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Precision Farming- The Future of Agriculture

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ABSTRACT

The change and upgradation of technologies has brought an impact on Agricultural scenario of the world from the last two decades. Precision farming which identifies the critical factors where yield is limited by controllable factors, and determines intrinsic spatial variability. The variations occurring in crop or soil properties within a field are noted, mapped and then management actions are taken as a consequence of continued assessment of the spatial variability within that field. Precision farming helps in the management of soil, land, management of various insect pest, weeds and diseases.

INTRODUCTION

"Agriculture" is the backbone of our country and economy, which accounts for almost 20 per cent of GDP and employs 70 per cent of the population. The number might be interesting but it be very difficult to feed the nation in the long run with the growing population. We cannot rely on traditional procedure for a long time. Agricultural technology available in the 1940s could not have been able to meet the demand of food for today's budding population, in spite of the revolution in agricultural produce. To meet the forthcoming call and challenges we have to divert towards new technologies, for transforming our agricultural thru put.

In the post-green revolution time frame farming creation has become stale, and flat extension of cultivable grounds became restricted due to prospering populace and industrialization. The land began to become restricted and it has become important to apply more manures and pesticides for getting more yield in the restricted land parcel. In this present circumstance, it is fundamental to create eco-friendly technologies for keeping up with crop efficiency. Throughout

the past ten years, specialized techniques have been created to use current hardware to answer field inconstancy.

Components and technologies in Precision Farming:

Technologies used in PF cover three aspects such as data collection, analysis or processing of recorded information and recommendations based on available information. Technologies required are as follows:

MAPPING

The absolute initial step is making a map which will measure spatial variability and give the premise to controlling spatial variability (Denton et al., 2017). It consolidates of a few key components: the World wide situating framework (GPS), on-the-fly information assortment gadgets, geographic data frameworks (GIS) and variable-rate executes. Current GPS collectors can lay out positions inside a field to about a meter. When associated with an information assortment gadget, like a yield/moisture meter, this information can be "stepped" with geographic directions.

Mapping should be possible done by RS, GIS and physically during field activities.

REMOTE SENSING:

It is the collection of various data from an object without actual coming of contact with the object which measures visible and invisible properties of a field. The visual observations are recorded through a digital notepad and geo-referenced to GIS database Satellite RS has provided a tool for acreage estimation one month in advance, with about 95% accuracy and in mono-crop area yield estimation with more than 90% accuracy ten days in advance (Mandal and Ghosh, 2000). The most popular method is to take images from satellites such as LANDSAT.

A) GEOGRAPHIC INFORMATION SYSTEM (GIS):

In agriculture due to misuse of natural non-renewable resources the use of GIS has increased. GIS is the principal technology used to integrate spatial data coming from various sources in a computer (Mani and Vargeshe, 2018). It manages the spatial data of soil properties, editing frameworks, pest invasions and weather patterns.GIS methods make weed control, pest control and fertilizers application site-specific, exact and powerful and furthermore it would be exceptionally helpful for drought monitoring, yield assessment, pest infestation and weather forecasting.

GLOBAL POSITIONING SYSTEM (GPS):

Location control is essential to precision farming for assessing spatial variability and for site-specific application control. During the initial face of precision farming relative position with in a field was determined by date reckoning, triangulation method which consumed time and money. By the early 1990's GPS known as NAVSTAR (Navigation system with time and ranging) was initiated by USA. It was followed by the Russian GLONASS (Global navigation satellite system). High position differential GPS are also now available than achieve high accuracy allowed for automated machinery guidance and kinetic mapping of topography and are useful in the creation of digital evaluation model needed for terrace analysis.

B) SENSORS:

Sensor are device that transmit and in response to a physical stimulus such as heat, light,

magnetism, motion, pressure and sound, with computer to record the sensor implies, a GPS measure position and GIS to map and analysis the resource data, any sensor output can be mapped a very fine scale. Sensors are essential to sense in the development of precision agricultural system for 3 important reasons. Sensors can be constant or remote ground based or spaced base direct or indirect. Sensor have been developed to measure machinery, soil, plants, pest atmospheric properties and water by sensing motion, sound, pressure, stain heat, light and magnetism.

D) APPLICATION CONTROL:

Application control is that of a portion of an automated system in which served information is used to influenced the system's state in order to meet an objective. If the needed accuracy cannot be achieved at the time of application of input, then precision farming cannot be successful. So cause of viability needs to be quantified to adjust the management practices to specific condition with in a field at appropriate time during the growing season. High resolution sensing will help to reveal that impart the crop during growing seasons. A future success of precision lies on the use of low cost and is of measures of high resolutions sensor.

E) CONTROL STRATEGIES:

The documented spatial variability in maps is used to control the variability of soils, crops or pests through field operations (Santra et al., 2008). The common response to soil variability within fields is the control of fertilizer application in a spatially variable manner. In the same way, soil moisture map is used to control irrigation. The crop yield and pest infestation maps are also used to control the application of irrigation, fertilizer and patch spray of pesticides.

Application in Agriculture:

i) Management of Soil Moisture:

Soil moisture forms one of the most important factors of crop production. Its supply to crop in adequate quantity is essential. Depending upon the soil and land features, the availability of soil moisture varies. The fact that crop water requirements vary over time and space indicate the scope of precision management of soil moisture. Irrigation scheduling using VRT combines knowledge of spatially variable soil water holding capacity, spatial and temporal variability of applied water, system delivery specification and weather-driven crop evaporation (ET) calculation (Baidya,2017). On the hand conventional systems, a single value of crop is typically used for entire field for use in irrigation scheduling software.

ii) Management of Soil Fertility:

Nutrient input to crop production is important because soils do not supply nutrients in sufficient quantities naturally to meet nutrient demands of commercial crops. Important inputs to crop production, fertilizers and manures are also identified as majors source of nutrient contamination of surface and ground water in agricultural areas. The potential for improved precision in soil fertility management combined with increased precision in application control make precision soil fertility management an attractive, but largely unproven, alternative to uniform field management.

iii) Management of Weeds:

The application of precision farming to weed management in potentially beneficial to agriculture because (a) it offers an opportunity to reduce chemical / non chemical inputs into crop

production through site–specific weed control and the use of precise application techniques and (b) the acquisition of spatial and temporal information on weed occurrence and distribution made possible with precision agriculture technologies. For prevention or pre- emergence weed control, site specific application requires prior knowledge of historical weed distribution since no weed are visible at the time of application.

iv) Management of Insects:

Precision insect management has potential because distribution of insect population is spatially variable, in part because insect is mobile during at least part of their life cycle and in part during the relative non-mobile stages' insects cluster in response to environmental and behavioral responses. Therefore, precision insect management has the potential to reduce insecticide application and improve the efficacy of both prevention insect management strategies. The major difficulty with the highly dynamic and prediction of insect density difficult or uncertain.

CONCLUSION:

During the last hundred years, various changes have occurred in the significant parts of Agriculture, both in the positive as well as in negative course. Over most recent couple of many years, the effect of science and innovation on society and environment has strengthened the crumbling of the environment, prompting consumption of organic assets. In future, agriculture will confront considerable difficulties to give sufficient nourishment to individuals. It is obvious that unless the latest tools of science and technology are applied for sustainable and equitable distribution of natural resources of our country, poverty and hunger will persist. The new innovation might have the option to outfit a few more current prospects in dealing with the ranch area definitively. In the radiance of the present dire need, there ought to be a work to involve new mechanical contributions for the improvement of our general public, as well as to make the 'Green Revolution 'an 'Evergreen Revolution'. Presently what we require is the improvement of a harmonious connection among man and nature to harmonize the ecological balance.

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Blue River Technology

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ABSTRACT

Blue River Technology is disrupting chemical intensive agriculture using artificial intelligence, computer vision and robotics. Increasing population and growing demand for chemical input i.e., Herbicide that's way needed to the precise application of herbicide are very important for saving the cost of cultivation.

INTRODUCTION

Blue River Technology aims to revolutionize the agricultural industry through the use of robotics and machine learning to fight weeds and improve crop yield.

Blue River Technology was started by two Stanford graduate students, Jorge Heraud and Lee Redden, in 2011 with the mission to "make farming more sustainable through robotics and computer vision". The startup, which has pioneered machine learning in agricultural fields by focusing on weed control, was acquired by Fortune 500 John Deere for $305 million in 2017.

Tractor giant John Deere just spent $305 million to acquire a startup that makes robots capable of identifying unwanted plants, and shooting them with deadly, high-precision squirts of herbicide.

John Deere, established in 1837 to manufacture hand tools, announced it had acquired Blue River Technology, founded in 2011, late Wednesday.

How exactly does Blue River achieve this monumental feat? As the tractor drives through the field at 12 miles per hour, the See and Spray machine leverages computer vision via its front and rear cameras along with machine learning to determine whether plants are crops or weeds. The See and Spray machine processes images of plants at a rate of over 20 times per second. The machine then compares these images to the training library of over one million images and uses technology similar to facial recognition to identify plants as herbs or crops.

In its current stage, Blue River is taking advantage of Facebook's PyTorch open-source

machine-learning framework to train the models.[5] Each frame captured by See and Spray's cameras is analyzed using an algorithm and convolutional neural network to identify and map weeds. Once the map has been created in a few milliseconds, the robot then sprays only the locations where weeds were identified. By consulting with professional agronomists and weed scientists to correctly identify and label weeds and then building a set of internal libraries on top of PyTorch Blue River can perform repeatable machine learning experiments while still benefitting from the speed and flexibility of PyTorch.

To understand this smart machine, you first need to understand how lettuce is cultivated. "We plant extra to make sure we get a good stand, and then we go in and thin out the extra plants," says Ron Yokota of produce company Tanimura and Antle.

On a windy summer day, Yokota surveys about a dozen farm workers in a lettuce field in the Salinas Valley. This is where most of the country's lettuce is grown.

As they walk between the lettuce beds, they use hoes to pull out budding heads of lettuce to create room for the most viable plants to grow. This is called lettuce thinning. It's a tedious job that requires a lot of quick decisions.

"That's why these automated machines are so difficult to make because replacing a human and their decision capabilities out in the field, it's not an easy task," says Yokota.

But Yokota believes technology is the future. For one thing, he says the ongoing labor shortage means there are not enough people to do this kind of work. So Tanimura & Antle is trying out automated lettuce thinning machines in some of its fields.

And one, developed by a Silicon Valley start-up Blue River Technology, seems to be the most promising. It's called a LettuceBot, and it makes the decisions about which plants will go and which will stay.

Blue River is not the first to automate lettuce thinning. It has competitors, and early efforts date back to the 1950s when Hewlett Packard tried to make a lettuce thinner. What's different now is how technology has advanced.

"Very recently there's been this revolution in how you can use machine learning and how you can apply it. These algorithms didn't really exist 15 years ago," says Lee Redden, a roboticist and cofounder of Blue River Technology.

The company's other cofounder is Jorge Heraud, a veteran engineer from the navigation industry. The two met in a Stanford entrepreneurship program. Both have family farming in their backgrounds, but are techies first.

They initially started out with the idea of making an autonomous lawnmower, but switched to a lettuce thinning after talking to farmers. "So actually, going out in the field and finding the lettuce thinning was a problem, a problem worth solving, so we didn't start with a technology a look for something to apply it to, we started with a problem," says Redden.

Building weed detection models

My team of researchers and engineers is responsible for training the neural network model that identifies crops and weeds. This is a challenging problem because many weeds look just like crops. Professional agronomists and

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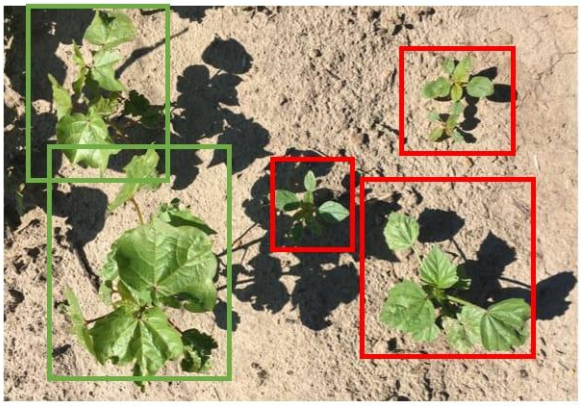
weed scientists train our labeling workforce to label the images correctly — can you spot the weeds below? In the image below, the cotton plants are in green and the weeds are in red.



