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PROBLEMS AND MANAGEMENT OF HILL SOILS

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INTRODUCTION

Hill soils cover an area of 4,217,440 ha, which is 64.94% of total geographical area of the country. These soils are developed from *biotite, schists* and *phyllitic* materials under cool humid climate with high rainfall. The major soil groups under this category are Brown forest soils, Sub-mountain soil, Mountain meadow, Skeletal soils and Red loam soils.

Problems related to soil and crop cultivation in hill regions

a. Land degradation- It refers to deterioration in the quality of land, its topsoil, vegetation cover or water resources which is caused usually by excessive or in appropriate exploitation or any change that decreases the productivity of land. Land degradation can lead to loss of nutrients, loss of natural fertility of soil, loss of vegetation cover and also changes in the various characteristics of soil. The various causes of land degradation are heavy runoff, overgrazing, deforestation, water erosion, unsustainable agricultural practices, construction of large dams and unplanned tourism and mountaineering activities. The various impacts of land degradation in hill areas include soil erosion, acidification, desertification, nutrient losses and organic matter losses.

b. Soil erosion - It is a process of detachment and transportation of soil particles by various erosive agents which includes rainfall, wind, overland flow or surface runoff. The various causes of soil erosion includes natural processes like water flowing downhill, human activities like faulty agricultural practices, cultivation of crops on steep slopes, shifting cultivation, overgrazing and deforestation. Soil erosion may lead to loss of valuable top soil, reduction of infiltration rates, loss of nutrients, flooding may occur due to siltation, land degradation and desertification.

C. Soil acidity - Mostly the soils of hill region are slightly acidic to strongly acidic in nature depending upon the elevation, vegetative cover and parent material.

D. Poor quality of FYM

E. Lack of proper irrigation facilities

F. High rate of runoff from undulating terrains

Management Aspects for hill soils

a. Agronomic measures – these measures are adopted where the slope is less than 2%.

Contour cultivation – contour is called as a line joining the points of equal elevation. When all the cultural practices such as ploughing, sowing and intercultivation are done along the contours of the slope. It can reduce soil erosion by around 50% on moderate slopes.

Strip cropping - it is an agronomical practice in which ordinary crops are planted or are grown in form of relatively narrow strips across the land slope. These strips must be wide enough to allow cultivation practices and narrow enough for the crops to interact. It is a feasible option for erosion control in areas where terraces are not practically possible.

Mulching - any material which is applied on the soil surface to check evaporation rate and increase soil water holding capacity is called as mulch. It protects the soil surface from the direct impact of raindrop and reduces the runoff losses. It also increases the ability of soil to hold nutrients through organic matter addition and by increasing the mineral solubility. Different types of mulches which can be used are soil mulch or dust mulch, straw mulch, stubble mulch, plastic mulch and stover mulch.

Tillage - it is defined as the physical manipulation of soil to destroy weeds, incorporate crop residues into soil, increase infiltration rate, reduce evaporation and for preparation of the seed bed.

Fig.1. Agronomic measures for management of hill soils

B. Mechanical measures - these measures are adopted where the slope is more than 2%.

Contour bunding - It is a mechanical barrier which built across the slope for safe diversion of excessive runoff and retaining eroded soil.

Terracing - A terrace is an embankment or ridge of earth constructed across a slope to control runoff and minimize soil erosion. It reduces the length of hill side slope, reduces sheet and rill erosion and also prevents formation of gullies. It is of two types - Bench terracing and Broad base terracing.

Water harvesting – It is a process of collecting, conveying & storing water from rainfall in an area for beneficial use. It can be Inter row water harvesting by making ridges and furrows or Inter plot water harvesting by keeping central beds plain and side bed elevated.

Fig.2. Mechanical measures for management of hill soils

C. Various techniques to improve nutrient use efficiency and reduce nutrient losses in hilly regions are-

- Balanced use of fertilizers
- Split application of nitrogen
- Band placement of phosphorus
- Deep placement of fertilizers below seed zone
- Use of slow release fertilizers and nitrification inhibitors
- Foliar spray of micronutrients

Conclusion

Since hill soils occupy a major share of productive soils in the country, there is a urgent need to adopt various measures for sustainable crop production. Soil conservation and management practices must be followed in such soils. Techniques of water harvesting should be encouraged for meeting the water requirement. Use of small and handy tools will minimize soil disturbance and thus reducing run off and soil erosion.

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THE FUNCTION FOR RHIZOBACTERIAL ENDOPHYTES

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The term Rhizobacteria-promoting plant growth (PGPR) refers to a community of beneficial rhizobacteria that can be used effectively to promote plant growth and increase crop yields. A few bacterial spp that can be used as PGPR are being described, such as; Pseudomonas, Azotobacter, Enterobacter, Azospirillum, Bacillus, Burkholderia, Alcaligenes, Klebsiella, Serratia, etc. In addition, Bashan and Holguin(1998) classify the PGPRs into two large categories i.e. (a) bio - control plant development bacteria (biocontrol PGPB) and (b) plant growth-promoting bacteria. (a) Biocontrol Plant Growth Promoting Bacteria (Biocontrol PGPB) The eco-friendly regulation of plant pathogens using antagonistic PGPR is a very cost-effective method. These rhizobacteria are powerful rivals throughout the rhizospheric zone of plant pathogens in terms from both space and nutrients. Many PGPRs also generate a diverse range of antifungal compounds, such as fluorescent pigments, siderophores, volatile compounds such as hydrocyanic acid (HCN), antibiotics, and lytic enzymes to prevent the growth of plant pathogens. PGPR produces lytic enzymes including such chitinase, beta-1,3-glucanase, and protease, which are necessary for cell wall lysis and hyperparasitism of adversaries against harmful fungal pathogens. Although some PGPRs do not produce any form of metabolites to fight plant pathogens, they also protect plants by activating a host defence mechanism that is responsible for disease protection. ISR is known as this process (b) Plant Growth-Promoting Bacteria (PGPB) The bacteria that increase plant growth by generating phytohormones or increasing nutrient availability are primarily included in this category. Nitrogen, phosphorus and iron are among the most essential nutrients plant available due to atmospheric nitrogen, solubilization of phosphorus and production of siderophores by several spp. N-fixing biofilm bacteria were progressively used in several non-legume crop crops such as sugar beet, sugar cane, rice, maize, and wheat, in plants with higher amounts of nitrogen. The most widely used PGPB worldwide is Pseudomonas spp. There's so many formulations of PGPBs widely accessible to be used on the marketplace. There are two types of formulations, dry powder (solid) and liquid suspension, which can be prepared in a number of ways. Generally, dry powder or dry granules also are effectively used for microbe bacteria, whereas " which involves is used as protective against seeds and soil-borne pathogens for seed care.

