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From the Chief Editors Desk…

Dear Readers,

Agriculture has been the very important occupation of human beings. Increasing population, climate change, shrinking the resources and increasing disposable incomes have put agriculture worldwide under tremendous pressure. To face the changes we need the basic knowledge with high research potential in agriculture. So we glad to launch our second issue of **“Agrisakthi e-Monthly Magazine for Innovative Agriculture”**. The main aim of this magazine is to explore the novel innovations, modern technologies, scientific information and latest findings in agriculture and allied sectors for upliftment of farming community. Agrisakthi e magazine is an open access peer reviewed English journal which will start publishing from January 2022.The Agrisakthi magazine will offer a platform to all the undergraduate and post graduate students, scholars, researchers and scientists to share their ideas about latest innovative topics. We invite the popular article, review article and short communication from various disciplines like agriculture, horticulture, forestry, animal science, dairy science, fishery, organic farming, medicinal plants, and sericulture. The following points to be considered before submission, an article must be free of plagiarism, author himself/herself is responsible for plagiarism, article must be within magazine article page limit (within 3-4 pages), article should not be sent for publication and published elsewhere and author agrees to guidelines and terms, conditions of our magazine.

We are happy to announce, our team already published **“Agrisakthi”** Magazine for past two years with 56 issues successfully in Tamil language and received huge positive responses from worldwide. We are looking forward for the same responses to this **“Agrisakthi e-Monthly Magazine for Innovative Agriculture”.**

Best wishes

Article Number : 010222-01

Effect of heavy metal contamination in soils and remediation strategies

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Introduction

Soil is the major source of nutrients which has both essential and non essential, in which non-essential elements may be toxic to plants. The presence of those non essential nutrient's toxic elements in the metal and metalloids forms available for the plants in soil are of utmost concern in the current scenario., the heavy metals like lead (Pb), arsenic (As), cadmium (Cd) and mercury (Hg) etc have no definite biological functions or their role is yet to be ascertained. However, their toxicity even at minimum concentration will cause harm evident for the biological system .

Generally, heavy metals are defined as elements that are characterized by relatively high specific density (>5.0 Mg m^{-3}) and relatively higher atomic weight with an atomic number greater than 20. The most common heavy metals are in order of Pb, Cr, As, Zn, Cd, Cu and Hg present in polluted, all of them were known to cause risks for human health, and damage the environment. In the recent past cadmium, nickel, and lead have drawn more attention due to their contamination in soil and groundwater and also their accumulation in plant.

Due to their impact on human life and environmental concerns the utmost importance is to need to go for remediation wherever and whenever there is a contamination of heavy metal in the soil. The techniques which are employed for remediation includes the In situ stabilization of metals that will make metals immobile or removal of contaminated soil will minimize the possibility of plant uptake or groundwater pollution.

Therefore, it is necessary to go for remediation whenever heavy metal contamination is found in soils. Removal of the contaminated soil or in-situ stabilization of metals rendering them immobile and minimizing the possibility of plant uptake or ground water pollution are generally applied techniques for remediation.

Sources of heavy metal contamination in soil

Pedogenic

Naturally, the soil contains metals and minerals their concentration and availability were far level to posing a threat to life and environment but the soil which was derived from those metal rich parent materials were exception.

By the impact of geomorphological changes such as weathering of igneous, sedimentary rocks and coal like minerals was main repository for heavy metal contamination in soil. Due to their low solubility characteristics , those heavy metals occurs in unavailable form to uptake by the plant itself and has less harm on soil microbes living in those contaminated soil with heavy metals .

Metals occur in the soils naturally, however, their concentration and availability is far from posing a threat to the environment and life with exceptions of the soils derived from metal rich parent materials.

Weathering of rocks and minerals including igneous, sedimentary rocks and coal are the main repository of metal contamination. At these aspect heavy metals occurs in forms which are not available to plant uptake. Due to their low solubility, heavy metals found in parent materials are not bio available to plants and has less impact on soil microbes.

Anthropogenic

By the anthropogenic activities, like industrial development and manufacturing, disposal of domestic effluents and excess usage of agricultural inputs such as fertilizer and pesticides releases larger quantities of trace elements into soil environment as compared to the pedogenic activity.

For example, the grey water from household was not only a rich source of organic matters but also having little amount of heavy metals at higher concentration including Fe, Mn, Cu, Zn, Pb, Cr, Ni, Cd and Co and unrestricted usage of lead based petrol also major concern in several countries including india.

Unlike pedogenic, the higher quantities of trace elements are being released in to the soil environment by anthropogenic activities, associated with industrial development and manufacturing, disposal of domestic industrial wastes and excess usage of agricultural inputs such as fertilizers and pesticides.

The grey waste water has not only a rich source of organic matter and other nutrients but also heavy metals like Fe, Mn, Cu, Zn, Pb, Cr, Ni, Cd and Co at high concentrations in these soils. Due to unrestricted usage of leaded gasoline from Pb-based petrol was the concern issue in several countries.

Effect of soil organic carbon on heavy metals

during soil reaction, organic carbon content in soil one of the important soil properties affecting heavy metal availability. It is one of the major contributors to the soil in retaining heavy metals in exchangeable form, the soil solution which act as chelates and increase the metal availability to crops. (McCauley *et al.,* 2009). Numerous studies had reported that on decreased organic matter content in soil declined the metal absorption onto soil.

Impact on plants

The heavy metals at higher concentrations hamper the germination, growth and production which are mainly associated with physiological, biochemical and genetic elements of the plant system.

The main effects of heavy metals on seeds are manifested by decrease in germination, reduced root and shoot elongation, total soluble protein level membrane alterations, oxidative damage, altered protein and sugar metabolism, nutrient loss (Pourrut *et al.,* 2011).

Effect of organic amendments in heavy metal contaminated soil

Organic amendments like farmyard manure (FYM), compost, press mud etc. not only improve physical, chemical, biological and fertility property of soils, but can also be employed in altering the availability of heavy metal contaminants in soils. Different organic amendments like manures, composts, bio-solid and municipal solid wastes, pressmud, and activated carbon are used for immobilization of metals in the contaminated soils (Sabir *et al.,*2013). Mineral ions, humic substances and microbes in compost considerably influence the immobilization of heavy metals and reduction of the environmental risk of heavy metals in agricultural soils.

Organic matter controls the bioavailability of different metals including Ni in soil where it could form stable chelates, which controls the accumulation and mobility of Ni in the soil.

Clement et al. (2006) reported EDTA extractable Pb decreased from 42.7 per cent of the total Pb in control samples to 37.3 per cent in compost and 32.3 per cent in manure treated samples. Organic matter controls the bioavailability of different metals including Ni in soil where it could form stable chelates, which controls the accumulation and mobility of Ni in the soil.

Being a bioconversion product by earthworms, it has been used as a bio sorbent for removing metallic ions such as Pb, Ni, Cd and Cr from wastewaters since it has maximum adsorption capacity for heavy metals (Zhu *et al.,* 2017).

Nejad and Jung et al. (2017) examined that on treatment of contaminated soil with rice husk biochar (RHB) and maple leaf biochar (MLB) the plant uptake and accumulation of Cu, Cd, Pb and Zn reduced by 13-19, 79-66, 87-86 and 37-36 percent, respectively.

The OM enhanced buffering of soil which affected the soils pH. Further, it may be due to byproducts released during OM decomposition, changes in redox potential and protonation/deprotonation (Hamid *et al.*, 2019).

References

Clement, R., Escolar, Á. and Bernal, M.P., 2006, Heavy metals fractionation and organic matter mineralisation in contaminated calcareous soil amended with organic materials. *Bioresour. Technol*., 97(15):1894-1901.

Hamid, Y., Tang, L., Yaseen, M., Hussain, B., Zehra, A., Aziz, M.Z., He, Z.L. and Yang, X., 2019, Comparative efficacy of organic and inorganic amendments for cadmium and lead immobilization in contaminated soil under rice-wheat cropping system. *Chemosphere*, 214: 259-268.

McCauley, A., Jones, C. and Jacobsen, J., 2009, Soil pH and Organic Matter. Nutrient management modules 8. Montana State University Extension Service.

Nejad, Z.D. and Jung, M.C., 2017, The effects of biochar and inorganic amendments on soil remediation in the presence of hyperaccumulator plant. *Int. J. Energy Environ. Eng.*, 8(4): 317-329.

Pourrut, B., Shahid, M., Dumat, C., Winterton, P. and Pinelli, E., 2011, Lead uptake, toxicity, and detoxification in plants. *Arch.Environ.Contam.Toxicol*., 213:113-136. Springer, New York.

Sabir, M., Hanafi, M. M., Aziz, T., Ahmad, H. R., Zia-Ur-Rehman, M., Saifullah, G. M. and Hakeem, K. R., 2013, Comparative effect of activated carbon, pressmud and poultry manure on immobilization and concentration of metals in maize (*Zea mays*) grown on contaminated soil. *Int. J. Agric. Biol*., 15: 559-564.

Zhu, W., Du, W., Shen, X., Zhang, H. and Ding, Y., 2017, Comparative adsorption of Pb^{2+} and Cd^{2+} by cow manure and its vermicompost. *Environ. Pollut.,* 227: 89-97.

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Article Number : 010222-02

Effect of cotton intercropping system on various crops

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Abstract

A Field experiment was conducted at Kallampuli village, Kadayanallur block, Tenkasi District during *Kharif* season (May to October) 2020 to evaluate the effect of different intercropping systems on yield attributes of cotton. The intercrops included in the investigation were T_1-Cotton alone, T_2-Cotton+Blackgram, T_3-Cotton+Greengram, T_4-Cotton+Cowpea, T_5-Cotton+Tomato, T_6-Cotton+Brinjal, T_7-Cotton+Coriander, T_8-Cotton+Sunflower, T_9- Cotton+ Sesame. Among the various intercrops evaluated, the growth and yield components of all individual crops were higher in sole cropping system compared to the intercropping system with cotton.

Key words: Cotton, intercropping system, Blackgram, Greengram, Cowpea, Tomato, Brinjal, Coriander, Sunflower, Sesame

Introduction

Cotton (*Gossypium sp*) king of fiber one of most important commercial fibre and cash crops cultivated in India known as white gold. it accounts for around 25 per cent of the total global fibre production. It plays a major role in sustaining the livelihood of an estimated 5.8 million cotton farmers and 40-50 million people engaged in chain of production and trading.. India got the first place in the world in Cotton cultivation acreage which is around 37 per cent of the world area. In india approximately 62% of cotton cultivated as rainfed cotton and remaining as irrigated cotton. In terms of productivity India performs poor as compared to China and USA. During 2018-19 India's productivity is estimated at 453.43 Kg / ha. In Tamilnadu cotton is cultivated in 0.70 lakh hectares with the production of 5 lakh bales and productivity of 1214 kg/ ha.