CONCLUSION:

The blue river technology uses see &spray technique. See & Spray™ Select can help farmers reduce their non-residual, pre-emerge herbicide use by 77% on average1 by targeting and spraying only weeds on fallow ground. With See & Spray Select, farmers can use more expensive and complex tank mixes, and use these mixes more efficiently than what they can broadcast today, reducing their costs, while improving their ability to manage herbicide-resistant weeds. See & Spray Select is built upon the John Deere Exact Apply™ foundation to provide a single machine that provides an effective spot-spray solution and highly productive broadcast machine.

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Importance of Jamun Fruit and its Processing

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ABSTRACT

Jamun fruit appears in May-June and resembles a large berryin vegetable and fruit markets across India and neighbouring countries.Due to perishable nature of jamun fruits, it suffers heavy losses after their harvest particularly during the post-harvest handling. It is necessary to process the fruits in to different value added products like jelly, jam, squash and vinegar by employing different methods of fruit preservation (Singh et al., 2018a). The fruit is universally accepted to be very good for medicinal purposes, especially diabetics. The seed is also used in various alternative healing systems like Ayurveda, Unani and Chinese medicine for digestive ailments. The leaves and bark are used for controlling blood pressure and gingivitis. Wine and vinegar are also made from the fruit.

INTRODUCTION

Jamun (SyzygiumcuminiL.) is commonly known as Indian Blackberry, Jambul, Black Plum &Java Plum and it belongs to the family Myrtaceae. Jamun or Black Plum evokes nostalgic memories of many childhood summers in most of us. It is a small fruit with a dark purple hue bordering to black. The flesh of this berry is pinkish white in contrast.

Jamun is the native berry of south Asian countries like India, Sri Lanka and Nepal. However, it was also introduced to Florida in the United States in 1911. Since all the fruits on the Jamun tree do not ripen at the same time, they can be picked every day. Ripened Jamun do not fall off the tree and mostly need to be foraged. Jamun is available in vegetable and fruit markets across India and neighbouring countries. While summer is the peak season when this berry is available, it is produced all through the year in subtropical and tropical climates.

The Jamun tree starts flowering in March-April. The fragrant flowers of Jamun are small, nearly

5mm in diameter. This is followed by the fruit which appears in May-June and resembles a large berry. The berry is oblong and ovoid. It is green when just appearing, pink when as it matures, and shining crimson black when fully ripe. Another variety comes in white and some people say that it can be used as a medicine. Jamun fruit is a mixture of sweet, slightly sub acid spicy flavor that stands out even after eaten since it turns the tongue into purple color. The fruit is universally accepted to be very good for medicinal purposes, especially diabetics. The seed is also used in various alternative healing systems like Ayurveda, Unani and Chinese medicine for digestive ailments. The leaves and bark are used for controlling blood pressure and gingivitis. Wine and vinegar are also made from the fruit.

Nutritional and Medicinal value of Jamun

The fruit has a combination of sweet, mildly sour and a stringent flavor and tend to color the tongue purple due to presence of high amount of anthocyanin and contain huge amount of vitamin C, gallic acid, tannins, and anthocyanin includes cyaniding, petuning, Maldivian glucoside. Jamun fruits have higher level of antioxidant activity compared to other popular fruits likes a pota, papaya, banana and guava. The pulp of Jamun is highly nutritive and contains important minerals like sodium, potassium, calcium, phosphorous, iron and zinc; water soluble vitamins like ascorbic acid, thiamine and niacin; carbohydrates like glucose, mannose, sucrose, maltose, fructose, galactose and mannose; free amino acids like alanine, asparagine, tyrosine, glutamine and cysteine.

The higher antioxidant activity attributed due to presence of vitamins, tannin and anthocyanin. Jamun fruits is widely used by traditional practitioner saver many centuries for the treatment of anumber of diseases due to presence of following pharmacological actions viz., free radicals cavenging, antioxidant, hepatic protective, anti-diarrheal, hypoglycemic, anti-diabetic effects, anti-bacterial, anti-fungal, anti-viral, anti-genotoxic, anti-inflammatory, anti ulcergenic, cardio protective, anti-allergic, anti-cancer, chemo preventive and radio protective (Koleyetal.2011).

Anti-diabetic: Jamun is an amazing fruit for people suffering from diabetes as it converts starch in the body into energy and thus keeps the blood sugar levels low. It has a low glycemic index (GI) and can be safely consumed by diabetic people to control symptoms like frequent thirst and urination. A decoction made using the bark and seeds of Jamun tree has proven anti-diabetic effects.

Aids digestion: Jamun works great in aiding digestion as it has diuretic properties that keeps the digestive system cool. It also contains fibre, which can help provide relief from constipation. Have jamun with roasted cumin seeds and black salt to solve the problem of acidity.

Increases haemoglobin: Jamun is brimming with vitamin C and iron, thus making it a great fruit to boost haemoglobin production in the body. The iron in it acts as a blood purifier and helps invigorate the red blood cells. Thus, jamun is beneficial during periods, when women face significant blood loss. People with jaundice or anemia must take this fruit for restoring their haemoglobin levels.

Importance of Processing and Value Addition in Jamun

Due to perishable nature of jamun fruits, it suffers heavy losses after their harvest

particularly during the post-harvest handling. It is necessary to process the fruits in to different value added products like jelly, jam, squash and vinegar by employing different methods of fruit preservation (Singh et al., 2018a). There is a great scope for the development of value added airy products with this fruit not only because of their exotic flavour but also due to their nutraceutical importance and therapeutic values. Thus, processing of Jamun fruit in to value-added products result in a wide variety of exotically flavoured product with better nutritional and sensory qualities may unveil new market for export. Therefore, development, standardization and popularization of value-added products from Jamun fruit are essential. Commercially, jamun is used to make jellies, jams, wines, vinegar, pickles and other beverages. It is also used to make squash when combined with sugar, water, citric acid and sodium benzoate. Jamun fruit have high demand in medicinal field. Pulp, juice as well as seed powder also used for human consumption. It is good source of magnesium.

Jamun Processing products: Seed and pomace powder, Juice, RTS, Squash, Syrup, Toffee, Wine, Medicinal products

Value Addition by Processing

Primary Processing (upto 50%)	Secondary Processing (100-200%)	Tertiary Processing (300-400%)
1) Cleaning 2) Sorting & grading 3) Attractive packaging 4) Pulping 5) Juice extraction	1) RTS 2) Squashes, syrups 3) Jams, jellies 4) Dehydration of whole fruits 5) Fruit candies 6) Preserves 7) Canning	1) Juice concentrates 2) Juice powders 3) Different wines 4) Confectionary items

Jamun Pulp Powder: The Jamun pulp powder was prepared from pilot scale spray dryer. Before the samples fed in to spray dryer pulp was well mixed with appropriate proportion of water and malt dextrin. The standardized level of inlet air temperature and concentration of malt dextrin were 185°C and10 % respectively.

Jamun Juice: Jamun juice can be processed into different types of beverages like RTS, nectar, syrup etc. A method of concentration of Jamun juice on lab scale has been standardized by Ramanjaneya (1985). Concentrate can be used by the beverage industries. The fruits may be utilized for making jam, jelly, beverages, wine vinegar and pickles. The maximum yield of jamun juice with a high level of anthocyanins and other soluble constituents may be obtained by grating the fruit, heating it to 70°C and passing the heated mass through a basket press. Jamun juice thus obtained is again heated to 85°C and then cooled to the room temperature. Sodium benzoate (500 ppm) is added to the juice before it is stored. Pure jamun juice may also be preserved by heat pasteurization. Jamun juice may be concentrated either in open pan evaporator or in a vacuum concentrator. In a vacuum concentrator, it may be concentrated to 60°Brix. A ready- to-serve beverage (nectar) is prepared with 25% juice, 18°Brix and 0.6% acidity. Acceptable dry table wine may be prepared from the jamun juice. In preparation of the must, dilution of the whole fruit pulp in a ratio of 1:1 with water was found to be suitable.

Pomace: During extraction of Jamun juice a large amount of pomace remains as waste. It contains a considerable amount of anthocyanins, tannins and sugars. A pomace extract can be obtained by mixing water with pomace in standardized ratio and this can be used for making fruit beverages. During the extraction of

Jamun juice, a large amount of pomace remains as waste. However, the pomace contains considerable amount of anthocyanins, tannins and sugars. A method has been evolved by addition of 3:4 ratio of the water to the pomace to obtain pomace extract, which may further be utilized in beverage industry. For preparation of pomace extract Pomace disintegration Addition of 75% water to pomace than heating up to 60oC Passing through basket press finally collection of extract.

Jamun Shrikhand: Shrikhand is popular dessert and forms part of a delicious supplement on religious functions, particularly in the state of Maharashtra, Gujarat, Karnataka and some parts of South India Devi et al.Shrikhand was prepared by using jamun pulp at 10 per cent, 20 per cent and 30 per cent on the weight basis of chakka with 40 per cent sugar. The main aim of using jamun pulp was to harvest and conserve the medicinal properties of jamun specially antidiabetic and used of a major and cheap source of manganese, calcium, iron, potassium and sodium. It is well known that inclusion of jamun in your diet and it may naturally reduce the amount of sugar in blood.

- **Collection of buffalo milk:** The whole fresh and clean standardized fresh buffalo milk was procured from local market of Latur city, of Natural Milk Pvt., Ltd., Latur having 6.0 per cent fat and 9 per cent SNF.

- **Collection of jamun Pulp:** Slice the frozen jamun were purchased from local market of Latur (MS), Homonizing and mixing of jamun slices and sieving of jamun pulp after that stored at refrigerator condition.

- Preparation of jamun pulp Preparation of Jamun Pulp added Shrikhand Standardized Buffalo Milk (6 % Fat and 9 % SNF), Filtration , Heating at 950C for 15 min, Cooling (300C), Inoculation of standard dahi culture @ 2 % and Incubation for 8 hrs at 370C , Hanging of curd in thin cloth, drainage of whey through muslin cloth (6 hrs.) Obtained solid mass (Chakka) Addition of sugar and jamun pulp (as per treatments) mixing after that Shrikhand is prepared

Jamun Nectar: Nectar prepared from the recipes 20 per cent juice, 14 per cent TSS and 0.30 per cent Acidity gavehighest organoleptic quality score followed by Nectar prepared from 20 per cent pulp, 18 per centTSS and 0.25 per cent .Jamun fruits free from bruises, damaged and white spot were harvested randomly from different plants o orchard. One kilogram of Jamun were harvested randomly from different plants for assessing the physical characters. The pulp obtained from 100g fruit replicated three times was subjected to chemical analysis. This nectar is delicately flavoured, which has an appealing colour and it has been found to be highly acceptable. The juice was obtained by the For making of Jamun nectar ripe fruits Washing Addition of water in the ratio of 1:0.5 Crushing Heating upto 700C Sieving Discarding of seeds Collection of Jamun juice. Fruit juice Mixing with syrup Straining and cooling Addition of preservative Bottling Crown-Corking Pasteurization Cooling Labeling Storage at ambient temperature.

Jamun seed powder supplemented noodles: Noodle is a form of pasta that is becoming extremely popular in India. Instant noodles are prepared by means of an extrusion machine. These products can be described as hard brittle pieces formed into thread like structure by extruding, cutting and drying tough dough. Instant noodles are consumed in more than 80 countries and have become internationally recognized food. Noodle industry supplies 95.4

billion servings annually to consumers throughout the world and the demands are on the rise. According to the World Instant Noodle Association, China ranks first in the consumption of noodles followed by Indonesia, Japan and Vietnam (Lee et al., 2002) [1] . The changing food habits of children and teenaged groups have created a good market of noodles in India and abroad. The cooking of these noodles is very convenient and requires few minutes. Generally, in the preparation of noodles, wheat flour is in variably used as an important member of blend because the presence of wheat gluten has an added advantage which not only helps in easy extrusion but also gives a smooth and fissure free texture to the noodles.

Jamun seed powder: Jamun fruits were got harvested from a private orchard of Jammu. The pulp and seed of jamun fruit were separated by pulper. Then the seeds were washed in water and dried in tray dryer at 60°C for 48 hours till complete drying and ground the seed in pulveriser to fine powder, passed through 20 mesh sieve and packed in air tight containers for further use. Other ingredients viz; wheat flour, salt, oil were purchased from local market. 2.2 Preparation of noodles. The preparation of noodles involved the mixing of wheat flour and dried jamun seed powder in their respective levels by adding optimum water. All these ingredients were mixed properly to get desirable consistency dough. The prepared dough was smeared with a little of refined oil and then it was extruded by the hand extruder through suitable shaped dies. The product was then dried for 6 hours at 50-55 0C. After drying they were cooled and packed in polyethylene bags and stored under ambient temperature.

