2.0ml l⁻¹ gingili oil. *A. niger* UV₁ was again subjected to UV-mutation and the *A. niger* UV₂ obtained gave 2.67g l⁻¹ d⁻¹ citric acid productivity. The ethyl methane sulphonate (2%,v/v; 75 min) induced mutation of *A. niger* UV₂ gave a mutant *A. niger* CM₁ giving a citric acid productivity of 7.2g l⁻¹ d⁻¹.

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SIMULTANEOUS SACCHARIFICATION AND FERMENTATION OF LIQUEFIED STARCH IN RICE FLOUR TO ETHANOL AND THE RECYCLING OF YEAST CELLS

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At present, most industries use a two step process in which the liquefied starch is first saccharified to glucose followed by its fermentation to ethanol. This technology is not only time consuming but also results in high concentration of glucose which inhibits the metabolism of yeast. Hence the simultaneous saccharification and fermentation of liquefied starch in rice flour to ethanol was investigated. Starch in rice flour (200g l^{-1}) was suspended in tap water and liquefied by thermostable alpha amylase ($2.5\text{KNUg}^{-1}\text{, DS}$) at pH 7.0 and 90°C . The total and reducing sugars obtained at 1h were 220g l^{-1} and 140g l^{-1} respectively. To the liquefied syrup (DE 63.6%) glucoamylase (Spiritamylase, 2.3AGUg^{-1} of initial DS) and yeast (Fermipan, 10^8 cells ml^{-1} medium) were added and allowed for simultaneous saccharification and fermentation at pH 5.0 and 35°C . At 48h, 65g l^{-1} ethanol was obtained. When the glucoamylase concentration added was reduced to half of its original concentration (1.15AGUg^{-1} of initial DS) for the simultaneous saccharification and fermentation process, 5g l^{-1} and 65g l^{-1} ethanol was respectively obtained at 48h and 72h. When the commercial glucoamylase (Spiritamylase) was replaced by glucoamylase preparation from our laboratory (obtained by solid state fermentation), similar result were obtained. A study was performed to recycle the yeast cells for ethanol production by manually decanting the spent medium and replacing the spent medium with fresh liquefied sugar syrup and glucoamylase. The ethanol production remained constant for first four cycle (65g l^{-1} , at 72h) and started to reduce to 59g l^{-1} and 41g l^{-1} in the 5th and 6th cycles respectively. From the results it can be concluded that the locally produced glucoamylase can be used instead of the commercial enzyme preparation and the yeast cells can be recycled for 4 batches without decreasing the ethanol production.

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DOWNSTREAM PROCESSING OF PALMYRAH FRUIT EXTRACT FOR SUGAR

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The main components of the palmyrah fruit plup (%w/w) were sugar 14 -16, crude protein 2.8, lipid 1.0 and fiber 1.5 . Pectin is also present in the pulp. Palmyrah fruits (five fruits weighing 7.3kg) were peeled and the pulp was manually extracted by adding water (1.6l). Pulp extracted was 28.4% (w/w) of the fruit weight and the pulp in extract was 0.57kg l^{-1} with 1.75 folds dilution. The pH and reducing sugar in the pulp were 3.9 and 90.8g l^{-1} . Pectin in the pulp extract was gelated by mixing with quick lime powder (containing 50% CaO) instead of $\text{Ca}(\text{OH})_2$ in solution. When 1.96g l^{-1} quick lime powder was added to the pulp gelation took 22min. However when the amount of quick lime used increased to 2.08g l^{-1} , gelation time was reduced to 12min. The effect of pH with constant amount of Ca^{2+} ion (20ml of 10% CaCl_2 , 0.7g of Ca^{2+}) on gelation was studied in the pH range from 7.0 to 10.0 by adjusting the pH using 0.1N NaOH. The optimum pH for the gelation in presence of Ca^{2+} was 9.0 and the time taken for gelation was 12min. The gelated pectin was separated using a strainer and a pale yellow colour sugar extract (780ml) was obtained. The sugar content and optical density (at 610nm) of the sugar extract were 96.2 and 0.06g l^{-1} respectively. The recovery of sugar in this process was 83.3%.