Hallikeri *et al*., 2007 reported that suppression of cotton yield when it was intercropped with tomato and bhendi. Aladakatti *et al*., 2011 concluded that less adverse effect of oilseed crops on cotton might be attributed to the lack of perceptible degree of competition between them due to short duration, growth habit and short stature of the intercrop.

Materials and methods

A Field experiment was conducted at Kallampuli village, Kadayanallur block, Tenkasi District during *Kharif* season (May to October) 2020. The field is situated at ($9^0$2' N latitude, $77^0$22' longitude and at an altitude of 143 meters above Mean sea level (MSL)). The soil of the experimental field was Clay loam soil with pH of 7.3 and EC of 0.3 d Sm^{-1}.

The experiment was laid out in Randomized Block Design with nine treatments and replicated thrice. The cotton hybrid RCH-659 was grown during the investigation. The intercrops Black gram (ADT 5), Greengram (CO 6), Cowpea (CO 2), Tomato (CO 3), Brinjal (PKM 1), Coriander (CO 1), Sunflower (CO 2), Sesame (CO 1) were chosen for the study.

Results and discussion

Blackgram

Blackgram grown as sole crop registered the highest plant height (31.89 cm), LAI (5.13) and DMP (2550 kg ha^{-1}). Blackgram grown as sole crop produced the highest yield 82 kg ha^{-1}. The lowest yield of 775 kg ha^{-1} was observed with blackgram grown as intercrop.

Green gram

Green gram grown as sole crop registered the highest plant height (45.00 cm), LAI (2.07) and DMP (4498 kg ha^{-1}). In respect of yield attributes of greengram viz., number of pods $plant^{-1}$(26) and number of seed pod^{-1} (11.86) were higher in sole crop compared to intercrop. Greengram grown as sole crop produced the highest yield of 780 kg ha^{-1}.

Cowpea

Cowpea grown as sole crop registered the highest plant height (48.59 cm), LAI (2.48) and DMP (2570 kg ha^{-1}). In respect of yield attributes of cowpea *viz.,* number of pods $plant^{-1}$(25.53) and number of seed pod^{-1} (13.46) were higher in sole crop compared to intercrop. Cowpea grown as sole crop produced the highest yield 762 kg ha^{-1}.

Tomato

Tomato grown as sole crop registered the highest plant height at flowering (70.31 cm), LAI (2.81) and

DMP (3950 kg ha^{-1}). In respect of yield attributes of tomato *viz.,* number of clusters plant^{-1}(10.39) number of fruits plant^{-1} (30.70) were higher in sole crop compared to inter crop. Tomato grown as sole crop produced the highest yield 18000 kg ha^{-1}. The lowest yield of 14000 kg ha^{-1} was observed with tomato grown as inter crop.

Brinjal

Brinjal grown as sole crop registered the highest plant height at flowering (81.72 cm), LAI (1.54) and DMP (3876 kg ha^{-1}). Brinjal grown as inter crop registered the lowest plant height (78.09 cm), LAI (1.23) and DMP (3765 kg ha^{-1}). In respect of yield attributes of brinjal *viz.,* number of clusters plant^{-1}(9) number of fruits plant^{-1} (41.69) were higher in sole crop compared to intercrop. Brinjal grown as sole crop produced the highest yield 17000 kg ha^{-1}.

Coriander

Coriander grown as sole crop registered the highest plant height at flowering (17.99 cm), LAI (1.7) and DMP (3200 kg ha^{-1}). Coriander grown as intercrop registered the lowest plant height (16.54 cm), LAI (1.2) and DMP (3000 kg ha^{-1}). In respect of yield attributes of coriander *viz.,* number of branches plant^{-1}(6.10) number of seeds pod^{-1} (2) were higher in sole compared to intercrop. coriander grown as sole crop produced the highest green yield 200 kg ha^{-1}.

Sunflower

Sunflower grown as sole crop registered the highest plant height (155.62 cm), LAI (3.79) and DMP (4776 kg ha^{-1}). In respect of yield attributes of sunflower *viz.,* number of filled seeds head^{-1} (652) and test weight (4.9) were higher in sole crop. Sunflower grown as sole produced the highest yield 1932 kg ha^{-1} The lowest yield of 1876 kg ha^{-1} was observed with sunflower grown as intercrop.

Sesame

Sesame grown as sole crop registered the highest plant height (98.88 cm), LAI (3.24) and DMP (3520 kg ha^{-1}). Sesame grown as inter crop registered the lowest plant height (94.43 cm), LAI (3.10) and DMP (3210 kg ha^{-1}). In respect of yield attributes of sesame *viz.,* number of capsules plant^{-1} (86.54) and test weight (3.15) were higher in sole crop compared to inter crop. Sesame grown as sole crop produced the highest yield 772 kg ha^{-1} .The lowest yield of 713 kg ha^{-1} was observed with sesame grown as sole crop.

Table 1. Growth and yield characters of Blackgram, Greengram and Cowpea

Characters	Blackgram		Greengram		Cowpea	
	Inter crop situation	Pure crop situation	Intercrop situation	Pure crop situation	Intercrop situation	Pure crop situation
Plant height at flowering (cm)	29.82	31.89	43.52	45.0	45.31	48.59
LAI at harvest	4.94	5.13	1.92	2.07	1.92	2.48
DMP at harvest (kg ha^{-1})	2430	2550	3675	4498	2172	2570
Number of branches $plant^{-1}$	5.91	6.10	5.9	6.1	4.7	5.8
Number of pods $plant^{-1}$	12.25	13.66	21	26	22.41	25.53
Pod length $plant^{-1}$	5.23	5.92	6.12	6.63	15.32	17.28
Number of seeds pod^{-1}	4.76	5.64	11.86	10.72	12.21	13.46
Seed yield (kg ha^{-1})	775	825	687	780	680	762
Haulm yield (kg ha^{-1})	1490	1530	2800	3044	2860	3126.07

Table 2. Growth and Yield characters of Tomato and Brinjal

Characters	Tomato		Brinjal	
	Intercrop situation	Pure crop situation	Intercrop situation	Pure crop situation
Plant height at flowering (cm)	65.72	70.31	78.09	81.72
Days taken for 50% flowering(days)	32.12	29.72	50.12	45.10
Number of primary branches $plant^{-1}$	6.54	7.07	4.10	4.45
LAI at harvest	2.31	2.81	1.23	1.54
DMP at harvest (kg ha^{-1})	3820	3950	3765	3876
Number of clusters $plant^{-1}$	9.86	10.39	7	9
Number of fruits $plant^{-1.k'}$	28.12	30.70	37.56	41.69
Fruit diameter(cm)	3.82	4.05	9.8	10.2

Fruit yield plant^{-1}	1.92	2.32	1.34	1.69
Single fruit weight(g)	68.58	72.80	37.52	40.80
Fruit yield (kg ha^{-1})	14000	18000	13000	17000

Table 3. Growth and yield characters of Sunflower and Sesame

Characters	Sunflower		Sesame	
	Intercrop situation	Pure crop situation	Intercrop situation	Pure crop situation
Plant height at flowering (cm)	148.09	155.62	94.43	98.88
LAI at harvest	3.23	3.79	3.10	3.24
DMP at harvest (kg ha^{-1})	4532	4776	3210	3520
Diameter of capitulum (cm)	17.20	19.01	-	-
Number of capsules plant^{-1}	-	-	81.23	86.54
Number of seeds head^{-1} / Number of seeds capsule^{-1}	859	910	61.21	64.08
100 grain weight(g)/1000 grain weight(g)	4.1	4.9	2.92	3.15
Seed yield (kg ha^{-1})	1876	1932	713	772

References

Aladakatti, Y.R, Hallikeri, S.S, Nandagavi, R.A, Hugar, A.Y, Naveen and N.E. 2011. Effect of intercropping of oilseed crops on growth, yield and economics of cotton under rainfed conditions. Karnataka Journal of Agricultural Sciences., 24:280-282.

Dayal, D., S. Mangalassery, S.L. Meena, and B. Ram, 2015. Productivity and profitability of legumes as influenced by integrated nutrient management with fruit crops under hot arid ecology. Indian Journal of Agronomy., 60: 297–300.

FAO [Food and Agricultural Organization of United Nations]. (2016). Pulses- Nutritious Seeds for Sustainable Future. Food and Agricultural Organization of United Nations, Rome, Italy. 189.

Hallikeri, S.S., Aladakatti, Y.R. Basanagouda, C. Patil and S.S. Patil. 2007. Intercropping of cotton with vegetables as the profitable cropping system under rainfed conditions of north Karnataka. University of Agricultural Sciences, Dharwad, Karnataka (INDIA).

Have you done seed treatment?

Application of fungicide, insecticide, or a combination of both, to seeds so as to disinfect them from seed-borne or soil-borne pathogenic organisms and storage insects.

For cotton, treat the delinted seeds with talc formulation of Trichoderma viride @ 4g/kg of seed
Treat the delinted fungicide treated seeds with 3 packets (600 g) of Azospirillum and 3 packets of phosphobacteria 600g and sow immediately.

L. Meena

Article Number : 010222-03

HYDROPONICS – AN ALTERNATIVE TECHNOLOGY

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Introduction

Vegetables grown in open fields are highly exposed to abiotic and biotic stresses like unseasonal heavy rainfall, high temperature, pests, soil-borne diseases, nematodes, etc. These constraints result in yield and quality loss of vegetables. Moreover, the fluctuating market prices are highly fluctuating and increasing population which cause decline in production and reduction cultivabe areas due to urbanization. To overcome these gaps of non-availability of fertile land and further there is deterioration organic content in soil, increase in salinity, soil-borne diseases and nematodes etc, more focus should be widened to employ new technologies such as hydroponic cultivation.

Hydroponics is derived from a greek word meaning "hydro" means water and "ponos" means labour. It is the technique of growing crops in an inert medium such as gravel, clay pebbles, vermiculite, perlite etc. along with nutrient solution containing the vital nutrients essential for proper development and growth of the crop. Hydroponics is an alternative technology to grow vegetables.

Nutrient film technique

The nutrient film technique (NFT) was developed by Dr. Allan Cooper during the late 1960s at England. It has emerged to be the most evolving type. In this method, a thin film of nutrient solution flows through pipes or channels in which the nutrients are pumped from a hydroponic reservoir to a growing tray. A thin film of solution flows throughout the end of each channel and flows back by gravity through dangling roots of the plant automatically throughout the growth period. Capillary material in channels prevents the roots of plants from drying out. The main concern in this system is the preservation of the root zone with optimum air-water conditions and proper availability of nutrients. Through hydroponic cultivation, good-quality vegetables can be grown throughout the year.

