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Spinosad and Indoxacarb Residues in Cowpea under Polyhouse Cultivation

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Dissipation of spinosad and indoxacarb applied at recommended dose of 75 and 50 g a.i. ha^{-1}, respectively, applied twice at 7d interval, in cowpea under polyhouse condition revealed that their initial deposits on cowpea pods which were 1.34 and 0.95 mg kg^{-1}, respectively, reached below quantification level after 10 and 5 days of spraying with half-lives of 1.17 and 3.19 days, respectively.

Key words: Spinosad, indoxacarb, dissipation, cowpea, polyhouse

Cowpea, *Vigna unguiculata* sub sp. *sesquipedalis* (L.) Verdc., also known as yard long bean, is a drought tolerant multipurpose leguminous crop grown throughout the arid and semi-arid tropics and sub-tropics. The immature fresh pods are mostly used as vegetable than the grains and they are rich in protein (4-5 per cent), vitamins and minerals[1]. In Kerala, the population density is high as compared to the national average and with an improvement in living conditions of people, there is a high demand for fresh vegetables, the year around. High temperature and relative humidity in the open field conditions favours the multiplication of pests and diseases which badly affects the successful crop production[2]. However, the pest and disease incidence can be reduced by growing crops under protected cultivation. It provides a way for an efficient utilization of land, water and other resources.

The constructional flaws in the structures of polyhouses often facilitate pest entry and their rapid multiplication due to the congenial environment inside the polyhouse[3]. Among the various pests infesting cowpea, the pod borer complex *Maruca vitrata* (Fabricius), *Lampides boeticus* (Linnaeus), *Helicoverpa armigera* (Hübner)[4] and leaf feeders like American serpentine leaf miner, *Liriomyza trifolii* (Burgess) and tobacco caterpillar, *Spodoptera litura* (Fabricius) are the major pests in the open as well as the protected cultivation.

The insecticides used under open field condition for pest management cannot be used inside polyhouse due to their peculiar environment and the dissipation rates may also vary[5]. Spinosad is a biologically derived fermented neurotoxic insecticide from the actinomycete *Saccharopolyspora spinosa*. It is a nicotinic acetylcholine receptor (nAChR) allosteric modulator[6] and is a mixture of two members of the chemical class of 12-membered macrocyclic lactones in a unique tetracyclic ring. Each component[7], spinosyn A and spinosyn D, is an unsaturated tetracyclic ester with two sugar derivatives (forosamine and rhamnose sugars) attached through ether linkages with the composition of 85:15. Indoxacarb, methyl 7-chloro-2,5-dihydro-2-[[(methoxy- carbonyl)[4 (trifluoromethoxy) phenyl] amino] carbonyl] indeno[1,2-e][1,3,4]oxadiazine-4a(3*H*) carboxylate, is a non-systemic, oxadiazine insecticide that blocks the sodium channels in insect nerve cells[8]. These two insecticides are recommended against pod borers of red gram and pigeon pea by the Registration Committee of Central Insecticides Board. The chemical structures of spinosad and indoxacarb are given in Figure 1.

This study was undertaken to study the persistence and dissipation of spinosad and indoxacarb under polyhouse condition in the cowpea pods.

MATERIALS AND METHODS

Reagents, chemicals, glasswares etc.

Analytical standards of spinosad (purity 97.3 per cent) and indoxacarb (purity 93.3 per cent) were procured from M/S

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Aloe vera gel as a bio preservative for shelf life extension of mature green tomato

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Abstract
The effect of *Aloe vera* gel on the physiological parameters like physiological loss in weight, respiration rate and membrane integrity of mature green tomato were analyzed. The untreated tomato fruits (without *Aloe vera* gel coating) showed highest respiration rate which resulted in higher physiological loss in weight and least membrane integrity for a period of 24 days. In contrary the mature green tomato fruits dipped in 2% *Aloe vera* gel concentration for two minutes recorded the least Oxygen evolution and hence resulted a lower physiological loss in weight and higher membrane integrity for a period of 36 days. Hence the study revealed the use of *Aloe vera* gel as a bio preservative for the shelf life of mature green tomatoes.