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APPLICATION OF FERTILIZER FOR α -AMYLASE PRODUCTION BY *BACILLUS LICHENIFORMIS* 6346 IN SOLID MEDIUM

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Bacillus licheniformis 6346 was activated in nutrient broth (25 g l^{-1}) and inoculated to solid fermentation medium (20%, v/w). The solid fermentation medium contained (g kg^{-1}) paddy husk, 250; rice flour, 62.5; $(\text{NH}_4)_2 \text{HPO}_4$ 15.5; $\text{Na}_2\text{HPO}_4 \cdot 2\text{H}_2\text{O}$, 7.8; $\text{Na}_2\text{H}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$, 4.7; KCl, 3.13 and $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, 0.0625 and (ml kg^{-1}) gingilli oil, 23.4; coconut oil, 7.8 and tap water, 425. The inoculated medium was incubated at 42°C and maximum α -amylase activity ($790 \text{ m mole g BDM}^{-1} \text{ min}^{-1}$,) was obtained on 6th day. When $(\text{NH}_4)_2 \text{HPO}_4$ (15.5 g kg^{-1}) in the solid medium was replaced with $(\text{NH}_4)_2\text{SO}_4$ (15.5 g kg^{-1} of commercially available fertilizer), maximum α -amylase activity obtained was $431 \mu \text{ mole g DBM}^{-1} \text{ min}^{-1}$ (6th day). Thus 0.6 fold reduction in α -amylase production was obtained. Then KCL (3.13 g kg^{-1}) was replaced with 3.036 g of $\text{K}_2 \text{O}$ (mured potash) and 2.457 g of NaCl (table salt) and maximum amylase activity obtained was $766 \mu \text{ mole g DBM}^{-1} \text{ min}^{-1}$ (6th day). Further $\text{Na}_2\text{HPO}_4 \cdot 2\text{H}_2\text{O}$, (7.8 g kg^{-1}) and $\text{NaH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$ (4.7 g kg^{-1}) in the solid medium was replaced with triple super phosphate (16.0 g kg^{-1} , T.S.P), maximum α -amylase activity obtained was $1075 \mu \text{ mole g DBM}^{-1} \text{ min}^{-1}$ (6th day). The results obtained indicated that the analytical grade salts can be replaced by locally available fertilizer for the production of α -amylase by *Bacillus licheniformis* 6346.

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ISOLATION OF A THERMOPHILE AND ITS IMPROVEMENT

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and Balasubramaniam, K.**

(Department of BioChemistry, University of Jaffna, Sri Lanka)

Different thermotolerant (45°C) bacterial and yeast strains were collected from cow-dung, sewage, soil, restaurant waste and distillery stillage. Fifteen different *Bacillus* strains were isolated and none of which produced alcohol. But a thermotolerant yeast strain showing 90% viability at 45°C for 10 h and zero viability at 55°C after 5 h was selected. Medium used for selection was YPD [(g l⁻¹) yeast extract, 10; peptone, 20 and glucose, 20]. Viability was determined by methylene blue staining method. Strain improvement of this selected yeast strain was carried out. Strain was subjected to UV-mutation (254 nm, 6 cm and 10 min) and thermal shock at 55°C for 10 min. This cycle was repeated 10 times. After each UV and temperature treatment, strain was subcultured and 18 h old culture was used for subsequent treatment. Finally an yeast strain with 100% viability after 5 h at 55°C was obtained. Glucose fermentation was carried out with parent and improved yeast strains at 30, 37, 40 and 45°C using YPD containing 140 g l⁻¹ glucose. The parent strain gave the alcohol yields of 92.9 and 57.1% at 37°C and 40°C respectively and above this temperature no alcohol production was observed. Improved strain gave 85.7% alcohol yield at 40°C which is 150.1% higher than that produced by the parent strain.