Plants grown hydroponically are grown without soil and so they grow 30-50% rapidly and virulently than plants in the earth. In this system the problem of soil borne diseases and crop losses due to them can be reduced. Thus, this system reduces the use of pesticides and agrochemicals. The main benefit of soilless cultivation is that both macro and micro nutrients required by plants reach their roots instinct around the clock. Gericke (1940) used hydroponics to grow crops like tomatoes, root vegetables in rows or on trellises, just like in a traditional garden, only with their roots in water.

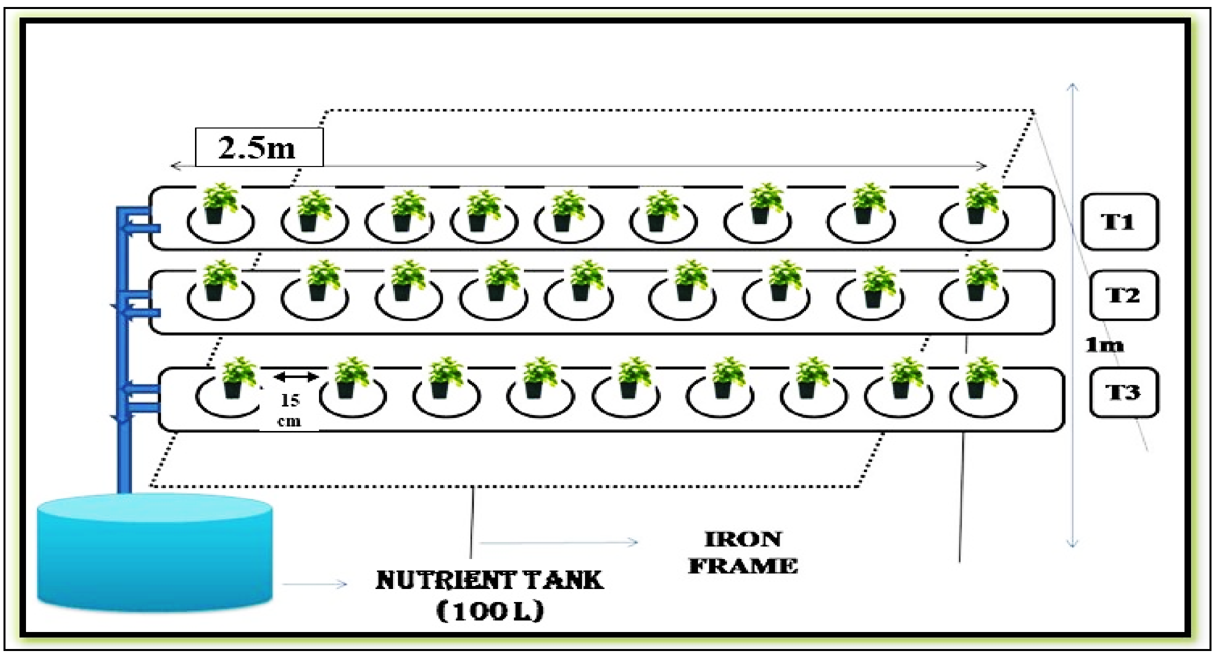
Hydroponics is an emerging sector and has scope on crop production, as it ensures more efficient use of water and fertilizers. Furthermore, hydroponically grown crops have its value for marketability due to enhanced quality and increased productivity, ending in higher increased competitiveness and financial returns. Hughes *et al.* (1995) reported that this system helps in continuous supply of vegetables in a shorter period of time. Hydroponics is a novel alternate system. But the initial investment is high. To utilize this system in a remunerative manner for commercially cultivation.

Management of pH and Electrical conductivity

For NFT in hydroponics the nutrient doses were computed for 100 litre tank and fertigated. The nutrients required for fertigation were weighed individually in a plastic beaker and were dissolved in distilled water by repeated stirring. Then the dilution was made for 100 litres as per the treatment specification and fertigation with the nutrient solution was given from the tank. The pH was maintained at a rate of 6.3 to 6.5 and EC around 2 d S/m^{-1}.

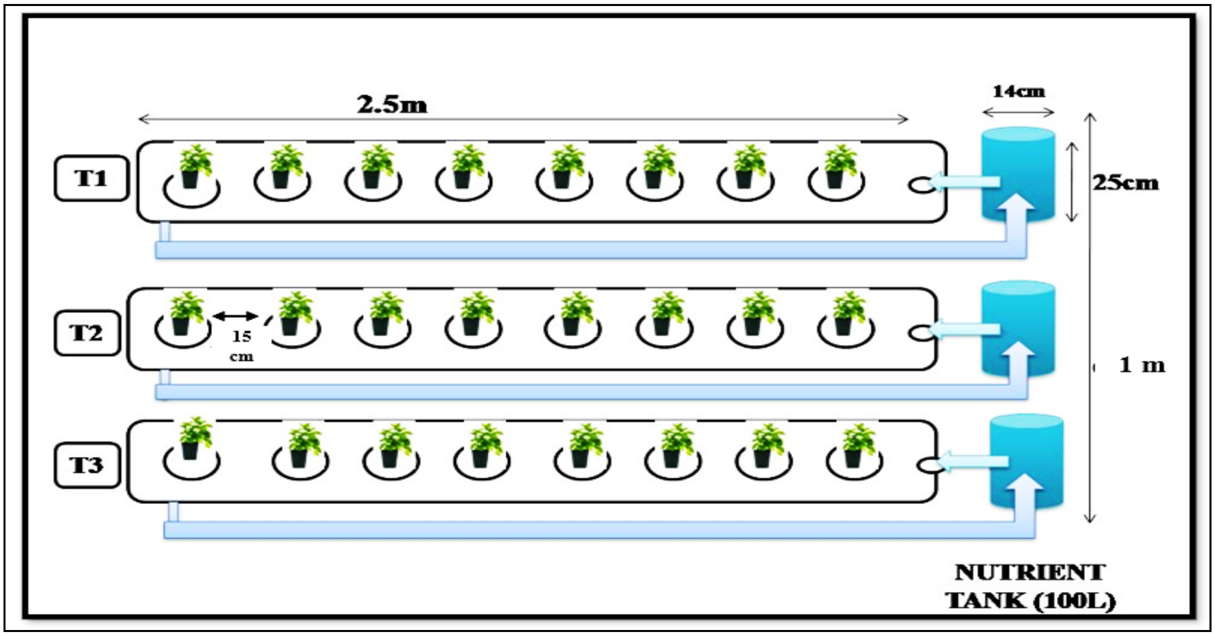
The nutrient solution used for hydroponics contains all the macro and microelements required for plant growth. The pH determines the availability of essential plant elements. The change in pH may result in nutritional insufficiency, causing plants to exhibit deficiency symptoms. So, pH calibration was done once in two weeks. To increase the pH range phosphoric or sulphuric acid was added at a rate of 6.25 g per litre to the fertilizer tank. Sodium hydroxide or potassium hydroxide at a rate of 12.5 g per litre was added to reduce the pH.

Hydroponic vertical A type- Nutrient Film Technique (NFT) system: Vertical NFT system was laid out with three PVC pipes of 2.5 m length and10 cm diameter each. The three PVC pipes were fitted in vertical iron rods of height 1.5 m in a triangular fashion with an angle of 60^0. The PVC pipes were fitted at a distance of 35 cm between each pipe in the iron rod. In each pipe holes are at a distance of 15 cm and sixteen plants were accommodated per row (Plate 2). The nutrient solution was supplied by tanks of 100L capacity. The water was circulated using 0.5hp submersible pump through PVC pipes to the dangling roots in the holes. End of each PVC pipes were closed with end cap with two holes one for inlet and another for outlet. The outlet pipes were directly connected to reservoir of nutrient tank for recirculation of nutrient solutions. This system was installed under a polyhouse with UV stabilized cladding material of 200micron thickness



Hydroponic horizontal NFT system: Three PVC plastic pipes with 2.5 m length and 10 cm diameter were placed at distance of 35 cm and mounted with a help of holder and clamp on three flat iron rods installed at a height of 1.0 m from ground. Each row of horizontal NFT consisted of sixteen numbers of plants planted at a distanceof

15 cm. The ends of each pipe were sealed with end caps. The inlet and outlet pipes were fixed to a barrel of 100lts capacity for recirculation



Conclusion

Vertical A type -NFT system of hydroponic cultivation is the best when compared to horizontal hydroponic system based on the evaluation of all the parameters such as growth, yield, physiological, plant growth attributes, quality parameters and B:C ratio. Therefore, hydroponics can be promoted to increase the productivity per unit area along with enhanced nutritional quality in limited spaces.

References

Gericke, William Frederick. 1940. "The complete guide to soilless gardening." *The complete guide to soilless gardening.*

Hughes, David, Walter Butcher, Abdullah Jaradat, and Water Penaranda. 1995. "Economic analysis of the long-term consequences of farming practices in the barley cropping area of Jordan." *Agricultural Systems* 47 (1):39-58.

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Aeroponics: soilless farming for the Modern Agriculture Technology

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Introduction

Aeroponics is a promising soilless farming method for solving future food crisis and is relatively a new way of growing plants that is getting increasingly popular with many people because of the speed, cost and novelty. Aeroponic farming is a form of hydroponic technique and a type of vertical farming. The word aeroponic is derived from the Latin word 'aero' (air) and 'ponic' means labour (work). This farming system empowered the producer to precisely control root zone nutrients, water regimes, and environmental conditions and have complete access to the roots throughout the life of the crop. This aeroponic farming is superior in terms of excellent aeration, water use efficiency, less time and space requirement, seasonal independence, disease free plant propagation, and large scale plant production etc. than the conventional methods of propagation. Aeroponic techniques have proven to be commercially successful for propagation, seed germination, seed potato production, tomato production, leaf crops, and micro-greens. Vegetable crops like potato, yams, tomato, lettuce and some of the leafy vegetables are being commercially cultivated in aeroponic system. Aeroponics appeared to be a highly feasible method for the production of both aerial parts and roots.

Need of Aeroponics

The current world population of 7.2 billion is projected to increase by almost one billion people within the next twelve years, reaching 8.1 billion in 2025 and 9.6 billion in 2050. With the increasing population growth the demand for the more food and more land to grow food is ever increasing. As the world population continues to grow, the rising demand for agricultural production is significant. Prime agricultural land can be scarce and expensive. Aeroponics is a technological leap forward from traditional hydroponics. Aeroponics-farming are also needed due to the many drawbacks of the traditional field farming system. Some of the drawbacks of the traditional farming system are 15 hours to harvest the crops, long time to harvest hence being sold for more expensive prices to earn back the time. Another factor is soil used in traditional system, decomposition of organic materials takes up long time. There is a high risk of getting soil disease. Pesticides are used, which is harmful for health. Whereas, in a developing country like India, it is very important to use resources like water, sunlight, soil and money very efficiently.