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SERICIN AND ITS APPLICATION

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Introduction

Sericin is a protein produced by the silkworm, *Bombyx mori*, a holometabolous insect belonging to the Lepidoptera order and Bombycidae family. *B. mori*, which produces a great amount of sericin to the end of fifth larval instar. It is a second type of silk protein, which contains 18 amino acids including essential amino acids and is characterized by the presence of 32 per cent of serine. The total amount of hydroxy amino acids in sericin is 45.8 per cent. There are 42.3 per cent of polar amino acid and 12.2 per cent of nonpolar amino acid residues.

Sericin contributes about 20-30 per cent of total cocoon weight. Their main role is to envelop the fibroin. In presence of sericin, the fibers are hard and tough and become soft and lustrous after its removal. Sericin occurs mainly in an amorphous random coil and to a lesser extent, in a β-sheet organized structure. The randomly coiled structure easily changes to β-sheet structure, as a consequence of repeated moisture absorption and mechanical stretching.

Forms of Sericin

Sericin can be classified into three fractions, depending on their solubility as sericin A, sericin B and sericin C.

Sericin A

Sericin A is the outermost layer and insoluble in hot water. It contains about 17.2 per cent of nitrogen and amino acids like, serine, threonine, glycine, and aspartic acid.

Sericin B

Sericin B is the middle layer and on acid hydrolysis it yields amino acid of sericin A, in addition to tryptophan. It contains 16.8 per cent of nitrogen.

Sericin C

Sericin C is the innermost layer, which is adjacent to fibroin and is insoluble in hot water and can be removed from fibroin by treatment with hot dilute acid or alkali. On acid hydrolysis it yields proline in addition to amino acids of sericin B. It also contains sulphur and 16.6 per cent of nitrogen.

Extraction of Sericin from cocoon

Applications of Sericin

Silk sericin due to its proteinous nature, it is susceptible to the action of proteolytic enzymes present in body and hence it is digestible. This property makes sericin a biocompatible and biodegradable material. Because of some additional properties like, gelling ability, moisture retention capacity and skin adhesion, it has wide applications in different areas.

Anti-frosting agent

Anti-frosting property of sericin can be utilized to coat a film on the surface of refrigeration equipment because of its anti-frosting action. Use of sericin film is an effective anti-frosting method that can be widely applied to refrigerators, deep freezers and refrigerated trucks and ships. Moreover use of the coated film on roads and roof can prevent frost damage. Sericin coating on surfaces of various durable materials has been reported to enhance functionality.

Biomaterials

Sericin has found to be useful as a degradable biomaterial and used as polymer for forming articles and functional membranes. Environment friendly biodegradable polymers can be produced by blending sericin with other resins.

Coating

Sericin used in preparation of art pigments and for the protection of surface antique articles. When the material is coated with sericin its weather ability increases. Sericin coatings enhance the functionality of materials.

Cosmetics

Sericin emerged as a valuable commercial resource in making cosmetics; the biopolymer sericin has a strong affinity to keratin. Excessive trans-epidermal water loss (TEWL) is one of the causes of dry skin and skin moisturizers which are recovered by Serine, the main component of sericin which gives it resemblance to the natural moisturizing factor (NMR) in human skin making sericin a good moisturizer. Sericin gel is prepared to prevent water loss from the upper layer of the skin. It forms a moisturizing, protective, anti-wrinkle film on the skin surface imparting an immediate, long lasting, smooth and silky feeling. Nail cosmetics, containing 0.02 – 20 per cent sericin are reported to prevent nail from chapping, brittleness, and impart inherent gloss to nails. Sericin with average molecular weight is added to both preparations of skin and hair conditioners.

Food industry

In the food industry, sericin has been used as a valuable natural ingredient since it enhances bioavailability of Zn, Fe, Mg and Ca in rats. Food with sericin suppresses development of bowel cancer and accelerates mineral absorption. Kato *et al*. provided the first evidence of antioxidant action of the silk protein by showing that sericin suppressed in vitro lipid peroxidation. Sericin layer when deposited on fruit protects it from ageing dues to its antioxidant activity. Furthermore, sericin also inhibits tyrosinase activity. These properties suggest that sericin is a valuable natural ingredient for food industry.

Natural textile

Cotton fabrics reported to show improved properties on treatment with sericin. In the presence of sericin, tensile strength and crease recovery of cotton fabrics were not reported to be affected, although moisture sorption properties, with indications of an increase in water retention and reduction in electrical resistivity, were substantially influenced. Although sericin has not really shown any antimicrobial properties on textiles, it has been suggested by researchers that silk sericin act as a functional agent for cotton and wool fabrics.

Medical and Pharmaceutical Applications

Sericin is soluble in hot water and as the time proceeds it converts into gel. Sericin gives a very stable emulsion when shaken with water immiscible liquid. The sericin protein is used as horizontal alignment film for the liquid crystal to achieve uniform optical properties and to increase the stability of product. Sericin found to possess wound-healing property and can be used as wound healing covering material in the form of film. Sericin also has adhesive property due to its chemical composition. It has affinity to keratin. Silk threads obtained from mulberry silkworm used for making surgical sutures.

Silk sericin membranes are good bandage materials and the film has adequate flexibility and tensile strength. Due to its good biocompatibility and infection resistant nature, it is a novel wound coagulant material. Additionally, its flexibility and water absorption properties promote smooth cure for defects in the skin and do not cause any peeling of the skin under regeneration when detached from the skin. Sericin, when given orally, causes a dose dependent decrease in the development of colonic aberrant crypt foci. The incidence and the number of colon tumours are suppressed by consumption of sericin. Sericin has anti-tumor activity.

Conclusion

Sericin with its several valuable properties has emerged as a commercial resource in many industries, such as those making cosmetics, pharmaceuticals and food; as well as in the production of many functional biomaterials. It can be observed that due to numerous valuable applications and ecological friendly properties sericin becomes precious biopolymer. Due to unawareness many silk producers and processors are still discarding this valuable sericin as it is in the effluent.

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ROLE AND USE OF DIFFERENT WEATHER PARAMETERS IN CROP PRODUCTION

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Introduction

Crop growth and development are primarily governed by environmental conditions. The success or failure of crops is intimately related to the weather during the crop periods. Weather has significant influence on every phase of agricultural activity from preparatory tillage to harvesting and storage. A sound knowledge of the climatic factors and its interactions with crop is essential for successful agriculture.

Components of weather

- Temperature
- Solar radiation
- Humidity
- Cloud
- Pressure
- Wind
- Precipitation

The influence of weather and climate on crop growth and development and final yield is complicated by complexity of interactions with crops and the environment during the crop season.

