

A Critical Study over the Constraints Faced By Subicsha Associated SHG Members in Kozhikode District

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Abstract: *Women are a vital part of the Indian economy, both at the national and household levels. Indian women contribute a much larger share of their earnings to basic family maintenance with the result that women's earnings positively and immediately affect the incidence and the security of poverty. Self help groups are considered as the tool for poverty alleviation and women empowerment in the economy. A study was conducted in Kozhikode district of Kerala to examine the constraints faced by SHG members associated with SUBICSHA. Primary data collected by interviewing 120 SHG members. It was revealed that inefficient financial management of SHGs, weak financial status of SHG members, poorer wages from SUBICSHA and age related constraints were negatively influenced the SHG members.*

Keywords: *Self help groups, SUBICSHA, socio economic constraints, women empowerment*

SUBICSHA (Special project for Sustainable Business Development of Innovative Coconut Based Micro-Enterprises for Holistic Growth and Poverty Alleviation), an innovative coconut based value added products venture, was developed jointly by Perambra block panchayath and Indian institute of management, Kozhikode, with basic intention of providing employment opportunities to the members of 522 SHGs/ kudumbasree in Perambra block panchayath. The project proposal envisage development of micro enterprises that could be effectively managed by women self help groups / kudumbasree from BPL families active in the project area. All these micro enterprises are limited to dependence on coconut, the most abundant resource available in the area. The project aimed to attain the novel objectives of poverty alleviation, women empowerment, social development and farmer friendliness. The innovative coconut based products were around 40, out of which 30 numbers were developed and marketed. This study focused on understanding the constraints faced by SHG members associated with SUBICSHA.

Singh (2012) studied the entrepreneurship and empowerment challenges of women groups. Study revealed that problem of scarcity of raw material, finance, stiff competition, family ties, male domination, lack of education, low risk bearing ability, limited mobility were the major problems stumbled on entrepreneurial development of women folks.

Muralidharan and Deepthi (2013) stated that SUBICSHA was a company endorsed by Perambra block panchayath for women self help groups for instigating the production of neera and its downstream products on preliminary scale.

Prakash and Ruhela (2015) assessed the feasibility factors of SHGs for women entrepreneurship. Findings of the study revealed that lack of self confidence, lack of interest of members, lack of education, non-repayment of loans, irregularities in savings and borrowings and lack of marketing abilities among member were some issues faced by self help groups.

I. MATERIALS AND METHODS

The study is based on primary data. Data on constraints faced by self help group members associated with SUBICSHA were collected from 120 SHG members. The respondents were categorized into three groups based on the income generation from SHG activities. Different constraints were listed into three different categories for SHG members based on the suggestion of extension specialists. Garrets ranking technique was used to assess the constraints. Three groups of constraints faced by SHG members were categorized as constraints related to the participation of SHG members in regular activities, constraints related to participation in SUBICSHA activities and socio economic constraints faced by the members. The respondents (SHG members) were asked to rank these constraints. These ranks were converted to percent position by using the formula.

$$\text{Percent position} = 100 \times \frac{R_{ij} - 0.5}{N_j}$$

PHENOLOGICAL PATTERN OF *RHODOMYRTUS TOMENTOSA* (AITON) HASSK. IN SHOLA FORESTS OF SILENT VALLEY NATIONAL PARK, KERALA, SOUTHERN WESTERN GHATS, INDIA.

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ABSTRACT

A study was conducted in Silent Valley National Park from March 2013 to April 2015 to deduce the distribution and phenological patterns of *Rhodomyrtus tomentosa* along various altitude gradients. The study revealed that the highest density (23/ha) of *Rhodomyrtus tomentosa* was in Valliyamkandam (2200-2250m), followed by Cheriyaamkandam (19/ha) Sispara (13/ha), Walakkad (9/ha), Poochippara (6/ha) and Sairandhri (2/ha). A definite pattern of flowering and fruiting was observed during the study period and the early flowering was observed as always associated with the zone with higher altitude. Fruits in the higher elevation were bigger than that in lower altitudes. *Rhodomyrtus tomentosa* in the understory of Nilgiri sholas are facing threat from some intrinsic factors like short dormant period, poor viability of seeds and higher seedling mortality rate, besides the over exploitation of fruits for their edibility.

Keywords: Phenological pattern, *Rhodomyrtus tomentosa*, Shola forest, Silent Valley National Park

INTRODUCTION

Rhodomyrtus tomentosa is an edible fruit bearing flowering plant, which is distributed in southern and south eastern Asia (Namera, 2014; Mohandass, 2016). The name *Rhodomyrtus* came from the Greek word, 'rhod' meaning rose and 'myrtos' meaning myrtle, in allusion to the rosy myrtle like flowers. Known as Downy Rose Myrtle, Downy Myrtle and Hill Guava, this plant grows to about 2 m in height, but some individuals reach up to nearly 4 m. In the Kerala part of the Western Ghats, this species is seen in the shola forest ecosystems of Eravikulam NP, Silent Valley NP, Anamudi Shola NP, Pampadum Shola NP and Mathikettan Shola NP. It has been employed in traditional medicine to treat colic diarrhoea, dysentery, abscesses, haemorrhage, and

gynaecopathy etc. (Karuppusamy, 2011). The present study was to deduce the distribution and phenological patterns of *Rhodomyrtus tomentosa* along various altitude gradients in Silent Valley National Park.

MATERIAL AND METHODS

Study area

Silent Valley National Park (SVNP) lies within the geographical extremes of latitudes 11°, 2' N and 11°, 13' N and longitudes 76°, 24' E and 76°, 32' E in the southwest corner of Nilgiri hills of Southern Western Ghats (Figure 1). Silent Valley National Park constitutes part of the core area of India's first biosphere reserve, the Nilgiri Biosphere Reserve. Silent Valley Division comprised of Silent Valley National Park as its core area (89.52 sq. km) was

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Distribution of polypores along the altitudinal gradients in Silent Valley National Park, Southern Western Ghats, Kerala, India

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Abstract

The distribution pattern of polypores in Silent Valley National Park along different altitudinal gradient were analyzed. A total of 34 species under five families were documented by the plot-based survey conducted from the National Park. Most of the species showed a drastic reduction in density as the altitude increases. In lower altitude wet evergreen forest at Sairandhri (1000-1050 m) possessed more number of species (29 species) and found to be gradually decreasing as the altitude increases. The species richness decreased to 27 species (7 % reduction) at Poochippara (1150-1200 m) and in Walakkad (1300-1350 m) it was reduced to 25 (14 % reduction). Interestingly it was reduced to 11 species in Sispara (1950-2000 m) with 63 % reduction as comparing to that of the lower altitude. At Cheriyaankandam (2100-2150 m) and Valliyamkandam (2200-2250 m) the species richness was found to be 8 and 5 with 72 per cent and 83 per cent reduction respectively as comparing to that of Sairandhri. This monotonic decrease in species richness is also reflected in the polypore density. The density was found to be decreased from 2613 at Sairandhri (1000-1050 m) to 435 in high altitude shola forest at Valliyamkandam (2200-2250 m).

Key words – Clinal Variation – Diversity – Evergreen – Mycology – Polyporales – Shola Forest

Introduction

Polypores or bracket fungi are macrofungi forming woody fruiting bodies with pores or tubes on the underside. The polypores are Basidiomycetes producing holobasidia and ballistospore basidiospores typically on the inside of the tubes lining the underside of the fructification (Leelavathy & Ganesh 2000). Most of the polypores are wood inhabiting, and rest are terrestrial. The polypores are polyphyletic and inhabit Coarse Wood Debris consuming the wood for their growth and reproduction (Ranadive et al. 2012a, 2012b), but some soil-inhabiting species form mycorrhiza with trees. Polypores plays a primary and central role in decomposition and nutrient cycling in forest ecosystems.

The importance of polypores and the diversity of polypores in tropical forest were not known or not properly assessed, but relatively well-studied in temperate areas. The tropics are very rich source of potentially useful polypores, many of which probably have not even been recognized, described or named (Yamashita et al. 2015). Polypores shows highest diversity in old natural forests with abundant Coarse Wood Debris than in younger forests or plantations. Consequently,



A checklist of polypores of Kerala state, India

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Adarsh CK, Vidyasagran K, Ganesh PN 2018 – A checklist of polypores of Kerala state, India. Studies in Fungi 3(1), 202–226, Doi 10.5943/sif/3/1/21

Abstract

A literature-based checklist of polypores reported from Kerala State, India is deduced. Altogether 148 species of polypores under 8 families belonging to 68 genera are recorded. The checklist is prepared after reviewing all the available literature and most of them have been published during the last two decades. The geographical distribution of polypores is presented districts wise, including all the 14 districts of Kerala state. The family Polyporaceae has the highest number of species (80), followed by Hymenochaetaceae (37), Fomitopsidaceae (9), Meripilaceae (7), Ganodermataceae (7), Meruliaceae (5), Schizoporaceae (2) and Phanerochaetaceae with a single species. The genus *Trametes* had the highest representation with 16 species followed by *Lentinus* and *Phellinus* with 13 species each. There is no comprehensive studies have been undertaken on the diversity, distribution and functional attributes of polypore fungi in Kerala parts of Western Ghats, which undoubtedly hosting the highest mycodiversity This list is inconclusive and covers only a part of the actual diversity of polypores in Kerala as most of the forest areas are unexplored for the polypore diversity documentation.

Key words – Basidiomycota – Diversity – Polyporales – Kerala – Forest

Introduction

Kerala lies in the south-west corner of peninsular India and is positioned between 8°18' and 12°48' north latitudes and 74°52' and 72°22' east longitudes (Fig. 1). It is bounded by the Western Ghats mountain ranges to the east and the Arabian Sea to the west. The Western Ghats, which is one of the biodiversity hotspots and World Heritage Site run parallel to the west coast at a distance ranging from 40-80 km. Most of the forested areas of Kerala are parts of the Western Ghats. The total geographical area of Kerala is approximately 38, 863 square kilometers which is only about 1.8% of the total geographical area of India. Altitude ranges from sea level to 2,600 m and the terrain falls into three well marked divisions (Leelavathy & Ganesh 2000):

1. The hilly tracts undulating from Western Ghats in the east and marked by long spurs, extensive ravines and dense forest,
2. The cultivated plains intersected by numerous river, streams and lagoons and
3. The coastal belt with dense coconut plantations and rice fields.

The tropical humid climate of Kerala with intermittent wet and dry periods is closely associated with two principal monsoons, viz. the South-West Monsoon and the North-East



Impact of cluster bean consumption on hyperlipidemia and hyperglycaemia

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Abstract

This study was conducted with the objective to promote cluster bean consumption in the daily diet and assess its effect on life style disorders. The health benefits of cluster beans have been established through laboratory studies on animals. Diet counselling was conducted to highlight the importance of this vegetable and also demonstrate dishes based on this vegetable. A supplementation study was conducted to study the impact of cluster bean among respondents having hyperlipidemia and hyperglycaemia. Blood profile analysed revealed reduced total cholesterol (TC), triglycerides (TG), LDL and VLDL in hyperlipidemic subjects and fasting blood sugar (FBS) and post prandial blood glucose (PPBS) in hyperglycaemic subjects. These results suggest that dehydrated cluster bean powder is effective in hyperlipidemia and hyperglycaemia.