CONCLUSION:

Wild Jamun is a very rich source of many nutritional and functional compounds but it has not yet been utilized for preparing different value added products. Medicinal properties of Jamun seeds need to be established. Integrated processing of Jamun will provide complete utilization of fruit so that nothing goes waste. Development of products from underutilized fruits like jamun could be ideal for processed food market. The new nutritious natural and healthy processed foods are in great demand.

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Soil Pollution: Their Causes and Solutions

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ABSTRACT

Soil pollution is the contamination of soil with pollutants that can result in adverse changes to its quality and chemical composition. It is a form of environmental pollution that can affect agricultural productivity, human health, and the environment. It is caused by a variety of sources, including hazardous waste, industrial activities, agricultural activities, and urbanization. The pollutants can be in the form of physical, chemical, and biological contaminants, and their effects can vary from short-term to long-term. Physical contaminants can include sediment, heavy metals, and other materials that can block or reduce soil's ability to absorb water and nutrients. Chemical contaminants can be organic, inorganic, or radioactive, and can come from industrial, agricultural, and urban sources. Biological contaminants can include microorganisms, fungi, and other organisms that can cause disease. The effects of soil pollution can vary from short-term to long-term, and can include reduced crop yields, leaching of pollutants, contamination of drinking water, and damage to the environment. As soil pollution can be difficult to detect and identify, it is important to monitor and assess soil quality regularly in order to mitigate its effects.

INTRODUCTION

Soil pollution is a major environmental problem that affects both human health and the natural environment. It occurs when the soil is contaminated with pollutants, such as chemicals, toxins, and radioactive materials. Soil pollution has become an increasingly serious concern in recent years, as it can lead to the decline of soil fertility, water pollution, and reduced crop yields.

Soil pollution is defined as the presence of toxic chemicals or contaminants in the soil, which has dangerous effects on human health and the environment. It is a major environmental problem that is caused by various human activities such as industrialization, mining, improper waste management, and agricultural activities. Soil pollution can lead to a decline in soil fertility, loss of biodiversity, and contamination of groundwater, which can lead to health problems for people and animals.

CAUSES OF SOIL POLLUTION

Soil pollution is typically caused by human activities, such as industrial and agricultural processes. Industrial activities, such as manufacturing, can release hazardous chemicals into the soil. Agricultural activities, such as intensive farming, can introduce excessive amounts of pesticides, fertilizers, and other chemicals into the soil. Mining activities can also lead to soil contamination, as they can release toxic metals, including lead, arsenic, and mercury.

The most common sources of soil pollution include industrial activities, agricultural activities, and urban development. Industrial activities such as mining and power plants can release heavy metals, such as lead and arsenic, into the soil. Agricultural activities, such as the use of chemical fertilizers and pesticides, can also contaminate soil with potentially hazardous substances. Urban development can result in the release of pollutants such as oil, grease, and metals from automobiles and construction sites.

EFFECT OF SOIL POLLUTION

Pollution can have a significant impact on human health. When chemicals and toxins enter the soil, they can make their way into the food chain, posing a risk to humans and animals. Ingesting contaminated soil has been linked to a range of health problems, including cancer, neurological disorders, and reproductive health issues. In addition, soil pollution can also lead to air pollution, as contaminated soil can release harmful pollutants into the atmosphere.

The release of heavy metals and other contaminants into the soil can contaminate water sources, leading to the ingestion of dangerous pollutants. These pollutants can cause health problems, such as respiratory problems. Soil pollution can also disrupt the food chain, as contaminated soil can contain toxins that are transferred to plants, animals, and humans. This can lead to a decrease in biodiversity and a decrease in food production.

In its simplest terms, soil pollution is contamination of the soil by synthetic or natural materials that disrupt the soil's health, balance, and fertility. These contaminants come in a variety of forms such as chemicals, oil, industrial waste, fertilizers, pesticides, and more. The effects of soil pollution are far-reaching. The most obvious result is the contamination of food and water sources, as all food comes from soil and water can be contaminated by runoff from polluted soil. This can lead to serious health issues for both humans and animals. In addition, soil pollution can lead to imbalances in the soil's composition, reducing its fertility and making it unable to sustain plant life. This can have a major impact on our environment, as it reduces the amount of land available for agriculture and can lead to desertification. Finally, soil pollution can also be damaging to our economy, as it decreases the value of land and can lead to expensive cleanup efforts.

CONTROL OF SOIL POLLUTION

The best way to address soil pollution is to prevent it from occurring in the first place. The use of sustainable agricultural practices, such as crop rotation and the use of organic fertilizers, can help reduce the amount of pollutants entering the soil. In addition, industrial facilities should be required to use filtration systems to reduce the amount of hazardous chemicals they release into the environment.

Fortunately, there are a number of ways to prevent and mitigate soil pollution. The most important step is to reduce the use of pollutants in the first place. This means reducing the use of pesticides, fertilizers, and other pollutants, as well as properly disposing of hazardous materials. Additionally, soil conservation practices such as crop rotation and cover crops can help to reduce soil erosion and keep pollutants from entering the soil. Another way to prevent soil pollution is to use better farming practices. For instance, farmers can use organic fertilizers instead of synthetic ones, and can practice no-till farming and other techniques that reduce soil erosion. Finally, soil pollution can be reduced by improving land management and ensuring that land is not overused or misused. This includes properly zoning land for agricultural and industrial uses, as well as ensuring that land is not overgrazed or over-farmed. In conclusion, soil pollution is a serious problem that can have serious impacts on our environment, health, and economy. In order to reduce

For industrial activities, proper waste management and monitoring of emissions is essential. For agricultural activities, it is important to reduce the use of chemical fertilizers and pesticides, and to use alternatives such as organic fertilizers and integrated pest management. For urban development, it is important to reduce the release of pollutants from automobiles and construction sites. Additionally, it is important to implement policies and regulations to protect soil from pollution.

Finally, farmers should be aware of local laws and regulations regarding soil pollution and take steps to comply. This may include monitoring soil and water quality, using best management practices, and following regulations for manure management. By taking these proactive steps, farmers can ensure that their soil is healthy and safe.

Governments should implement laws and regulations to ensure that companies are held accountable for any soil pollution they cause.

CONCLUSION:

When there are large concentrations of hazardous substances, contaminants, or pollutants in the soil, this is referred to as soil pollution or contamination. They endanger the ecology. Soil pollution is brought on by industrial activities, inappropriate waste disposal, and agricultural chemicals. Chemical fertilisers used in excess can affect the pH of the soil and damage the soil's structure. Arsenic, uranium, and other toxic substances may build up in the soil and eventually make their way into the fruits and vegetables. Reuse and recycling are two ways that people can prevent soil pollution. Instead of paper or plastic containers that must be thrown away, glass and other reusable containers should be utilized. The local waste management companies should recycle plastic and paper to reduce the amount of waste going to landfills.

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Therapeutic Applications of Blowfly Maggots

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ABSTRACT

Blowfly maggots (Diptera: Calliphoridae): greenbottle blowflies (Luciliaillustris; Meigen, L. sericata; Meigen) and blackbottle blowfly (Phormiaregina; Meigen) used in maggot therapy. Necrotic wounds that are complicated and resistant to conventional treatment are treated with maggot therapy due to its effectiveness and environmental friendly nature. It is used for the treatment of traumatic wounds such as pressure ulcers, diabetic ulcers, neurovascular and vascular ulcers, osteomyelitis, postsurgical wound infections, and burns. Recently, maggots are produced and distributed especially and supplied to hospitals as a medical device using in medicine. There is still little research on the effectiveness of maggot therapy in comparison to other conventional treatments. We should recommend maggots therapy in hospitals due to cost effective and rapid debridement of dead tissue.

INTRODUCTION

Maggots are used to kill and restrict the growth of many pathogenic bacteria [Choudhary, et al., 2016] by producing antimicrobial peptides [Steenvoordeet al., 2004]. In this therapy live sterile maggots are kept into soft wounds of animals and humans for removal of the dead tissue and disinfection [Dholariaet al., 2014]. For many years, non-healing soft tissue wounds are treated with maggot's therapy [Bekins, 2010] and it is also known as maggot debridement therapy (MDT), larval therapy, larva therapy, larvae therapy, bio-debridement or bio-surgery that is used for the treatment of chronic wounds [Dholariaet al., 2014]. But, because of improved surgical techniques and antibiotics, it is disappeared. Now a days, it has made resurgence and inspected medicinal maggots [Bekins, 2010]. Maggot's therapy has 3 benefits: Debridement of necrotic tissue, development of tissue granulation, and wound antiseptic due to antimicrobial activity of maggots [Sherman and Pechter, 1988]. The three

species of blowflies (Diptera: Calliphoridae) used in maggot therapy. These are greenbottle blowflies (Luciliaillustris; Meigen, L.sericata; Meigen) and blackbottle blowfly (Phormiaregina; Meigen) [Choudhary, et al., 2016].

In human medicine, a dose of 5-10 maggots/cm2 of wound surface area is applied. Inveterinary medicine, a dose of 5-10 maggots/cm² and 8-12 maggots/cm² of wound surface area is applied [Choudhary, et al., 2016]. Average larva eats 10-15g dead tissue per day. After 4-5 days, when larvae full grown, stop feeding. They are removed from wound and new cluster of larvae introduced. This process is repeated for 3-4 weeks [Sherman and Pechter, 1988]. Maggots secrete mixture of proteolytic enzymes (carboxypeptidases A and B, leucine aminopeptidase, collagenase, and serine proteases) at wound site, where these enzymes remove dead tissue, microbes and foreign matter. Growth of bacteria is blocked due to the secretion of sodium bicarbonate by maggots [Choudhary, et al., 2016]. There are two ways to applymaggots on wound: one is direct application of maggots on wound while secondly we apply maggots contacting bag along with foam to provide ideal environment to maggots [Acton, 2007].

Therapeutic applications of blowfly larvae for treatment of osteomyelitis and venous ulcers

Inflammation of bone and bone marrow is known as osteomyelitis. It is the indication of infection and mainly caused by bacteria, also caused by fungi, parasites, and other microorganisms [Choudhary, et al., 2016]. Maggots excretion include urea and allantoin that is important for the treatment of osteomyelitis because its decreases secondarily infections [Singh and Singh, 2010]. An 88 - year-old woman was referred from a local convalescent hospital to the Emergency Room of San Francisco General Hospital Medical Center facial tumor. Blowfly larvae were used to treat this facial tumor. In 1930, 89 patients of osteomyelitis were treated by using maggots of blowfly larvae [Bunkis, 1985].

Therapeutic applications of blowfly larvae fortreatment of chronic wounds

The larvae of the green-bottle fly, Luciliasericata used to treat chronic wounds [Chanet al., 2005]. Deep penetrating wounds such as palmer regions of the foot, navicular apparatus, digital cushion, and coffin joint infections of animals are treated with maggot therapy. Maggot therapy has been used successfully in a wounded bull, two donkeys, two ponies, mule and horses [Choudhary, et al., 2016]. Maggots of the blowfly Luciliasericata affect the wound healing by effecting the differentiation of monocytes into pro-inflammatory and anti-inflammatory macrophages, because these cells are important in wound healing [van der Plaset al., 2009].Twenty five patients suffering chronic leg ulcers and pressure sores were treated through maggot therapy. Maggots of the green bottle fly, Phaeniciasericata were used for his treatment. Wounds were chronic; thirty five wounds were present on foot, one on thumb, whereas pressure sores were present on lower back. Maggots were applied at wound sites 2-3 times weekly. Hospitalized patients were treated in different departments of the Israel Hadassah Hospital. Complete debridement was attained in 38 wounds (88.4%); in three wounds (7%), the debridement was significant, in one (2.3%) partial, and one wound (2.3%) remained unchanged [Mumcuoglu, 1999]. In May 1999, A 53 year old man left leg ulcers was treated by the

application of common green bottle fly (Luciliasericata) maggots on wound site at satisfactory level [Lau, 2000]. A 51 year old white female had multiple necrotic ulcers on hips and lower extremities. Those ulcers were treated by the application of sterile surgical maggots, Phaenicia sericata [Massariet al., 2010].

Advantages and Disadvantages of Maggot Therapy

Blowfly maggots feed only on dead tissue, so they don't giveharm to normal tissue. These maggots are easily availableand this therapy is cost-effective [Seppanenet al., 2004]. Necrotic wounds that are complicated and resistant to conventional treatment are treated with maggot therapy due to its effectiveness and environmental friendly nature [Ruedaet al., 2010]. It reduces the healing time and relatively rapid treatment for chronic wounds that require surgery and resistant to conventional therapy [Mumcuoglu, 1999]. Initially, when larvae are introduces at wound site, they cause itching sensation over normal skin around the wound by crawling. This is inhibited by covering the wound containing larvae with gauze [Choudhary, et al., 2016].