DIFFERENCE BETWEEN WEATHER AND CLIMATE

Weather is a state or condition of atmosphere at a given place and at a given time. It is daily variations or conditions of lower layers of the atmosphere. Weather pertains to smaller area like village, city, or even district and smaller duration of time *i.e.* part of a day, or complete day. Some examples are hot day, rainy day, cloudy weather, dry weather, etc.

Climate is a generalized weather or summation of weather conditions over a given region during a comparatively longer period. Climate is related to larger areas like zone, state, country, part of continent and longer duration of time like month, season, or year and best described by the normal and averages e. g. cold season, tropical climate, temperate climate, etc.

Effect of weather and climate on crop environment

Weather and climate is the most persistent factors of crop environment.It has practical utility in timing of agriculture operations so as to make the best use of favourable weather conditions and make adjustments for adverse weather. The dangers of crop production due to the pest and disease incidence, occurrence of prolonged drought , soil erosion, frost and weather hazards can be minimized. Weather support also provides guidelines for long range or seasonal planning of crops and cultivars most suited to anticipated climatic conditions.Agrometeorological information can be used in land planning, risk analysis of climatichazards, production and harvest forecasts and linking similar crop environments for crop adaptability and productivity.

Weather parameters with favourable influence

Weather and climate are important factors to determining the success or failure of agriculture. All the agriculture operations from sowing to harvest of crops depend on themercy of weather. Climate determines suitability of a crop to a particular region while weather plays a major role in the productivity of a crop in the region. The excess or shortage of elements of weather and climate exerts a negative influence on crop growth, development and final yield. The effect of weather and climate is complex as elements of climate operate simultaneously in nature. Due to complexity of environment in which a crop is grown, it is difficult to assign an optimum value of climatic element for maximum crop productivity.

Weather parameters with negative influence

Excessively and untimely rains.
Scanty rains with prolonged dry spells.
Heat and cold waves.
Dust-storms.
thunderstorms and hailstorms.
High winds.
Floods.

Precipitation

Precipitation includes all forms of water,which falls from atmosphere such as rainfall, snow, hail, fog and dew. Rainfall one of the most important factor influences the vegetation of a place. Total precipitation in amount and distribution greatly affects the choice of a cultivated species in a place. In heavy and evenly distributed rainfall areas, crops like rice in plains and tea, coffee and rubber in Western Ghats are grown. Low and uneven distribution of rainfall is common in dryland farming where drought resistance crops like pearl millet, sorghum and minor millets are grown In desert areas grasses and shrubs are common where hot desert climate exists Though the rainfall has major influence on yield of crops, yields are not always directly proportional to the amount of Precipitation as excess above optimum reduces the yields Distribution of rainfall is more important than total rainfall to have longer growing period especially in drylands .

Based on rainfall

Quantity decides the crop and variety and the cropping system.Distribution decides the LGP and the crop, variety & cropping system.Onset of monsoon decides the time of sowing.Quantity and intensity affect the type of moisture conservation.Quantity, distribution and reliability of rainfall decide the nutrient management practices such as quantity and time of application. Time of occurrence and length of dry spells influence many management practices including midterm corrections. Analysis of rainfall data is useful to understand the behaviour and abnormalities and accordingly devise suitable crop plans and management strategies

MOISTURE CONSERVATION

Cultural	Mechanical	Agrostological
Addition of organic matter Summer ploughing, Contour farming, cover crops mulching, strip cropping, cropping systems, Tillage practices	Basin listing, Subsoiling, Compartmental Bunding, Ridges and furrows, Broad bed furrow, Contour bunding, graded bunding, Bench terracing	Pasture, Strip cropping with grasses, Ley farming, Vegetative barriers

Temperature

Temperature is a measure of intensity of heat energy. The range of temperature for maximum growth of most of the agricultural plants is between 15 and 40°C. The temperature of a place is largely determined by its distance from the equator (latitude) and altitude.It influences distribution of crop plants and vegetation.Germination, growth and development of crops are highly influenced by temperature. Affects leaf production, expansion and flowering. Physical and chemical processes within the plants are governed by air temperature. Diffusion rates of gases and liquids changes with temperature. Solubility of different substances in plant is dependent on temperature.The minimum, maximum (above which crop growth ceases) and optimum temperature of individual's plant is called as cardinal temperature.

Crops	Minimum temperature °C	Optimum temperature °C	Maximum temperature °C
Rice	10	32	36-38
wheat	4.5	20	30-32
Maize	8-10	20	40-43
Sorghum	12-13	25	40
Tobacco	12-14	29	35

Atmospheric Humidity

Water is present in the atmosphere in the form of invisible water vapour, normally known as humidity. Relative humidity is ratio between the amount of moisture present in the air to the saturation capacity of the air at a particular temperature. If relative humidity is 100% it means that the entire space is filled with water and there is no soil evaporation and plant transpiration. Relative humidity influences the water requirement of crops.Relative humidity of 40-60% is suitable for most of the crop plants. Very few crops can perform well when relative humidity is 80% and above. When relative humidity is high there is chance for the occurrence of pest and disease.

Solar radiation

From germination to harvest and even post harvest crops are affected by solar radiation.

Biomass production by photosynthetic processes requires light. All physical process taking place in the soil, plant and environment are dependent on light Solar radiation controls distribution of temperature and there by distribution of crops in a region. Visible radiation is very important in photosynthetic mechanism of plants. Photosynthetically Active Radiation (PAR - 0.4 – 0.7μ) is essential for production of carbohydrates and ultimately biomass.
0.4 to 0.5 μ - Blue – violet – Active
0.5 to 0.6 μ - Green –yellow – low active
0.6to 0.7 μ - Orange – red - Active
Photoperiodism is a response of plant to day length
Short day – Day length is <12 hours (Rice, Sunflower and cotton),
Long day – Day length is > 12 hours (Barley, oat, carrot and cabbage),
Day neutral – There is no or less influence on day length (Tomato and maize).

• Phototropism — Response of plants to light direction. E.g. Sunflower

• Photosensitive – Season bound varieties depends on quantity of light received

Wind velocity

The basic function of wind is to carry moisture (precipitation) and heat.

The moving wind not only supplies moisture and heat, also supplies fresh CO_2 for the photosynthesis. Wind movement for 4 – 6 km/hour is suitable for more crops. When wind speed is enormous then there is mechanical damage of the crops (i.e.) it removes leaves and twigs and damages crops like banana, sugarcane. Wind dispersal of pollen and seeds is natural and necessary for certain crops. Causes soil erosion. Helps in cleaning produce to farmers. Increases evaporation. Spread of pest and diseases

Atmospheric gases on plant growth
CO_2 – 0.03%, O_2 - 20.95%, N_2 - 78.09%, Argon - 0.93%, Others - 0.02%.