Keywords: *Aloe vera*, bio preservative, shelf life, mature green, tomato

Introduction
Tomato (*Solanum lycopersicum L.*) is one of the most widely cultivated warm season crop and extensively consumed horticultural crops globally (Grandillo *et al.,* 1999) [9]. The crop is believed to have been originated from the wild in Peru, Ecuador and other parts of tropical Americas, the nutritional and economic importance of the crop has led to its global production (Rick and Butler, 1956) [12]. Fresh tomatoes are a popular and versatile fruit vegetable throughout the world, making significant contributions to human nutrition. Tomato contains higher amounts of lycopene, a type of carotenoid with antioxidant properties (Arab and Steck, 2000) [3] which is beneficial in reducing the incidence of some chronic diseases like cancer (Basu and Imrhan, 2007) [5] and many other cardio vascular disorders (Burton and Reimers, 2011) [6].
During the peak season there is a high production of tomato fruits, but due to inefficient post-harvest processing and preservation techniques faster spoilage of the produce occurs. Major losses in quality and quantity of fresh tomatoes occur between harvest and consumption.
Bio preservation is a novel food preservation method defined for extension of shelf life and enhanced food safety by the use of natural or controlled micro biota and/or anti-microbial compounds (Baldwin *et al.,* 1996) [4]. *Aloe vera* gel has been one of the promising bio preservatives which has been identified as a novel edible film coating with good antimicrobial properties (Jawadul *et al.,* 2014) [10].
Bio preservation using *Aloe vera* as an edible film coating on fresh tomatoes can provide a modified internal atmosphere for the product and thereby acts as an alternative for reducing the quality and quantity losses, and thus the major post-harvest loss of tomatoes can be reduced.
Edible film coatings on fresh tomatoes can provide a modified internal atmosphere for the product and thereby acts as an alternative for reducing the quality and quantity losses, and thus the major post-harvest loss of tomatoes can be reduced (Dhall, 2013) [8]. The present study was conducted to standardize an efficient post-harvest management practice for shelf life extension of tomato using *Aloe vera* as a bio preservative.

Methodology
A study was conducted at the Department of Post-Harvest Technology, College of Agriculture, Vellayani with the objective to standardise an Aloe vera gel based edible film coating for mature green tomato fruits. Tomatoes (Lycopersicon esculentum) were harvested at mature green stage from the Instructional Farm at College of Agriculture, Vellayani, and Kerala, India. In the laboratory, mature green tomatoes were selected to obtain homogeneous batches based on colour, size, and absence of injuries and healthy. Then the fruits were washed, surface sanitized in 2ppm ozonized water for 5 minutes. Followed by this the fruits were subjected to diffrent treatments as explained below.
Good quality fresh Aloe vera leaves were procured from the local market. Aloe gel matrix which lies underneath the green outer rind was separated and the colorless hydro parenchyma was homogenized in a blender. The resulting mixture was then filtered to remove the fibers to form 100 percent fresh aloe gel. The filtered aloe gel was pasteurized at 70^0C for 45 minutes and then cooled immediately to ambient temperature after maintaining pH at 4.0 by adding citric acid (0.5-1gl^{-1}) and ascorbic acid (0.10-0.50 gl^{-1}). Two different types of gelling agents each at 1% was added to it for increasing the consistency of aloe gel. From this prepared aloe gel two different concentrations of 1% and 2% were taken for the experiment and the fruits were dipped for three different durations as one minute, two minutes and five minutes.

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Assessment of hydrological processes in a small watershed using SWAT

■ **V. Tejaswini and K. K. Sathian**

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■ **ABSTRACT :** Water availability is declining and the demand is increasing, leaving the gap between these two more wide day by day. Quantifying the elements of hydrologic processes at micro watershed scale and at weekly or monthly temporal scale is the prerequisite for water resources development of a locality. Hydrologic modeling is a very powerful technique in planning water resources of a locality. Valancheri watershed, which is a sub basin of Bharathapuzha river basin, Kerala is taken for the study. As the study watershed is ungauged one, calibration was done for Kunthipuzha basin which is having similar characteristics with the study area and the calibrated parameters were transferred to the study watershed (Regionalization technique). The model was calibrated for the period 2000-2006 and validated for 2007-2009. Performance of the model was satisfactory with NSE = 0.81, R^2 = 0.82 for calibration period and R^2 = 0.95, NSE = 0.82 for validation period. The calibrated model was used to predict the hydrologic elements of the Valancheri watershed at micro watershed level. The simulation results were great use in planning water resources development of the locality.