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SOME ASPECTS OF FERTILITY PARAMETERS IN DAIRY CATTLE IN JAFFNA PENINSULA

Navaratnarajah, A.

(Department of Animal Science, University of Jaffna, Sri Lanka.)

A cross sectional survey, followed by longitudinal studies for one year period was carried out in 21 sentinel herds 54 sampled stall fed dairy herds and a Govt. Farm in Jaffna Peninsula to assess the fertility levels in these herds. Ninety days non- return rate ranged from 76.9% to 88%. The mean calving interval ranged from 403.1 to 458.4 days in three groups of herd studied. There was no significant difference between mean calving interval of sentinel herds and sampled stall fed herds. Calving rate to first insemination was 39.2%. Calving to conception interval ranged from 27 days to 430 days with a mean of 171 days and a standard deviation of 103.2 days. The mean calving to the first service interval was $132.4 + 75.2$ days and had a range of 18 to 331 days. 83.1% of breeders served their cows 90 days or more after calving. The mean interservices interval was $55.5 + 51$ days and the heat detection rate estimated by using this value was 37.8 %. On an average, 2.7 inseminations were needed for successful conception. First oestrus in heifers was observed when they were 18 to 30 months of age and heifers were served 2 to 3 months after the detection of first oestrus. The average age at first conception was 25.7 months with a standard deviation of 5.1 months. The average age of heifers at first parturition was 36.3 months with a standard deviation of 7.2 months.

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SOME ASPECTS OF FERTILITY PERFORMANCE IN INDIGENOUS GOATS OF VANNI DISTRICT

Kalaivani, M. and Navaratnarajah, A.
(Department of Animal Science, University of Jaffna, Sri Lanka.)

The study was carried out to assess some aspects of fertility performance in indigenous goats of Vanni District by conducting cross sectional survey on 200 sampled flocks in Kilinochchi veterinary range and longitudinal studies at the University flock.

Measures of fertility such as Kidding pattern, Type of birth, Age at first service, Age at first kidding, Kidding to first service interval, Kidding to conception interval, Kidding interval, Annual kidding rate and gestation length and factors influencing fertility levels were studied.

Higher percentage of kiddings occurred during rainy season because of the availability of abundant forage and long grazing hours during the tail end of the rainy season. Most of the sampled flocks (85.7%) had long post partum interval (90 days) than University flock (60days) due to low plane of nutrition. This leads to longer kidding interval and low kidding rate in sampled flocks resulting in low productivity in these goats.

Further Age at first service and Age at first kidding were found to be higher in sampled flocks than in University flock which could be attributed to low plane of nutrition. Under high plane of nutrition higher twinning percentage observed in Vanni breed both in University and sampled flocks (40.2% and 41.7% respectively) as compared to saanan crosses (30.4%) improves the reproductive efficiency resulting in increased profitability in these goats.

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PATTERN OF KID MORTALITY OBSERVED IN INDIGENOUS GOATS / VANNI GOATS OF KILINPOCHCHI

Kalaivani, M. and Navaratnarajah, A.

(Department of Animal Science, University of Jaffna, Sri Lanka.)

An attempt was made to study the kid pattern of mortality pattern in indigenous goats/ vanni goats of Kilinochchi. As a preliminary stage to the study a cross sectional survey was conducted on 200 sampled flocks in Kilinochchi veterinary range and was followed by longitudinal studies undertaken at the University farm where both vanni and saanan breeds were found. Prenatal and postnatal losses and all events related to these losses were recorded. Exposure of pregnant dams to nutritional stress during rainy and dry seasons resulted in heavy prenatal and postnatal wastages and poor production characteristics. Prenatal and postnatal losses were heavy during rainy season. Poor milk production potential of dam associated with low plane of nutrition resulted in heavy neonatal mortality rates, low preweaning growth rates and jeopardized the optimum benefits from twinning. Long hours of grazing in the morning and evening improved the growth and survivability rates of kids by increased plane of nutrition of the dams.