CO_2 is important for Photosynthesis, CO_2 taken by the plants by diffusion process from leaves through stomata.CO_2 is returned to atmosphere during decomposition of organic materials, all farm wastes and by respiration.O_2 is important for respiration of both plants and animals while it is released by plants during Photosynthesis .Nitrogen is one of the important major plant nutrient, Atmospheric N is fixed in the soil by lightning, rainfall and N fixing microbes in pulses crops and available to plants Certain gases like SO_2, CO, CH4, HF released to atmosphere are toxic to plants

SOLAR RADIATION

Solar energy provides light required for seed germination, leaf expansion, growth of stem and shoot, flowering fruiting and thermal condition necessary for the physiological function of the plant. The effect of solar radiation on plant communities can be divided into four categories (a) Thermal effect of radiation (b) Photosynthetic effect of radiation (c) Photoperiodic effect and (d) Other effects.

Thermal effect of radiation

More than 70 per cent of the solar radiation absorbed by the plant is converted into heat. This heat energy is utilized for transpiration and for convective heat exchange with the surroundings. This exchange determines the temperature of leaves and of other plant parts.

Photosynthetic effect of radiation

A portion of solar radiation, up to 28 per cent in terms of energy is used in photosynthesis. Solar radiation influences the production of enzymes useful in photosynthesis, development of photosynthetic apparatus, growth, yield formation and finally yield.

Enzymes

The reduction of carbon dioxide to carbohydrates is catalyzed by enzymes, namely phosphophenol pyruvate carboxylase and ribulose biphosphate carboxylase. Light intensity increases activity and amount of these enzymes.

Development of photosynthetic apparatus

The different pigments necessary for photosynthesis are produced in the presence of light. Chlorophyll formation is promoted by light. Light influences the orientation of leaves also. With higher light intensity, leaves become horizontal.

Growth

Interception and utilization of solar radiation can be increased by proper management practices, such as adjustment of row spacing, plant population and selection of most advantageous time for planting.

Yield formation and yield

Light intensity affects yield attributes and finally yield. In groundnut, low light intensity during peak flowering reduce number of flowers per plant. Flower open during cloudy period do not produced pegs. Low light intensity at pegging and pod filling reduces peg and pod number. In cereal, number of tillers increase with increase in light intensity. Reduction in grain yield of rice in rainy season compared to summer season is attributed to solar radiation.

Photoperiodic effect

Crop developmental processes like rate of leaf production, flowering, etc. are influenced by duration of sunlight. Most plants are influenced by relative length of day and night especially for floral initiation. The duration of the night or complete darkness is more important than the day light. This effect of light on plant is known as photo-periodism. Depending on the length of photoperiod required for floral initiation, plants are classified as long day, short day and day neutral plants.

Long day plants require comparatively long days (usually more than 14 hours) for floral initiation. They put forth more vegetative growth when days are short. Most of the temperate crops like wheat, barley and oats fall under this category.

In short day plants, floral initiation takes place when days are short (less than 10 hours) or when the dark period is long. Most of the tropical crops like rice, sorghum, maize, etc. are short day plants.

Day neutral plants do not require either long or short dark periods. Photoperiod does not have much influence for phasic change for these plants. The crops belong to this group are cotton, sunflower, buck wheat etc.

Other effects

Assimilation of nutrients: In maize accumulation of phosphorus is high under white, yellow, orange and light blue light and high under darkness. Higher solar radiation alone gives higher protein content due to greater assimilation of nitrogen.

Translocation of photosynthates: sucrose and fructose accumulated in culms up to two to three weeks after anthesis in cereals. Fructose appears to be the most important storage carbohydrate in leaves and culms prior to grain filling, plants shaded during grain filling are able to retranslocate stored photosynthates to grain, thus maintaining certain amount of stability.

Utilization of solar energy: The basic principle for increasing yield is harvesting more solar energy. All the management practices like optimum time of sowing, plant population, fertilizer application, irrigation, etc. are aimed at increasing the interception of solar radiation by the foliage so as to get the more yield.

Sensitive stages for solar radiation: In broad terms, leaves are considered as **source** for supplying carbohydrates to grains while storage organs are called **sinks.** In some crops like rice, wheat, etc., source is not limited but yield potential is less due to less number of storage organs. For such sink limited crops, amount of solar radiation in sufficient quantities is necessary during the period of formation of storage organs. i.e. from panicle initiation to flowering.

Conversion efficiency: Efficiency of conversion of absorbed radiation to dry matter decreases with the age of crop for the production of one gram of dry matter 3700 to 4100 calories of solar energy is utilized.

TEMPERATURE

Cardinal temperature: For each species of plants there are upper (maximum) and lower (minimum) limits of temperature at which growth

is nil or negligible and optimum temperature at which growth is maximum. Most of the crop plants grow best at 15 to 30 ˚C. Many crop plants die at temperature of 45 to 55 ˚C. There are also optimal temperatures for different growth stages.

Cool season crops : The crops which grow best in cool weather period are called cool season crops and are generally grown in winter season (November to February). Most of the cool season crops cease to grow at an average temperature of 30 to 38 ˚C. The important cool season crops are wheat, barley, potato, oats, etc. These crops are also called temperate crops. The cardinal temperature ranges for cool season crops are maximum Temperature 30-38 ˚C. Minimum temperature 0-5 ˚C and optimum temperature 25-30 ˚C.

Warm season crops: The important warm season crops are rice, sorghum, maize, sugarcane, pearl millet, groundnut, pigeon pea, cowpea, etc. These crops are also called tropical crops. These crops are generally grown in monsoon and some also in summer season. The cardinal temperature ranges for warm season crops are maximum temperature 45-50 ˚C, minimum temperature 15-20 ˚C and optimum temperature 30-38 ˚C.

Influence of temperature on growth

Biochemical reaction: Any chemical reaction increase with increase in temperature. This rate of increase in reaction for every 10 ˚C increase in temperature is called quotient 10 or Q10 .

$$Q10 = \frac{\text{Rate o reaction at } (t+10)^{\circ}C}{\text{Rate of reaction at } t^{\circ}C}$$

Where t is temperature in ˚C.

Uptake of carbon dioxide: The optimum temperature for net carbon dioxide uptake is about 24˚C for wheat and barley. As the temperature increases above the optimum, C_2 uptake is decreased due to increase in stomatal and mesophyll resistance.

Enzymatic activity: Temperature increases the activity of certain enzymes important in the reduction of carbon compounds including ribulose diphosphate dehydrogenase and glyceraldehyde dehydrogenase.