Keywords: cluster bean, diet, cholesterol (TC), triglycerides (TG)

Introduction

Cluster bean or guar bean (*Cyamopsis tetragonoloba* (L.) Taub.) Is an under exploited annual legume which belongs to the family *Leguminaceae* (*Fabaceae*). India produces 80 per cent of guar bean in the world production scenario. (Tripathy and Das, 2013) [7]. Cluster bean has been reported to be a rich source of protein and fibre. It has several health benefits in both its vegetable and powder form (guar gum). They contain vitamins C, K, and a, iron, folate, manganese and dietary fibre. Each of these nutrients play an important role in cardio protection. In addition, guar beans are potentially high sources of phytochemicals (Wang and Morris, 2007) [9]. Cluster bean or guar bean is a well-known traditional plant used in folklore medicine. It acts as an appetizer, cooling agent, digestive aid, laxative and is useful in healthy dyspepsia and anorexia. It is also found to have. Anti-ulcer, anti-secretory, cytoprotective, hypoglycaemic, hypolipidemic and hypoglycaemic properties (Mukhtar *et al.*, 2006) [3].

Hypercholesterolemia is a condition which refers to increase in cholesterol levels or increased plasma proteins which is a major risk factor for atherosclerosis (Kumar *et al.*, 2007) [12]. In a rat study, it was found that garlic potentiated the beneficial influence of dietary cluster bean on serum, liver and biliary lipids in high cholesterol fed situation (Pande and Srinivasan, 2012) [4, 5]. The freeze dried cluster bean powder consumption reduced total cholesterol and LDL cholesterol to 13.5 per cent and 18 per cent respectively (Patel *et al.*, 2012) [14, 5].

Guar gum, an indigestible carbohydrate derived from cluster bean was observed to lower post prandial blood glucose for diabetic patients (Jenkins *et al.*, 1976) [11]. When 5g of guar gum in a glass of water was consumed either before dinner or lunch, a definite reduction in PPBS was noted in patients from 1 to 12 weeks. The fall was significant at all levels (Triveni *et al.*, 1999) [8]. A significant reduction was noted in serum cholesterol concentration of diabetic subjects after 15 and 30

days of consumption of roasted and cooked guar fibre per day (Soni. Y and Rajnee, 2011) [6].

This vegetable is a very cheap and abundant commodity in the local market. However, its utilization is very low in home preparations and also in large scale food industry. This is largely due to its hard texture owing to its high fibre content. Lack of awareness about the nutritional value of cluster bean is another chief reason why the vegetable remains unpopular. This study aims at exploiting this locally available foods for ensuring health security.

Materials and Methods

Twenty experimental and twenty control subjects, were females selected at random. Ten members of the experimental group comprised of hyperlipidemic subjects (group A) and the remaining of hyperglycaemic subjects (group B).

Socio- economic status, health profile and life style pattern of respondents were assessed using developed schedule. An interview schedule was developed for the purpose which was pretested and used for data collection. Socio economic profile included family size, educational status, family income and food expenditure pattern. Health profile was analysed with respect to family history of disease, duration of disease, disease encountered during the last six months, anthropometric indices like height, weight, waist and hip circumferences. Diet survey was conducted to analyse food consumption pattern, food use frequency, food preferences, food timings and nutrient adequacy of respondents. Life style pattern such as exercise pattern, Leisure time activities, Stress level, Consumption of alcohol/tobacco of respondents were also studied.

The selected subjects were counselled on 'The importance of fibre rich locally available fruits and vegetables for maintaining normal blood profile'. To assess the level of knowledge on diet and health a set of statements were given to



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Effect of various organic nutrient schedules on growth and nutrient uptake of chilli (*Capsicum annum*)

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Abstract

The experiment was conducted at Instructional Farm, College of Agriculture, Vellayani during July-November of 2012. The treatments consisted of three levels of FYM - F1 (20 t ha⁻¹), F2 (15 t ha⁻¹) and F3 (10 t ha⁻¹) and three levels of substitution of the recommended dose of nitrogen. The levels of substitution are N1 (100 % recommended dose of N- 75 kg ha⁻¹), N2 (75 % recommended dose of N -56.25 kg ha⁻¹) and N3 (50 % recommended dose of N - 37.5 kg ha⁻¹). Three controls were, C1 - Kerala Agricultural University (KAU) POP recommendation (FYM @ 25 t ha⁻¹ along with 75:40:25 kg N:P₂O₅:K₂O ha⁻¹ as inorganic fertilizer), C2 -KAU Adhoc organic POP recommendation (FYM @ 25 t ha⁻¹ + Poultry manure at 5 t ha⁻¹ + Pseudomonas + Trichoderma and PGPR mix 1, each @ 2.5 kg ha⁻¹) and C3-Farmers practice - (Cow dung slurry @ 20 t ha⁻¹). FYM @ 20 t ha⁻¹ recorded significantly higher plant height, number of branches and LAI. The maximum value for all growth parameters were observed at 100% level of N substitution. Combined application of FYM @ 20 t ha⁻¹ along with 100% substitution of recommended dose of N (75 kg ha⁻¹) in organic form registered maximum plant height, branches, LAI, and root spread.

Keywords

Growth Nutrient uptake Nutrient schedule Organic.

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Functional properties of raw jackfruit based textured vegetable protein (TVP)

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Abstract

Textured vegetable protein or TVP is a meat substitute that mainly focuses on vegetarian population. Even though koozha, fibrous type of jackfruit (*Artocarpus heterophyllus*) is highly available it is an underutilized fruit. A textured vegetable protein (TVP) was developed based on jackfruit bulb flour, seed flour and gluten in varying proportions. Functional properties such as yield, rehydration ratio, water absorption index and appearance of the products were analyzed.

Keywords: TVP, vegetarian, koozha, functional properties, yield, rehydration ratio, water absorption index

Introduction

Jack is a tropical fruit species found in tropical, high rainfall, coastal and humid areas of the world. It belongs to family Moraceae. Scientifically known as *Artocarpus heterophyllus*, it is the favourite fruit of many, owing to its sweetness. The jackfruit tree is widely cultivated in tropical regions of India, Bangladesh, Nepal, Sri Lanka, Vietnam, Thailand, Malaysia, Indonesia and the Philippines. Jackfruit is also found across Africa, e.g., in Cameroon, Uganda, Tanzania and Mauritius, as well as throughout Brazil and Caribbean nations such as Jamaica. However, India is considered to be the native of jack fruit. In our country, the trees are found distributed in southern states like Kerala, Tamil Nadu, Karnataka, Goa, coastal Maharashtra and other states like, Assam, Bihar, Tripura, Uttar Pradesh and foothills of Himalayas.

The jack fruit trees naturally exist in the farm lands and in secondary forest regions. They produce fruits only with the blessings of nature and there is no human intervention. Therefore, by default, they are organic produce. While fresh consumption of jack bulbs is limited, processing and value addition is also negligible. In many cuisines, immature and mature jack fruits are relished in various forms of dishes. But the half ripened and ripened fruits are mostly fed to cattle. It has been reported to increase milk yield of cattle. Thus, the full potential of jack fruit has not been realised by the local folk of certain regions in our country. The huge post harvest loss of the fruits paves way for loss of nutrients in the fruit that would otherwise nourish the consumers. Thus, jack fruit is a commercially unexploited fruit and there exists no awareness among the farmers about its potential.

The successful utilization of seed flour and bulb flour as a food ingredient and its blending with wheat gluten depends on functional characteristics, which it would impart to the end products. This analysis would provide useful information towards effective utilization of the product.

Materials and Methods

Development of jackfruit based Textured Vegetable Product (TVP)

Eleven formulations of jackfruit based TVP using jackfruit bulb flour (JBBF) and seed flour (JBSF) along with gluten (G), yeast and soya flour (in constant proportion) were processed to form TVP. The quality analyses of the treatments were undertaken using standard procedures.

Table 1: Treatments for the development of TVP

S. No.	Treatment	G	JBBF	JBSF
1	P ₁	50	20	30
2	P ₂	50	30	20
3	P ₃	50	10	40
4	P ₄	50	25	25
5	P ₅	50	-	50
6	P ₆	50	50	-
7	P ₇	70	20	10
8	P ₈	70	10	20
9	P ₉	70	15	15
10	P ₁₀	70	-	30
11	P ₁₁	70	30	-

(G - Gluten, JBBF – Jackfruit bulb flour, JBSF- Jackfruit seed flour)

Functional quality analysis of TVP

Functional properties describes how ingredients behave during preparation and cooking, how they affect the finished food product in terms of how it looks, tastes and feels. Functional properties are the fundamental physico- chemical properties that reflects the complex interaction between the composition, structure, molecular conformation and physico- chemical properties of food components together with the nature of environment in which these are associated and measured (Kaur and Singh, 2006) [7]. Functional qualities such as yield, appearance, and rehydration ratio and water absorption index were studied.



Root colonization by the endophytic fungus *Piriformospora indica* improves growth, yield and piperine content in black pepper (*Piper nigrum* L.)

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ABSTRACT

Plant growth and yield characteristics of black pepper (*Piper nigrum* L.) on inoculation with the root endophytic fungus *Piriformospora indica* are reported. Experiments were carried out using plants raised from the lateral branches of black pepper which develop into miniature plants known as “bush pepper” that bear fruits in the same year of planting. *P. indica* (*Pi*) inoculated plants put forth more number of leaves and leaf area per plant compared to the control plants throughout the period of the experiment. There was significant difference between the inoculated and uninoculated plants with respect to the chlorophyll a and total chlorophyll content of leaf tissues. Early flowering and spike setting was observed in plants inoculated with *Pi*. The total fresh and dry weights of berries harvested from the *Pi* inoculated plants were significantly higher than that from the control plants. Inoculation with the fungus also increased the total oleoresin and piperine content in the berries.

1. Introduction

Black pepper (*Piper nigrum* L.), also known as the “King of spices” is the most important spice crop in the world. The dried mature berries of the plant are used for culinary purposes and it also has medicinal value against a number of ailments. The biological role of *Piper nigrum* has been reviewed extensively by Ahmad et al. (2012). Black pepper plants are endowed with pungent bioactive alkaloids, the piperamides which have diverse therapeutic potential. Black pepper oleoresin which contains the essential oil that contributes to the aroma of pepper, and piperine, the alkaloid that gives the pungency, have many advantages over the raw product and are preferred to black pepper powder in processed foods. Piperine has been found to positively influence digestion of food by stimulating the digestive enzymes of pancreas and intestine. Besides the antioxidant activity, it also has antimutagenic and tumor inhibitory activities. The various physiological effects of the pungent principle, piperine has been reviewed by Srinivasan (2007).