Maggot Therapy Future Prospects

In case of diseases, osteomyelitis and deep wound infections, when conventional antibiotic and surgical therapy remain unresponsive than maggot therapy become available for treatment [Nigamet al., 2006]. In future, it may be used for superficial infection. It should use for medical and veterinary aspects [Whitakeret al., 2007].

CONCLUSION

Recently, chronic ulcers were treated by using antibiotics and surgery while maggot therapy used for wound healing. When we focus on debridement than maggot therapy is best option and gives good results. Surgery is harmful and sometimes causes damage to healthy tissues while maggot therapy only debrides dead tissues and don't cause damage to healthy one but harmful only for bacteria. This article shows the effectiveness of blowfly larvae for the treatment of non-healing wounds, pressure ulcers, diabetic ulcers, chronic wounds, osteomyelitis and venous ulcers. There is still little research on the effectiveness of maggot therapy in comparison to other conventional treatments.

RECOMMENDATIONS

Maggot therapy is effective than conventional therapy and surgery method. It should be used for the treatment of manydiseases that are incurable to antibiotic and surgery. It should be used for the treatment of many above mentioned diseases instead of using conventional therapy. But care always should be in mind while using maggot therapy. Maggotsshould be sterilized when used for treatment. Dressing must be done on wound to prevent maggots from escaping. Tickling and itching sensation by maggots crawling should be minimizes by doing dressing on wounds. We should recommend maggots therapy in hospitals due to cost effective and rapid debridement of dead tissue.

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Entrepreneurship Aspects in Apiculture

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ABSTRACT

The following article contains information about Beekeeping and the steps involved in establishing a Bee Farming with information about rearing species, selection of site, tools for Apiculture, management of pollination bees, diseases and pest management in Apiculture, various products of the business and about loans and subsidies by Government.

INTRODUCTION

Beekeeping is an art and science. Most people are attracted to this fascinating world of honeybees by their behavior and their importance to human existence. But over the year collection of honey from honeybees has been seen as a potential business. Apiculture not only gives us honey but also economical products like beeswax, royal jelly, bee venom etc. These products are used in various areas like cosmetics, pharmaceuticals, paints etc.

In India there are mainly four Apis species of honeybee viz. Rock Bee, Apisdorsata F.; the little bee, Apisflorea F.; Asian honeybee, Apiscerana F and European honeybee, Apis mellifera L. The former two species are wild and latter two can be domesticated and used for commercial production. Among these species A. mellifera was successfully introduced by Dr A.S Atwal in 1962 at Nagrota Bhagwan as these bees have higher production in commercial cultivation and are also resistant to Thai Sac Brood Virus (TSBV).

According to IMARC Group, in India the apiculture market size reached INR 23,060.5 million in 2022 and are exhibiting a growth rate (CAGR) of 11.65% during 2023-2028.

How to Start Honey Bee Farming in India?

1. Selection of Bee Species.

Beekeeping can be taken up with either of the two domesticated species (A. cerana and A. mellifera). However, in cold area e.g., high hills, A cerana being cold hardy performs better than A. mellifera. Moreover, this bee is more frugal

and does well even in areas, which are not very rich in bee flora. The capital investment is also comparatively low as compared to A. mellifera. Average yield of Apiscerana (6-8kg/per colony/year) and of Apis mellifera (25-40kg/colony/year).

2. Selection of Suitable Place.

The apiary should be rich in bee flora which may provide forage for most part of the year. The site should be easily accessible by road, there should be proper availability of fresh running water. The site should be dry as high level of moisture affects the bee flying and honey ripening. The site should also receive morning and afternoon sunshine. During summer provision of shade either naturally by trees or by artificial structure should be made.

3. Tools for Apiculture.

Different geographical conditions may require different equipment. So, the entrepreneur can contact the local beekeeper or can buy tools according to their needs and requirements.

Some common tools are

- Hive Stand
- Smoker
- Protective Wear
- Queen excluder
- Uncapping Knife & Bee Brush

4. Management of Pollination Bees.

The nectar yielding plants contributing to nectar/honey flow are specific to different areas. Some important honey flow sources are eucalyptus, brassica, toon, soapnut, citrus, sunflower, jamun etc.

The qualities of good bee flora:

- Long flowering peiod
- High density of flower per unit of the plants
- Good quality of nectar with high sugar concentration
- Easy availability of flora in the close vicinity of the apiary
-

Generally during winter honey bees do not make honey but it is advised to feed the bee colonies with sugar syrup prepared by dissolving 100gm of sugar in 150-200 ml of hot water, boiled and cooled.

GM crops on Bee Health

There is a growing body of published research on the impact of GM plants and novel proteins on bee health. This research has been reviewed (Pham-Delegue et al., 2002). GM plants may have direct and indirect effects on bees. Direct effects arise when bee ingests a novel protein expressed by a GM plant. Indirect effects may arise if the process of introducing the transgene into the plant results in advertent changes to plant phenotype affecting its attractiveness or nutritive value to bees.

5. **Disease Management in Apiculture**.

- **Sacbrood disease:** This disease is caused by a virus named sacbrood virus (SBV). Typically, there are number of uncapped or partially uncapped cells throughout the brood nest. These cells contain discolored larvae, usually grey to black, lying flat on the cell bottom with markedly darkened heads.

  Management: There is no definite management but keeping the colonies strong, avoiding exchange of hive parts and restricted movement of bees are suggested.

- **American foul brood:** Bacillus larvaeis the causative bacterium of the disease. There is a report of the disease incidence in India on Apis mellifera since its establishment in the country. Cell capping of infected brood becomes darker in colour, sunken and perforated. The brood turns brown and has fish glue odour.

- **Management:** Regular inspection, visually the disease can be detected. Destruction of affected colonies and equipment can be followed. Ethylene oxide, 1g/litre space at 43°C for 48 hr is effective for sterilization. Many antibiotics has been tested with variable efficacy. Kerosene can also be poured over the pile and set alight.

- **European foul brood:** Melissococcus pluton is the causal bacterium of the disease. Diseased larvae are killed usually when 4-5 days old. Diseased larvae becomes flaccid, turn brown and give foul sour smell.

- **Management:** The extend of disease is higher in spring and there is recovery during honey flow. Control of disease is achieved by sterilizing the equipment with ethylene dioxide and treatment with selective antibiotics heal the disease.

6. Pest Management in Apiculture.

- **Wax Moths:** Generally, Greater wax moth (Galleria mellonella) and Lesser wax moth (Acroiagrisella) cause serious damage especially to weak colonies. The attack is more prevalent during monsoon.

Management: Proper sanitation measures, keeping the beehive without cracks and crevices protect the colony from wax moth attack. The comb stored can be disinfected by Sulphur dusting @2gm/hive.

- **Ants:** Ants are one of the most common predators of honey bee in tropical and subtropical India. Among the most frequent recorded species are the weaver ant (Oecophyllasmaragdina) and the black ant (Momomorium indicum).

Management: Attacks of ants can be controlled by making the hive ant proof by putting the legs of hive stand in pots containing water.

- **Beetles:** There are several beetles that lives in bee colonies and feed on pollen or honey. Small Hive Beetle is such which harms the colonies.

Management: The best way to protect against Small Hive Beetle is to keep strong colonies and to remove those that are weak from apiary. Currently, a successful control is made possible using a preparation named ‘Checkmate’ strip produced by Bayer.

7. Bee Harvesting

Honey, Bee Wax, Royal Jelly, Bee Venom, Propolis and Pollen are famous byproducts of Apiculture. Honey is extracted from the Super Hive with the help of Honey Extractor Equipment.

Loans and Subsidies for Beekeeping Business

The NBB (National Bee Board) in association with NABARD, has schemes for financing Apiculture in India. It is recommended to visit their websites. The entrepreneur can also visit the office to get a holistic view of the nature and assistance that is being provided for Bee Farming.

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Geminivirus: A Curse for Agriculture Crops

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ABSTRACT

The agriculture area assumes a huge part in Indian economy. The efficiency and productivity of an assortment of yields are truly ground down by viral infections. A dissimilar assortment of infections is available on earth that show unfriendly impact on crop plants, however among these Geminiviridae family spread by whitefly have a major impact. The curse of geminivirus in India is considered and few experimental achievements have provided insight of minimizing this virus family. But, despite of large data available the emergence of studying the geminivirus infection in Solanaceous and Cucurbitaceous crops is needed as it has been seen that aggregates of a few plant infection disease can cause a critical complex by incorporating connections between host and viral elements which are helped by positive ecological circumstances. It is very exigence of time to plan the novel trial strategies to comprehend the complex molecular/genetic science and pathology of geminiviruses.

INTRODUCTION

Agro-climate state of India broadened in tropical, subtropical and mild areas showing normal to high, low and uncommon precipitation in deserts, cold and upland regions. In addition, this higher deviation in agro-climatic condition in India prompts a most extreme variety in biological diversity of plants and animals (Meetei et al., 2012). However, in this advanced period additionally, India actually accounts as second biggest nation and an incredible part of the world's agro-items are developed in India like fruits, vegetables, organic products, grains and pulses. However, there are number of prevalence revealed in regards to loss, low quality and distress related with horticultural yield that are compromised by different biotic and abiotic factors (Pandey et al., 2017). Many biotic elements incorporate microorganisms, parasites, viruses-like structure, nematodes which contaminate the harvests and retard the yield, alongside huge financial loss to country (Kataria et al., 2012). Among these biotic variables, significant limitations to horticulture creation in India are by viruses

(Jonas et al., 2019). Globalization of farming and worldwide exchanging framework are liable for scattering of infections and their vectors to new host and broadened the geological areas, this would prompts startling variance in environment and food industry. The family Solanaceae is mostly attacked by these viruses. Begomovirus is the head and biggest genus of Geminiviridae and are conveyed by whitefly in circulative constant set of three relationship way, which influence both dicots and monocots in huge amount (Gnanasekaran et al., 2019). Also, the Cucurbitaceae family is widely infected by geminiviruses. Squash leaf curl virus, tomato yellow leaf curl Delhi virus and other species specific viruses where reported in cucurbit family.

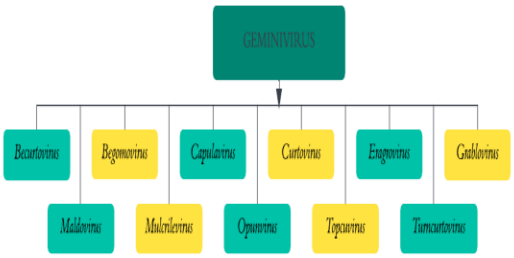

Fig1. Taxonomy of Geminivirus

Geminivirus infects large plant species and are transmitted by four insects' families of homopterans (whiteflies, leafhoppers, treehoppers and aphids). They mostly cause infection in sub-tropical and tropical regions of world.

1.2. Genome organization of Geminivirus:

Some begomoviruses have two single-stranded DNA particles, named as DNA-A & DNA-B, separately, as their genome. Both DNA-A & DNA-B are 2.8kb long. DNA-A has 5 to 6 open reading frames, a couple of which are in the virion-sense, and the other four in the viral integral sense. Virion-sense ORFs are (AV1also, AV2) & correlative sense are AC1-AC4. Those having just DNA A part are monopartite begomoviruses while others having both DNA-A & DNA-B parts are known as bipartite begomoviruses (Briddon et al., 2010). Along with these genetic materials there is inclusion of alphasatellite and betasatellite as well.

1.3 Virus pathogenesis of Geminivirus:

During the most recent 20 years, molecular techniques contributes essentially to evaluate elements aligned with viral sicknesses of affordable harvests, i.e. Cassava (Cassava Mosaic virus); Maize (Maize Streak infection). These strategies were applied to check the pestilence factors related with viral infection. These techniques were once utilized in Reunion Island to assess the study of diseases transmission of Tomato yellow leaf curl virus, which was affecting potato crops in island in 1990s. The ecological elements including relative moistness, temperature and precipitation helps in spread of viral diseases. The power of viral diseases is directed by natural variables in specific region.