Types of Aeroponics:

A. Low-pressure Units: In most of the low-pressure aeroponic gardens, roots of the plant are suspended above a reservoir of nutrient solution or a channel which is inside and is connected to a reservoir. The nutrient solution is delivered by a low-pressure pump through jets or by ultrasonic transducers, which drips or drains the nutrients back into the reservoir. When plants grow to maturity, then the units suffer from dry sections of the root systems and thus adequate nutrient uptake is avoided. These types of units lack features to purify the nutrient solution, removal of debris and unwanted pathogens because of cost. These units are usually suitable for bench top growing. And it is also used for the demonstration of principles of aeroponics.

B. High-pressure Devices: In high-pressure aeroponic devices, mist is created by high-pressure pump(s). And it is generally used in the cultivation of high value crops. This method includes technologies for air and water purification, nutrient sterilization, low-mass polymers and pressurized nutrient delivery systems.

C. Commercial System: The commercial system has high-pressure device hardware and biological systems. An enhancement for extended plant life and crop maturation is included in the biological systems matrix.

Working:

Aeroponic system is an endless process in a confined space and therefore it cuts down agricultural labour. Aeroponics are based on the possibility of cultivating vegetables whose roots are not inserted in a substratum (the case with hydroponics) or soil, but in containers filled with flowing plant nutrition. The basic principle of aeroponic growing is to grow plants suspended in a closed or semi-closed environment by spraying the plant's dangling roots and lower stem with an atomized or sprayed, nutrient-rich water solution. The set up for aeroponic includes a proper monitoring and control system for water and nutrients distribution for utilizing the aeroponic cultivation at its best. A distribution system of pipes, spray nozzles, a pump and timer distributes the spray from a nutrient solution storage tank is required. It uses a small internal micro jet spray that sprays the roots with fine, high pressure mist containing nutrient rich solutions from the nutrient reservoir as a fine mist in the rooting chamber. There is a programmable cyclic timer which is used to trigger the high-pressure aeroponic pump to go on. Nutrients are mixed in with water in a reservoir basin, this is than filtered and pumped into a pressurized holding tank that is intermittently misted on to the root system. Developed root hairs help in absorbing nutrients from the moisture. It is also easier to administer all sorts of nutrients to the plant, via the root system. Since the spray particles are small in size, there is negligible wastage of nutrient solution. And with an ample amount of oxygen supply, root rot is completely avoided.

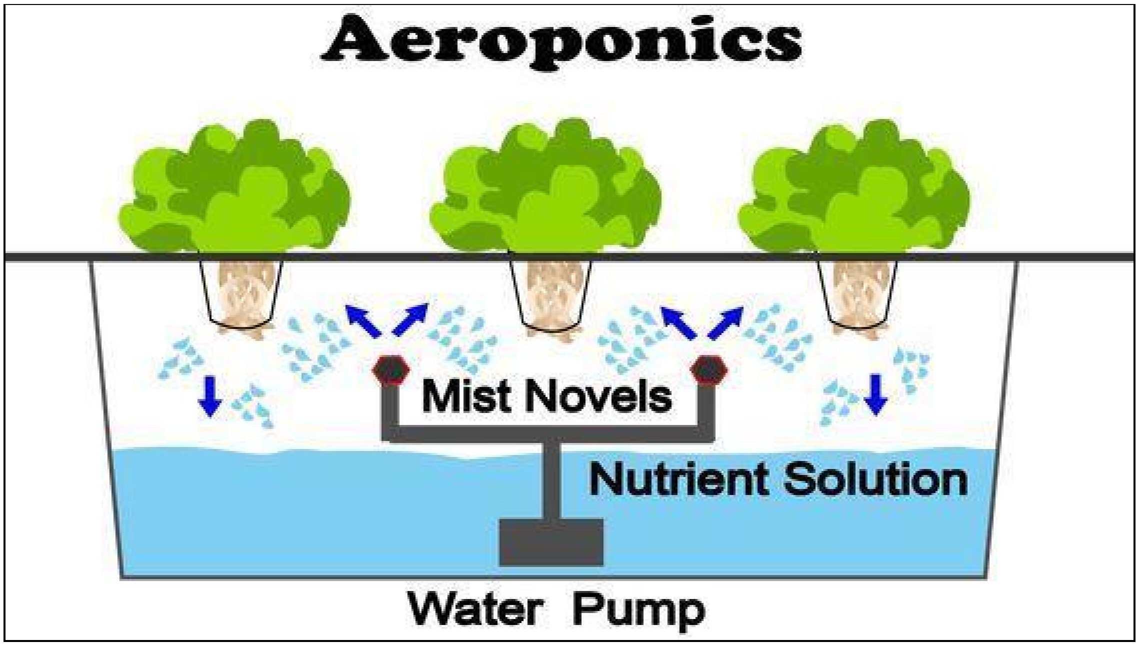
The misting is usually done every few minutes around the hanged roots. The system normally turned on for only a few seconds every 2-3 minutes. Because the roots are exposed to the air, the roots will dry out rapidly if the misting cycles are interrupted. A timer controls the nutrient pump much like other types of hydroponic systems, except the aeroponics system needs a short cycle timer that runs the pump for a few seconds every couple of minutes. However, the chamber must be lightless materials from everywhere, so that the roots are in darkness functionally good also to inhibit algal growth that impedes the growing plants and pollute the system. The droplet size of a nutrient mist is a crucial element in aeroponics. An oversized droplet may reduce the oxygen supply. An undersized droplet may stimulate root hair growth which prevents lateral root growth which influences the efficiency of an aeroponic system. The water droplets must be big enough to carry the nutrients to the roots in sufficient quantity, but small enough to not immediately precipitate out of the root mass. Unused solution drips down into the base of the unit is strained, filtered, and pumped back into the reservoir. Aeroponics system is that of easy monitoring of nutrients and pH. In aeroponics there is the minimal contact between the support structure and plant, due to which the unconstrained growth of the plant is possible.

Different Components of Aeroponics:

1. Nutrients used in aeroponics: Mainly N-NH_4 (0.54 g/L), N-NO_3 (0.35 g/L), P (0.40 g/L), K (0.35 g/L), Ca (0.17 g/L), Mg (0.08 g/L), Na (0.04 g/L), Fe (0.09 g/L), Zn (0.03 g/L) and B (0.03g/L) are commercially being used in most of the crops.

2. Water used in aeroponics: Water to be used in aeroponics should have a low EC, not exceeding one mS/cm. Water pH is also a useful indicator. Water sources with a pH of over eight are questionable for aeroponics. It is useful to have a water chemical analysis; even if EC and pH measures fall into acceptable levels. The other problem we may have to face is water biological contamination. Water from deep wells is usually not contaminated. Water from superficial wells, especially near urban areas, is likely to be contaminated with coli form bacteria, including Pectobacterium. Water from suspicious sources should have a microbiological analysis. Special filters can minimize this risk. If available, water should be filtered before going into the nutrient tank. Boiling is also another alternative if no other is available.

3. The plant material used in aeroponics: Optimum plant material should be used for aeroponics. In vitro plants are preferred because of sanitary reasons. However, they need to be handled with proper care by experienced technicians. These plants should be the appropriate age and size and should go through a thorough acclimatization period before going into the greenhouse. Other plant materials, such as rooted cuttings and tuber sprouts, should be clean and disease free. The presence of any kind of symptom should be sufficient reason to discard the whole batch of plants. This should be noticeable when transplanting into the boxes. The underground part of the tissue coming from the sand trays should be completely clean and sand free. Before placing into aeroponics, plants should be managed in a clean greenhouse environment.



Benefits of Aeroponics:

Round the year cultivation: Since plants are grown in a controlled environment crops can be grown year-round without being dependent on the weather or atmosphere conditions outside.

Fast plant growth: Plants grow fast because their roots have access to a lot of oxygen.

Easy system maintenance: In aeroponics, all you need to maintain is the root chamber (the container housing the roots) which needs regular disinfecting, and periodically, the reservoir and irrigation channels.

Less need for nutrients and water: Aeroponic plants need less nutrients and water on average, because the nutrient absorption rate is higher, and plants usually respond to aeroponic systems by growing even more roots.

Mobility: Plants, even whole nurseries, can be moved around without too much effort, as all that is required is moving the plants from one collar to another.

Requires little space and high yield: Aeroponic systems can be stacked up in layers to build vertical farms that take up much less space than traditional farming methods.

Great educational value: Plants and root growth study in laboratories is easier for students and researchers.

Proper root growth: In this system, plant roots have proper space to grow well. So they don't stretch or wilt.

No transplantation shock: Plants can be shifted to any growing media system without any transplantation shock after root development.

Easier fruit harvest: Fruits produced from the system are easier to harvest.

Disease free produce: Due to clean and sterile growing conditions, plant diseases and infections reduce up to a great extent.

Production at moon stations: Using this technique, fruits can be grown at zero gravity i.e at moon stations.

Potentially healthier and nutritious plants can be grown at homes; indoors or at roof top.

Nurseries can propagate seeds and cuttings into healthy, harvestable plants in a fraction of time of traditional methods.

Aeroponics systems can reduce water usage by 98 per cent, fertilizer usage by 60 per cent, and pesticide usage by 100 per cent, all while maximizing crop yields.

Power loss for a small period does not cause any damage to plants.

Conclusion:

Water plays an important role in the world economy. Approximately 70 per cent of the fresh water used by human goes to agriculture. Out of that 45 per cent is wasted due to gaudy irrigation techniques. By using aeroponic systems, we can save 98 per cent of total water because of recirculatory system. Fresh, clean, healthy, efficient and rapid food production can be obtained from aeroponic systems throughout the year. This soilless culture can overcome all the constraints that are present in soil culture production. Enhanced disease-free yield leads India to be at top growers and exporters in near future. Aeroponic system has the potential to produce enhanced vegetative growth without use of any artificial hormones, pesticides or insecticide. Aeroponics is still a good way to learn how to master plant growth and learn about their needs, within a controlled environment. For urban dwellers that live in apartments, sometimes aeroponics is the only practical way to garden. And on arid lands, aeroponics circumvents this problem, and provides the best means of growing plants effective.

Future Prospects:

Soilless cultures consider as a new developed technique for agriculture development but it is not simple technique. However, there is lack of technical background of the new technique among growers and horticulturists in many countries and well trained employs are needed. Moreover, most substrates are internationally markets, so they are expensive. Therefore, it is better to look locally about not expensive good substrates. The growers can adept the soilless systems according to their needs, the place of the system and according to their potential cash. The system in any case need to take strong care and observation for the parameters needed for the good growth of the plants such as nutrient concentrations, light, oxygen around the plants root zone, water quality, pH, disinfection, temperature of the solution and more. Aeroponics helps conserve water, land and nutrients, so the aeroponics system is the way of the future, making cultivation of crops easier.