The axenically cultivable root endophytic beneficial fungus *Piriformospora indica*, isolated from the desert soil of northwest India in the state of Rajasthan, interacts with many plant species and promotes their growth (Weiss et al., 2004; Oelmüller et al., 2009; Varma et al., 2012). It also enhances plant resistance to biotic stresses such as bacterial, fungal, viral and nematode diseases and abiotic stresses like heavy metals, salinity and drought (Deshmukh and Kogel, 2007;

Sherameti et al., 2008; Daneshkhah et al., 2013; Lakshmipriya et al., 2016; Li et al., 2017; Varkey et al., 2018). Significant increase in growth and yield of many medicinal plant species was recorded on inoculation with *P. indica* (Rai et al., 2001; Kilam et al., 2016). Several reports have also shown the impact of *P. indica* inoculation on increasing the secondary metabolite content in plants (Dolatabadi et al., 2011a, 2011b; Satheesan et al., 2012; Das et al., 2012; Prasad et al., 2013; Sharma and Agrawal, 2013; Sharma et al., 2014; Kilam et al., 2017). Co-culturing of *Bacopa monnieri* with the fungus resulted in enhanced growth and the treated plants had several fold increase in plant biomass, anti-oxidant activity and the secondary metabolite, bacoside (Prasad et al., 2013). An increase of 28.8% in aristolochic acid content was reported in *Aristolochia elegans* treated with culture filtrate of *P. indica* (Bagde et al., 2014). Enhanced production of asiaticosides has been demonstrated by our group in *Centella asiatica* on inoculation with *P. indica*. Up-regulation of squalene synthase and β -amyrin synthase, the key enzymes in the synthesis of asiaticoside, in the inoculated plants has also been reported (Satheesan et al., 2012). Previously our group reported for the first time root colonization of *Piriformospora indica* in black pepper, and its effect on plant growth promotion in tissue cultured plantlets (Anith et al., 2011).

Black pepper is a perennial vine with a long juvenile phase of 3–4 years before reaching the bearing stage. Hence long term experimentation is necessary to understand the effect of biological agents on

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Research Article

In vitro mutagenesis creates distinct morphological variants in cassava (*Manihot esculenta* Crantz.): a characterisation study

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Abstract

The present investigation was conducted to evaluate the variability created due to induction of *in vitro* mutagenesis in cassava. The calli and somatic embryos from the leaf explants of superior cassava genotypes Sree Jaya and CC1 established in Murashigie and Schoog (MS) media supplemented with 8 mg L⁻¹ picloram were subjected to treatment with Ethyl Methyl Sulphonate (EMS), 0.6-1.2 per cent at 0.1 per cent interval. Forty-four plants survived out of sixty-eight regenerated plants kept for hardening under pad and fan greenhouse followed by rain shelter. Irrespective of the dosage field evaluation of these plants showed variations in morphological traits with respect to their respective controls at 3, 6 and 9 months after planting (MAP). These plants can be clonally propagated and the genetics of the observed variations in quantitative traits of these plants can be validated under different conditions.

Keywords

In vitro, hardening, callus, somatic embryo, mutation

Introduction

Cassava (*Manihot esculenta* Crantz.) is a nutritionally important root crop grown in tropics with global production expanding by an average of 1.2 per cent annually (Ford, 2015). As cassava seeds are dormant and germinate very slowly, setts which are uniform with respect to different traits are used for propagation. However, this leads to the accumulation of viral and bacterial diseases Nassar and Ortiz (2007). Creation of variability for improvement of cassava through hybridisation is severely constrained by low fertility, low hybrid seed set and poor germination rate (Nassar, 2007). Hence, the breeder has to adopt alternate strategies like induction of mutation. *In vitro* techniques have been standardized in cassava by Magaia (2015) and he reported that the frequency of obtaining desired variability is more when mutation is done *in vitro*. Hence, an attempt was made to create variability in cassava through *in vitro* mutagenesis and characterise the treated plants.

Materials and Methods

The newly sprouted shoots of four to five centimetres were collected and properly labelled. Leaf bits with veins of about 1 × 1 cm from unfolded to partially unfolded leaves of cassava genotypes, Sree Jaya and CC1 were inoculated in MS medium supplemented with 8 mg L⁻¹ picloram. The Friable embryogenic callus and somatic embryos at torpido stage were then treated with chemical mutagen Ethyl Methyl Sulphonate (EMS) at

0.6, 0.7, 0.8, 0.9, 1.0, 1.1 and 1.2 per cent. The treated calli when attained friable stage was used for induction of SEs which was germinated in medium, MS + 8 mg L⁻¹ picloram Magaia (2015).

When the *in vitro* derived plants attained at least 3 cm height with 3 to 5 roots, primary hardening was done, under pad and fan green house for three months. The Plants were grown in plastic pots of 15 cm height and 5 cm radius in Soilrite™ (commercial product consisting on perlite, Irish peat moss and vermiculite) at the proportion of 1:1. The temperature and humidity inside the chamber were maintained at 24.0- 27.0°C and 80-85 per cent, respectively. A water-soluble fertilizer concentrate Greencare TM (N:P₂O₅:K₂O - 30:10:10), secondary and micronutrients like Boron, Calcium, Copper, Iron, Magnesium, Manganese, Molybdenum, Sulphur, Zinc) was applied as foliar spray at a concentration of 0.01 per cent. Initially nutrient preparation was applied only once in a week. Subsequently the frequency was increased to thrice a week up to third week and then on daily basis Magaia, (2015). Secondary hardening was done under rain shelter (temperature and relative humidity during hardening ranged from 27-32 °C and 60-90 per cent, respectively) for three months. The hardened plants were transplanted into large pots (60 cm × 40 cm) which were placed in rain shelter for one week, later transferred to the field



Studies on sensory attributes and microbial analysis of stored osmo dehydrated bilimbi (*Averrhoa bilimbi*)

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ABSTRACT

A study was undertaken during 2015-2017 to study the sensory evaluation and microbial analysis of selected osmo dehydrated bilimbi treatments during storage. Osmo dehydrated bilimbi in 60°Brix for 180 minutes and 80°Brix for an immersion time of 120 and 180 minutes were packed using polypropylene packaging material and stored at ambient temperature for a period of four months. Minimum fungal count (2.42 cfu/g) and bacterial count (2.53 cfu/g) was recorded for bilimbi osmosed in 80°B for 180 minutes. Bilimbi osmo dehydrated in 80°Brix for 180 minutes recorded highest sensory score for taste (8.17), texture (8.17) and flavor (7.97) and overall acceptability (8.17) after four months of storage. All the treatments were microbiologically safe and acceptable during the storage.

Key words: Osmodehydrated, Bilimbi, Microbial count, Sensory evaluation.

INTRODUCTION

Osmotic dehydration (OD) is a food preservation method used for the partial removal of water from plant tissues by immersion in an osmotic solution. This has wide application in the preservation of food-materials since it lowers the water activity of fruits and vegetables. Osmotic dehydration is preferred over other methods due to their color, aroma, nutritional constituents and flavor compound retention value. This technique can be used for producing high quality products, which provides minimum thermal degradation of nutrients due to low temperature water removal process. It also helps to improve the sensorial, nutritional and organoleptic properties of foods.

Averrhoa bilimbi L. commonly known as 'bilimbi' belongs to the family Oxalidaceae, a native of Malaysia and Indonesia, is widely cultivated in southern India as a backyard fruit crop. It has been widely used in traditional medicine to treat cough, cold, itches, boils, rheumatism, syphilis, diabetes and whooping cough. Experimental pharmacological studies have shown that the fruit alleviates hypertension (Goh, *et al.*, 1995).

MATERIALS AND METHODS

The experiment was conducted at Department of Post Harvest Technology, College of Agriculture, Vellayani, Kerala Agricultural University, during the year 2015-17.

Osmotic dehydration of bilimbi: Bilimbi fruits of uniform size, maturity, free from mechanical damages were harvested and washed in water and surface dried. Fruits were pricked and then blanched in hot water for 1 minute as a pre treatment. Osmotic solutions (sucrose) of two different concentrations

viz. 60, 80p B were prepared and 0.1% of KMS was added to the osmotic solutions as preservative.

Treatments:

A1- fruit osmosed in 60°Brix for 180 minutes

A2- fruit osmosed in 80°Brix for 120 minutes

A3- fruit osmosed in 80°Brix for 180 minutes

All the treatments were replicated thrice

Parameters:

Sensory evaluation of the product: Osmo dehydrated bilimbi fruits prepared by different treatments were evaluated for sensory characteristics *viz.*, appearance, colour, flavour, taste, texture and overall acceptability by 30 semi trained members. Each character was given a score from 1 to 9 according to Hedonic rating (Ranganna, 1986). The score was statistically analysed using Kruskal-Wallis test (chi-square value) and ranked (Shamrez *et al.*, 2013).

Microbial count in dehydrated slices: The quantitative assay of the micro flora in stored samples was carried out by serial dilution spread plate techniques. Nutrient agar and Rose Bengal agar medium were used for the enumeration of bacterial and fungal population of fruits respectively. The data from study was subjected to analysis in a Completely Randomized Design (crd) with factorial concept.

RESULTS AND DISCUSSION

Sensory parameters *viz.*, taste, colour, flavor, texture and overall acceptability were analysed at monthly interval for a period of 4 months. Results revealed that there was slight reduction in all the parameters toward the end of storage.

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Bioassay for detecting flucetosulfuron residue in wetland rice soils

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ABSTRACT

In order to assess the residue of flucetosulfuron in wetland rice soils, bioassay was conducted in two parts viz., identification of suitable indicator plants for flucetosulfuron and assessment of herbicide residue in post experiment soil using selected indicator plant. To identify indicator plant for flucetosulfuron, pot culture experiments were conducted using four test plants viz., barnyard millet, cucumber, sunflower and maize. Each plant species was allowed to grow in 8 different concentrations of flucetosulfuron viz., 0, 0.01, 0.05, 0.1, 0.5, 1, 10, 50 and 100 $\mu\text{L L}^{-1}$. The effect of different concentrations of flucetosulfuron on germination percentage, shoot length, root length, shoot fresh and dry weight of each indicator plant species were recorded. Based on statistical analysis, sunflower was selected as the most sensitive indicator plant for assessing the residual effect of flucetosulfuron, since it recorded the highest regression co-efficient for the parameters tested. Among the various parameters compared, shoot length of sunflower was selected as the most suitable parameter to detect the residue of flucetosulfuron in soil. Logarithmic linear regression equation developed for shoot length of sunflower was $Y = 4.309788 - 0.64968 \ln(X)$, $R^2 = 0.946$. Field experiments were carried out with 3 different concentrations (20, 25 and 30 g ha^{-1}) of flucetosulfuron at 3 different times of application (2-3, 10-12 and 18-20 days after sowing) for the Kharif and Rabi seasons of 2016-'17. After each field experiment, bioassay was conducted in post experiment soil and results revealed that there is no toxic residue of flucetosulfuron in the soil of the experimental plots indicating the safety of the chemical.

Keywords: Bioassay, flucetosulfuron, herbicide residue assessment, indicator plants, sunflower, wet seeded rice

Weeds are the most harmful group of pests and one of the major constraints which affect rice productivity (Bhimwal and Pandey, 2014) adversely if not managed during critical period of crop growth. To bring weeds under control without affecting the yield, adoption of weed management practices at critical periods of crop growth is a necessary. Even though hand weeding is the best method, herbicide based weed management is the smartest and viable option due to scarcity and high wages of labour (Anwar *et al.*, 2012). Despite some undesirable side effects, no viable alternative is presently available to shift the chemical dependence for weed management in rice (Juraimi *et al.*, 2013). Sulfonyl urea group of herbicides are low dose high efficacy herbicides having acetolactase synthase (ALS) inhibition as mode of action in plants, and are safe for mammals. Flucetosulfuron is such a new generation, pyrimidinyl sulfonylurea, broad spectrum herbicide, odourless white solid, soluble in water, acetone, ethyl alcohol, ethyl acetate, n-hexane and methanol. Even though new generation herbicides are required in smaller quantities, their persistence and safety to the succeeding crop in the herbicide applied field must be analysed thoroughly. The phytotoxic activity of the herbicide molecule can be measured by bioassay method which is cost-effective and do not require expensive equipments like High Performance Liquid Chromatograph (HPLC). Bioassays or biological tests

applied to the study of herbicides, are based on the response of different species, chosen as controls, to the application of the herbicide under study (Horowitz, 1976). Bioassay is the simplest and direct method of residue assessment. It possesses several advantages over mechanical or chemical methods of residue assessment like determination of both active or biologically active substance and possible degradation products of the herbicide; being based on the observation of the response of the plants to herbicide, it provides more practical information and materials involved and the methodology is simple with high reproducibility (Günther *et al.*, 1993).