1.4 Incidence of Geminivirus in Solonaceous crops and Cucurbitaceous crops:

In view of semi DNA A successions, a monopartite begomovirus was accountaed to be related with diseases which was a type of the Chili leaf twist virus from Pakistan (ChiLCV-PK; the total infection was consequently clone and sequenced and was found to share 95% arrangement with ChiLCV-PK. In the interim, Tomato leaf twist Joydebpur infection, were simmilar in Joydebpur, Bangladewsg and Punjab (Shih et al., 2006). As of late, from Nagpur, India, a bipartite begomovirus has been accounted for eggplant showing mottling and

yellow mosaic symptoms. The DNA A and DNA B of the infection imparted high characters to the separate DNA parts of Tomato leaf twist New Delhi virus. This showed that ToLCNDV has begun attacking another host plant i.e. eggplant and tomato and pathogenicity exhibited by aggro-filtration (Pratap et al., 2011). Leaf twist diseases of tobacco (TbLCD) is endemic in India. A monopartite begomovirus, a betasatellite and an alphasatellite were viewed as related with the sickness in Bihar (Pusa). A betasatellite, related with TbLCD, was viewed as a variation of Tomato leaf twist Bangladesh betasatellite showing 90.4% succession character. An alphasatellite, identified in unhealthy plants, have 87% nucleotide succession character with Tomato leaf twist alphasatellite. Utilizing succession investigation, the begomovirus was closed to be result of recombination of different begomovirus (Singh et al., 2011). Intensification of DNA A part of the infection was performed from 27 samples, while that of DNA B was enhanced by 2 samples. Yellow mosaic diseases (YMD) infection was seen on bitter gourd, effecting few supplements levels and cell reinforcement. Relationship of begomovirus with disease was shown using PCR with begomovirus primers specific to it and Southern hybridization namely, Bitter gourd yellow mosaic virus (BGYMV). The whitefly contagiousness of BGYMY was exhibited using immunological and PCR investigation showing similarity to Indian cassava mosaic infection (ICMV) in bittergourd which was whitefly yet not sap-contagious to healthy plant host. Even in cucumber relationship of geminivieus with Yellow mosaic diseases of Cucumins sativus was shown using nucleic acid hybridization test. Large geminivirus have been accounted for from India, presumably to some extent because of its hot tropical environment supporting all year endurance of the whitefly as vector and escalated crop development. One of the essential issues obligated for this covering host reach could be the polyphagous nature of the vector whitefly the mixed yield cropping dominating in the country.

CONCLUSION

The rise of an enormous number of betasatellites and alphasatellites related with geminivirus in India is likewise astounding. The relationship of these satellites is according to an area of tremendous significance for experimenting as well as adequately compensating by opening up new techniques for infection prevention, a test for begomovirus disease in India. The reports of outcome in controlling geminiviruses with infection inferred and different transgenes are empowering. Subsequently, more work should be attempted to look for regular geminivirus-safe wild assortments of harvest plants, against begomoviruses, and, when found, to describe the opposition attributes. The collaboration of geminivirus with the vector whiteflies, an urgent advance in the spread of geminivirus in the field, additionally should be checked out. These should be desperately conveyed to guarantee crop insurance against the immense misfortunes caused due to geminivirus diseases in India. Further finding will provide useful information in further epidemiological study and effective management development in Solonaceous and Cucurbitaceous crops in India. Also, the infectivity study would help to understand factors and pathway of how geminivirus infect these crops and its effectivity.

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Large Scale Production of Vaccines and its Automation

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ABSTRACT

A vaccine is a preparation of a dead or an attenuated pathogen, or their products, that when introduced into the body stimulates the production of protected antibodies or T- cells without causing the disease. The term vaccination and vaccinesare derived from the work of Edward Jenner who over 200 years ago showed that inoculating people with material from skin lesions caused by cow pox (L. vaccinus; of cows; vacca; cows) protected them from highly contagious and frequently fatal small pox. He tested his theory in 1796 by inoculating 8-year-old James Phipps with liquid from cowpox pustules. Subsequent infection of boy with small pox produced no disease. Since Jenner's time the term has been retained for any preparation intended to attain the same. However, this approach dates back, well before Jenner's time in India and China where they performed what is known as variolation(variola virus i.e., small pox virus). Variolation, procedure developed in China and India 1000 AD used a live smallpox vaccine to generate immunity. And with the time period this variolation developed into vaccination and attenuated live virus into killed, DNA, subunit, recombinant vaccines.

INTRODUCTION

Standard manufacture uses a bacterial or viral antigen, e.g. bacterium or virus, which may be killed or may be living but attenuated. To make a live attenuated vaccine, the disease-causing organism is grown under special laboratory conditions that cause it to lose its virulence or disease-causing properties. The attenuation can be obtained by heat or by passage of the virus in foreign host such as embryonated eggs or tissue culture cells. Cell cultures are required for viral vaccines since viruses can replicate only inside the living cells. For example

to produce the Sabin polio vaccine, attenuation was only achieved with high inocula and rapid passage in primary monkey kidney cells. Inactivated vaccines are produced by killing the disease-causing microorganism with chemicals or heat.

Vaccines are currently produced by gene techniques, i.e. instead of using a virus or bacterium, a single gene (usually a surface glycoprotein of the virus) can be expressed in a foreign host by Cloning. (Expression vectors are used to make large amounts of antigen to be used as a vaccine. Most used vectors for expression are Bacteria: Escherichia coli, Yeasts, Baculovirus). This process induces the vector to produce an antigen, which is then purified. The purified antigen, when combined with an adjuvant results in a safe and very effective vaccine.

General steps involved in Vaccine production are:

1) Identification and generation of antigen
2) Production and isolation of antigen
3) Purification of antigen
4) Modification and Storage of antigen
5) Packaging and transportation of vaccine.

Manufacturing begins with small amounts of a specific virus (seed). Viruses or Bacteria used in manufacture shall be derived from a Seed Lot System. A record of the origin, passage history (including purification and characterisation procedures) and storage conditions should be maintained for each Seed Lot. The virus must be free of impurities, including other similar viruses and even variations of the same type of virus. The seed must be kept under "ideal" conditions, usually frozen, that prevent the virus from becoming either stronger or weaker than desired & stored in small glass or plastic containers.

Growing the microorganisms:

1) Batch Culturethe microbe is grown in a closed vessel typically in a test tube or flask
2) Continuous Culture the microbe is grown in vessel which has medium constantly added and spent medium constantly removed. It is performed in a chemostat.
3) Cell (Tissue) Cultures – cultured cells grow in sheets that support viral replication and permit observation for cytopathic effect.
4) Bird Embryos – incubating egg is an ideal system; virus is injected through the shell.
5) Live Animal Inoculation – occasionally used when necessary (Transgenic Animals Growing Viruses).

Isolation & Purification of microorganism: Product isolation is the removal of those components whose properties vary markedly from that of the desired product. Purification selectively separates and retains the desired product at the highest purity per its pre-determined specification. (Remove unwanted compounds) The most common method of vaccine production is based on an initial fermentation process followed by purification.

Centrifugation, Filtration & Chromatography.

Centrifugation:

Centrifugation is a process by which solid particles are sedimented and separated from a liquid using centrifugal force as a driving force. Centrifugation is used to separation and purification of pathogenic virus antigens and other agents used in the production of vaccine. Centrifugation is also used to remove dead cells, cell debris etc. Example: Influenza vaccine, rabies vaccine, Hepatitis B vaccine, and Japanese encephalitis vaccine production. Centrifugation methods used for purification are –

A) Differential Centrifugation
B) Density gradient Centrifugation

Differential Centrifugation – This technique is used for separation of cell organelles and involves different speeds and at different times. Pellet and supernatant obtained as a result are subjected to different speeds at different times, further the supernatant is taken and the process is continued. At low speeds some fractions get separated and small fragments remain in the supernatant. Repeated centrifugation at progressively higher speeds will fractionate cell homogenates into their components.

Density gradient Centrifugation - Density gradient centrifugation is a technique that allows the separation of cells, organelles and macromolecules, depending on their size, shape and density.

Chromatography:

It is a separation technique, which is characterized by the separation of mixtures due to differences in the distribution coefficient of sample components between two phases, one stationary and the other mobile phase.

Example: Modified Vaccinia Ankara virus (Small pox vaccine).

Column Chromatography: - Separates molecules by their chemical and physical differences. Most commonly used column chromatography are-

Ion exchange chromatography: - Separation on the basis of charge (Cell culture-derived inactivated whole virus vaccines).

Affinity chromatography: Separation on the basis of specific binding sites on the protein (Recombinant human glycoprotein, Cell culture-derived influenza virus particles).

Filtration:

Separation of particles from liquid by applying a pressure to the solution to force the solution through a filter. Filtration is classified in two ways. 1. Dead end filtration 2. Tangential filtration

1) Dead End Filtration: all the flows are directed through the membrane with material building up on the surface of filter (Flow perpendicular to membrane surface). As these particles build up, flow through the filter is quickly reduced and finally it ceases completely (Causes build-up of filter cake on membrane).
2) Tangential Flow Filtration (Cross Flow Technology): During CFF, culture fluid is re-circulated in tangential flow, parallel to the filter membrane. Build-up of viral particles on the membrane is minimised by the recirculation of fluid over the surface, which also facilitates the concentration of particles present in the retained fluid (Mainly used in purifying inactivated Arboviral antigen).

Ultrafiltration: - A technique for separating dissolved molecules in solution on the basis of size rating the particles will be retained at the surface of the membrane. During this process the desired proteins and their allied products are separated by their molecular weight, and the volume is reduced thereby increasing the purity considerably compared to the starting volume.

Killed/Inactivated Vaccine:

Virus Inactivation: Viruses can be lipid-coated (enveloped) or non-enveloped. Virus inactivation involves reducing the pathogenicity of virus.

Virus inactivation

1) Solvent/detergent (S/D) inactivation
2) Pasteurization/Heat Killed

3) Acidic pH inactivation(Low pH Treatment)
4) Ultraviolet (UV) inactivation.

Solvent/detergent (S/D) inactivation:

Effective with lipid-coated viruses. The detergents used in this method-disrupts the interactions between molecules in the lipid coat, rendering the coat dysfunctional and impeding replication. Most enveloped viruses cannot live without their lipid coating, so they die when exposed to these detergents. Other viruses may still live, but they are unable to reproduce, rendering them non-infective. The detergent typically used is Triton-X100.

Pasteurization –

Effective for both non-lipid and lipid-coated viruses. Because pasteurization involves increasing the temperature of solution to a value that will sufficiently denature the virus, it does not matter whether the virus has an envelope or not because the envelope alone cannot protect the virus from such high temperatures (at 60°C for 10 hours).

Acidic pH inactivation (Low pH Treatment)– Most effective with lipid-coated viruses. Acidic conditions deactivate virus. Incubation typically occurs at a pH of 4 and lasts anywhere between 6 hours and 21 days.

Ultraviolet (UV) inactivation - UV rays can be used to inactivate viruses since virus particles are small and the UV rays can reach the genetic material, inducing the dimerisation of nucleic acids. Once the DNA dimerised, the virus particles cannot replicate their genetic material.

Inactivation by Extraction Nucleic acid— nucleic acid is obtained from collected and lysed cells. The nucleic acid is purified by solvent extraction and chromatographic techniques and formulated for the final vaccine product. Nucleic acid vaccines can be regions of RNA or DNA that code for disease associated proteins.

Inclusion bodies — Bacterial cells often are used to produce proteins that can function as vaccines. Bacteria produce proteins intracellular and store the produced proteins in internal structures called inclusion bodies. Following bacterial cell collection and lysis, the inclusion bodies are collected and disrupted. This often involves a series of steps involving protein denaturation followed by protein renaturation or folding. Filtration is employed to achieve clarification of the protein solution during this process.

Membrane extraction— vaccine products can be portions of bacterial or mammalian cell membrane structures. These membrane structures are typically protein, but, can be lipid or carbohydrate molecules. The membrane components are usually associated with a disease state. The vaccine product is formulated from the extracted and purified membrane structure.

Capsule extraction — some bacteria grow and secrete a complex carbohydrate material forming an external capsule. This capsular material can be isolated and purified to formulate a vaccine. The capsule extraction process usually requires multiple steps of solvent extraction, followed by chromatographic separation or other standard purification techniques.

Live Whole Vaccines: Several methods have been used to attenuate viruses for vaccine production-use of a related microorganism from another animal, administration of pathogenic or partially attenuated microorganism by an unnatural route, passage of the microorganism in an "unnatural host" or host cell Development of temperature sensitive mutants.

Use of a related virus from another animal (cross protection) - the earliest example was the use of cowpox to prevent smallpox.

Administration of pathogenic or partially attenuated virus by an unnatural route - the virulence of the virus is often reduced when administered by an unnatural route. This principle is used in the immunization of military recruits against adult respiratory distress syndrome using enterically coated live adenovirus type 4, 7 and (21).