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Energetics in Agriculture

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Introduction

Agriculture is basically an both energy conservation and energy spending process. It is both producer as well as consumer of energy. The process involves their conversion of solar energy into chemical energy in the biomass by the way of photosynthesis. The upper limit of maximum photosynthesis efficiency of terrestrial plants has been calculated to be of the order of 6% but most of the cereals and oil seeds plants achieve only 0.15 - 0.2%. Modern agriculture practices enhances production of biomass by increasing photosynthetic process through better plants types and use of irrigation water, fertilizer, pesticides and other growth promoting substances. .

There is direct relation between energy consumption and per capital gross national product (GNP). In modern times commercial energy sources such as coal, oil, natural gas and electricity have been the foundation inputs for modernization of agriculture and development of industries. The developing nations have made strides, based on the experience of the developed nations in boosting their agricultural, industrial and national productivity. However, rapid cost escalations around mid-1970s in commercial energy inputs to every sector of economy and living flaying the aspirations. Feasible substitution and supplementation of commercial energy by new and renewable sources have become very important.

Energy in Agriculture

Technically, sources of energy are classified into commercial and non-commercial, and renewable and non-renewable. Commercial sources of energy are direct such as coal, oil, natural gas and electricity and indirect such as chemical fertilizer, plant protection chemicals, machinery etc. Non-commercial energies could also be direct such as human labour, draft animals, vegetative fuels as well as indirect like seeds, organic manures, etc., Coal oil, natural gas and fossil fuels are non-renewable. Whereas solar energy, biomass, wind energy and draft animals are renewable.

Another aspect of energy consumption pattern I agriculture is of its peculiar nature. Agriculture is a seasonal industry where demand of energy flection throughout the year. There are certain months of the year when agriculture demands more energy to meet its requirements to complete crucial operations like sowing, transplanting, harvesting, threshing, etc. in time. No doubt, some resources are surplus, as human resources but it is also rendered unemployed in the lean months, whereas animal resources do not have work throughout the year. However, in the peak periods animals draft power is not enough to cope with the heavy load. These flection's must be taken into consideration while planning the resources to meet energy demands of agriculture fully.

Traditionally, men and animals have been the main source of energy for Indian agriculture for Indian agriculture and still continue to be so in spite of substantial agriculture mechanization. Indian has about 200 million agricultural workers, providing 43,000 TJ of human energy and 80 million draught animals, providing 81,000 TJ of animal energy. For a desirable level of agricultural activity, farm power requirement is considered to be 0.7746 kW/ha. India with limited land mass and increasing human population cannot afford to have more draught animals. Therefore, the desired level of farm energy availability has to be met from electro-mechanical sources.

Energy identification and Energy Equivalents

For clear understanding of energy consumption for different farm operations of crops, the energy identification and accounting are given in a way such that the energy input classified on the basis of source and use as direct and indirect energy. The direct energy is the energy which is released directly from power sources for crop production, while the indirect energy is dissipated during various conversion process like energy consumed indirectly in manufacturing, storage, energy inputs are considered as energy in farm operations except sequestered energy of mechanical power sources and implements. However, for the purpose of computation and analysis, three groups of energy resources are considered viz, physical, chemical and biological energy inputs. The chemical and biological energy inputs are considered as indirect energy inputs, whereas physical energy inputs are considered as both indirect and direct energy inputs.

Energy Inputs in crop Production

Direct energy inputs

The direct energy input is the energy consumption of physical energy resources for physical work during field operations. Field operations consume significant energy in agricultural production, with most of usage being fuel consumption. Physical energy input such as human labour, draft animal and mechanical power sources are considered as direct energy input.

Human labour: Human muscle power is inputs for physical work in field operations activities in crop production. A power equivalent of 74.6 W for human labour was considered appropriate.

Draft Animal: A power equivalent of 746 W for pair of bullocks was considered appropriate.

Mechanical power: Energy consumed during farm operation is affected by many factors, including weather, soil type, depth of tillage etc. Therefore, information on fuel consumption and working hours of mechanical power sources for different farm operations are used for calculation of mechanical energy inputs. These data are gathered from field survey from individual farmer at farm level. In case of farmer using hired machine or no information on fuel consumption, the average and estimated value based on type and size of mechanical power estimated value based on type and size of mechanical power source gathered from the field survey are adopted.

Indirect energy inputs

Physical energy inputs in terms of energy sequester of mechanical power source, chemical and biological energy inputs are considered as indirect energy input. Chemical fertilizers and pesticide are considered as chemical energy input, while seed and hormone are considered as biological energy input. Energy equivalents of these power sources given below.

Physical energy input: Only indirect energy of mechanical power source is being accounted. Energy for manufacturing repair and maintance as well as transportation and distribution of machinery and equipment is considered as energy sequestered or indirect energy input for mechanical power sources. The energy sequestered in manugactureing is energy used in producing the raw materials and energy required in the manufacturing process. The standard unit for energy in manufacturing is MJ/kg of final product.

Chemical energy input: Fertilizer and pesticides are main sources for chemical energy inputs. The total chemical fertilizer input is calculated in terms of N equivalent. The energy equivalent value is 60.0, 11.1 and 6.7 MJ/kg for N, P_2O_5 and K_2O respectively are used for calculation of total fertilizer and energy inputs. Energy equivalent of 120 and 10 MJ/kg for pesticide which may or may not require dilution respectively are used to calculate energy.

Biological energy inputs: Seeds and hormone are include as biological energy inputs.

Conclusion

The direct energy is the energy which is released directly from power sources for crop production, while the indirect energy is dissipated during various conversion process like energy consumed indirectly in manufacturing, storage, energy inputs are considered as energy in farm operations except sequestered energy of mechanical power sources and implements. However, for the purpose of computation and analysis, three groups of energy resources are considered viz, physical, chemical and biological energy inputs. While differentiating renewable and non-renewable energy usage in crop cultivation, it was found that cultivation crop under more usage renewable very effective. Environmental damage caused by GHG emissions and exhaustion of finite natural resources can be mitigated by promotion of renewable energy usage.

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Green Synthesis of Nanoparticles for Application in Agriculture

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INTRODUCTION

Nanotechnology has led to new revolution in every field of science through the incorporation of nanoparticles (NPs). Use of nanoparticles is becoming a promising strategy to enhance plant growth and productivity due to the presence of exceptional properties such as small size, high surface area or volume ratio, high adsorption, large number of reactive sites, high catalytic activity and high chemical stability as compared to bulk ions. These properties make the nanoparticles highly reactive upon their exposure to biological systems. Among the latest line of technological innovations in the field of agriculture, nanotechnology occupies a distinguished position in remodelling agriculture and food production to fulfil the demands in an efficient and cost effective way (Sabir *et al.,* 2020). Plants, which have great potential for detoxification, reduction and accumulation of metals, are promising, fast and economical in removing metal-borne pollutants. Metallic nanoparticles having various morphological characteristics can be produced intracellularly and extracellularly. Synthesis process is initiated by addition of extracts obtained from plant parts such as leaves, roots and fruits into the aqueous solution of metal ions. With the materials present in the plant extract, such as sugar, flavonoid, protein, enzyme, polymer and organic acid acts as a reducing agent and takes charge in bio induction of metal ions into nanoparticles. Exploitation of food and commercial valued plant products for nanoparticles synthesis reduces the overall efficacy of the biosynthetic process because of competition for use as food materials or for other economic purposes. The conventional methods of synthesizing nanoparticles using chemical method were found to be more expensive and also found to involve the use of toxic, hazardous chemicals that were responsible for various biological risks. In order to avoid the use of toxic chemicals, scientists have developed better methods which can be done in two ways. First one is the use of microorganisms such as bacteria, fungi and yeast. Using microorganisms for the synthesis of nanoparticles were found to be more tedious and required more steps in maintaining cell culture, intracellular synthesis with more purification steps. Whereas the second one is with the use of plants known as „Green synthesis" or "Biogenic synthesis". This type of biosynthesis shows better advancement over chemical and physical methods as it is lesser toxic, cost effective, environmental friendly and also involves proteins as capping agents. Proteins are biomolecules and are advantageous by giving low toxic degradable end products (Sandhu *et al.,* 2019).

COMPONENTS OF SYNTHESIS OF NANOPARTICLES

Distinctive natural specialists respond contrastingly with metal particles prompting the arrangement of NPs so the exact instrument for synthesis combination through organic methods shall have to be considered. For the most part, NPs are biosynthesized when the micro-organisms, plant extracts snatch target particles from their condition and afterward transform the metal particles into the NPs through the catalysts produced by the cells itself. It can be characterized into intra-cellular and extra-cellular amalgamation depending upon the area where NPs are framed.

Nanoparticles synthesis by organisms: The synthesis of nanoparticles by green approach is an easy, reasonable and environmentally friendly method involved different types of natural sources like plants, fungi, algae, bacteria and yeast that have potential to produce nanoparticles at extracellular as well as intracellular level. In the biosynthesis of nanoparticles from microorganisms grow in a suitable growth medium. After a proper period of incubation mycelia of fungi wash with sterilized distilled water for 4 to 5 times to remove medium from biomass and transfer in sterilized distilled water and incubated for an appropriate period of incubation. After incubation flask contains fungal mat filter again and supernatant transfer in another sterilized flasks, add metal and incubated for a suitable duration or until the visual colour is changed.

Nanoparticles synthesis by plants: The biosynthesis of nanoparticles by plants is free from toxic compounds and also provides natural capping agents. Different parts of plant viz., leaves, bark, stem, shoots, seeds, roots, twigs, peel, fruit, seedlings, tissue cultures have confirmed the potential for synthesis of nanoparticle. The methanol extract of Emblica officinalis has the possibility to synthesized zinc oxide NPs and also have significant antimicrobial activity against *Bacillus subtilis, Streptococcus pneumonia, Staphylococcus epidermidis, Klebsiella pneumonia, Salmonella typhimurium, Escherichia coli* and fungal pathogens such as *Aspergillus niger* and *Candida albicans.* The information also exists for biosynthesis of gold nanoparticles from plants used in pharmaceutical, separation sciences and biomedical purposes (Irfan et al., 2020). The plant extract of *Emblica officinalis, Terminalia catappa* and *Eucalyptus* hybrids were also examined for the synthesis of silver nanoparticles and observed under UV-Visible spectroscopy, XRD, transmission electron microscopy (TEM), energy diffraction and X-ray to confirm capping over silver nanoparticles.

METHODS OF SYNTHESIS OF NANOPARTICLES

Chemical methods: In the chemical approach, the main components are the metallic precursors, stabilizing agents and reducing agents (inorganic and organic both). Reducing agents such as sodium citrate, ascorbate, sodium borohydride, elemental hydrogen, polyol process, tollens reagent, N,Ndimethylformamide and poly (ethylene glycol)-block copolymers are used.

Physical methods: Physical approach for synthesizing NPs is mainly “top-down” approach in which the material is reduced in size by various physical approaches like ultra-sonication, microwave (MW) irradiation, electrochemical method *etc.* In this approach, a tube heater is utilized at barometrical weight for integrating NPs by evaporation condensation. Evaporation condensation and laser removal are the most essential physical methodologies. The source material inside a pontoon focused at the heater is vaporized into a bearer gas.