Bioassays are usually conducted with sensitive plant species, also called as indicator plants or test species. A plant that can be used as an indicator species must be sensitive enough to detect even very small amounts of herbicide in the soil or another substrate. It must also show a gradual increase in susceptibility with increasing herbicide concentrations. The indicator plant should be vigorous and grow rapidly under the conditions of bioassay. The more commonly used indicator species are cucumber, oats, barnyard grass, sunflower, tomato, barley, sorghum, crab grass (*Cenchrus sanguinalis*), yellow foxtail (*Setaria glauca*) *etc.* The ideal test species must however be determined from preliminary experiments with the herbicides under study (Rao, 2000).



Statistical Key to Predict the Performance of Cocoa Accessions (*Theobroma cacao* L.)

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Abstract

Cocoa is an important beverage crop grown all around the world for the delicious chocolates. Fifty clonal accessions of cocoa belonging to various countries of origin maintained at the Cocoa Research Centre, Thrissur were observed for key qualitative and quantitative characters. Pod shape, pod apex, pod basal constriction and pod rugosity which were highly variable and easily identifiable were selected as key qualitative characters. The commercially important characters viz., pod weight, total wet bean weight (TWBW), number of beans/pod, percentage of flat beans/pod and dry weight of peeled bean ranged from 318.67g to 1268.33g, 42.21g to 206.08g, 22.93 to 49.27, 0.00% to 12.60% and 0.58g to 1.72g respectively were identified as key quantitative characters. Statistical keys were developed for different combinations of key qualitative characters which can serve as a preliminary tool for predicting the performance of an accession of cocoa.

KEYWORDS: Cocoa, statistical key

Introduction

Cocoa (*Theobroma cacao* L.) belonging to the family Malvaceae (Alverson et al., 1999), is

an important beverage crop grown all around the world for the delicious chocolates. It is indigenous to the tropical humid forests on the lower eastern equatorial slopes of the Andes in South America (Amma, 2010). The term 'cocoa' is believed to have been derived from the word 'cacahoatl' used by the Aztec Indians of the high Mexican plateau to represent the seeds of this plant. According to their belief cocoa was brought to earth by the God 'Quetzacoatl' (the plumed serpent) whom they called as 'xocolatl'. Hence, cocoa is considered to have a divine origin and is popularly known as the 'Food of Gods'. It was from 'xocolatl' the word 'chocolate' was derived. It may probably be with this legend in mind that Linnaeus gave the name *Theobroma cacao* to the cultivated cocoa plant using the Greek words *theos* meaning Gods and *broma* meaning food (Mossu, 1992).

Cocoa, the only source of chocolate, is cultivated in 58 tropical countries of the world for its nibs (Amma et al., 2011). The nibs form the source of energy rich and nutritious chocolates as well as an array of products. The large-scale cultivation of cocoa started in India in 1970's (Nair et al., 2002) and now it is widely grown as an intercrop in Kerala, Tamil Nadu, Andhra Pradesh

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India

Effect of biofertilizers and organic supplements on the growth of black pepper (*Piper nigrum* L.)

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Abstract

An experiment was conducted at the Cardamom Research Station, Kerala Agric Pampadumpara (Kerala) with an objective to study the effect of different biofertil solubilizing bacteria, *Azospirillum* and Plant Growth Promoting Rhizobacteria l supplements (fish extract and humic acid) on the growth of black pepper ro results of the experiment indicated that application of Phosphorus solubiliz along with *Azospirillum* (5 g), humic acid (0.2%) and fish extract (0.5%) was the for the production of black pepper rooted cuttings with improved vegetative height, number of leaves, number of roots, length of roots and leaf ar their individual inoculation. This innovative information can be effectively utiliz for the commercial production of black pepper rooted cuttings with lusty grc

Keywords: black pepper, bio fertilizers, organic supplements, roots and shoo management

The availability of quality planting material is one of the major issues that black pepper growers face in India. The conventional propagation methods have several limitations due to low success rate, poor rooting, spread of soil borne pathogens and poor survival rate of transplanted rooted cuttings (Rini *et al.*

low cost, capable of improv quality sustainably. Biofer growth rate of plants and s act as plant strengtheners, 1 plant health improvers, and to fix nitrogen (Babalola 201 the soil is also restored by bi

ASSISTIVE TECHNOLOGY IN GARDENING FOR CHILDREN WITH DISABILITY UNDERGOING HORTICULTURE THERAPY

Dr Beela G. K.¹ & Dr. V. Ganeshan²

Horticultural Therapy is an integrated approach to human development using horticulture with behavioural science. (Beela and Reghunath 2010) Several studies have shown that horticulture therapy resulted in an improvement in fine motor skills (Beela et al 2015), encourage creativity (Dorothy Blair 2009), and developed higher self-esteem. (Beela and Reghunath 2010) Horticulture or farming is considered to be an intensive occupation that involves physically demanding work. But if the proper assistive technology is used and devices are provided horticulture therapy can be made fun and easier for children. In order to implement horticulture therapy for physically challenged children, accessible gardening tools need to be developed which is ergonomically suitable for them. This study aimed to develop lightweight, flexible, and inexpensive gardening tools to implement horticulture therapy for physically challenged children with this objective some simple agricultural tools were developed after collecting and evaluating by the children with locomotor disability. The User-Centred Design (UCD) (User-Centered Design Basics 2017) was used in this study for designing the tools. The implementation of UCD method in this study involves four phases, namely, Analysis phase, Design phase, Implementation phase and Evaluation phase. The developed tools included cushion kneeler, tools with velcro, arm support cuff tools, gripping aids, T-handles and tools with extenders.

Keywords: Assistive technology, Horticultural therapy, Gardening tools.

INTRODUCTION

Any technology that helps an individual with disability to carry out a functional activity is defined as Assistive technology. (Robert et al 2012) It can be low tech or high tech, but helping a person with disability to complete a job. (Mukherjee et al 2008) Assistive technologies (AT) in agriculture is the application of ergonomics that can help in increasing the efficiency and thereby productivity of the people with disability. (Vijaya et al 2013) As per the Manual on Disability Statistics 2012 and National Sample Survey Organization 2003, in India there are more than 50 million children with disability. Despite the belief that these children should share the same quality of life as all children there are no assistive devices or garden tools specially designed and built for children with disabilities. Horticulture is an area neglected by the physically challenged populations due to the physical limitation. When physical challenges are making gardening difficult, then one needs to be creative in order to continue gardening without excessive pain or further injury to joint and tissues. Recently Horticulture therapy is widely applied all over the world. The results of several studies on horticulture therapy reveals that the subjects are more easily cured of their ailments(Mark et al 2012, Matilda et

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Bulked line analysis: a useful tool to identify microsatellite markers linked to drought tolerance in rice

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Abstract Eighty rice germplasm collections were used to study the variation in root traits and water use efficiency (WUE based on $\Delta^{13}\text{C}$ value) for two seasons. Deep and shallow root genotypes were selected on the basis of phenotypic data. Similarly based upon $\Delta^{13}\text{C}$ values, high and low WUE plant types were selected. Basis of selection for BLA being, the genotype with extreme values on either side of the grand mean is given as either positive (+) negative (−) sign for each trait studied. The genotypes which has scored nearer value to either side of the grand mean is omitted and were not considered for bulking in order to have two very distinct bulks amongst the genotypes. Varieties identified for deep and thick roots were Chuvanna modan (Ptb 30), Ptb1 (Aryan), Ptb2 (Ponnaryan), Ptb 6 (Athikkiraya) and Ptb15 (Kavunginpothala). Varieties identified for high WUE (based on $\Delta^{13}\text{C}$ value) were Ptb5 (Veluthari kayama), Ptb7 (Parambuvattan), Ptb9 (Thavalakannan), Ptb10 (Thekkancheera) and Ptb19 (Athikiraya). Selected genotypes were used for molecular characterization using microsatellite markers. A total of 216 microsatellite markers representing 12 different chromosomes were selected for genotyping. DNA from each group were bulked together for bulked line analysis of root traits and WUE. RM 202 showed polymorphism between deep root and shallow root bulked DNA. For WUE, RM313 is polymorphic between the high and low WUE genotypes. Although the BLA method cannot be used directly to localize genes, it is useful for the identification of DNA markers that are associated with the target

gene. Through such markers, the linked trait can be precisely localized if the markers used have been previously mapped.

Keywords Rice · Drought tolerance · Root traits · Water use efficiency · Bulked line analysis

Introduction

Rice accounts for about 27% of total cereal production, with a worldwide production of roughly 738.2 million tons (FAO 2011). By 2035, a 26% increase in rice production will be required to feed the growing population. Worldwide, rice is cultivated on an area of 154 million hectares with an annual production of 700 million tonnes (FAO 2011). Globally, India ranks first in cultivable area under rice and second in production, producing 131 million tonnes. Drought is a major abiotic stress that limits rice productivity in rainfed and upland ecosystems (Bimpong et al. 2011) and worldwide, drought affects approximately 27 million hectares of rainfed area. In India, area under rice cultivation remained stagnant and even declined in the recent years due to less water availability. Drought reduces yield by 15–50 per cent depending on the stress intensity and crop growth period at which the stress occurs in rice (Srividhya et al. 2011). Drought is particularly frequent in unbunded uplands, bunded uplands and shallow rainfed lowland fields in many parts of South and South-East Asia, sub-Saharan Africa and Latin America (Sellamuthu et al. 2011). Developing high yielding and drought resistant varieties for rainfed area is the priority for improving rainfed rice production. Root system play an important role in crop adaptation in the changing climate scenario. The contribution of a deep and abundant at depth root system to

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Research Article

STERILITY MODULATION IN TGMS SYSTEM USING PLANT GROWTH REGULATORS FOR HYBRID RICE PRODUCTION

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Abstract: Thermo-sensitive genic male sterility (TGMS) is a system in which temperature controls the sterility/fertility expression. TGMS genes are conditioned by temperature variations during critical thermosensitive stage. TGMS plants become male sterile when temperature is above critical sterility temperature (CST) and it remains fertile if the temperature is below the CST. It can overcome the difficulties in three line system of hybrid rice development and can successfully be utilized in tropical countries where significant variations in temperature exist between season and between altitudes. Frequent fluctuations in temperature can affect pure hybrid seed set in TGMS rice since complete male sterility is a prerequisite for hybridisation programmes. Phytohormones play a key role in attaining functional spikelet development. They are also involved in the thermo signalling pathway and control the male reproductive development in rice. Hence this study aims at identifying effective plant growth regulator in modulating pollen development and controls the expression of tms gene. Three plant growth regulators (PGR) namely ethrel, salicylic acid and maleic hydrazide (MH) were applied as foliar spray at two stages viz., panicle initiation and two weeks after panicle initiation. The results have shown that MH, ethrel and salicylic acid at different concentrations were effective in influencing anther development and induced pollen sterility. The study suggests that spraying of MH (8.92 mol m^{-3}) two times; at the time of panicle initiation and fifteen days after panicle initiation were more efficient in inducing pollen sterility in TGMS rice and can be used for commercial hybrid rice seed development.