Passages of the virus in an "unnatural host" or host cell - the major vaccines used in man and animals have all been derived this way. After repeated passages, the virus is administered to the natural host. The initial passages are made in healthy animals or in primary cell cultures. There are several examples of this approach: - the 17D strain of yellow fever was developed by passage in mice and then in chick embryos. Polioviruses were passaged in monkey kidney cells and measles in chick embryo fibroblasts. Human diploid cells are now widely used such as the WI-38 and MRC-5.

Development of temperature sensitive mutants (Some strains are attenuated by sudden change in temperature). This method may be used in conjunction with the above method.

Formulation of Vaccine

1. Other than microorganism or its part a vaccine contain the following substance:

2. Suspending fluids - The liquid which contains the chemicals used during production which kill or weaken the organism for use in vaccines.

3. Sterile water, saline or fluids containing protein, - Egg proteins are found in influenza and yellow fever vaccines , which are prepared using chicken eggs - Yeast Proteins , Hepatitis B vaccines are made by transfecting cells of Saccharomyces cerevisiae (baker's yeast) with the gene that encodes hepatitis B surface antigen, and residual quantities of yeast proteins are contained in the final product.

4. Preservatives and stabilizers (the vaccine remain unchanged) - Albumin, Phenols, Glycine - Monosodium glutamate (MSG) and 2-phenoxy-ethanol which are used as stabilizers in a few vaccines to help the vaccine remain unchanged when the vaccine is exposed to heat, light, acidity, or humidity.

5. Antibiotics, which are added to some vaccines to prevent the growth of bacteria during production and storage of the vaccine. Antibiotics that are used during vaccine manufacture include neomycin, streptomycin, polymyxin B, chlortetracyline, and amphotericin B.

6. Thimerosal is a mercury-containing preservative that is added to vials of vaccine that contain more than one dose to prevent contamination and growth of potentially harmful bacteria. Ex. diphtheria-tetanus, Acellular pertussis (DTaP), hepatitis B and Haemophilus influenza type B (Hib).

Inactivating Agents

Formaldehyde is used to inactivate bacterial products for toxoid vaccines, (these are vaccines that use an inactive bacterial toxin to produce immunity). It is also used to kill unwanted viruses and bacteria that might contaminate the

vaccine during production. Most formaldehyde is removed from the vaccine before it is packaged. It is used to inactivate influenza virus, poliovirus, and diphtheria and tetanus toxins. β-propiolactone, which is used to inactivate rabies virus; glutaraldehyde, which is used to inactivate toxins contained in Acellular pertussis vaccines.

Adjuvant or enhancers –aluminium gels or salts (Alum) Alum is used in several licensed vaccines including: diphtheria- pertussis -tetanus diphtheria-tetanus(DT) DT combined with Hepatitis B (HBV) Haemophilus influenza B Inactivated polio virus Hepatitis A (HAV) Streptoccucus pneumonia vaccine Meningococccal vaccine Human papilloma virus (HPV). Adjuvants enhance vaccine immunogenicity indirectly.

Automation of vaccine production

The aim of automation is

1. To reduce manual handling of process
2. To save time
3. To reduce the cost of production
4. To reduce contamination
5. To increase production level

Roller bottle processing system, single use bioreactors are examples of approaches towards automation of process.

Roller cell bottles are gamma sterilized bottles. They are preassembled with tunings and filter. They provide a closed production environment, virtually eliminating handling related contaminations. They also provide increased surface area- 36000 Cm2, 85000 Cm2 - for cell culture growth. The inner surface of the bottle are treated with chemicals' like PETG(polyester terephthalate glycol is an 'easy to use' water clear material for all types of applications), Polystyrene which confirms thermo static nature to the bottle.

We need to set these bottles into their respective slots and connect the tubes to container containing culture media and other respective input containers and then handle the bottles through computer to add input to the bottle and collect the product out of it.

Single Use Bioreactors

Single-use bioreactors are widely used in the field of mammalian cell culture and are now rapidly replacing conventional bioreactors. The disposable bag is usually made of a three-layer plastic foil.

- First layer is made from Polyethylene terephthalate or LDPE to provide mechanical stability.
- A second layer made using PVA (Polyvinyl alcohol) or PVC (Polyvinyl chloride) acts as a gas barrier.
- Finally, a contact layer is made from PVA or PP (polypropene- is a thermoplastic polymer).

In general there are two different approaches for constructing single-use bioreactors, differing in the means used to agitate the culture medium.

- Some single-use bioreactors use stirrers like conventional bioreactors, but with stirrers that are integrated into the plastic bag. The closed bag and the stirrer are pre-sterilized. In use the bag is mounted in the bioreactor and the stirrer is connected to a driver mechanically or magnetically.

- Other single-use bioreactors are agitated by a rocking motion. This type of bioreactor does not need any mechanical agitators inside the single-use bag.

- The capacity of the bag is generally 1000 to 2000 L.

Advantages of use of single use technology:

- Application of single-use technologies reduces cleaning and sterilization demands.
- Some estimates show cost savings of more than 60% with single use systems compared to fixed asset stainless steel bioreactors.
- The application of single-use bioreactors reduces the risk of cross contamination and enhances the biological and process safety.
- Single-use applications are especially suitable for any kind of biopharmaceutical product.

Three challenges exist for faster and greater single use bioreactor adoption:

1) Higher quality and lower cost disposable bags and containers,
2) More reusable and disposable sensors and probes that can provide high quality analytics including real-time cell culture level data points and
3) A family of bioreactors from lab to production that has full scale-up of the bioprocess.

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BIOFLOC- Merely a New Blue Revolution

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ABSTRACT

Biofloc technology is an emerging technology that has its principle on reuse and recycling of nutrients. It has its potential role in the production of fish, promoting the reproduction of fish, regulating the quality of water and enhancing the growth of fish culture. The successful implication relies upon the ability to reuse/recycle the harmful nitrogenous compounds in the system. This method is considered to be highly reliable, cost-effective, ecologically friendly order to get implicated.

INTRODUCTION

Biofloc Technology (BFT) can be called as a new "blue revolution" as the nutrients constantly recycled and repurposed in the culture medium with little or no water exchange. It is an aquaculture method that is beneficial to the environment and relies on in-situ microbial production. The term "biofloc" refers to the aggregated live and dead organic particle matter, phytoplankton, bacteria, and bacteria grazers that are suspended in ponds and tanks. It uses microbial activities found in the pond or tank to function as a water purification method as well as a source of food resources for cultivated organisms. So, it is also called as active suspension ponds, heterotrophic ponds, and even green soup ponds.

Essentials of Biofloc:

The tanks were first filled with water to construct the biofloc, then a specified amount of nitrogenous material most likely aquatic feed and urea fertiliser was added to supply the nitrogen, and finally carbonate organic materials (such as molasses, starch, wheat flour) amounting to about 0.7 of diet that were distributed on the surface of the tanks to supply the carbon. Additionally, clay is added to the microbial reservoirs to aid in the formation of the microbial

mass after dissolving and passing through the sieve (mesh size of 270). For further mass continuity, adding clay at the start and throughout biofloc production is recommended. To stimulate the formation of biofloc, 20 g of clay, 10 mg of ammonium sulphate, and 200 mg of carbonaceous organic matter, such as molasses was added. Numerous studies have demonstrated that the initial inoculum used in a biofloc production cycle, which is clay and water rich, enhances microbial mass development in the new culture system. Furthermore, using farm wastewater containing nitrogenous wastes as an inoculum is beneficial.

Why Biofloc Technology?

Aquaculture effluent and its environmental consequences can be managed by substituting floc compounds for soybean or fish meal in aquatic feeding. Production in the biofloc systems can have its implications for marine and coastal ecosystems. Total Ammonia Nitrogen (TAN) and nitrite may be removed by culture in a biofloc system, which can also reduce water use and waste production, reduction in the vibrio density, enhance bodybound crude protein, and improve feed utilisation efficiency. The presence of microbial floc and the system's ability to regulate water quality may also improve the growth performance in a biofloc system. Compared to non-biofloc systems like traditional and recirculating aquaculture systems, the biofloc systems can increase net production by 8 to 33%. More importantly, the biofloc nutrient-rich waste may be utilised as a feed in BFT to reduce environmental hurdles in the aquaculture sector.

Importance of Nitrification in the FLO Conomics:

The nitrification process needs to be properly managed in order for a biofloc technology system to operate. The process of nitrification involves the conversion of the toxic forms of the nitrogen (NH3 and nitrites) to less toxic ones (nitrates), mitigating its effect on aquatic species. Typically, autotrophic nitrifying bacteria such as ammonia-oxidizing bacteria (AOB) and ammonia-oxidizing archaea (AOA) carry out this process, which is then finished by nitrite-oxidizing bacteria (NOB). Managing the toxic nitrogenous chemicals inside the biofloctechnology system directly impacts the success of the biofloc technologyand the aquaculture business

CONCLUSION:

Hence, this biofloc technology (BFT) system has been recognised as a superior technology that can address some of the economic and environmental problems that were associated with conventional aquaculture production methods. Due to its operation's reliance on the actions of microorganisms, this innovative aquaculture method has been characterised as being very environmentally benign. The three ways in which these microorganisms work are as follows: 1) Regulation of water quality by immobilising nitrogen, which produces microbial protein; 2) microbial protein subsequently serves as a source of nutrition for aquatic species; and 3) the microorganisms inhibit the growth of pathogens through competition.

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Hydroponics and Horticulture

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ABSTRACT

Today challenge lies in finding constant solutions to feed the increasing population. As the soil is limited, implementing strategies for crop cultivation without soil, becomes very useful and crucial. Thus, this article demonstrates the emerging of a scientific strategy of growing plants in nutrient rich liquid medium despite of soil, termed as hydroponics. Hydroponics operates both actively and passively using growing media like coco-peat, perlite and vermiculite in its different growing systems facilitating plant growth and development. However,though it has certain limitations but it has all the potential to become an important technique of horticultural crop production in the future.

INTRODUCTION

Hydroponics do engage a pivotal role in horticulture by boosting its economy and productivity generated through growing horticultural crops all-round the year against the biotic and a biotic constrains. Conversely, hydroponics shall be a holistic novel approach in horticulture in the next 10 years with its technological flexibility for both developed and developing countries and holds potential for food supply for space stationed as well. For instance, it is capable of growing crops in dessert, infertile lands, mountain regions, city rooftops and even in concrete school yards. Hydroponics system is becoming propitious worldwide. Consequently, it is predicted to obtain growth of 18.8% from 2017 to 2023 and the global hydroponic market will reach USD 490.50 million by 2023 (Jensen and Collins, 1985).

The advent of urbanization and civilization finds lack of fertile cultivable lands due to unfavorable topographic and geographical conditions which poses a great threat to our future. This further enhances the present day need of other non-conventional techniques like hydroponics.

Hydroponics can be classified under two categories viz.

Active system: The system of hydroponics whose mechanism of working actively follows by passing the nutrient solutions directly over plants roots. Example: Deep water culture, Drip system, Ebb and Flow and NFT.

Passive system: The system of hydroponics whose mechanism of working passively follows by growing media using a wick with a very high capillary action, where water is allowed to be drawn to the plant roots. Example: wick system.

Usage of distinctive nutrient solutions formulations is based on certain factors like specific growing system of hydroponic, rate and frequency of dosing the roots of the plants with nutrient solutions and requirement of particular nutrient elements in the plants during growth and development. In hydroponics, ideal pH range should vary from 5.5-6.5, water used must be either reversed osmosis water or deionised water (Waters et al., 1972).

Hydroponics application factors

Selection of cultivar: Selection of cultivar best suited for hydroponic system does not exist. Thus, grower must Select those cultivars which have "high cash value" whereas as wrong-selection can lead to poor plant performance and low fruit yield.

Constancy: Constancy is the conditions in hydroponic growing system which leads to high yield and quality productions. In most of the hydroponic growing system, the recirculation of water and nutrient are not constant. Introduction of the nutrient solutions into a growing media causes 3 changes in the hydroponic growing system.

1. Roots of plants absorbs water along with nutrient from the solutions at varying rates (Bugbee, 2003).
2. Nutrient elements and water which are not absorbed rather accumulate in the rooting medium (Jones and Gibson, 2002).
3. Applied water and nutrient elements passing through rooting vessels collected as recirculation or discarded as waste. As a result, rooting environment is continuously affected adversely in the plant growth parameters.

Competence and skill of grower: Hydroponic growing venture requires proficiency of the grower having the potential to mean the differences between the failure and success irrespective of the operational quality characters of the hydroponic system. Therefore, anticipation of the problem accurately should be the prime skill of the grower.