THE EFFECT OF VARIOUS FEED MANAGEMENT TECHNIQUES ON COST OF PRODUCTION OF COMMERCIAL BROILERS

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and Sunil Gamege, D.V.S.

(Animal Production Unit, Veterinary Research Institute, Gannoruwa, Sri Lanka.)

Research study was carried out to determine the effect of new feeding techniques on the cost of feeding, performance and mortality of broilers.

This experiment consists eight trials and each contains one control and one treatment group. Each group consists 25 day old broilers chicks. The treatment groups (Layer Grower Mash Group) were fed with Broiler Starter (BS) for first 0 - 7 days and subsequently fed with Layer Grower (LG) mash from 8 - 21 days. Each control group received BS from 0 - 21 days. Then all eight trials received Broiler Finisher (BF) from 21 to 42-49 days. The body weight and feed consumption of birds were measured at weekly interval. From these, the total feed cost was found to be Rs. 77.52 ($p=0.05$) and the cost production per Kg meat was Rs. 51.89, ($p=0.05$) of LG mash groups were lower than that of control groups Rs. 82.89, ($p=0.05$); 51.95, ($p=0.05$) respectively, but the total feed cost only showed significant difference.

After four weeks each trial was additionally fed with offals. Trial 1 - no offal feeding; Trial 2 - once during life time; Trial 3, 4, 5, 6 and 8 - twice during life time and Trial 7 - thrice during life time. The first three trials and the rest five trials were slaughtered at 42 days and 49 days respectively, and the carcass weight was taken at each time. Feed per Kg of meat at 49 days (50.64, $p=0.05$) was significantly lower than that of 42 days (54.19, $p=0.05$). Feeding offal thrice gave (70.30, $p=0.05$) significantly lower feed cost per bird than that of feeding once (57.43, $p=0.05$). Further, all trials revealed that the feed conversion ratio and the feed cost per unit weight of males were superior than that of females.

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ESTIMATION OF NORMAL VALUES OF MAJOR MINERALS IN CATTLE AND BUFFALO MILK

Sivatharsiny, S., Navarathinarajah, A.

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and Ranawana, S.S.E.

(Animal Nutrition Unit, Veterinary Research Institute, Gannoruwa, Sri Lanka.)

A research study was carried out to estimate normal values of major minerals in cattle and buffalo milk and study components and special characters of milk which can use to differentiate both cow and buffalo milk.

Some chemical and physical characters of Friesian, Sahiwal (cattle) and Niliravi milk (Buffalo) were studied using standard techniques in dairy chemistry. A total of ninety samples of milk were collected from both Ambewela and Nikaweratiya farms and analysed in the course of the studies.

The mean value of mineral constituents of Friesian, Sahiwal and Niliravi were respectively (mg/L); total calcium, 1300.8, 1131.8 and 1430.8; total magnesium, 96.7, 96.3 and 142.6; total sodium, 847.5, 769 and 849.7; total potassium, 1291.1, 1044.3 and 1164.5; total phosphorus, 1190.7, 959.7 and 1417.3.

The overall mean values of the major constituents of Friesian, Sahiwal and Niliravi were respectively (g/l): fat 35.3, 51.2 and 77.8; protein, 36.1, 39.1 and 42; lactose, 49.8, 46.3 and 50.2; total solids 122.4, 142.3 and 173.7; SNF, 87.91 and 96.8.

The average pH, titrable acidity, specific gravity and electrical conductivity of Friesian were: 6.3, 0.2, 1.0239 and 5.1 (ms/cm) respectively. For Sahiwal breed: 6.7, 0.19, 1.0299 and 4.2 (ms/cm) respectively. Niliravi gave 6.7, 0.19, 1.0288 and 3.1 (ms/cm) respectively.