Rate of photosynthesis: Rate of photosynthesis is reduced due to reduction in temperature. When maize plants are subjected to cold temperature of 10˚C for 10 days, the rate of photosynthesis is reduced by 33 per cent of that of untreated plants.

Development of photosynthetic infrastructure: Temperature has considerable influence on chlorophyll synthesis and leaf area development. Temperature enhances the production of chloroplast. At low temperature leaves become yellow due to degradation of chlorophyll. Temperature governs rate of leaf emergence and leaf expansion.

Influence on growth substances: At optimum temperature, the activity of auxin, gibberellins and cytokinins (growth promoters) are high and activity of abscisic acid (growth regulators) is low with the result that growth rate is increased.

Dry matter production: The response of dry matter production to temperature depends on the stage of the crop and optimum temperature. Higher temperature during maturity of maize depressed the dry matter accumulation, while higher temperature over the normal, increased growth during tasselling and silking.

Influence of temperature on development

Temperature has greater influence on development rates like rate of germination, leaf initiation, tillering, flowering, spikelet initiation and grain filling. All these development processes proceed at a faster rate at higher temperature.

Yield formation and yield

Effect of temperature on grain formation, grain filling and grain yield is complex. Low temperature during panicle initiation stage to flowering results in formation of higher number of grains per plant due to prolongation of this period. Yield therefore, increases though the duration is more. Grain filling is faster with increase in temperature and this decreases duration of grain filling period in several crops. In wheat, average temperature more than 19^0 C during grain filling period reduces duration of grain filling.

Growing Degree- Days

The heat unit or growing degree- day concept was proposed to explain the relationship between growth duration and temperature. A degree-day or a heat unit is the mean temperature above base temperature. Mathematically, it can be expressed as,

$$\text{Growing Degree} - \text{Days (GDD)} = \sum_{i=1}^{n} \frac{\{(T_{max} + T_{min}) - T_b\}}{2}$$

Where, T_{max} is maximum temperature, T_{min} is minimum temperature and Tb is the lowest temperature at which no growth which is also called base temperature.

Photothermal Units

In photothermal units, the degree-days are multiplied by length of night in case of short day plants and length of day for long day plants. The basic principle is that flowering is hastened as the length of night increases in short day plants, while in long days plants, flowering is delayed as the length of night increases. It can be expressed mathematically as

$$PTU = \sum_{i=1}^{n} \text{GDD X length of night or day}$$

Extreme temperatures

Excess or deficit of any growth factor is called stress. High or low temperature causes stress on crops.

High temperature stress

High temperature stress adversely affects mineral nutrition, shoot growth and pollen development resulting in low yield.

Mineral nutrition: High temperature stress causes reduction in absorption and subsequent assimilation of nutrients.

Shoot growth: High temperature, even for short period, affect crop growth especially in temperate crops like wheat. High air temperature reduces the growth of shoots and in turn reduces root growth.

Pollen development: Higher temperature during booting stage results in pollen abortion. In wheat, temperature higher than 27°C cause under development of anthers and loss of viability of pollen.

Low temperature stress

Low temperature affects several aspects of crop growth viz., survival, cell division, photosynthesis, water transport, growth and finally yield.

Survival : Temperate crops like wheat and barley have high resistance to low temperature damage especially at very early stage.

Cell division and cell elongation : Low temperature results in retardation of cell elongation than cell division.

Photosynthesis: When C_4 plants like maize and sorghum are subjected to low temperature of 10°C, the activity of pyruvate dikinase is reduced, resulting in less photosynthesis.

Water transport: Low temperature cause moisture stress. Entry of water into the plant is restricted due to low permeability of cells. The active transport of water from roots to the shoot is stopped at low temperature.

Vegetative growth: Temperate crops prefer low temperature during vegetative growth, while tropical plants require high temperature. In maize, seedling growth is reduced by 50 per cent at 10°C.

Reproductive growth: Low temperature causes high spikelet sterility in rice. It ranges from 3.6 to 96.8 percent depending on variety. The critical temperatures for spikelet sterility are 15-17 0°C. The main reasons for the failure of fertilization are (1) uneven pollen (2) indehiscence of anthers, and (3) abnormalities in micropores.

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DRONES AND AGRICULTURE

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ABSTRACT

This paper helps in providing information regarding drones and its importance in agriculture, the use of drones in the agriculture industry is steadily growing as part of an effective approach to sustainable agricultural management that allows agronomists, agricultural engineers, and farmers to help streamline their operations, using robust data analytics to gain effective insights into their crops. Crop monitoring, for example, is made easier by using drone data to accurately plan and make ongoing improvements, such as the use of ditches and evolving fertilizer applications.

KEY WORDS: Agriculture, Drones, Precionfarming

INTRODUCTION

Agriculture is one of the most crucial elements for the sustainability of human civilization. It has been forecast that agricultural consumption would increase by 69% from 2010 to 2050 due to increase in population. The current technological trends in agricultural practices are not suitable for small land holdings that are a norm in developing countries. As such, meeting future food demands seems like an uphill task for such countries. To stay sustainable, maximize productivity and optimize land spaces, the concepts of advanced farming techniques need to be explored and integrated into agriculture. One such concept is drones Agricultural drones help to achieve and improve what's known as precision agriculture. This approach to farming management is based on observing, measuring, and taking action based on real-time crop and livestock data. It erases the need for guesswork in modern farming and instead gives farmers the ability to maximize their yields and run more efficient organizations, all while enhancing crop production. In recent years the cost of agriculture drones has rapidly declined, which has not only led to the explosion of drone use cases in agriculture but has made it a no-brainer investment for modern farmers. In fact, the agricultural drone market is expected to grow over 38% in coming years. Driven by growing population levels and changing climate patterns, the need for efficient agriculture is only going to become more important. There are multiple uses for agricultural drones, including: Scouting land and crops, checking for weeds and spot treating plants, monitoring overall crop health, managing livestock and monitoring for health issues. Drones are equipped with technology like propulsion systems, infrared cameras, GPS and navigation systems, programmable controllers, and automated flight planning. Plus, with custom-made data processing software any collected information can instantly be put to use towards better management decisions. Drones are transforming how agriculture and farming are done. By implementing drone technology, farms and agriculture businesses can improve crop yields, save time, and make land management decisions that'll improve long-term success. Farmer's today has a variety of complex factors that influence the success of their farms. From water access to changing climate, wind, soil quality, the presence of weeds and insects, variable growing seasons, and more. As a result, farmers are turning to high-level drone technology to help remedy these problems, and provide fast and efficient solutions. Agricultural drones allow farmers to obtain access to a wealth of data they can use to make better management decisions, improve crop yields, and increase overall profitability. Drones can be used to collect data related to crop yields, livestock health, soil quality, nutrient measurements, weather and rainfall results, and more. This data can then be used to get a more accurate map of any existing issues, as

well as create solutions based upon extremely reliable data. The agriculture industry is no stranger to embracing changing technological trends to streamline business. The use of drones in agriculture is the next technological wave that'll help agricultural businesses meet the changing and growing demands of the future.