Controlled Environment Conditions : Consequently, most hydroponic growing system conducted in an environmentally controlled climate, such as a greenhouse or enclosed chamber using artificial lights.

Illumination: Illuminations system played a crucial role in controlled environmental conditions. To illustrate, it is seen that increase in chlorophyll content is observed when the plants are exposed to prolonged light intensity of same wavelength uniformly (Um et al., 2010).Likewise, the content of chlorophyll in the seedlings would be different when exposed to other illuminating system.

Hydroponic intervention in urban India

Hydroponics is a fairly novel farming technology can be invested in for huge return. India has rich climatic conditions which positioning us to market such produce. On the contrary,

Progressive farmers can adopt it commercially. In additions, People can adopt it as hobby in highly populated areas where land prices have evicted traditional practice of growing horticulture crops. Moreover, it stands out as potential urban farming in metros. Furthermore, this technique is ideal for growing crops like tomato, cucumber, peppers and leafy vegetables, fruits like strawberries has also reported successful with rapid growth rate than traditional system and even in quality fodder productions. In addition, hydroponically grown crops have increasing nutritive value and grower can even successfully grow them on concrete floors. On the other hand, busy people of urban areas can grow hydroponics crops in short time period. Nevertheless, hydroponics growing system provides pesticides free surplus production which is quite difficult to obtain in urban areas through conventional method of growing crops.

Limitations

Hydroponics requires huge initial capital investments which is not easily affordable by marginal or landless labours. In addition, all inputs like electricity, water and nutrition for plant might not be easily available. Skilled manpower is required to maintain such high lucrative model as well. In spite of the availability of all hydroponic support, it is difficult to maintain constancy as the pH keeps changing during the plant growth. At the same time, orthodox growers are not ready to accept the changes. Furthermore, hydroponically grown crops are higher in price than conventionally grown crops, thus local people may not find it affordable.

CONCLUSION

To summarize, hydroponics stands out as the nutrition rich culture technique which invades sustainably towards the precision agriculture because it uses just the adequate amount of inputs nor too high nor too less with high profit per unit area. Furthermore, hydroponically grown crops are premium quality products holding higher export potential. In addition, they are pesticides and disease-free crops causing no harm to mankind. In other words, progressive farmers can grow the crops all-round the year despite of weather and climatic constrains.

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Site Specific Nutrient Management: One Step Towards Sustainable Agriculture

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ABSTRACT

There are several reasons behind such yield reduction including poor soil nutrient status. Soil fertility declination under continuous cropping has been witnessed which need to be restored for sustaining and increasing crop yield. Soil fertility restoration can effectively be achieved by proper used of organic and inorganic fertilizer. Site specific nutrient management practices were now properly in different location of the country. But due to lack of proper knowledge of this method and time of fertilizer application; the cost of cultivation increased. For proper implementation of site-specific nutrient management practice increased production, economic yield, nutrient use efficiency, achieved targeted yield, reduce cost of cultivation of different crops with maintain environment sustainability.

INTRODUCTION

Site specific management include practices that have been previously associated with maximum economic yield management, best management practices as well as general agronomic principles. The systematic implementation of these practices in to site specific system is probably our best opportunity to develop a truly sustainable agriculture system. The component of site specific management may not be new but we have the capability with new technology to use them more effectively.

The SSNM (site specific nutrient management) approach does not significantly aim to either reduce or increase fertilizer use. Instead, it aims to apply nutrients at optimal rates and times in order to achieve high yield and high efficiency of nutrient use by the crop, leading to high cash

value of the harvest per unit of fertilizer invested (Shankar and Umesh, 2008).Site specific nutrient management (SSNM) is a set of scientific principles for optimally supplying essential nutrients to achieve targeted yield (Umesh et al., 2014).

The modern approach of fertilizer recommendation is site specific nutrient management (SSNM) which provides the scientific principles for determining the amounts of N, P2O5 and K2O that best match the field-specific needs of a cereal crop for supplemental nutrients(Tripteshet al. 2016).

Fertilizers have played a key role in the success of India's green revolution and subsequent self-reliance in food-grain production. The increase in fertilizer consumption has contributed significantly to sustainable production of food grains in the country. As a result, the demand of fertilizers has witnessed double digit growth rates over the past several years.

Total fertilizer nutrient consumption (N+P2O5+K2O) was estimated at 29.80 million metric tonnes (million MT) as against 32.54 million MT in the previous year registering a negative growth of 8.4%. The consumption of N, P2O5 and K2O at 19.44 million MT, 7.83 million MT and 2.53 million MT during 2021-22 declined by 4.7%, 12.8% and 19.8%, respectively, over 2020-21 (Annual Review of Fertilizer Production and Consumption 2021-22).

Fertilizer production at 18.58 million MT (N+P2O5) during 2021-22 witnessed a marginal increase of 0.5% over 2020-21. While production of nitrogen (N) increased marginally by 0.9% to 13.87 million MT, phosphate (P2O5) declined by 0.5% to 4.71 million MT in 2021-22 (Annual Review of Fertilizer Production and Consumption 2021-22).

In view of the above facts, SSNM help to maximized of production and productivity of different crops through site specific nutrient management with combination of sustainable agriculture.

Site Specific Nutrient Management

Many of nutrients required by crop come from soil. But the supply of nutrients is typically insufficient to meet the nutrient requirements for high crop yields. The use of fertilizer is consequently essential to fill the gap between the crop needs for nutrients and the supply of nutrient from soil and available organic inputs. SSNM eliminates wastage of fertilizer by preventing excessive rates of fertilizer and by avoiding fertilizer application when the crop does not require nutrient inputs. It also ensures that N, P, K are applied in the ratio required by the intended crop. Sushantaet al (2011).

It enables farmers to dynamically adjust fertilizer use to fill the deficit between the nutrient needs of a high-yielding crop and the nutrient supply from naturally occurring indigenous sources such as soil, crop residues, manures, and irrigation water. The SSNM approach aims to apply nutrients at optimal rates and times to achieve high crop yields and high efficiency of nutrient use by the crop. It does not specifically aim to either reduce or increase fertilizer use (Bureshet al., 2005).

Principle of site-specific nutrient management

Site Specific Nutrient Management (SSNM) is an approach to feeding crop with nutrients as and when needed. The application and management of nutrients are dynamically adjusted to crop needs of the location and season. The SSNM approach aims to achieved maximum benefit through below points -

(i) Increased yield of crop per unit of applied fertilizer.
(ii) Gain higher yield of crops
(iii) Decrease impact of disease and insect damage.

The Key features of Site-Specific Nutrient Management

i. Dynamic adjustments in fertilizer N, P, and K management to accommodate field- and season-specific conditions.
ii. Optimal use of existing indigenous nutrients
iii. Efficient fertilizer N management through the use of the leaf colour chart (LCC), which helps ensure N is applied at the time and in the amount needed by the crop.
iv. Use of the omission plot technique to determine the requirements for P and K fertilizer.
v. Managing fertilizer P and K to both overcome P and K deficiencies and avoid the mining of these nutrients from the soil.

Why use Site Specific Nutrient Management

a) Nutrient use efficiency
b) Increase Profitability

When to use SSNM:

Suitable target areas for the introduction of improved nutrient management strategy are likely to have one or more of the following characteristics. Insufficient or imbalanced uses of fertilizer, resulting in the low attainable yield despite high yield potential find out about local fertilizer use from farmers' fertilizer suppliers.

Advantages of SSNM:

Site specific nutrient management is a concept that can be applied to any field or any crop, while most often use of computer and satellite technology in the site-specific nutrient management does not require special equipment and does not require a large farming operation. The technology tools certainly expand the capabilities for using site specific management.

Site-specific nutrient management (SSNM) is a widely used term in all parts of the world, generally with reference to addressing nutrient deficiencies which exist within fields, and making adjustments in nutrient application to match these location or soil differences. In this context, site-specific nutrient management (SSNM) can be an effective tool to enhance the productivity of oilseed crops (Dwivediet al., 2009).

Site-Specific Nutrient Management (SSNM) is a tool which intends for balanced precision nutrition of N, P and K along with secondary and micronutrients based on the nutrient supplying capacity of the soil, the nutrient requirement of a particular crop to produce a unit quantity of yield or set yield target. Further SSNM provides an approach for need based ‘feeding’ of crops with nutrients by paying close attention to the “Four Rights” (4R’s) of fertilizer application: Applying the right nutrient source at the right rate, at the right time in the growing season, and in the right place. This approach aims at increasing farmers’ profit by achieving the goal of maximum economic yield of crops.

The SSNM approach provides the principles and guidelines for tailoring nutrient management practices to specific field conditions Optimally supplying crops with essential nutrients as and when needed to achieve high yield and high efficiency of input use involves three steps. The first step is to establish an attainable yield target, which is location and season-specific depending upon climate and crop management. This yield target or goal reflects the total amount of nutrients that must be taken up by the crop.

Why Do We Need SSNM?

Soil and crop residue supply essential nutrients for crop, but high yields require additional nutrients. Farmers often apply fertilizer at a rate and time not well matched to the needs of their crop. SSNM provides principles and guidelines that enable farmers to apply fertilizer that match the needs of their crop in a specific field and season. It aims for efficient nutrient use by crop, and hence, help the farmer obtain high crop yields, translating to high cash value of the harvest per unit of fertilizer applied.

When to Use SSNM?

- In the areas where low yields are obtained despite the high yield potential due to inefficient and unbalanced fertilizer application.
- In the areas where deficiency of one or more nutrients is common, it results in the nutrient deficiency symptoms.
- The areas where excessive use of N fertilizer that area incidence of pests and diseases are more.
- In the areas where variability in soil fertility is more due to imbalance use of fertilizers, it leads to strong mining of native nutrients such as P and K.
- In the areas of insufficient and inadequate splitting and time of application of N fertilizer

Advantages of SSNM:

- Uniform crop stand with more yields
- Increase in fertilizer and other input use efficiency
- More saving of inputs leads to more profit
- Ensures the balanced application of fertilizer
- Protection of environment
- Less pest and disease incidence
- Identification of yield potential variability within field

Problems in Adopting SSNM in India

Small land holdings where small and marginal farmers follow subsistence farming, do not allow successful use of high tech. tools such as GPS and GIS. High cost of equipment and lack of availability is other major problem. Though leaf colour chart is cheaper, transfer of technology is again a problem.

Specific Nutrient Management (SSNM) is the application of nutrients to meet the specific needs of plants within the pre-defined, spatially explicit LMUs, by way of variable rate fertiliser application technologies (Haneklaus and Schnug, 2006).

Components of SSNM

Global positioning system (GPS)

Global positioning system contains 24 orbiting satellites emitting radio signals that allow the GPS receivers to capture their location. Having precise information at any time allow soil and crop measurement to be mapped. GPS receivers, either carried to the field or mounted on implements allow users return to specific location to sample or treat those areas. The precise locating is necessary to the data capture and farming operation in precision farming. In case of crop production, many operations are executed in terms of the internal diversity in every field plots such as the precise seeding, fertilizing, irrigating, and controlling of plant diseases, insect pests, and so on. The use of GPS in Agriculture is limited but it is fair to expect wide spread use of GPS in future. In the years to come, GPS system role in precision agriculture may help the Indian farmers to harvest the fruits of frontier technologies without compromising the quality of land and produce.

Remote sensing

Remote sensing technique is the key technique to acquire the field information in precision agriculture, and it can provide the interior details of field plot for decision-making of precision agriculture as the habits of crop growth, the status of crop growth, and the information of spatial variability. The technique of agricultural remote sensing was trended gradually to comparative perfect in last 30 years. It is of powerful potentials to apply in many fields such as the monitoring of soil moisture, monitoring of crop nutrients, monitoring of crop pest and disease, monitoring of crop growth status, yield estimation of crop etc. and serve as an important resources of information to precision agriculture.

Geographic information system (GIS)

GIS are computer hardware and software system that use feature attributes and location data to produce map. An important function of agricultural GIS is to store layers of information, such as yield, soil survey maps, remotely sensed data, etc. This platform goes hand in hand with other systems or users by the exchange of information. In general, the information service includes mostly the service of information management, the service of message exchange and update, the service of decision analysis, and the service of information release.