Fat, total solids, SNF and electrical conductivity gave significant differences between breeds and species. So can be used to differentiate both cow and buffalo milk.

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GROWTH AND DEVELOPMENT OF CYPERUS ROTUNDUS L. AND ITS NUTLET VIABILITY IN THE DRY ZONN.

Rajadurai. S. and Sunthareswaran.S.

(Department of Agronomy, University of Jaffna, Sri Lanka)

Cypures rotundus is an aggressive perennial weed. It is commonly known as "purple nutsedge" and is considered to be one of the world worst weed. Field experiments were conducted at the Faculty of Agriculture Kilinochchi to study the following aspects of C.rotundus.

- * Nutlet distribution in soil
- * Growth pattern
- * Nutlet desiccation and viability and
- * Nutlet viability under glyphosate treatment.

The result of the experiment reveals that a total of 1860 nutlets per square meter of soil were found up to a depth of 30 cm, of which 88% was in the layer of 0-15 cm and non below 30 cm. Among the newly formed brown nutlet 91% sprouted. But only 49% of the perantal black nutlets had sprouted. A single nutlet produced 54 nutlets within 10 weeks. Formation of dormant nutlets started after the 4th week. All nutlets desicated to 30% moisture content (fresh basis) by sun drying for 5 hours, faild to produce sprout. Three consecutive applications of glyphosate (1.4 Kg a.i /ha.) at 14 days intervals reduced nutlet viability by 80% in the dry season while a single application of the same rate reduced nutlet viability by 93% during the wet season.

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INJURIES CAUSED BY LANDMINES AND UNEXPLODED DEVICES (UXD) IN THE JAFFNA PENINSULA

Sivarajah, N. and Sivarajah, M.

(Department of Community Medicine, University of Jaffna, Sri Lanka)

Injuries due to antipersonnel pressure mines (commonly termed landmines) and other unexploded devices have been claiming the lives and limbs of several civilians in the Jaffna Peninsula. Accurate data of those injured are not available.

This is a on-going prospective study of injuries caused by antipersonnel pressure mines and other explosive devices. The data collected from 1.5.1997 to 31.12.1997 is analyzed.

The data was collected using an interviewer administered questionnaire. The injured were identified from admission records in hospitals (Teaching Hospital, Jaffna and Base Hospital, Point Pedro) and news reports in the daily papers.

81 persons were injured during the 8 month period. 77 cases were investigated and analysed.

The incidence was high (12 - 13 per month) during the months of October , November and December. 59.7% of the cases were from Valigamam area.

75% of the injuries were cause by stepping on a mine and 25% due to handling of an explosive device.

75% of the injured were males. 53% were injured while at work.

25% of the injuries occurred in their own compound. A majority (58%) of those injured in their own compound had been women.

25% of those injured had been children. Among the children more boys (79%) were affected than girls and 89% of the children had been between 10-19 years old. 58% of the children were injured as a result of handling the unexploded device.

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A 10 YEAR STUDY OF INFANT MORTALITY IN THE COMMUNITY HEALTH PROJECT AREA OF THE JAFFNA UNIVERSITY.

Nachchinarkinian, C.S. and Sivarajah, M.

(Department of Community Medicine, University of Jaffna, Sri Lanka)

Infant Mortality is considered one of the sensitive indicators of the Socio-economic and health status, and health care of a community. In recent years, political unrest and the war situation have been detrimental to normal life of the people. Life was affected in every possible situation and at different levels. This study attempts to evaluate the impact of this abnormal situation using one indicator, namely infant mortality.

This study was carried out in the Jaffna University Community Health Project Area in Kokuvil-Kondavil which had a population of around 32,000 prior to the mass exodus in October 1995.

The study period was from 1.1.1988 to 31.12.1997.

Data were collected using an interviewer administered questionnaire. The interviewers were family Health Workers.

During the 10 year period 149 infant deaths were recorded. All except one death for which data was not available, have been analysed.