Keywords: Pollen development, Male sterility, Pollen sterility, TGMS rice, Plant growth regulator

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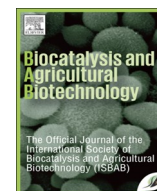
Introduction

Hybrid rice technology is the most appropriate method to meet the demand of ever growing population since hybrids can produce 15 to 20 % higher yield over conventional varieties. The identification of male sterility in rice was a breakthrough in the development of commercial rice hybrids. Hybrid rice development is focussed mainly on the three-line and two-line male sterile systems. The two line breeding system exploiting TGMS has a great potential to overcome the difficulties in three line system of hybrid development using cytoplasmic male sterility (CMS) and has nearly ten percent yield advantage over CMS hybrids. It is more useful in tropical countries compared to photosensitive genic male sterile system, where the day length differences are marginal. TGMS lines are sensitive to the temperature for the expression of their male sterility gene(s). TGMS lines will remain sterile when temperature is above CST and it will remain fertile if the temperature is below the CST. Male sterility is controlled by single nuclear recessive gene which can be transferred to any rice line of interest [1]. Ten tms genes were reported in TGMS lines developed so far [2,3]. Reverse TGMS genes exhibiting sterility at low temperature and fertility at high temperature were also identified [4]. The most significant effect of frequent fluctuations in temperature is the reversion of fertile phase of TGMS plants resulting in selfing of female parent and vice versa. Any depression in temperature due to an unexpected climate change can turn the sterile TGMS lines into male fertile plants. Phytohormones play a significant role in male reproductive development through its differential distribution in plants. It regulates the anther development and formation of functional pollen grains. PGRs are reported to control male sterility and can better be utilized for sterility regulation in TGMS system. The chemicals such as ethrel, salicylic acid and MH are reported to cause male sterility in rice and other crops. Salicylic acid is one of the phenolic compounds exhibiting thermogenic properties.

Salicylic acid triggers an increase in the alternate oxidase pathway which increases inflorescence temperature up to 14°C in arum lily [5]. Therefore the external application of salicylic acid may cause pollen sterility in the TGMS lines. Insufficient amount of active indole acetic acid and gibberellic acid would cause pollen abortion, which is a common reason for male sterility [6]. Any defects in gibberellic acid biosynthesis affect pollen development in rice. Halogen substituted oxanilates like ethyl 4'fluoroxanilate and ethyl 4'bromoxanilate were reported to be highly efficient in inducing the pollen sterility in rice, wheat and sorghum [7-9]. The treatment with exogenous 2-chloroethyl phosphonic acid (CEPA), an ethylene releaser, increased the frequency of sterile pollen grains in TGMS wheat [10]. Besides inducing male sterility in crops, PGR alter biochemical constituents also in TGMS rice under sterility inducing and fertility inducing conditions [11-13]. Endogenous levels of bioactive gibberellins and cytokinin in anthers were lower in the rice autophagy mutant *Osatg7-1* than in the wild type at the flowering stage which causes defects in pollen maturation [14]. In this context, a study was conducted for evaluating the potential of growth regulators in regulating the expression of male sterility genes in TGMS rice.

Materials and methods

Stable TGMS line IR75589-31-27-8-33 (EC720903) was imported from International Rice Research Institute (IRRI), Philippines through Standard Material Transfer Agreement (SMTA) through National Bureau of Plant Genetic Resources (NBPGR), New Delhi. The critical sterility temperature and the critical stage of thermo sensitivity of the TGMS line were identified at Department of Plant Physiology, College of Agriculture, Vellayani which is located $8^{\circ}5'N$ latitude and $76^{\circ}9'E$ longitude with an altitude of 29 m above Mean Sea Level (MSL). The critical sterility period was found to be 15-22 days before heading and the sterility inducing average temperature was 26.9°C .



Variability of *Pectobacterium carotovorum* causing rhizome rot in banana

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Rhizome rot

ABSTRACT

The rhizome rot or tip over is a major and emerging disease of banana, causing substantial economic losses. Common cultivars such as Grand Naine, Rasthali and Nendran are highly susceptible to this disease caused by different *Pectobacterium* species. Understanding the disease etiology and pathogen variability are essential in management programs. Bacterium *Pectobacterium carotovorum* was isolated from infected rhizomes from 18 locations of Kerala and Tamil Nadu states of India. Pathogenicity of all isolates were confirmed by *in vitro* inoculation in rhizome bits and *in vivo* inoculation in rhizomes of three months old plants and pseudostems of two months old tissue cultured plants of cv. Nendran. Isolates were characterized by cultural, morphological, biochemical, physiological and molecular methods. Cultural characterization was carried out on Nutrient agar (NA), Yeast Extract Glucose Calcium Carbonate (YGC), Logan's medium and Nutrient broth. Morphological characterization was carried out by Gram staining, capsule staining and flagellar staining. Biochemical characterization was done through potato and carrot soft rot test, intrinsic antibiotic resistance, growth of bacteria in three and four per cent NaCl and growth of bacteria in CVP medium. Physiological characterization was carried out by growing the bacterium at different temperatures and pH. Based on these results, 18 isolates were allocated to six groups.

16S rDNA regions of representative isolates of each group have been PCR amplified and the 1.5 kb amplicons were sequenced. Homology and phylogeny analyses had shown that all the groups belong to *Pectobacterium carotovorum*, and two subspecies *carotovorum* and *brasiliense* were identified.

1. Introduction

Banana or plantain (*Musa* sp.) known as 'Apple of Paradise' is one among the ancient fruits known to humankind. Recently, rhizome rot has emerged as a major disease, especially in southern states of India (Usha, 2003; Snehalatharani and Khan, 2010; Nagaraj et al., 2012). Popular banana cultivars Grand Naine, Nendran and Rasthali are susceptible to this disease. Symptoms of the disease include massive soft rot accompanied by disagreeable foul smelling rot of the rhizome and internal decay of the pseudostem as the infection spread upward. Infected plants show stunted growth, water soaked appearance on the leaf base, yellowing of leaf and finally toppling over of the plant (Nagaraj et al., 2012).

Different *Erwinia* species (syn. *Pectobacterium*) cause rhizome rot in banana (Kwon et al., 2000). Usha (2003) reported that in Kerala state of India, *Pectobacterium carotovorum* is the pathogen causing rhizome rot

in banana. This study reveals the extent of variability and the subspecies of this pathogen present in humid tropics of India, through cultural, morphological, biochemical, physiological and molecular methods.

2. Materials and methods

2.1. Development of bacterial pure cultures

Infected rhizome samples at the initial stage of rotting (10% rotting) were collected from 18 banana fields from Kerala and Tamil Nadu states of India. Type of soil varied between sandy loam to laterite and the disease was observed mainly under conditions of high soil moisture. Samples were collected in sterile polythene bags and brought to the laboratory for pathogen isolation (Fig. 1).

Rhizomes have been washed, cleaned thoroughly and small rhizome

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STANDARDISATION OF SEEDLING PRODUCTION IN THAATHIRI (*Woodfordia fruticosa*) (L.) KURZ

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ABSTRACT

Thaathiri (*Woodfordia fruticosa*) belonging to Family Lythraceae is a medicinal plant extensively used in the Ayurvedic system of medicine. The plant flowers profusely and seeds are produced abundantly. Seeds are very fine, powdery in nature; one milligram contains more than 3000 seeds. 70-75% seeds germinate in fine sterile medium, but survival percentage of seedling is very low under normal conditions. Hence trials were carried out at Aromatic and Medicinal Plants Research Station, Odakkali for standardizing a protocol for seedling growth management. Seeds sown in sterilized coir pith compost medium germinated in 15-20 days. The tiny seedlings were then picked up at 5-6 days of germination and transferred to protrays of eight treatments comprising of four types of growing media and three nutrient application treatments. It was observed that growing in sterilized coirpith compost medium with weekly spray of vermiwash or NPK mixture (19:19:19) at 0.2% concentration was effective in achieving 70% survival and good seedling growth. After a month, at 4-5 leaf stage, the seedlings were again transplanted to poly bags containing potting mixture (soil and coir pith compost in 4:1 ratio) and they become ready for field planting within 2-3 months. Thus a two stage transplanting under appropriate management is found essential for successful seedling production of this plant.

KEYWORDS: *Woodfordia fruticosa*, Thaathiri, Medicinal Plant, Propagation

Woodfordia fruticosa belonging to Family Lythraceae is a medicinal plant extensively used in the Ayurvedic and unani systems of medicine. It is a much branched beautiful shrub, 1-4 m high producing numerous bright red flowers in dense, axillary, paniculate cymose clusters. Flowers are the officinal part and it is effective against skin diseases, burning sensation, bilious fever, hepatopathy, verminosis, erysipelas, haemorrhages etc. They are an important ingredient in *Aristams* and *Asavams* as they aid in fermentation. It is an ingredient of a preparation that is used to make barren women fertile (Burkill 1966; Dey 1984). The red dye extracted from the flowers is extensively used throughout India for dyeing fabrics (Das *et al.* 2007). The flowers of this plant possess high content of tannins and they have astringent, acrid, refrigerant, stimulant, styptic, uterine sedative, anthelmintic, constipating, antibacterial, vulnerary, alexeteric and febrifuge properties (Anjaria *et al.*, 2002). A wide range of chemical compounds including tannins, flavonoids, anthraquinone glycosides, and polyphenols have been isolated from this species. Extracts and metabolites of this plant, particularly those from flowers and leaves, possess useful pharmacological activities (Pratap *et al.*, 2007). Parekh and Chanda (2007) reported that the plant extract can be used as antimicrobial agents in new drugs for the therapy of infectious diseases caused by pathogens.

It can be propagated using branch cuttings and seeds. Vegetative propagation is difficult as this plant is considered to be a hard-to-root species irrespective of season and hormone treatment (Bahuguna *et al.*, 1988; Rajesh *et al.*, 1993; Raju *et al.*, 1994). Micropropagation techniques in the plant has been standardized by many workers (Krishnan and Seenii (1994), Kokkiralala *et al.* (2012), but it is highly sophisticated and costly.

The plant flowers profusely and seeds are produced abundantly. Seeds are very fine, powdery in nature; one milligram contains more than 3000 seeds. 70-75% seeds germinate in fine sterile medium, but survival percentage of seedling is very low as they often die off within a few days of germination. Bhagat *et al.* (1992) observed that seed germination was better in sand and that the seeds stored at normal room conditions remain viable upto 3-4 months. However, seed propagation is not adopted owing to the problems in development of healthy seedlings from the tiny seeds. If this problem is overcome, seed propagation would be a cheap and easy method for multiplication of this medicinally important plant which of threatened status. Hence a study was conducted to standardize a seed propagation protocol for *W. fruticosa*. (Fig. 1 to Fig. 4).