■ **KEY WORDS :** Watershed model, SWAT, ArcGIS, Hydrological response units, Water balance components

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Water is the most indispensable natural resources for the survival of all living beings, but unfortunately this resource is becoming scarce day by day. Hence, scientific water management is a must to sustain the domestic and irrigation water needs. Conservation of water at micro watershed scale is prerequisite since all the hydrologic process takes place within individual micro watersheds. Physically based distributed watershed models play an important role in exploring a variety of watershed problems and to manage water resources. Currently, the use of distributed models has been increased in hydrologic applications (Pechlivanidis *et al.*, 2011). Some of the physically based models developed and presently in use are TOPMODEL (Beven and Kirkby, 1979), SHE, MIKE SHE, WEPP (Laflen *et al*., 1991) and SWAT (Arnold *et al.*, 1998). SWAT is one of the physically based distributed watershed model which is widely used and highly recommended by the researchers (Arnold and Fohrer, 2005 and Gassman *et al*., 2007). SWAT model was found to be computationally efficient in simulating the hydrology and water quality of the catchments in continuous time periods (Neitsch *et al.*, 2005 and Arnold *et al.*, 2012). SWAT model had got excellent capabilities in simulating

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ORIGINAL RESEARCH
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Alternaria Brassicae Induces Systemic Jasmonate Responses in Arabidopsis Which Travel to Neighboring Plants via a *Piriformsopora Indica* Hyphal Network and Activate Abscisic Acid Responses

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Stress information received by a particular local plant tissue is transferred to other tissues and neighboring plants, but how the information travels is not well understood. Application of *Alternaria Brassicae* spores to Arabidopsis leaves or roots stimulates local accumulation of jasmonic acid (JA), the expression of JA-responsive genes, as well as of *NITRATE TRANSPORTER* (*NRT*)*2.5* and *REDOX RESPONSIVE TRANSCRIPTION FACTOR1* (*RRTF1*). Infection information is systemically spread over the entire seedling and propagates radially from infected to non-infected leaves, axially from leaves to roots, and *vice versa*. The local and systemic *NRT2.5* responses are reduced in the *jar1* mutant, and the *RRTF1* response in the *rbohD* mutant. Information about *A. brassicae* infection travels slowly to uninfected neighboring plants via a *Piriformospora Indica* hyphal network, where *NRT2.5* and *RRTF1* are up-regulated. The systemic *A. brassicae*-induced JA response in infected plants is converted to an abscisic acid (ABA) response in the neighboring plant where ABA and ABA-responsive genes are induced. We propose that the local threat information induced by *A. brassicae* infection is spread over the entire plant and transferred to neighboring plants via a *P. indica* hyphal network. The JA-specific response is converted to a general ABA-mediated stress response in the neighboring plant.

Keywords: systemic signaling, interplant communication, REDOX RESPONSIVE TRANSCRIPTION FACTOR1, NITRATE TRANSPORTER2.5, *Piriformospora indica*, *Alternaria brassicae*, jasmonic acid, abscisic acid

Abbreviations: NRT, NITRATE TRANSPORTER; RRTF1, REDOX-RESPONSIVE TRANSCRIPTION FACTOR1; JA, jasmonic acid; ABA, abscisic acid; CMN, common mycorrhizal network; dpi, days past infection.