Concept of drones

An agricultural drone is an unmanned aerial vehicle used to help optimize agriculture operations, increase crop production, and monitor crop growth. Sensors and digital imaging capabilities can give farmers a richer picture of their fields. Using an agriculture drone and gathering information from it may prove useful in improving crop yields and farm efficiency.

In precision agriculture, drones have a range of uses from soil and crop field analysis to planting and pesticide spraying. Drones can be used with different imaging technologies like hyperspectral, multispectral, thermal etc. that can provide the farmers with time and site-specific information regarding crop health, fungal infections, growth bottlenecks etc.

Soil and Field Analysis

At the beginning, middle, and end of a crop cycle drones can be used to help obtain useful data surrounding the quality of the existing soil. By obtaining 3D maps of existing soil, you'll be able to see if there are any issues surrounding soil quality, nutrient management, or soil dead zones. This information can help farmers determine the most effective patterns for planting, managing crops, soil, and more. Ongoing monitoring can help to better utilize water resources, and more effectively manage crop nutrient levels.

Seed Planting

Drone planting is a relatively newer technology and not as widely used, but some companies are experimenting with drone planting. Essentially, manufacturers are experimenting with custom systems that have the ability to shoot seed pods into prepared soil. This technology helps to minimize the need for on-the-ground planting, which can be costly, time-intensive, and strenuous work. This same drone technology can be adapted and applied to a wide range of farm types, reducing overall planting times and labour costs across the board.

Crop Spraying and Spot Spraying

Crops require consistent fertilization and spraying in order to maintain high yields. Traditionally this was done manually, with vehicles, or even via airplane. These methods are not only inefficient, and burdensome, but they can be very costly as well. With approval from the FAA, Drones can be equipped with large reservoirs, which can be filled with fertilizers, herbicides, or pesticides. Using drones for crop spraying is much safer and cost-effective. Drones can even be operated completely autonomously and programmed to run on specific schedules and routes.

Crop Mapping and Surveying

One of the biggest advantages of using drone technology is the ease and effectiveness of large-scale crop and acreage monitoring. In the past, satellite or plane imagery was used to help get a large scale view of the farm, while helping to spot potential issues. However, these images were not only expensive but lacked the precision that drones can provide. Today, you can not only obtain real-time footage but also time-based animation which can illuminate crop progression in real-time. With drone mapping and surveying, technology decisions can now be made based on real-time data, not outdated imagery, or best-practice guesswork. With near infrared (NIR) drone sensors you can actually determine plant health based upon light absorption, giving you a birds-eye view of the overall farm health. With agriculture drones you'll be able to collect information like:

- The overall crop and plant health
- Land distribution based on crop type
- Current crop life cycle
- Detailed GPS maps of current crop area

The end result is simple, drones can help to maximize land and resource usage, and help farmers better determine crop planting locations.

Irrigation Monitoring and Management

Irrigation can be troublesome. With miles and miles of irrigation, issues are bound to arise. Drones that are equipped with thermal cameras can help to spot irrigation issues, or areas that are receiving too little or excessive

moisture. With this information, crops can be better laid out to maximize drainage, adhere to natural land runoff, and avoid water pooling, which can damage sensitive crops. Water and irrigation issues are not only costly but can ruin crop yields as well. With drone surveying, these issues can be spotted before they become troublesome.

Livestock Monitoring

Some drones are equipped with thermal imaging cameras that enable a single pilot to manage and monitor livestock. This allows farmers to keep track of livestock a much greater frequency, and with less time and staff investment. The drone operator can quickly check in on herd to see if there are any injured or missing livestock, as well as see livestock who are giving birth. Drones are used to keep an eye on the heard at all times, a once costly and time-intensive task.

Plus, thermal imaging will also help to keep an eye out for any livestock predators, which can be a huge advantage for some farm owners.

CONCLUSION

Drones have already vastly altered the agricultural industry and will continue to grow in the coming years. While drone use is becoming more useful to small farmers, there is still a way to go before they become part of every farmer's equipment roster, particularly in developing nations. Regulations around drone use need to be made and revised in many countries and more research needs to be done on their effectiveness at certain tasks, such as pesticide application and spraying. There are many ways drones can be useful to farmers but it is important to understand their limitations and functions before investing in expensive equipment.

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UZHAVAN APP: ONE STOP SOLUTION FOR FARMERS NEED

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Abstract

World of agriculture is now travelling towards technological based farm management. ICT tools play a major role in this transmission. Indian agriculture is obtained many positive effects through involvement of ICT. The usage of ICT in agriculture empowers support the production, improving marketing, capacity development empowerment, access to relevant agricultural information. The trending concept in this mobile ecosystem is mobile application and its major impact on agriculture marketing. The mobile phone network benefits smallholder farmer through four access, affordability, appliance and applications. Uzhavan app is a type of ICT based platform which provides all kind of information and support to farming community in one app.

Introduction

Mobile applications related to agriculture and rural development provides most economic and practical ways to information related to markets, governance, and finance. ICT such as business apps, conference apps, disease and pests' apps, farm management apps, learning and reference apps, location-based apps, market data apps and weather apps. One of the major issues in rural areas are the farmers have not known the true power of ICT due to low awareness and indifferent attitude and perception on same.

Uzhavan mobile application- *one stop solution*

The Uzhavan app is launched by Tamil Nadu government on April 7, 2018, especially for Tamil Nadu farmers. This app is developed in bilingual languages - Tamil and English. Currently, this app provides nearly fifteen services to farmers such as Farm subsidy and schemes, Benefit registration, Crop insurance, Fertilizer and seed stock position, Custom hiring centre, market price, weather forecast, AO/HO Visit, Farm guide, Organic and FPO products, reservoir levels, agriculture news and feedback. More than 5 lakh farmers have registered this app and get various benefits.