The Infant Mortality Rate varied between 14 per 1000 live births in 1990, and 69 in 1996. There was a gradual rise in trend during the past 10 years.

59.5% of the infants who died were males. 56.1% of the deaths occurred within 4 weeks of birth (neonatal period).

The major causes of deaths were respiratory tract infection (33.1%), Prematurity and Low Birth Weight (LBW) (28.4%), and Gastro-intestinal tract infection (14.2%). Respiratory tract infection and Gastro-intestinal tract infection were mostly among post neonates. A majority of those who died of prematurity and LBW were early neonates. 45.2% of the infants who died had a birth weight of less than 2500 grams.

70% of the infants died in a Government Hospital, 7% in a Private Hospital and 23% at home.

50% of the mothers had a monthly family income of less than Rupees 1000.

54% of the mothers of Infants who died had made less than 5 Ante Natal visits. In 56% of the cases, the Family Health Worker (FHW) had made less than 5 visits during the antenatal period. In 11% of the cases the FHW had never visited the mothers during their pregnancy.

Out of the 148 infant deaths only 18 (12.2%) had been registered of births and deaths.

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EFFECT OF TIDAL CURRENTS ON SIRAHUVALAI FISHERY IN THE JAFFNA LAGOON

Soosai, A.S.

(Department of Geography, University of Jaffna, Sri Lanka)

The fishing methods performed in the shallow water areas of coastal regions and lagoons are influenced by tidal currents, depths, sea bed and coastal features of that particular water body. Investigating into the relationship among these factors will bring out the importance of tidal current on fishing methods. Such investigation would further help to reveal the importance of the tidal effects in fishery. The present investigation was carried out to determine the relationship between tidal currents and Sirahuvalai fishery which is one of the long time important fisheries in the Jaffna lagoon of the northern part of Sri Lanka.

Kurunagar and Pasaiyoor are two main landing centres in the Jaffna Lagoon, where Sirahuvalai fishing is in operation. Daily production data of fishery from 40 fishermen of the above landing centres were collected for North East Monsoon period - 1996 November/December and 1997 February/March and South West Monsoon period - 1997 June/July. In addition tidal water levels were measured twice a day during the above mentioned period in Kurunagar landing centre.

Data obtained were analysed statistically for the relationship of tidal water levels and production. Tidal water level range was the highest (61.0 cm) in Full-moon and New-moon days. During November/December in Full-moon days, the average production was 3.5 kg/day and during New-moon day at Kurunagar the production was 7.5 kg/day and during the same period at Pasaiyoor the corresponding productions were 6.1 kg/day and 10.0 kg/day.

During the Half-moon days when the tidal range was the least (25.0 cm) the average production during June/July were 3.1 kg/day at Kurunagar and 2.0 kg/day at Pasaiyoor.

The monthly production figures from Sirahuvalai for the period November 1996 to October 1997 indicate higher production during the North-East Monsoon and lower production during the South-West Monsoon, confirming that the changes in tidal level between Monsoon periods are reflected in the fishery productions.

Direct observations revealed that the nets were installed so that the fishes get trapped when the water recedes. The present investigation reveals that the Sirahuvalai fishery depends mostly on tidal current rather than the other physical factors mentioned. For effective operation and good resource management Sirahuvalai should be installed paying attention to tidal periods.

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AGING AND CULTURE: CASE STUDY OF SELECTED HOMES FOR THE ELDERS IN JAFFNA

Shanmugalingan, N.

(Department of Economics, University of Jaffna, Sri Lanka.)

This study proposed to examine the problems of aging in the context of culture. Aging was once felt a problem for the developed Western World. But now the modernization process with its related changes has overturned the earlier social and family relations, typical of the traditional cultural patterns, where the elderly were well integrated and made to feel wanted and loved.

In support of the disengagement theory of Gerontology, welfare policies in many traditional countries are now modeled along the lines of the Western family structure and demote the traditional kinship values. Increasing number of homes for the Elders and the demand for such centres are good indicators of this nature.