Yield monitoring

Yield monitoring and mapping are key elements of site-specific farming and they were the most widely used components of precision farming initially (Heacox, 1998). Yield monitoring offers the most intensive measure of spatial yield variability that exists in farm fields, allowing producers to assess how management skills and environmental factors effect crop production (Stombaugh and Shearer, 2000). This assessment provides direct and valuable feedback to the farmer enabling them to make better management decisions (Pelletier and Upadhyaya, 1999). Yield monitoring over time creates a unique GIS database that assists farmers to easily identify yield variability within a field, to make better variable-rate decisions, and to create a history of spatial field data. This technology is being researched and commercialized for other crops such as potato, onion, sugar beet, tomato.

Variable rate technologies (VRT)

Variable-rate technology (VRT) is used to adjust the agricultural inputs according to the site-specific requirements in each part of the field. If machines are used, this requires variable-rate machinery. On small farms, inputs can be applied manually. Variable-rate applications need: a) Correct positioning in the field; b) Correct information at the location; and c) Farm machinery equipped with VRT controllers which typically have a DGPS receiver to identify the precise location of spatial variability in the field and automatically control the rate of application based on pre-derived input application maps. There are various applications of VRT technology in site-specific cropping systems management. Variable-rate application equipment is perhaps the most widely used precision agriculture technology.

Nutrient Expert®

Nutrient Expert® (NE) is a nutrient decision support software that uses the principles of site-specific nutrient management (SSNM) and enables farm advisors to develop fertilizer recommendations tailored to a specific field or growing environment (Dobermann and Witt, 2004).

CONCLUSIONS

Site specific nutrient management (SSNM) isa new concept. This concept is fundamental to precision nutrient applications in different crops. SSNM provides an approach for need-based feeding of crops with nutrients while recognizing the inherent spatial variability. This makes the efficient utilization of nutrients by crop plants and avoids the wastages of fertilizers. SSNM helps to reduce the environmental footprints of chemical fertilizers. Crop yields increase by over 15%, while amount of nutrients applied mostly decrease. Farm profitability and NUE increase convincingly by using this novel concept.

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Documentation of Potential Edible Insects Consumed by Different Ethnic People of Manipur, Northeast India

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ABSTRACT

The documentation of entomophagy on various ethnic communities in Manipur is based on a survey from 2019 to 2022 covering data collected from the villages and markets of rural areas of the ten (10) different districts through random field studies, questionaire survey, key informant interviews and group discussion. Prior to survey, village heads were informed in advance for selection of informants for authentic documentation. Therefore, 6–8 informants comprising of village heads, traditional knowledge holders, edible insect farmers, edible insect collectors, educated youths, and homemakers were selected for the study. In Manipur, a total of 43 wild edible insect species belonging to 8 orders under 25 families have been reported as edible by human with Hemipterans having the maximum number of edible species whereas lowest in case of Dictyoptera and Isoptera order. The species composition comprises of 1 species each in Dictyoptera and Isoptera, 5 species in Lepidoptera, 4 species in Orthoptera, 8 species in Coleoptera, 6 species in Odonata, 8 species in Hymenoptera, and 10 species in Hemiptera.

INTRODUCTION

Insects are the most diverse and abundant form of life that organize a main component of the total faunal biodiversity on earth. Many species of insects serve as traditional foods among indigenous peoples thereby playing an important role in human nutrition. To ensure adequate nutritional and functional quality food supplements, effort have been made by indigenous population by using the affordable staple commodities of a region (Orr, 1997). Traditionally-consumed unconventional food items like edible insects may supplement the dietary requirement of a population, thus preventing the development of a wide range of diseases associated with malnutrition and others (Mishra et al., 2003). Over 2000 species of edible insects have been consumed by more than 300 ethnic groups from 113 countries (MacEvilly, 2000).

Overview

The high expense of animal protein, which is beyond the reach of poor people, has incredibly supported entomophagy. Insects are highly nutritious and healthy food with good amount of fat, protein, vitamin, fibre and mineral content. The nutritional value of edible insects is variable because of their wide range of insect species. Depending on the metamorphic stage of the insect, the nutritional value may differ even within the same group, the habitat and diet they consumed. The environmental benefits of rearing insects for food and feed are established on their high feed conversion efficiency value. Edible insects provide us food at a very low environmental cost, hugely contributing towards food security and livelihood upliftment playing its vital role in nature in spite of considering as a nuisance to humans and pests to crops and animals. They deliver ecological services for survival of mankind with important roles as pollinators in plant reproduction, in improving soil fertility through waste bioconversion, natural bio-control for harmful pest species, and provide a variety of valuable products for humans such as honey and silk and medical applications such as maggot therapy. In addition, insects have assumed their place in human cultures as collection items and ornaments and in movies, visual arts and literature.

Edible insects proved to be an inexhaustible resource obtainable by harvesting from nature inhabiting a wide range of habitats, from aquatic ecosystems to farmed land and forests. But climate change will likely affect the ecological distribution and availability of edible insects in many ways. Also, anthropogenic factors, such as overharvesting, pollution, wildfire and habitat degradation, have contributed much to the population decline. Any effort to release the huge potential that insects offer for enhancing food security requires that the following four key bottlenecks and challenges are addressed simultaneously. First, further documentation is needed on the nutritional values of insects in order to more efficiently promote insects as healthy food. Second, the environmental impacts of harvesting and farming insects must be investigated to enable comparison with traditional farming and livestock rearing practices that may be more environmentally damaging. Third, clarification and augmentation of the socio-economic benefits that insect gathering and farming can offer is needed, in particular to enhance the food security of the poorest of society. Finally, a clear and comprehensive legal framework at (inter)national levels is needed to pave the way for more investment, leading to the full development (from the household to the industrial scale) of

production and international trade in insect products as food and feed sources.

Insect gathering and rearing as mini-livestock at the household level or industrial scale can offer important livelihood opportunities for people in both developing and developed countries. In developing countries, some of the poorest members of society, such as women and landless dwellers in urban and rural areas, can easily become involved in the gathering, cultivation, processing and sale of insects. These activities can directly improve their own diets and provide cash income through the selling of excess production as street foods. Insects can be directly and easily collected from nature or farmed with minimal technical or capital expenditure (i.e., for basic harvesting/rearing equipment). Rearing insects may also require minimal land or market introduction efforts, as insects already form part of some local food cultures. In India, North-East region is inhibited by diverse ethnic communities where entomophagy practiced is one of their inseparable food cultures. The region is known for being a distinctive part of the Indo-Burma biodiversity hotspot having a very rich and fascinating diversity of insect fauna. Within the northeast, the state of Manipur is gifted more than 33 ethnic communities with distinct identity, culture and food habit ensuring advantage for evolving innumerous knowledge on entomophagy. Therefore, the present study was designed to the documentation of various potential edible insects consumed by different ethnic people of Manipur.

CONCLUSION

In Manipur, a total of 43 wild edible insect species belonging to 8 orders under 25 families have been reported as edible by human with Hemipterans having the maximum number of edible species whereas lowest in case of Dictyoptera and Isoptera order. The species composition comprises of 1 species each in Dictyoptera and Isoptera, 5 species in Lepidoptera, 4 species in Orthoptera, 8 species in Coleoptera, 6 species in Odonata, 8 species in Hymenoptera, and 10 species in Hemiptera. There are 30 recognized ethnic communities in Manipur namely Meitei, Aimol, Anal, Chiru, Chothe, Gangte, Hmar, Kabui, Kachanaga, Koireng, Poumai, Kom, Lamkang, Mao, Maram, Maring, Mizo, Monsang, Moyon, Paite, Purum, Kharam, Tarao, Kuki, Simte, Sukte, Tangkhul, Thadou, Vaiphei and Zou (Devi, 2006).

Table 1 and 2 shows the list of aquatic and terrestrial edible insects consumed with the particular stages in which they are eaten along with seasonal availability period and market value. The growth and development in the life cycle of insects need favourable conditions for their emergence and survival correlating strongly with weather and climate variation. The method of preparation for consumption is mostly traditional and is handed down from generation to generation. Edible insects are prepared in four different forms viz. curry, roasted, fried or raw. Depending upon the type of insects and form of the consumption, these are prepared with or without other ingredients like oil and local spices (ginger, garlic) along with fermented fish, fermented bamboo shoot etc. On the basis of palatability, the mentioned ingredients are added to enhance the flavour of food and also for having cultural importance in tribal customs. Hard bodied insects are eaten in roasted or fried form whereas soft bodied insects are eaten as curry or raw. Nymphs/grubs and adult stages are mainly eaten in Dictyoptera, Orthoptera, Hemiptera, Isoptera and Coleoptera groups. Odonates are eaten in nymph stage only but Lepidoptera are eaten in both larval and pupal stages. In Hymenoptera insects, eggs are also eaten along with other stages. Edible insect

species which are readily available and easy to capture are usually brought to markets for sale. Edible insects provide us food at a very low environmental cost, hugely contributing towards food security and livelihood upliftment of poorer section of the community as a replacement of conventional meat source (e.g., beef, chicken, pork).

Table1. Seasonal availability of aquatic edible insects consumed in Manipur along with their market value

Scientific name	Seasonal availability	Consumable stage	Mode of preparation	Market value
Lethocerus indicus	Nov-July	Adult	Roasted adults are crushed and mix with chilly, salt and steamed fermented fish	Rs 15-30 per piece
Laccotrephes maculatus	Sept-Mar	Nymph, adult		NS
Diplonychusrusticus	Sept-Dec	Nymph, adult	Fried along with other herbs	NS
Ranatrasp.	June-July	Nymph, adult	Roasted	NS
Coridiussp.	Oct-Dec	Nymph, adult	Raw	Ukhrul market @ Rs 500/250g
Udongamontana	Nov-April	Nymph, adult	Fried	Churachandpur market @ Rs. 50/kg
Pomponia sp.	Mar -Aug	Nymph, adult	Roasted	NS
Micronectasp.	April-July	Nymph, adult	Roasted	NS
Notonecta sp.	April-July	Nymph, adult	Roasted	NS
Hydrometra greeni	May-June	Nymph, adult	Roasted	NS
Hydrous olivaceous	Feb-May	Adult	Fried	Rs. 30-40/500g, insects are crushed and applied to cure dog bite, tumour
Hydrous indicus	Oct-Dec	Adult	Fried	
Cybistersugillatus	Apr-Sept	Adult	Fried	Rs. 80-100/kg, an important aquatic predator
Cybistertripunctatus	Sept-Oct	Adult	Fried	
Cybisterventralis	June-July	Adult	Fried	

Table2. Seasonal availability of terrestrial edible insects consumed in Manipur along with their market value

Scientific name	Seasonal availability	Consumable stage	Mode of preparation	Market value
Vespa magnifica	May-July	Larva, pupa, Adult	Fried and curry form	Senapati market @ Rs 2000-5000/hive
Vespa affinis	Oct -Jan	Larva, pupa		Ukhrul market @ Rs 1000-2000/hive
Apisdorsata	Mar-Aug	Larva, pupa		Rs 500-1000/hive
Apiscerana indica	Perennial	Larva, pupa		Rs 200-500/hive
Apis mellifera	Mar - Sept	Larva, pupa		
Polistes sp.	Oct -Jan	Larva, pupa		Churachandpur market @ Rs 500-1000/hive
Vespula vulgaris	Oct -Jan	Larva, pupa		
Solenopsisgeminata	Oct -Jan	Adult		NS
Bombyx mori	May-June	Pupa	Curry form	Cocoon @ Rs 300-500/kg
Samiacynthiaricini	Sept-Feb	Pupa		
Antheraea proylei	Sept-Feb	Pupa		Cocoon @ Rs 100-200/kg
Omphisafuscidentalis	Sept-Feb	Larva	Fried	Bhisnupur and Churachandpur market
Lepidopteran insect	Nov-Feb	Larva		Senapati market @ Rs 1500/6-7 piece
Odontotermes sp.	Feb-Aug	All stages	Fried	NS
Pantalaflavescens	Oct-July	Nymph	Fried	Chandel, Senapati market @ Rs 20/plate
Acisomapanorpoides		Nymph		
Crocothemisservilia		Nymph		
Orthetrumtriangulare		Nymph		
Rhyothemisvariegata		Nymph		
Diplacodestrivialis		Nymph		
Heirodulasp.	Sept-Jan	Nymph, adult	Fried	NS
Oxyahylahyla	Aug-Dec	Nymph, adult		

Acridiummelanocorne	June-Dec	Nymph, adult		
Gryllussp.	Oct-April	Nymph, adult	Fried, roasted	NS
Gryllotalpa orientalis	Mar - July	Nymph, adult		
Cyrtotrachelus dux	June-Feb	Grub, adult	Fried	NS
Oryctes rhinoceros	Mar-July	Grub	Fried, roasted	
Anoplophoraglabripennis	April-July	Grub, adult	Fried	

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