RESEARCH ARTICLES

Standardization of adventitious root induction in stem cuttings of *Cynometra travancorica* Bedd Willd., an endangered tree species of Western Ghats

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Abstract

Cynometra travancorica Bedd. belonging to family Fabaceae is an endangered tree species endemic to Western Ghats with restricted distribution. There is an urgent need for conservation of this endangered species and the vegetative propagation techniques can play major role in planting stock production. Present study focuses on the standardisation of vegetative propagation protocol of *C. travancorica* using stem cuttings with different concentrations of three plant growth regulating substances in different season. The anatomical, physiological and biochemical changes of the sprouted cuttings belonging to different growth regulator treatments were also conducted. Softwood, semi hardwood and hardwood cuttings were collected in three seasons (January–April, May–August and September–December) and treated with indole 3 butyric acid, indole 3 acetic acid and naphthalene acetic acid in different concentrations. Rooting response was measured after 45 days in the mist chamber. The adventitious rhizogenesis of *C. travancorica* stem cuttings was influenced by type of cutting, season of collection, type of growth regulator and its concentration. Semi hardwood cuttings collected during season III treated with 8000 mg l⁻¹ IBA recorded about 84% rooting. Anatomical studies on the sprouted cuttings treated with different growth regulator did not show any significant differences, whereas physiological and biochemical parameters of sprouted cuttings varied. Hence, we recommend this treatment combination for the large scale planting stock production.

Keywords *Cynometra travancorica* · IBA · NAA · Propagation · Rooting

Introduction

Cynometra travancorica Bedd. is an endangered tree of Western Ghats reaching up to 20 m height belonging to Fabaceae. It is rarely found in Agasthyamalai of South Sahyadri, North Malabar and Palakkad Hills to Coorg Region in Central Sahyadri. In Kerala, it is distributed in Palakkad, Thiruvananthapuram, Kollam, Thrissur, Kozhikkode, Wayanad districts. It is a tree species with antimicrobial properties and attempt on phytochemical screening is also done (Desai and Chavan 2010, 2011). There is a crucial need to conserve this species due to narrow distribution and

destruction of natural habitats. Vegetative propagation is ideal in rapid multiplication of the species under threat while trying to maintain certain desired characteristics (Hartmann *et al.* 2002). Rooting efficacy of tree species propagated by stem cuttings is greatly influenced by factors such as cutting position from the shoot, type of cutting, season of collection, growth regulator and its concentration, etc. (Husen and Pal 2006). Till date, there is no feasible standard protocol available for vegetative propagation of *C. travancorica* through stem cuttings. Hence, the present study was undertaken:

1. To standardise the rooting of *C. travancorica* cuttings (softwood, semi hardwood and hardwood cutting) in different seasons on treatment with three growth regulators at different concentrations.
2. To study the anatomical variation in cutting treated with growth regulators.
3. For understanding of physiological and biochemical variation due to growth regulators during adventitious rooting.

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Medicinal Plants in the Broad-Leaf Mixed Coniferous Forest of Tshothang Chiwog, Bhutan: Floristic Attributes, Vegetation Structure, Ethnobotany, and Socioeconomic Aspects

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The Himalayan Kingdom of Bhutan, located in one of the global biodiversity hotspots, is endowed with abundant floral wealth, including a wide array of medicinal plants (MPs). However, over-exploitation of these resources is widespread, and only a few studies have assessed the richness and diversity of Bhutanese forests and in particular about the MP resources. A vegetation survey was conducted in Tshothang Chiwog, south-eastern Bhutan to characterize the floristic structure of the broad-leaf mixed coniferous forests with a special focus on MPs. A questionnaire survey involving 40 farmers was also conducted to assess the ethnobotanical and socioeconomic aspects of MP extraction. A total of 157 plant species (38 trees, 19 shrubs, 85 herbs and ferns, and 15 climbers), representing 74 families and 137 genera were identified from the study area, of which 69 species (14 trees, 10 shrubs, 38 herbs and ferns, and seven climbers), belonging to 41 families and 69 genera were medicinally important. The most species-rich families of medicinal plants were: Asteraceae (eight spp.), Apiaceae (four spp.), Polygonaceae, Brassicaceae, Zingiberaceae, and Urticaceae (three species each). Herbaceous flora exhibited the highest diversity (Simpson diversity index, $D = 0.97$ and Shannon-Weiner index, $H' = 5.82$), followed by trees and shrubs ($D = 0.95$ and 0.92 and $H' = 4.86$ and 3.97 , respectively). All but one herb showed abundance-to-frequency ratio ($A/F \geq 0.05$), signifying a contagious distribution pattern (large aggregated distribution). Girth class distribution of trees followed an inverse J-shaped pattern. Results of the ethnobotanic study documented 55 MPs. MP collection, as reported by the interviewees, generally improved the socioeconomic status of the people of Tshothang Chiwog. Apart from improving the livelihood security of the local people, aspects relating to health care and culture are also important. Respondents were also concerned about the declining MP wealth of the Chiwog over the years, due to over-exploitation. Monitoring the plant resources and adopting conservation programmes in the Chiwog, in their opinion, may improve the MP wealth of the locality. The lessons learned from the study may have applicability over the south-eastern part of Bhutan and other regions with similar eco-climatic features.

Keywords: Himalayas, floristic composition, vegetation structure, medicinal plant collection, socioeconomic status



Litter fall, decomposition and nutrient release dynamics of *Thyrsostachys oliveri* gamble in humid tropics of Kerala, Southern India

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Abstract

Thyrsostachys oliveri is a bamboo species native to Myanmar cultivated in Arunachal Pradesh, Uttar Pradesh, Kerala and Tamil Nadu, India. Due to multifarious uses, this species has been preferred by farmers for large-scale cultivation all over India. Little is known about litter production, decomposition and nutrient release dynamics of this species. Litter dynamic studies are imperative, prior to integration of a species into any plantation program or agroforestry systems. The present study is framed to investigate the litter production, decomposition and nutrient release dynamics of *T. oliveri*. Litter production during 2010-2011 was quantified using specially designed litter traps made of bamboo baskets with a diameter of 1 m and depth 10 cm. Litter decomposition was studied using nylon litter bag techniques. The total annual litter production of this species was to the tune of 4.488 t ha⁻¹. The major share of total litterfall in *T. oliveri* was contributed by leaves (93.60±0.99 %) followed by branches (5.82±0.99 %) and culm sheaths (0.76±0.75 %). Litter production followed a biphasic pattern with a major peak in February 2011 and minor peak in July 2010. Weight loss expressed as percentage of the original dry weight decreased exponentially with time and the mass loss in *T. oliveri* was a good fit to exponential decay model. The decomposition rate constant of *T. oliveri* was 0.009 day⁻¹ and the half-life was 77 days. The release of nutrients from the decomposing litter was in the order Mg > N > Ca > P > K.

Keywords: *Thyrsostachys oliveri*, litterfall, litter decomposition, nutrient release, decomposition rate

Introduction

Bamboos are fast-growing, arborescent grasses belonging to the family Poaceae, subfamily Bambusoideae, tribe Bambuseae. It is multipurpose species with more than one thousand five hundred recorded uses. The Government of India has launched two bamboo missions viz., National Mission on Bamboo Applications (NMBA) and the National Bamboo Mission (NBM) under Ministry of Science and Technology and Ministry of Agriculture and Co-operation, respectively, to focus on bamboo sector development. *Thyrsostachys oliveri* Gamble is a moderate sized tropical clumping bamboo with rather small leaves and persistent culm sheaths. Usually, the culms are 15–25 m high, 5 cm in diameter, bright green with the whitish silky surface when young, greyish green to light white in colour of maturity, thick-walled (2–2.5 cm), internodes 40–60 cm long. It was introduced to India from the native Myanmar and is being cultivated in Arunachal Pradesh, Uttar Pradesh, Kerala and Tamil Nadu. Culms of *T. oliveri* are in great demand for construction purposes, reinforcement for concrete slabs, poles, basketry and handicrafts. Young shoot is edible. The culms are also in good demand for pluckers and banana props. Because of its small clump size, straight growth and

branching only from top one-third of the culms, it is the most preferred species by farmers for growing in homesteads. It is identified as one of the priority species for large-scale cultivation in India by NMBA (Haridasan and Tewari, 2008).

Plant litter acts as the temporary sink for nutrients and slow release of nutrients guarantees the permanent contribution to the soil. Litter decomposition plays a major role in maintaining soil fertility in terms of nutrient cycling and formation of the soil organic matter (Singh *et al.*, 2007; Guendehou *et al.*, 2014; Bargali *et al.*, 2015). Litter dynamics studies are crucial in the nutrition budgeting in tropical ecosystems where vegetation depends on the recycling of the nutrients held in the plant debris (Prichett and Fisher, 1987). Data on its litter production and decomposition dynamics is vital, prior to the introduction of bamboos into farmer's field. Decomposition of litter by which organic matter and nutrients are returned to the soil is a primary mechanism and has received substantial attention in sustainable soil fertility. However, the litter dynamics studies of bamboos are scanty and most of the available literature is limited to monopodial bamboo species. No data is available on the litter dynamics of *T. oliveri*. With this background, the present study was formulated to understand the litter production, decomposition and nutrient release dynamics of *T. oliveri*.

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RESEARCH ARTICLE

PERFORMANCE OF A LOW COST AUTOMATION SYSTEM FOR GREENHOUSE COOLING

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Greenhouse automation, greenhouse cooling, greenhouse microclimate control, greenhouse environment control, greenhouse cultivation, protected cultivation.

ABSTRACT

The Land available for cultivation is decreasing and population is increasing. This necessitates the requirement of adopting scientific methods for achieving maximum production. Maximum yield from crops can be achieved by providing required quantity of nutrients and water and also the desired level of microclimate. Microclimate modification is possible in greenhouses and this is the advantage of greenhouse cultivation compared to open field cultivation. Greenhouse cultivation requires microclimate management as well as application of water and nutrients to plants daily. This requires labour and this cost can be reduced by adopting automation systems. This paper presents a performance study of a locally developed low cost automation system on greenhouse cooling. Temperature inside the greenhouse is to be reduced in summer in Kerala which falls under humid tropical climate. The automation system installed in one greenhouse and temperature recorded at hourly intervals. Temperature measurements were taken from another greenhouse which is manually controlled. Saniya variety of salad cucumber was cultivated in both the greenhouses. Temperature data and crop data from both the greenhouses collected and compared. Performance of the automation system was good in controlling the greenhouses temperature. Yield obtained from greenhouse operated by automation system was higher compared to other.

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INTRODUCTION

Food security of the exponentially growing population can only be met through the application of suitable technologies which can maximize agricultural production. This can be achieved by developing and adopting technologies which can maximize agricultural production. For a plant of given genetic makeup the factors that affect the plant growth are light, temperature, air composition and nature of the growing medium. Hence the crop growing environment is to be suitably modified to maximize production leading to optimum productivity. The environmental factors to be modified include light, temperature, relative humidity, carbon dioxide concentration and nature of growing medium. In the case of open field cultivation only the growing medium can be controlled and the environmental factors which affect crop growth cannot be controlled manually, whereas in greenhouses all the environmental parameters can be suitably controlled or modified.