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A REVIEW

Self-incompatibility: a pollination control mechanism in plants

■ **Vijayakumar B. Narayanapur, B. Suma and J.S. Minimol**

SUMMARY

Mode of pollination is very important in plant breeding because it determines the genetic constitution, nature of gene action, ease in pollination control and stability of varieties after release. There are several mechanisms that promote cross pollination, among these self-incompatibility (SI) is of special significance as it is used in hybrid seed production. SI is defined as the prevention of fusion of fertile (functional) male and female gametes of the same plant (Gowers, 1989). SI is a system where self-recognition and rejection is the rule that prevents inbreeding depression. Bateman (1952) classified self-incompatibility based on the interaction between pollen grains and pistil as complementary and oppositional system. Lewis (1954) has classified SI into homomorphic and heteromorphic systems. Homomorphic SI is again subdivided into gametophytic (determined by the genotype of gametes) and sporophytic (determined by the genotype of the plant) systems. Molecular studies after 1980's revealed that at least two genes within S-locus control the SI, among these one unit function as male and the other as female determinant. In Brassicaceae family, the determinant gene encodes a pollen ligand and its stigmatic receptor kinase and their interaction induces incompatible signaling within the stigma papilla cells. In the Solanaceae, Rosaceae, and Scrophulariaceae, the female determinant is ribonuclease and F-box protein, suggesting the involvement of RNA degradation and protein degradation within the system. In the Papaveraceae, the female determinant induces Ca^{2+} dependent signaling network that ultimately results in the death of incompatible pollen (Takayama and Isogai, 2005). Genes controlling the SI is multiallelic in nature and number of alleles varies depending upon the crop. Number of alleles reported are five in *Theobroma cacao* (Knight and Rogers, 1953), 30 in *Brassica campestris* (Singh, 2012), 32 alleles in *Raphanussativus* (Karron *et al.*, 1989). SI is commercially exploited for the production hybrid seeds. Pusa Hybrid-2, Snow Queen and Snow King hybrids of cauliflower, BRH-5, H-44 of cabbage and CCRP8 to CCRP15 (Minimol *et al*., 2015a) of cocoa are some of the examples. Kucera *et al.* (2006) has compared the quality between SI and male sterility hybrids in cauliflower and it was found that SI hybrids are superior in their performance. Minimol *et al*. (2015b) emphasized the importance of polyclonal garden in cocoa for production of F_1 hybrid seeds by utilizing the self-incompatibility. Rego and Rego (2013) evaluated the efficiency of three methods of overcoming self-incompatibility in passion fruit and found fruit set of 16.67 and 10 per cent in bud and double pollination, respectively. The main limitations in exploiting SI is the maintenance of inbreds, however, it can be overcome by some temporary methods such as bud pollination, salt sprays and irradiation methods.

MEMBERS OF THE RESEARCH FORUM

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RESEARCH ARTICLE

ASSESSMENT OF CHANGE IN LAND USE PATTERN OF KANTHALLOR PANCHAYATH, IDUKKI, KERALA

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Abstract: Kerala is highly vulnerable to climate change effects due to its high dependency of climate sensitive agriculture, fisheries, forest, and water resource and health sectors. Climate together with soil, natural resources, human resources and economic considerations, determines land use patterns. The present study examined the changes in cropping pattern in Kanthallor Panchayath from 2010-2018. The land use change over a period from 2010 to 2018 was tabulated from the available Land use maps by Kerala State Land Use Board and the land use map generated using Google Earth Pro by creating *kml* file. It was found that total forest area including all kinds of forest has been reduced from 77. 28 sq.km to 72.61 sq.km.It can also be seen that the area under Eucalyptus has increased from 7.70 Km² to 9.96 Km². But the area under Sandal wood remains unchanged as there are legal restrictions and the entire area is under government control. There was a drastic increase in area under vegetables from 2.36Km² to 10.15Km² within a span of eight years which indicate that the main livelihood option is annual cool season vegetables and there is a good market support from the Agricultural Department. The traditional food grain crops cultivated in the panchayath were Rice, Wheat and Millets which were now replaced by vegetables and sugarcane.