Features available in Uzhavan mobile application

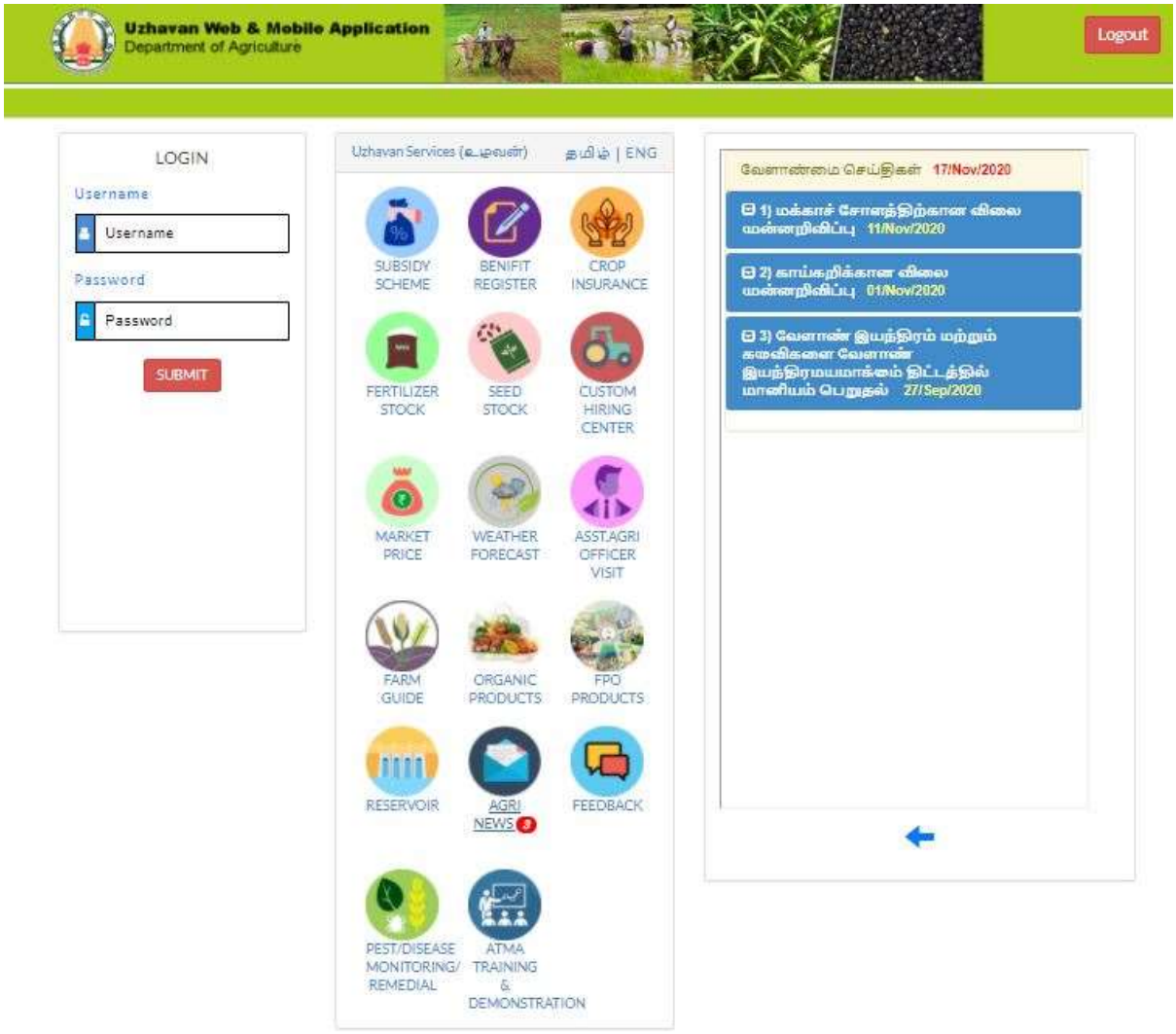
The Uzhavan app provides detailed information about subsidy scheme available for various inputs like seed, farm machinery, solar pump set, plastic mulching, shade net, beehives, poly house, micro irrigation, cold storage unit, custom hiring centre, water harvesting system, mushroom shed, hi-tech nursery along with the subsidy amount and percentage of subsidy for small, marginal, and large farmers.

Objective of Uzhavan app:

The objective of the UZHAVAN – உழவன் App is to empower farmers with accurate so that they can take appropriate decisions. The app is launched and maintained by Department of Agriculture, Tamil Nadu.

Benefits of Uzhavan app:

- Real-time information such as weather updates & crop prices
- Farmers can easily apply for government schemes & subsidies
- Track status of their application
- Easy application procedure for application of crop insurances
- Updates on compensation amount on the insurance and various schemes
- Provides information on Customer Hiring Center for hiring farm Machinery



Uzhavan mobile application – Milestone in agricultural development

The app help the farmers to get detailed information about the crop insurance notified on crops for particular village along with the insurance premium amount and places to insure like PACS, DCCB. Apart from that it also provides information like price and stock availability of seeds and fertilizer in both public and private stores. Custom Hiring Centre is the new service or facilities added to the Uzhavan app on Feb 5, 2019.

The Tractor and farm equipment services integrated with Tamil Nadu government and providing services to farmers to reduce their cultivation cost. This service brings out the facilities like renting the tractor and farm equipment to other farmers those who seeks to hire the tractors and farm equipment for field use. The app also provides market prices for agriculture and vegetables crops. It also provides information on weather forecast, date and places of AO/HO visit along with the contact number.

This app provides information on FPO products availability and organic product availability and the organic farmers in nearby region. Apart from these services, it also includes Reservoir Levels, Agriculture news and feedback services. At present, the farmers have to register in this app for getting PM Kisan Samman Nidhi Scheme benefits. The highest usage of Uzhavan app by farmers is from Villupuram district and lowest users are from Nilgiris district. The effort made by the government is to take the use of technology to next level to aid farmers in their profession.

Uzhavan mobile application and Tamilnadu Agriculture

Tamil Nadu has procured 22 lakh tonnes of paddy this season according to state Food Minister Kamaraj. In spite of Covid 19 lock down, the state

is expected to procure 6 lakh tonnes of paddy before the next season. No words of praise would suffice as our farmers continue to toil hard to ensure food for all with bumper crop. But Covid 19 pandemic induced lockdown has challenged farmers the most as they are unable to transport their farm products and face the shortage of farm labourers.

India is combating the pandemic and the ill effects of the lockdown with health sector, agriculture sector and many ministries led by Home Ministry initiating coordinated efforts to mitigate the sufferings of people across sectors with the cooperation of state governments. The State governments' digital initiative Uzhavan app has proved to be very beneficial in reaching the farmers with much needed intervention in this crisis hour.

Conclusion

ICT tools created mass change in the farmer's utilization pattern of information sources. Farmers are started to use ICT tools for immediate query clarification and decision making. Uzhavan app is one of the ICT inventions which created much awareness among the farming community of Tamilnadu farmers regarding suitable package of practices. This app still has its reaching capacity to the rural farmers. So farmers have to develop a positive attitude towards ICT inventions and need to adopt these kinds of technological advancements in their decision making.