We can cultivate any crop, anywhere during any season inside a greenhouse by modifying crop growing environment. Automatic regulation of crop growing environment is of great importance and most of the cultivators are unable to manage it manually. Greenhouse is a type of protected cultivation which is used for protection of plants from wind, precipitation, excess solar radiation, temperature extremes, pests and diseases. Greenhouses are framed or inflated structures covered with transparent or translucent material, in which crops can be grown under the conditions of at least partially controlled environment and are large enough to allow a person to walk within them to carry out agricultural operations. A greenhouse protects plants from wind, precipitation, excess solar radiation, temperature extremes, pests and diseases. Advantages of growing plants in greenhouses include; maximum production per unit area, increasing intensity of cropping, cultivation of any crop anywhere during any season of the year depending on the demand from the market, cultivation of problematic areas, better planting material production, better protection from pests etc. The covering material causes the greenhouse microclimate different than outside climate. Because of the covering material greenhouse effect occurred in greenhouse and this increases the temperature inside the greenhouse.

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Research article

Piriformospora indica cell wall extract as the best elicitor for asiaticoside production in *Centella asiatica* (L.) Urban, evidenced by morphological, physiological and molecular analyses

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ABSTRACT

Vascular plants synthesise a multitude of organic molecules or phytochemicals, referred to as “secondary metabolites”. These molecules are involved in a variety of roles in the life span of plants, ranging from structural ones to protection. *Centella asiatica* (L.) Urban has probably been used since prehistoric times and has been reported to have been used for various medicinal and cosmetic purposes. The plant contains several active constituents, of which the most important is asiaticoside, a triterpenoid. Asiaticoside content in *C. asiatica* can be enhanced by the use of biotic elicitors like *Piriformospora indica*. *P. indica* has been used as a model to study the mechanisms and evolution of mutualistic symbiosis. *P. indica* is similar to Arbuscular Mycorrhizal (AM) fungi in terms of plant growth promotional effects. The autoclaved fraction from *P. indica* (PiCWE) was found to be the most active fraction in promoting the plant biomass and asiaticoside content. To date, there are no reports on the potential role of PiCWE in enhancement of asiaticoside over the control and *P. indica* colonized plants, which was evidenced by the differential expression of key genes involved and final asiaticoside content along with the determination of phytohormones. Moreover, differential expression of selected miRNAs in PiCWE - *C. asiatica* root interactions over the control and *P. indica* treated *C. asiatica* leaf samples was also scrutinized. The important consequence of induction with PiCWE was the significant enhancement of asiaticoside in the PiCWE induced plants in comparison with the asiaticoside content in control and *P. indica*-*C. asiatica* interaction. In addition, the role of miRNAs in *C. asiatica* - PiCWE would enable more in-depth studies for deciphering the molecular and physiological mechanisms of the association and regulation of PiCWE - *C. asiatica* interactions.

1. Introduction

Elicitation is the process of inducing or enhancing synthesis of secondary metabolites by the plants to ensure their survival, persistence and competitiveness (Gorelick and Bernstein, 2014, 2017). Plant cells *in vitro* show physiological and morphological responses to microbial, physical or chemical factors which are the elicitors. Various elicitors have been reported to control metabolic flux between the steroid and the triterpene pathways, probably by acting at the level of cyclases. Efforts to elicit the biosynthesis of centellosides mainly focus on using Methyl Jasmonate (MJ), thidiazuron (Kim et al., 2004), and a permeabilization and feeding strategy by treatment with DMSO alone or in combination with β Amyrin (Hernandez-Vazquez et al., 2010) in cell cultures, roots and whole plants of *Centella asiatica*. Efforts to

improve the triterpenoid content of *C. asiatica* in *in vitro* shoot cultures by elicitation with exogenously supplied MJ resulted in a significant enhancement of the triterpenoid content at the expense of plant growth and decreased free sterol content (Mangas et al., 2006). However, eliciting transformed hairy root cultures of *C. asiatica* with MJ enhanced asiaticoside production as well as root biomass (Kim et al., 2007). The raise in secondary metabolite production effected by endosymbiosis is apparently due to elicitation of plant defense in response to fungal elicitors like lipopolysaccharides and glycoproteins formed by the action of plant derived hydrolases secreted in response to endophyte colonization (Gao et al., 2010; Netzker et al., 2015). Symbiotic nitrogen fixation is a longer term relationship often involving a special structure to house a microbial partner. Nitrogen fixing symbiotic association involves a nitrogen fixing symbiotic organism - the microsymbiont like

Abbreviations: MJ, Methyl Jasmonate; DMSO, Methyl Sulfinyl Methane; AM, Arbuscular Mycorrhiza; DSM, Deutsche Sammlung für Mikroorganismen; PiCWE, *P. indica* Cell Wall Extract; SQS, Squalene Synthase; β AS, β Amyrin Synthase; CYS, Cycloartenol Synthase; miRNA, micro RNA; IAA, Indole Acetic Acid; t-ZR, trans-Zeatin Riboside; PDA, Potato Dextrose Agar; PDB, Potato Dextrose Broth; BHT, Butylated HydroxyToluene

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Effect of bee wax coating and modified atmospheric packaging on shelf-life of slicing cucumber (*Cucumis sativus*)

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ABSTRACT

The cucumbers (*Cucumis sativus*) fruit is highly perishable and losses its quality immediately after the second or third day of harvest. The post-harvest loss in quality and commercial value is due to the intense respiratory activity and significant moisture loss. Hence a study has been undertaken to increase the shelf-life of cucumbers by using edible coatings and MAP. Various samples of the cucumbers were treated with bee wax and were packed in 260 \pm 1 gauge LDPE bags (0% perforations and 0.25% perforations) and 200 gauge self-breathing bags and was stored at 11 \pm 2°C and 95% RH. The effect on the shelf- life extension of fruits was investigated. The physical and biochemical quality parameters of stored samples were tested periodically at an interval of 5 days. Prediction equations were also developed for various post-harvest quality parameters of slicing cucumber under EMA storage. This study showed that use of edible coating (natural bee wax) and EMA condition could reduce the respiration rate and thereby extend the shelf-life of the slicing cucumbers for two weeks. From this study it was able to conclude that wax coating in combination with EMA condition created by self-breathing bags was the best treatment suited for extending the shelf-life for seventeen days for slicing cucumbers at 11 \pm 2°C and 95% RH with acceptable quality.

Key words : *Cucumber, Cucumis sativus, Edible coating, MAP, Shelf-life.*

INTRODUCTION

Though India is one of the largest producers of fruit and vegetables, it processes only less than 2.5% of the huge production as compared to 70-83% in advanced countries (Akhila and Sharina, 2009). According to Nanda *et al.* (2012), the post-harvest losses in India are estimated to be 5.8-18% of the total production which valued over ₹ 27, 500 crores annually. Fresh fruits and vegetables normally have an elaborate spoilage micro flora, due to intensive contact with various types of microorganisms during growth and post-harvest handling (Gorris *et al.*, 1992). In addition to this, the highly perishable nature of fruits and vegetables due to their high water content, make them susceptible to desiccation, mechanical injury and pathological breakdown. This results in changes in texture, colour, flavour and nutritional value of the food. These changes can render food unpalatable and potentially unsafe for human consumption. If we reduce even 1% of the loss, that would save about ₹ 900 crores. Though post-harvest management technology is available in certain sectors, the supply chain inefficiency and inadequate

infrastructure are the main causes for such wastages.

Pre-harvest factors appear to be responsible for much of the variation in cucumber quality and shelf-life. The ability to predict the post-harvest longevity of cucumbers would facilitate the commercial segregation of fruit with different storage potentials. Cucumber shelf-life has been found to decline with increase in fruit age at harvest (Lin and Ehret, 1991; Jolliffe and Lin, 1997). Although cucumbers have a limited shelf life, they offer high quality. The perishable nature of cucumbers prevents the economical storage of fresh fruits for longer than 1 month (Todd *et al.*, 2000). Various packaging techniques like modified atmospheric packaging (MAP), self-breathing bags, controlled atmospheric storage (CAS) etc., various post-harvest techniques like wax coating and temperature control can extend the shelf-life and helps in maintaining the freshness and hence results in increasing consumer satisfaction (Madhana, 2012).

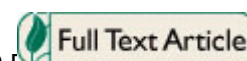
With this background this study has been taken up with the aim of studying the suitability of various packaging methods for extending the shelf-life of cucumber. And also to study effect of wax coating on shelf-life extension.

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The Beneficial Root-Colonizing Fungus *Mortierella hyalina* Promotes the Aerial Growth of *Arabidopsis* and Activates Calcium-Dependent Responses That Restrict *Alternaria brassicae*-Induced Disease Development in Roots.

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Abstract

The endophytic fungus *Mortierella hyalina* colonizes the roots of *Arabidopsis thaliana* and stimulates growth and biomass production of the aerial parts but not of roots. An exudate fraction from the fungus induces rapid and transient cytoplasmic Ca^{2+} elevation in the roots. The Ca^{2+} response does not require the well-characterized (co)receptors BAK1, CERK1, and FLS2 for pathogen-associated molecular patterns, and the Ca^{2+} channels GLR-2.4, GLR-2.5, and GLR-3.3 or the vacuolar TWO PORE CHANNEL1, which might be involved in cytoplasmic Ca^{2+} elevation. We isolated an ethyl-methane-sulfonate-induced *Arabidopsis* mutant that is impaired in this Ca^{2+} response. The roots of the mutant are impaired in *M. hyalina*-mediated suppression of immune responses after *Alternaria brassicae* infection, i.e., jasmonate accumulation, generation of reactive oxygen species, as well as the activation of jasmonate-related defense genes. Furthermore, they are more colonized by *M. hyalina* than wild-type roots. We propose that the mutant gene product is involved in a Ca^{2+} -dependent signaling pathway activated by *M. hyalina* to suppress immune responses in *Arabidopsis* roots.

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CHANGE DETECTION OF REMOTE SENSING IMAGES USING LEVY FLIGHT PSO

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Abstract: In this paper, we propose an improved fusion technique for the change detection of remote sensing images. Two difference images, one log ratio image and other a difference image generated by subtraction were fused in the undecimated wavelet domain, as UWT is good in representing images into multiscale, pyramidal form. The resultant sub band images were segmented with a Particle Swarm Optimization algorithm with Levy flights due to its robustness against local optima, unlike the standard PSO. The accuracy metrics - Percent Correct Clustering (PCC) and Kappa statistic - were used to compare the performance of the proposed method with a few other algorithms and found to be outperforming.

Keywords: Undecimated Wavelet Transform, Fusion, Particle Swarm Optimization, Levy Flight, Remote sensing

I. INTRODUCTION

Due to diverse applications such as medical diagnosis, industrial production, video surveillance and land cover changes monitoring, change detection[1-3] has gained great interest in the recent decades. In this paper the emphasis is on geographical change detection using remote sensing imageries as the rationale behind this is manifold. The first fact is the availability of satellite images of different resolution and various technologies present in processing and analyzing them. At the same time, the challenges arising in real-time problems such as disaster management, protecting ecology and monitoring land use changes are increasing and therefore, developing potential solutions to handle these complexities have become the need of the hour. Though several methods are available today, many of them are inefficient in detecting the actual changes occurred when the nature of changes involved are heterogeneous, and which makes this research relevant.