Green methods for synthesis of NPs: Traditional methods are used from past many years but researches have proved that the green methods are more effective for the generation of NPs with the advantage of less chances of failure, low cost and ease of characterization. Physical and chemical approaches of synthesizing NPs have posed several stresses on environment due to their toxic metabolites. Plant-based synthesis of NPs is certainly not a troublesome procedure, a metal salt is synthesized with plant extract and the response is completed in minutes to couple of hours at typical 8 room temperature. Generation of NPs from green techniques can be scaled up effortlessly and they are fiscally smart too. In light of their exceptional properties the greenly orchestrated NPs are currently favoured over the traditionally delivered NPs. Use of more chemicals, which are harmful and toxic for human health and environment, could increase the particle reactivity and toxicity and might cause unwanted adverse effects on health because of their lack of assurance and uncertainty of composition. Green methods of synthesis are significantly attractive because of their potential to reduce the toxicity of NPs.

CONCLUSION

Application of nanoparticles significantly promoted the seed germination, grain and dry matter production in cereals. Different concentrations of nanoparticles can be the most effective treatment for the improvement of seed germination and seedling growth in many crops.

FUTURE LINE OF WORK

Exploration at molecular level to understand the mechanism of entry of NPs and their mode of action in invigorating the seeds during priming that would help to increase the yield by improving seed quality.

Thorough research is needed to develop nano composite to supply all essential nutrients through green synthesis.

There is still a need for commercially viable, economic route for large scale production of NPs through green synthesis.

REFERENCES

Sabir S , Muhammad A, Seema H S, Tayyaba B and Farah F, 2020, Effect of green synthesized silver nanoparticles on seed germination and seedling growth in wheat. International Journal of Agronomy and Agricultural Research, 12(4): 1-7.

Sandhu R S, Ravindra P A and Suneel K, 2019, Green synthesis: A novel approach for nanoparticles synthesis. International Journal of Pharmaceutical Sciences and Research, 10(8): 3550- 3562.

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GROW MILKY MUSHROOM FOR MORE PROFIT

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Milky mushroom (*Calocybe indica*) is a tropical edible fungus. In nature, milky mushrooms grow on humus rich soil in agricultural fields or along the roadside in tropical and subtropical parts of India, especially in the plains of Tamil Nadu and in Rajasthan. It can be cultivated at temperature of 30-35°C. Its cultivation is similar to oyster mushroom with a difference that bags are cased and mushrooms appear on the top side only. Its high biological efficiency, better keeping quality, simple cultivation technique and white attractive colour are major factors for its popularity. It is more popular in South India in Tamil Nadu, Karnataka and Andhra Pradesh.

Strains and Nutritive Value

ICAR-DMR Solan has released a variety DMR-Milky 334. The fruit body weight is 33-38 g. The fruit body colour is white with yield around 74-82 kg/100 kg of dry wheat /paddy straw. Another strain of Macrocybe mushroom viz., DMR-Macrocybe-1 has also been released. This species is similar to milky mushroom and method of cultivation is same. This species, however, does not have the off smell and this strain can be stored up to 10 days in refrigerator and 3-4 days at room temperature (20-26ºC).

Milky mushroom is rich in both the essential and non-essential amino acids that make it a perfect source of quality protein. It can be easily preserved for a longer period of time as compared to other mushrooms. The very important property of this mushroom is that it is rich in the anti- oxidant i.e. ergothioneine which helps in replenishing the organs of the body like bone, kidney, liver, etc. It is a rich source of riboflavin and selenium.

Substrate and its Preparation

The mushroom can be grown on a wide range of substrates like straws of paddy, wheat, ragi, maize, bajra, cotton stalks and leaves, sugarcane bagasse, cotton and jute wastes, etc. However, cereal straws (paddy/wheat), which are easily available in abundance, are favoured. Straw is chopped in small pieces (2-4 cm size) and used for cultivation. Substrates do not need to be composted but those exposed to rain or harvested prematurely (i.e. green in colour) are not desirable. Substrate is soaked in fresh water for 8-16 hours. This period can be reduced when pasteurization is to be done by steam. It is easier to soak straw if it is first filled in gunny bag and dipped in water.

Pasteurization/Sterilization

Pasteurization/sterilization can be achieved by any of the following ways.

(a) Hot water treatment

Water is boiled and chopped wet straw filled in gunny bag is submersed in hot water for 40 minutes to achieve pasteurization. This is very popular method particularly with small growers.

(b) Steam pasteurization

Wet straw is filled inside insulated room either in perforated shelves or in wooden trays. Steam is released from a boiler and temperature inside substrate is raised to 65°C and maintained for 5-6 hours. Air inside the room is circulated to achieve uniform temperature in the substrate.

(c) Autoclaving

Substrate is filled in polypropylene bags (35 x 45 cm, holding 2-3 kg wet substrate) and sterilized at 15 psi for 1 hour. Once pasteurization/sterilization is over straw is shifted to spawning room for cooling and spawning.

(d) Chemical sterilization technique

Technique defined for oyster mushroom (straw soaked in solution having 75 ppm bavistin and 500 ppm formalin) can also be used. In South India many farmers are using this technique. However in 5-10% of bags, spawn run may not be complete and Coprinus appears in such cases.

Spawning and Spawn Running

Spawning methods are similar to that mentioned for oyster mushroom. However, layer spawning is most commonly used in milky mushroom. Higher spawn dose of 4-5% (wet wt. basis) is used which is almost double than that we use in oyster mushroom. Normally a bag having 5 kg wet substrate (= 2 kg dry substrate) may require about 200 gram spawn.

Moisture content in the substrate is highly important and it should be around 60%. Higher moisture leads to incomplete spawn run. After spawning bags are shifted to spawn running room and kept in dark where temperature between 25-35°C with 80% RH is maintained. It takes about 20 days for substrate to get colonised and after that bags are ready for casing.

Casing

Casing means covering the top surface of fully colonised bags, with pasteurized casing material. After complete spawn run, the bags are cut open from the top and are cased. The pond soil and sand, or coir pith, FYM and other materials can be used for casing. Casing thickness is 3-4 cm. The pH of casing material is adjusted to 7.8-7.9 with chalk powder.

The casing is sterilized by autoclaving or using chemicals. It is either sterilized in autoclave at 15 psi for one hour or chemically treated with formaldehyde solution (2%) about a week in advance of casing. Temperature of 30-35°C and RH 80-90% are maintained thereafter for entire cropping cycle. When long bags are used, these are cut into two at the time of casing.

Cropping

It takes about 10 days for mycelium to reach to top of the casing layer, thereafter fresh air is introduced and minimum 3-4 air changes per hour are required. The bags are watered regularly as the good moisture and humidity is important. Similarly, diffused light is also important for the initiation and growth of the fruit bodies. Light should be provided for maximum duration during entire cropping period. It is believed that blue light is more useful for induction of pinheads. These changes in environment result in the initiation of fruiting bodies within 3-5 days.

The mushrooms appear on the top of bag just like that in button mushroom within two weeks. Mushrooms are harvested by twisting, cleaned and packed in perforated polythene/ polypropylene bags for marketing. The mushrooms keep on growing but it is advised to harvest these when these are about 10 cm long (Fig 6.2). The bigger mushrooms become fibrous. The mushroom has white colour as indicated by its name and has good keeping quality. The fruit bodies can be easily kept at room temperature for 3-4 days. The mushrooms can be used for making pickles or cooked just like other mushrooms. Due to strong aroma, it is advisable to boil these fruit bodies in water for 10-15 minutes and discard the water before their use in different recipes.

Water Management

Water management is very important for a good and healthy crop. During spawning the water content should be low (around 60-62%) as there are problems in spawn run if water content is high. Also, during rainy season controlled watering is required and watering once in a day may be enough. During winter watering twice may be sufficient.

However during summer as water loss is high, it becomes very difficult to maintain required RH and moisture of the substrate. During such period one should spread sand on floor and use mist sprayer 3-4 times and frequently check the moisture of the casing by touch so as to maintain RH of at least 80-85% inside cropping room. The mushroom is cultivated in huts made of coconut leave or other materials. To maintain high humidity the bags are kept below ground for homogeneous temperature and humidity.

Yield

Yield of 350-400g can be obtained from 250g of dry weight of the straw (providing all the optimum conditions inside the mushroom shed).The cost of production depends upon the cost of raw material, yield/unit, production level and the wholesale price.

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PARTHENIUM COMPOST

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Parthenium utilisation in making compost:

Scientific name of parthenium is *parthenium hysterophorus* which is commonly known as Carrot grass, Congress grass, Chatak chandni etc., It is a threat to farmland, environment, bio- diversity, animals and human beings. In previous days it was only a problem of waste and barren land but now a study reveals that about 35 million hectare of land is infested and is being a big menace in each and every land like crop field, orchards and even in the forest areas.

We attain two uses when we get rid of this weed, the first one is increasing in productivity of land by weeding out and the next is earning money by making compost on commercial way.

Why is there a fear in using this?

The fear is because when the Parthenium biomass is used to make compost, it may result in more germination of this seeds. The confusion arises only when the compost is made out of unscientific ways because in a survey it was found that in a compost made with flowered parthenium plants is creating problems in farmer's field. In a study happened at the Directorate of Weed Science Research at Jabalpur, it is observed that Parthenium compost made out of flowered Parthenium by using methods like NADEP or heap or open pit contained more amount of Parthenium seeds which are viable and also in a research study it is found that 350-500 seeds can germinate from 300 gram compost made by pit or NADEP method. Thus, compost made out of scientific way is safe and does not have any viable seeds.

How to make compost from Parthenium?

Scientists always recommend farmers to collect Parthenium biomass before it attains flowering stage for making compost by open pit or NADEP method but practically it is a tiring process, therefore farmers uproot every stage of Parthenium while weeding in their fields.

Procedure for making Parthenium compost:

Pit size should be 3*6*10 feet (depth*width*length) in a place where water does not stagnate.

Note: Depth should not be compromised but size of the pit can be increased or decreased.

The surface and sidewalls of pit can be covered with stone chips, if possible. By doing this absorption of essential nutrient of compost by the soil can be avoided.

Collect about 100 kg dung, 10 kg urea or rock phosphate, 1.2 Quintals soil and 1 drum of water near the pit.

Collect all the Parthenium plants from nearby area or from own field.