Keywords: Kerala, Kanthallor panchayath, Land use pattern, Land use map

INTRODUCTION

Indian economy is an agriculture based economy, similarly food production is much sensitive to changing climate such as variations in monsoon rainfall and temperature. Changes in rainfall pattern mainly affect rain fed agriculture which leads to reduced crop productivity and increased risk for farming. It is really necessary to reduce the climate change impact of a local environment through the timely application of adaptive measures. Agriculture in Kanthallor panchayath of Idukki district has undergone some conversions in response to many factors, including advances in technology, variations in weather elements changing market forces and some socio economic factors. Farmers adjust to changing conditions by using their land in a way which yields the greatest return on their investment of energy, time and money. External factors that contributed to the change in land use change in the past continue to plan the direction of land use change in the future. An inventory of land use pattern prevailing in a special agricultural zone of Kerala with a unique climatic and ecological situation helps in development of suitable farming system models. Hence the present study was undertaken with an objective to find out the changes in land use pattern in Kanthallor panchayath.

MATERIALS AND METHODS

Study Area

Kanthallor panchayath of Devikulam Block of Idukki district comes under Marayur dry hills agro ecological unit (AEU 17), representing low rainfall region with a tropical sub humid monsoon with annual temperature 23.7°C and rainfall 1276 mm. This panchayath is flourished with a diversity of tropical, subtropical and temperate crops including field crops, plantation crops, spices, aromatic crops and vegetables. There were three cropping season for Rice, Aadi, Avani and Masi. Presently two cropping seasons are prevailing for cultivation of annuals .The panchayth is blessed with natural beauty and cool pleasant climate. Earlier this area was the granaries of Keralaand later paddy cultivation declined and settlers planted *Eucalyptus grandis.*

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Research Article

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Abiotic stress tolerant *Trichoderma harzianum* strain for growth promotion and foot rot management in black pepper

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Abstract

A study was conducted to evaluate and identify an abiotic stress tolerant PGPR and *Trichoderma* sp. for growth promotion and foot rot management in black pepper (*Piper nigrum* L.). The study found *Trichoderma harzianum* (CKT isolate) as the most abiotic stress tolerant isolate for growth promotion and *Phytophthora* management in black pepper nursery maintained under polyhouse conditions (elevated temperature up to 41 ^{o}C). In the case of ambient condition (up to 29.7 ^{o}C), *Pseudomonas fluorescens* (PAP isolate) was the most promising isolate. However, considering both natural and polyhouse conditions and per cent disease incidence, *T. harzianum* (CKT isolate) was the most promising high temperature tolerant culture for growth promotion and disease management in black pepper nursery.

Keywords: Abiotic stress, black pepper, PGPR, *Phytophthora*, *Trichoderma harzianum*

Introduction

Black pepper is an important spice crop of Kerala and the state is known as "land of spices" due to contribution to Indian economy through export. In India, black pepper production was high in Karnataka (31000 t) followed by Kerala (20000 t) and Tamil Nadu (2000 t) during 2016-17 (Spices Board, 2017) whereas, the area under black pepper was highest in Kerala (85000 ha). The productivity of the black pepper in India declined due to various reasons including biotic and abiotic stresses. Anandaraj *et al.* (2014) reported that black pepper production was highly affected due to spatial and temporal variation in rainfall and temperature. Incidence of *Phytophthora* foot rot in the nursery is a problem in most of the black pepper growing areas of Kerala and cause severe economic loss to farmers (Sarma, 2003). The chemical control measures are harmful to the beneficial microorganisms and hazardous to the environment. An alternate method should be developed to mitigate the biotic and abiotic stresses, which is effective, low-cost and eco-friendly. In this context, plant growth promoting microorganism (PGPM) could be a potential tool for growth promotion, disease management and abiotic stress tolerance in black pepper. PGPM are associated with plant roots and mitigate the impact of abiotic stresses effectively (drought, low temperature, salinity, metal toxicity and high temperature) (Potters *et al*., 2007) and biotic stresses (pest and diseases) (Lugtenberg and Kamilova, 2009).

Beneficial effect of *Azospirillum* inoculation has been reported in black pepper (Kandiannan *et al*., 2000). Raza and Faisal (2013) reported that *Micrococcus luteus* (chp37) produced cytokinin which improved the plant growth directly in maize plants. Castanheira *et al*. (2016) reported that most of the *Burkholderia* strains were able to solubilize mineral phosphate, synthesize IAA, produce siderophore and antagonistic to plant pathogenic oomycetes. Deshwal, *et al*. (2013) reported *Pseudomonas* sp. as an effective plant growth

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