In order to detect changes occurred, two images of the same scene acquired at two time stamps are required. Since the quality of remote sensing images are prone to be affected by many external factors while capturing, it has to be pre-processed for minimizing such effects. The radiometric errors due to atmospheric haze, sun angle, azimuth etc. are rectified by suitable software. Geometric errors are corrected by co-registering the images to the same coordinates. Filtering operations are often done for removing the noise inherent in the images while capturing. After preprocessing operations, the difference image(DI) is generated, for which, two commonly adopted methods are rationing and subtraction [3]. While the former employs ratio operation on corresponding pixels of the two input images, the latter generates the DI by subtracting the pixels of the input images. Finally, the labeling of pixels into two groups - changed and unchanged- are done to produce a binary change map. For this, the techniques often used are segmentation in the supervised or unsupervised paradigm[4] or by the usual thresholding method. From the literature, it

is evident that the quality of the difference image and the segmentation algorithm determines the accuracy of the change map, and therefore, in this study, the emphasis has been given on these two issues. In order to enhance the quality of difference images, we have proposed a fusion technique[5] using two types of difference images, one being a DI generated by subtraction and other DI, by rationing that can complement information each other while combining. Rationing has been done on logarithmic scale as the logarithmic operation scales down the range of variation of pixels, and thus, the effect of noise also can be reduced considerably. Since the DI by subtraction is a true reflection of the intensity values of the various covered objects of the scene, for the change detection problems, it is more appropriate. In [3], fusion of two difference images at the DWT coefficient level is done to enhance the true signal components in the resultant DI in a change detection problem. Although the accuracy obtained is found to be high, the shift and scale variance of DWT, which are not suitable in the case of change detection, reduces the attraction of this method. Therefore, we have performed the fusion in the Undecimated Discrete Wavelet Transform (UWT/UDWT) domain, which are scale and shift invariant. For more details, it can be referred to [6] as present study is an extension of the work done in [6].

The rest of the paper is organized as follows: Section II discusses the motivation behind the proposed method and the theoretical framework available in the literature. Section III details the proposed algorithm and the datasets and the experiments are discussed in section IV. A brief discussion on the results is presented in section V and finally, the future work intended are discussed in section VI.

II. METHODOLOGY

A. Motivation

Wavelets are multiscale or multiresolution in nature with efficient representation of frequency and space



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Change Detection using undecimated Wavelet Transform Fusion and Genetic Algorithm

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Abstract— Change detection using remote sensing images have great significance in this information age, since it has diverse applications such as urbanization study, protection of nature, monitoring land use changes and disaster management. In this paper, an algorithm to enhance the information contents, two input images have been fused in the UDWT domain and further, these coefficients are segmented by a genetic algorithm to label the changed and unchanged pixels to generate the change map. The efficacy of the method was evaluated by qualitative as well as quantitative accuracy metrics and found to be performing superior to individual methods. The results of the two data sets chosen demonstrate the suitability of the proposed technique in the urbanization and the land use changes studies.

Keywords— Undecimated Wavelet Transform, fusion, Genetic Algorithm, change detection, remote sensing.

I. INTRODUCTION

Change detection using images has gained enormous attraction in the recent decades due to its wide array of applications in various fields. It involves medical diagnosis[1], detecting alteration in geography[2] caused by natural phenomena or human interventions and diverse industrial applications. Due to the leap in space technology, a huge volume of remote sensing images are piling up every day, which can be utilized for various studies such as urbanization, protection of nature and wild life, land use changes, disaster management etc [2]. Multispectral satellite images contain multiple spectral bands carrying details of various land cover objects as the onboard MSS operates at different range of spectral radiation and therefore, these images are more suitable for the remote sensing change detection analysis. In order to evaluate the changes, it requires two co-registered images [3] of the same scene acquired at two time points. In literature, change detection involves three major steps[2-3]. Firstly, the images are pre-processed for rectifying errors trapped in, due to various environmental conditions while capturing. The images are to be registered on the same co-ordinates which is also called geo-referencing, to align them into the same latitude-longitude measures.

Next, from the pre-processed, co-registered images, the difference image is generated by employing various methods such as rationing and subtraction. The logarithmic operation is often applied on rationing, as it is efficient in handling different noise models. Since the range of variation in the signals gets reduced on logarithmic scale, the weak signals get enhanced as well [2]. Finally, the difference image is grouped into two using various methods such as thresholding or by a segmentation algorithm. However, from the literature, it is evident that the whole performance and quality of the change map largely depends upon the quality of the difference image and the segmentation algorithm[3]. Several attempts can be seen in literature to improve the quality of difference image as well as the quality of the change map. One popular and much explored technique is fusion[2-5]. In [3] a fusion technique was employed in the discrete wavelet transform (DWT) domain to enhance the quality of the difference image and thereby the accuracy of the change detection map in combination with a fuzzy clustering algorithm for labeling the changed and unchanged pixels. A bunch of fuzzy variants and hybrid algorithms have been used in [6], to find the geographical changes occurred. Support vector machine based algorithms have been attempted in [7]. In [8] minimization of a cost function using genetic algorithm was employed to generate a good quality change map. Thresholding [9-11] is often used to delineate the changed and unchanged pixels, but, the choice of a proper threshold has always been a problem[10]. In this paper, we are addressing the two issues mentioned above, with the help of Undecimated Wavelet Transform (UDWT) [12] and genetic algorithm[8] due to their multiple properties as detailed in section 2.

The rest of this paper is divided into following sections. Section 2 describes various state-of-the-art techniques that we have used in this paper. Section 3 is a detailed account of the proposed algorithm. Data sets used in the experiments have been discussed in the section 4, followed by the experimental outcomes are detailed in the section 5. Finally, in section 6, the conclusion and future recommendations have been presented.

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Harnessing phytodiversity for decontamination of aquatic pollutants in freshwater lakes.

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Abstract : The metal phytoextracting ability of aquatic macrophytes is being widely exploited for phytoremediation of contaminated wetland ecosystems. A study was carried out in Vellayani wetland ecosystem comprising a fresh water lake and surrounding polders lying 8 24' 09" to 8 26' 30" N latitude and 76 59' 08" to 76 59' 47" E longitude at an elevation of 29 m above mean sea level. Water, sediment and plant samples were collected from 15 geocoded sites during different seasons, biomass was recorded and analysed for various chemical constituents. Fourteen dominant species were identified within the ecosystem. Highest number of plant species was found during pre-monsoon and the lowest during monsoon season. *Panicum repens* was the most abundantly distributed macrophyte. The biomass production was highest for *Pistia stratiotes*. Water and sediment properties were significantly influenced by the seasons. Water properties, acidity, EC, BOD, COD, NH₄-N, NO₃-N, Fe, Al, Cd, and Pb contents were at their lowest during monsoon season and highest during pre-monsoon season except for NH₄-N. Sediment also showed almost similar trend with exceptions for NH₄-N, Cd and Pb. With regard to water pollution in Vellayani lake, the entire lake was contaminated with Al and at two sites with Fe, six sites with Cd and eight sites with Pb. Among tested macrophytes, *Eichhornea crassipes* was the best phytoextractor for Fe and *Dryopteris erythrosora* and *Eichhornea crassipes* for Al and *Nelumbo nucifera* for Cd and *Nymphaea odorata*, *Nelumbo nucifera* and *Pistia stratiotes* for Pb.

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Efficacy of New Insecticide Molecules against Major Pests of Rice

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Abstract

The experiments were conducted during the year 2013- 2014 in two cropping seasons viz., *Kharif* 2013 and *Rabi* 2013-14 at Regional Agricultural Research Station, Pattambi and farmers field at kondurkara, Ongallur using the rice variety Jyothi. The insecticide molecules tested during the periods were fipronil 5% EC @ 1.50l/ha, chlorantraniliprole 0.4G @ 10kg/ha, chlorantraniliprole 18.5EC @ 150ml/ha, fipronil 0.3G @ 10kg/ha, thiodicarb 75% WP @ 750g/ha, novaluron 10% EC @ 450ml/ha, lufenuron 5.4EC @ 600ml/ha and flubendiamide 20%WDG (125g/ha) as check insecticide with an untreated control. The pooled results of two crop seasons and farmers field trials revealed that new insecticides, chlorantraniliprole @ 150ml/ha, lufenuron 5.4EC @ 600ml/ha and fipronil 5% EC @ 1.50l/ha were the most effective treatment against rice yellow stem borer, while insecticides lufenuron 5.4EC @ 600ml/ha and chlorantraniliprole @ 150ml/ha found effective against leaf folder and whorlmaggot. The grain yield per plot was also higher in chlorantraniliprole 0.4G @ 10kg/ha, lufenuron 5.4EC @ 600ml/ha and chlorantraniliprole @ 150ml/ha treated plots.

Key words: Insecticides, rice, efficacy

Introduction

Rice is a staple crop of India cultivated in diverse ecologies leading the world in area with 41.85 mha with a production of 104 m tones but the productivity is only 75% of world production of 4.02 t/ha (Anonymous, 2012). Insect pests are major constraints limiting rice productivity besides diseases and weeds (Behura, *et al.*, 2011). Chlorantraniliprole 25 SC a new insecticide found effective against major lepidopteran pests (Sidde Gowda, 2009). Mahal *et al.*, (2008) reported that fipronil application significantly reduced the incidence of leaf folder in rice and similarly Dhawan *et al.*, (2010) reported the efficacy of thiocylam hydro oxalate against leaf folder. Satapathy and Mukhurjee (2012) reported the efficacy of lufenuron against rice gallmidge. To find the efficacy of new insecticide molecule against major rice pests, trials were conducted at the station and farmers field.

Materials and Methods

Field experiments were conducted at Regional Agricultural Research Station, Pattambi, Kerala Agricultural University during two cropping seasons viz., *Kharif* 2013 and *Rabi* 2013-14. Twenty five days old seedlings of Jyothi were transplanted in a plot size of 7 x 4m with a spacing of 20 x 15 cms at the rate of two seedlings per hill. The experiment included nine treatments with seven

insecticides using flubendiamide as check insecticide and an untreated control, with four replications. The sprays were made at 25, 45 and 60 days after transplanting with a hand sprayer of 9 litre capacity. The observations were made a day before spraying and a week after spraying on per cent tiller damage (dead heart) at vegetative stage and white ear at reproductive stage for yellow stem borer (*Scirpophaga incertulas* Walker), per cent damaged leaves in case of whorlmaggot (*Hydrellia philippina* Ferino) and leaf folder (*Cnaphalocrocis medinalis* Guenee). The grain yield was recorded in kg's per ha and the experiments were laid out using completely randomized block design. The means were compared for significance using CD at 0.05% level.

Results and discussion

Effect on stem borer

The results of the first crop season (*Kharif* 13) showed that per cent incidence of yellow stem borer (dead heart) was lowest with 3.1 percent in lufenuron 5.4 EC @ 600 ml/ ha followed by chlorantraniliprole 18.5 SC, fipronil 5% SC and chlorantraniliprole 4% G treated plot with 3.6, 4.0 and 5.0 per cent respectively at 50 days after transplanting and was on superior over flubendiamide (Check) sprayed plots which recorded 5.2 per cent dead hearts. In case of white ear damage produced by stem borer during the reproductive