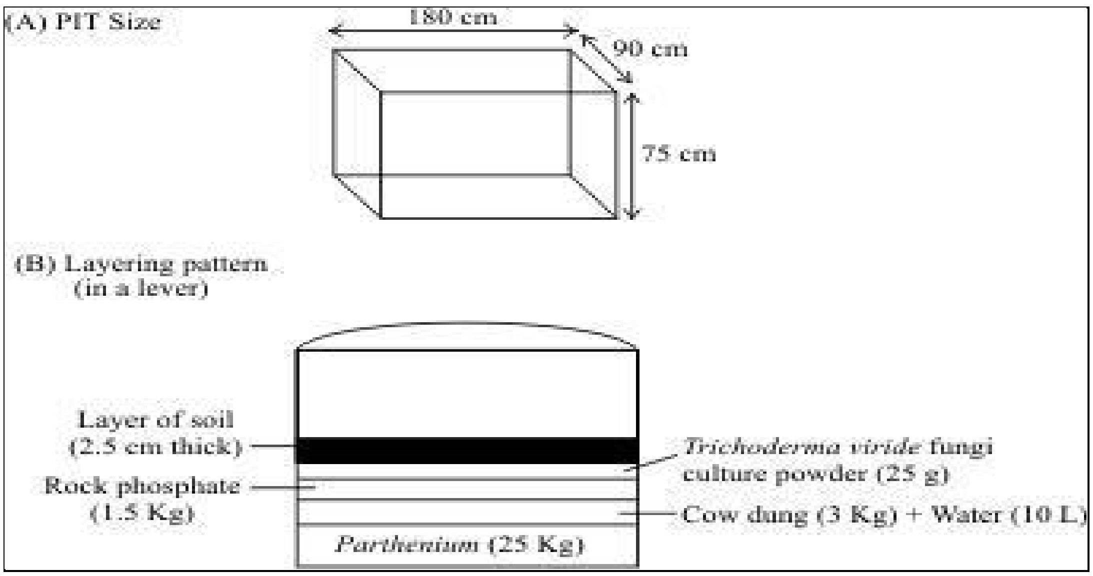
Spread about 50 kg of Parthenium in the pit.

Then sprinkle 500 gm urea or 3 kg rock phosphate.

Add *Trichoderma viride* or *Trichoderma harziana* in the amount of 50 gm/layer.

With the above mentioned components make a layer and continue to make upto 1 feet height from the ground surface.

Fill the pit in dome shape and then while making layers apply pressure by feet to make weed biomass compact.



If soil is not there with the roots of Parthenium that is uprooted then add 1013 kg of loamy soil in each layer.

When pit is full, atlast cover it with mixture of cow dung, soil and husk.

After 4-5 months period, we will get well decomposed Parthenium compost.ie., 37-45% compost from 37-42 Quintals of Parthenium biomass.

Compost sieving:

After compost is taken from pit we may find some Parthenium stem in the mixture. Spread that compost in shady place to dry it.

Then sieve that compost with 2*2 cm size mesh.

For selling point of view, packets of 1,2,3,5 kg for kitchen garden and 25-50 kg for agriculture crops and horticulture crops are made.

The list of nutrient composition:

A comparative study showed that in Parthenium compost the nutrients were double more than that of ordinary compost and almost equal to vermi compost.

Type of Bio-fertilizer	Nutrients (%)				
	N	P	K	Ca	Mg
Parthenium compost	1.05	0.84	1.11	0.9	0.55
Vermi compost	1.61	0.68	1.31	0.65	0.43
FYM	0.45	0.3	0.54	0.59	0.28

Precautions and attentions:

Pit must be in shady and open upland.

Cover pit with mixture of soil, dung and husk.

When you find germination of Parthenium plant near the pit then destroy it immediately.

Check the moisture level from time to time and if it seems dry then make some holes in the pit and pour water and close the holes.

During the process, the temperature rises 60-70 degree Celsius due to which seeds are killed.

In cold regions it may take some more time for compost to get ready.

Benefits:

Parthenium compost is a Bio-fertilizer which has no harmful effects.

Parthenin, a poisonous chemical of Parthenium gets fully degraded during compost making process.

It is a balanced Bio-fertilizer and some essential micro-nutrients are also present in it.

It is an eco-friendly bio-fertilizer made by low-cost inputs.

Amount for use:

During basal dressing in the field, apply 2.5-3.0 tonnes/hectare.

In vegetable or horticulture crops apply 4-5 tonnes/hectare.

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Article Number : 010222-09

Rugose Spiralling Whitefly: A Threat to Coconut Gardens

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Introduction

Coconut, *Cocos nucifera* is an important multipurpose tree grown in India and known as the 'tree of heaven' or 'kalpavriksha' because of its significant role in the religious, cultural, social and economic life of humans. Coconut is grown in an area of 21,73,280 ha with an annual production of 20,308.70 million nuts and productivity of 9345 nuts/ ha in India. In Tamil Nadu, coconut is cultivated in 4,37,570 ha with a productivity of 12,280 nuts/ ha, totally accounting to 5373.21 million nuts (CDB, 2019-2020).

Rugose spiralling whitefly (RSW), *Aleurodicus rugioperculatus*

Coconut tree is infested by several insect pests throughout the year. Among the various coconut pests, sucking pests, more importantly, whiteflies are posing greater threat to coconut yield. Recently, rugose spiralling whitefly (RSW), *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae) was reported rampant in coconut plantations across South India. It was first reported in 2004 in Belize, Central America and later in 2009 at South Florida, United States; Changanassery, Kottayam district of Kerala in 2016; Mangalore and Udupi of Karnataka in 2016 and in Pollachi tract, Coimbatore district, Tamil Nadu, in August 2016 (Srinivasan *et al*., 2016).

Identification Characteristics

Colonies with groups of woolly wax puparia grouped under the leaves of the host plants.

Immature stages are creamy yellow in colour and produce profuse quantity of wax filaments both tufts of fluffy and long crystal like glassy rods.

The whitefly adults are about three times larger than the commonly found whiteflies and have slow movements.

The rugose spiralling whitefly adults can be distinguished by the presence of a pair of irregular light brown bands across the wings

Males have long pincer like structures at the end of their abdomen.

Host Plants

Rugose spiralling whitefly is extensively polyphagous with over 118 hosts from 43 plant groups including numerous economically significant crops. They feeds mainly on coconut, oil palm, areca palm, sugarcane, banana, mango, sapota, papaya, guava, custard apple, citrus, cashew, water apple, jack fruit, mulberry, fig, avocado, brinjal, bhendi, chilli, cucumber, tapioca, maize, sorghum, groundnut, curry leaf, betel vine, nutmeg, Indian almond, neem and many other ornamental plants such as bottle palm, powder puff, Indian shot, false bird of paradise, butterfly palm, hibiscus, croton and weed plants like congress grass, milk weed, Indian acalypha, thumbai, glyricidia, *etc.,*

Banana

Guava

Custard apple

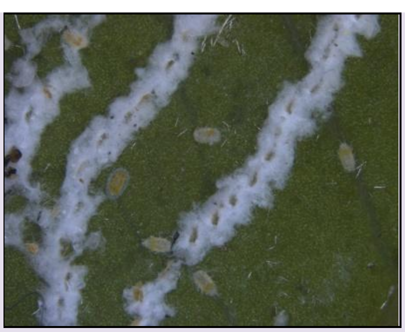
Life cycle

Egg: Females deposit their eggs (225 - 250 eggs) in a concentric circular or spiral arrangement on the undersurface of the leaflets. The eggs are oval in shape and colour ranges from creamy white to dark yellow. Egg period is 6 - 8 days.

Nymph: The first instar nymph being the crawler as hatches out of the egg and searches for a place to start feeding with the needle-like parts of the mouth and sucks the plant sap. The nymphs are light to golden yellow, fully covered with a waxy material. Nymphs range in size from 1.1 to 1.5 mm in length. The nymphs generate a thick, cottony wax as well as long, thin waxy filaments and are light to golden yellow in colour. Nymphal instars are round and flat initially, but as the life cycle progresses, they become more convex. Nymphal period is 17 - 20 days.

Pupa: Pupal colonies are seen on the underside of the leaves of coconut and it is covered with woolly wax. The puparium possess a pair of tiny compound pores on each of the seventh and eighth abdominal segments as well as a rugose/ corrugated operculum, reticulated dorsal cuticle and sharp lingual apex. Pupal period is 8 - 10 days.

Adult: Adults are roughly three times bigger than nymphs, measuring 2.5 mm length and with a pair of uneven light brown stripes across the wings. Females are bigger than males in adulthood. Males have lengthy pincer-like features on the end of their abdomen. Pincers are utilised to defend against predators and also play an essential part in male and female mating. Adult longevity is 20 - 25 days.


Egg

Nymph

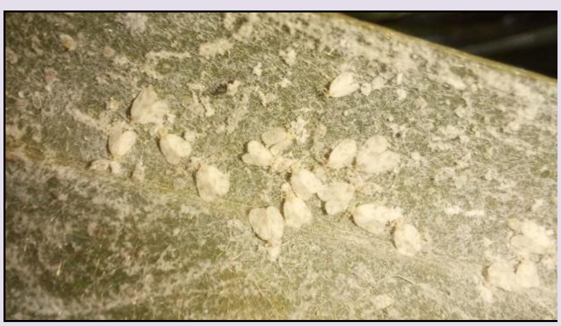
Pupa

Adult female

Adult male

Symptoms of damage

The rugose spiralling whitefly deposit creamy golden eggs in a spiral pattern at the under surface of the leaves. When the nymphs hatch, they begin sucking the plant sap from the underside of the leaves, releasing honeydew that falls on the upper surface of the fronds below them. The fungus *Capnodium* grows on the honeydew, giving it a charcoal black appearance that may be visible from distance (Chandrika *et al*., 2016). This colouration affects photosynthesis and in turn reduction in yield and quality of nuts. Waxy flocculent material produced by adults causing nuisance to human being where heavily infested areas.



RSW on the under surface of coconut leaflets

Sooty mould on coconut fronds

Management

1. Monitoring the movement of adult whiteflies and their intensity of damage
2. Application of water forcibly using sprayers wherever possible
3. Installation of yellow sheets (5' x 1.5') 8 smeared with castor oil at 10 Nos/ acre
4. Encouraging the natural parasitization by stapling coconut leaf bits containing nymphal parasitoid, *Encarsia guadeloupae* under the leaflets (100 Nos/ acre)

5. Release of predators *viz., Chrysoperla zastrowii sillemi* or *Dichochrysa astur* at 400 eggs/ acre by stapling the egg sheets on the undersurface of the coconut leaflets
6. Spraying of neem oil 0.5% if necessary
7. Pesticide holiday should be followed to conserve the natural enemies

Yellow sheet smeared with castor oil

RSW nymphs parasitized by *Encarsia*

***Encarsia guadeloupae* adult**

Chrysoperla zastrowi sillemi

References

CDB (2019-20). Area, Production & Productivity of Coconut in India, Coconut Development Board http:// www.coconutboard.nic.in/stat.html

Srinivasan, T., Saravanan, P. A., Josephrajkumar, A., Rajamanickam, K., Sridharan, S., David, P.M.M., Natarajan, N., & Shoba, N. (2016). Invasion of the rugose spiralling whitefly, *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae) in Pollachi tract of Tamil Nadu, India. *Madras Agric. J., 103*(10-12): 349-353.