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MANAGEMENT OF SUGARCANE WHITE GRUB BY USING ENTOMOPATHOGENIC NEMATODES

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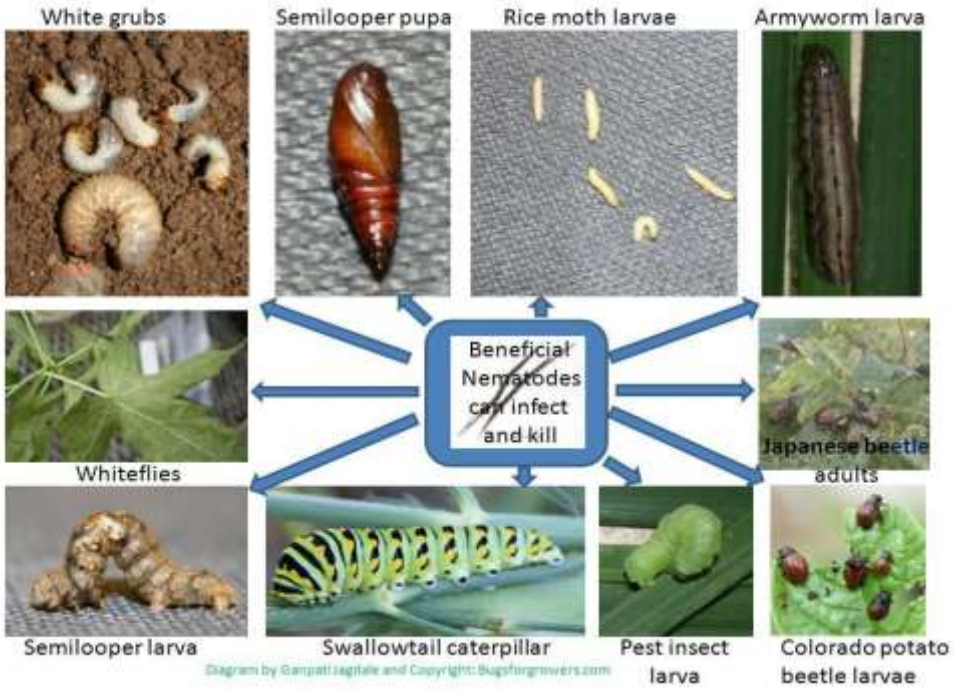
Sugarcane is one of the most important commercial crops in tropics and serves as the main source of sugar in the world. India is one of the leading countries in sugarcane cultivation with respect to area and production. During the period of last five decades the production, productivity and sugar recovery has also shown remarkable resilience. Today there is a growing concern about sustainability of sugarcane production as the growth rate has stagnated and rather declining trend is seen in India. Insect pest, among other factors, are considered as one of the main problems that reduce the average productivity per unit area. Among the insect pest of sugarcane, the most important one is scarabaeid beetles, which are commonly known as white grubs. White grubs have become serious root feeding insect pests in India during the last few years. Their infestation has been reported throughout the country and the magnitude of the problem has been widespread over the past years. Nearly 20 species of white grubs are reported to attack sugarcane in India. Of these, *Holotrichia serrata* (Blanch), *Anomala varicolor* (Gryll), *A. viridis* (F), *Apogonia destructor* (Bos.), *Cyclocephala parallela* (Casey), *Dermolepidia pica* (Arrow), *Lepidiota stigma* (Fab.), *Ligyrous subtropicious* (Blanch), *Leucopholis lepidophora* Blanch, *Phyllophaga helleri* (Brsk) and *Schizonycha rificollis* (Fab.) are reported to assume the pest status in sugarcane growing regions. Besides sugarcane other cultivated crops such as groundnut, cereals, millets, pulses, vegetables and plantation crops were also preferably attacked by white grub. Sugarcane crop is infested by white grubs after the onset of the summer showers. The grubs are subterranean having complex life cycle and actively feed on living roots, therefore the control of this pest becomes very tedious. Adult collection and insecticidal applications are the major tactics of management followed against all the white grub species. Early damage was similar in appearance to that of drought damage, with an initial yellowing of the leaves and drooping of the inner spindle leaf and later it causes leaves senescence and finally the maturing stalks deteriorates. In extreme cases, the whole clump roots were damaged and all the canes in the clump lodged on ground due to its own weight. The damaged clumps can be easily pulled out of the ground and subsequently the grubs tunnel into them. The beetles have three stages in grub in which the third stage is causing the greatest damage. These grubs are generally found immediately beneath cane stools in infested fields. Normally, only cane roots are eaten by the grubs, although, in some cases the base of the cane stalks is also eaten. Infested cane shows signs of water stress and lodging occurs in severely infested cane and the harvesting becomes uneconomic. In general, the management strategies primarily depends on the use of chemicals pesticides However, the efficacy of controlling grub population by using insecticides are not satisfactory because of quick development of insecticide resistance with more concerns for the environment and human safety. Several techniques have been adopted for the management of white grubs including cultural, mechanical, biological, chemical and integrated methods. But the effectiveness is not encouraging due to difficult in application of these methods in cane crops, because of its dense and dropping canopy, lack of adequate man power for mechanical collection. Moreover, white grubs are difficult to manage because of their hidden nature, their life cycles and it's below ground ecology. The use of synthetic insecticides against soil pests also ineffective due to the limitations of leaching,

adsorption or rapid break down and the impracticability of applying contact pesticides. Environmental friendly management strategies are urgently needed to replace the highly toxic chemical pesticides. Among the most promising bio-control agents of root pests, the soil-borne nematodes are obligate parasites of arthropods, also known as Entomo Pathogenic Nematodes (EPN) belongs to the families Steinernematidae and Heterorhabditidae. Several species of EPN are currently used as classical, conservational, and augmentative biological control agents. These EPNs are acting as a good alternative with a natural occurrence in soil and possess a number of favorable attributes *viz.*, motile infective stage that can actively seek out and infect a broad range of insects without affecting birds and mammals these credentials facilitates to utilize its as biological control agents. They have the ability to search for its hosts and due to their high reproductive potential causing tremendous changes in the reduction of density of grub population. They are non-toxic to humans, considered safe to the environment and can often be mass cultured, formulated and applied with common agricultural practices. For application of entomopathogenic nematodes in drip or soil @ ten lakhs (10×10^6) infective juveniles / ha .can effectively control the white grub in sugarcane. After the successful establishment in the host, EPNs undergo several cycles of multiplication. Their persistence was recorded in the soil even 90 days after application. Moreover the soil moisture of 17% and temperature of 23°C were favorable for the EPNs survival and persistence.



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