At the same time, the presently proposed Welfare Act (1997) for the elderly, refutes this nature of caring for the elders and encourages the traditional mode of care within the family.

In this background, this study proposed to analyze this problem by selecting two homes for the Elders in Jaffna for in-depth studies.

The Methodology adopted in collecting data primarily consisted of field work. In-depth interviews were also made. Number of key informants were selected by judgement sampling technique and case histories were recorded. Day-to-day activities were observed. Facilities they get and their physical and mental health were assessed. In addition, records and documents available in these centres were used as secondary sources.

By analysing the data, it was revealed that these centres are a panacea for the inmates, who are feeling unwanted and unable to take care of themselves, especially for those who do not have any kith or kin.

Also this data reiterate the proposed Act, accordingly the elderly persons should be cared for in the cultural means and which only will give them mental health and peace, and also it is beneficial to the community as their immense and enriched expenses could be of great use to the younger generation.

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INTEREST GROUPS AND THE POLITICAL PROCESS

Nathan, S.K.S.

Political action by organized interest groups is a fundamental aspect of modern democracy. Next to political parties, interest groups are very important in the political process.

Democracy depends upon public opinion and public opinion is organized by interest groups, pressure groups and political parties.

Political parties are crucial for the political activity in a democracy; but interest groups are of different forms and activities.

In conjunction with political parties, interest groups constitute the principal avenue through which political power is managed. This is true of developed countries as well as developing countries.

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DIVORCE PATTERN IN THE JAFFNA DISTRICT

Kugabalan, K.

(Department of Geography, University of Jaffna, Sri Lanka)

It is customary to categorize the Population Studies as Population variation, Population Composition and Population Dynamics. Population composition is for an effective analysis. The marital status is a very important component in population composition. Marriage and married life are treated as noble in the Eastern countries in general. Such practices are held in great esteem by religious, laws and traditional norms.

However it is an accepted fact that in recent times, the ratio of the separation of the spouses during the marriage life or the legal break of marriage (divorce) is relatively higher in the Western Countries compared with the Eastern countries. In the developed countries, the average ratio is 10.2. The percentage of divorces is very low in Sri Lanka. Anyhow, not only the various Socio economic and cultural factors but some other related factors also have jointly led to divorce on several instances.

In Sri Lanka, marriage is recognized in reverence and respect for its virtuous holiness among Tamils. However, various factors cause adverse effects on divorce among some people. The Jaffna District is not exceptional in regard to this feature. Thus this study is carried out on the basis of the record of the divorce allowed and of the reconciliation cases during the period from May 1996 to December 1997, in the District courts functioning on the Jaffna District.

The details of the cases filed and the judgement delivered are the prime data of this study. Further data obtained through interviews with family counsellors and observation of the divorce cases in the District Courts would be presented.

In addition, the reports released by the Dept. of Census of Sri Lanka and various research articles are obtained.

Thus the study is structured as follows:

1. Marital Status
2. Marital Status and Divorces in the International level.
3. Divorces in the Jaffna District
4. Factors for the above

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THE HISTORY OF THE UNITED STATES

OF THE UNITED STATES OF AMERICA

The history of the United States is a story of a people who have built a great nation out of a wilderness. It is a story of a people who have fought for freedom and justice, and who have shown the world that a better way of life is possible.

The story begins with the first settlers who came to the New World. They were men and women who were seeking a new life, a new home. They found a land that was full of promise, but also full of challenges. They had to learn to live with the land, to work the land, and to build a life for themselves.

As the years passed, the settlers grew in number. They built towns and cities, and they began to shape the land around them. They fought wars, and they made peace. They were always moving forward, always seeking a better future for themselves and for their children.

The story of the United States is a story of a people who have never stopped growing. They have always been a people of progress, of innovation, and of courage. They have shown the world that a better way of life is possible, and they have inspired others to follow their lead.

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