Chandrika Mohan, Josephrajkumar, A., Vinayaka Hegde., Krishnakumar, V., Renjith, P. B., Anjali, A. S., & Chowdappa, P. (2016). Gradient outbreak and bio-suppression of spiralling whitefly in coconut gardens in South India. *Indian Coconut Journal*, *59*(8): 9-12.

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Article Number : 010222-10

EFFECTS OF AIR POLLUTION ON PLANTS

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Air Pollution

Plants are at the forefront of air pollution because they are fixed organisms at the basis of the functioning of terrestrial and aquatic ecosystems. The nature and extent of the impact of air pollutants on plants will depend on the physiological and biochemical characteristics of the affected plant, and the properties of the pollutant(s) encountered. According to the nature of the pollutant, various physiological disturbances can be observed on plants, over areas ranging from the local scale to the entire planet. They will immediately affect ecosystem functioning and in particular plant-insect relationships. They can also have effects on human health, as plants are the source of many food chains.

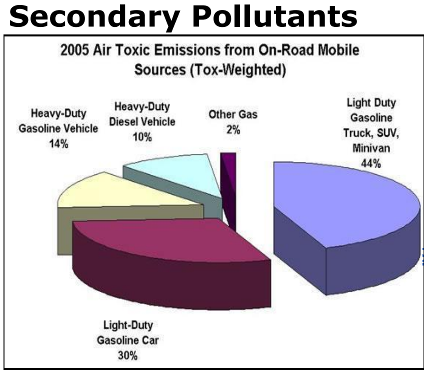
Classification of air pollutants

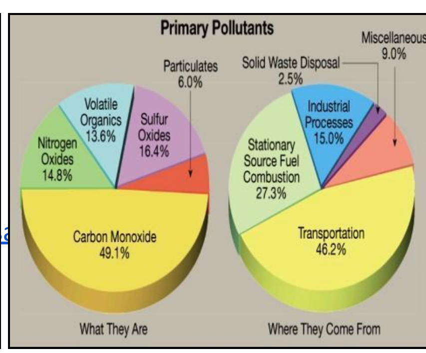
Pollutants can be grouped into two categories:

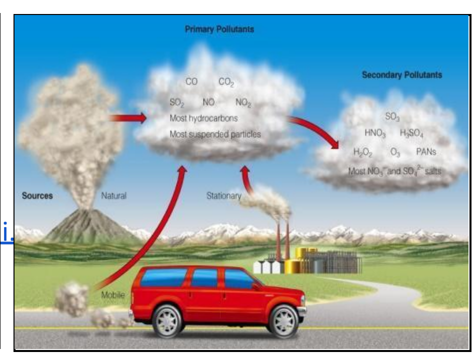
Primary pollutants: Which are emitted directly from identifiable sources

Secondary pollutants: Which are produced in the atmosphere when certain chemical reactions take place among primary pollutants.

Source and classification **Primary Pollutants** **Secondary Pollutants**

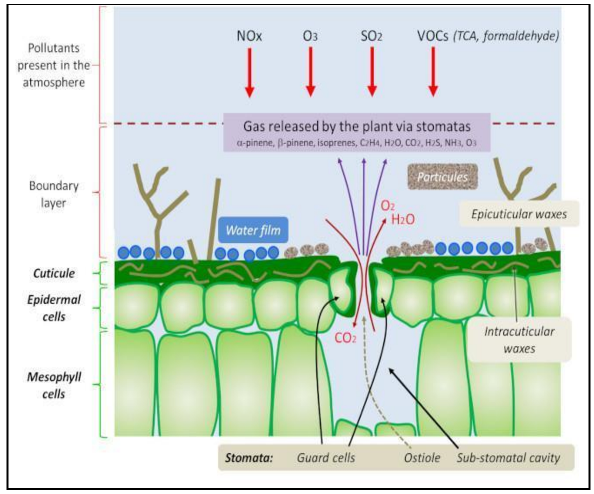






Effects of air pollution on plant

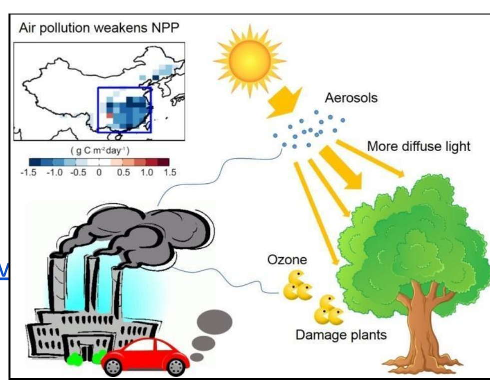
Penetration of pollutants into plants



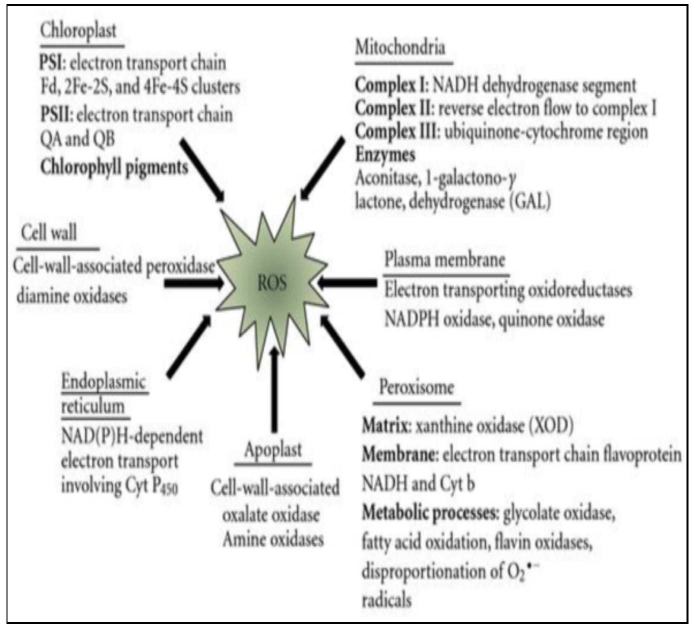
Gaseous air pollutants enter plants through **leaf stomata** while particulate pollutants are captured by the micro-structure of leaf surfaces. The phytotoxicity of air pollutants depends on their chemical nature. Under polluted conditions, plants develop different physiological, morphological and anatomical changes. Pollutants cause damage to cuticular waxes by which then they enter the leaves through stomata. This further leads to injury to plants which can be either acute or chronic.

Air pollution affects photosynthesis

Photosynthesis is the basic physiological event affected in plants exposed to air pollutants. Reduction in leaf area, closure of stomata and the damage to the photosynthetic apparatus limit the photosynthetic capacity of plants. Initially, photosynthesis is directly affected as the cellular metabolic functions of chloroplasts exposed to air pollution have a lowered ability to fix carbon. ... Accumulation of dust on leaves damages chloroplasts and minimizes their overall number within the leaf, so the plant has a lower photosynthetic rate.Respiration also gets affected because of the exposure of plants to air pollutants. The dust decreased the photosynthetic rate by shading the leaf surface. The dust of smaller particles had a greater shading effect. The increase in leaf temperature also increased the transpiration rate.

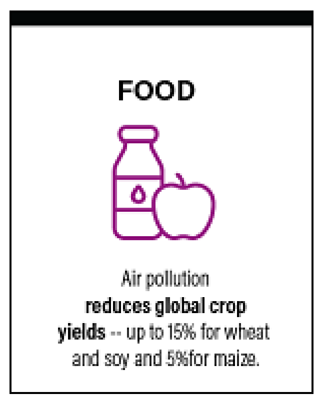


Production of reactive oxygen species in plants



Reactive oxygen species (ROS) are produced as a normal product of plant cellular metabolism. Various environmental stresses lead to excessive production of ROS causing progressive oxidative damage and ultimately cell death. Under normal physiological conditions, cells control ROS levels by balancing the generation of ROS with their elimination by scavenging systems. But under oxidative stress conditions, excessive ROS can damage cellular proteins, lipids and DNA, leading to fatal lesions in the cell that contribute to carcinogenesis.

Impact of air pollution on yield loss



Researchers have long known that man-made climate change will harm yields of important crops, possibly causing problems for the world's food security. But new research shows air pollution does not just harm crops indirectly through climate change; it seems to harm them directly. Pollution from soot and ozone has caused a major decrease of crop yields in India, with some densely populated states experiencing 50% relative yield losses. Air pollution has caused a third of loss in wheat yield and one fifth of loss in rice yield in India. To ensure the world has enough food, we need to look directly at air pollution.

Article Number : 010222-11

Drum seeding of rice - An Improved Technology in Rice Production System

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Introduction

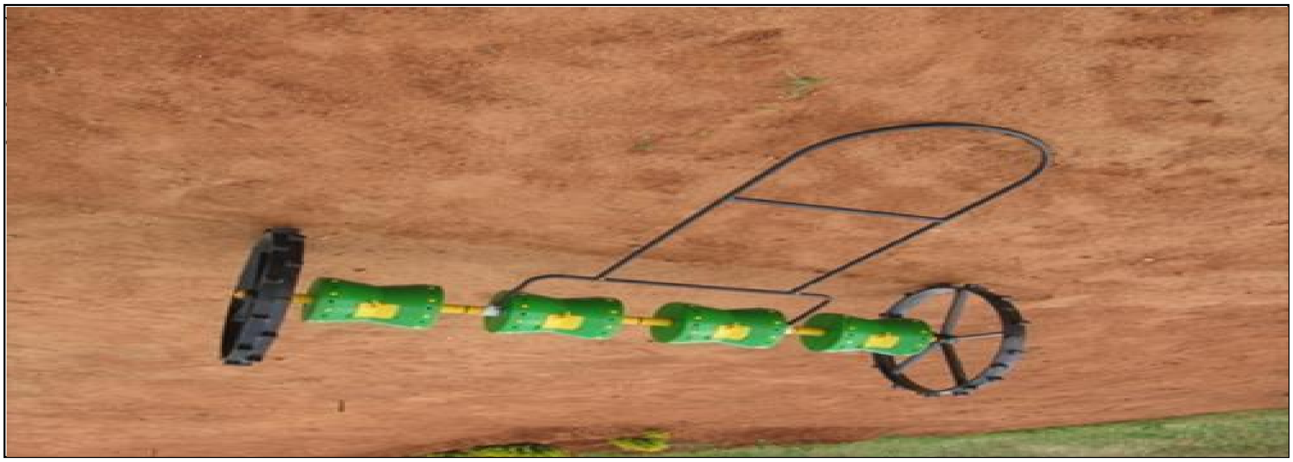
Farmers cultivating transplanted rice in irrigated and rainfed areas are increasingly faced with water shortages due to deficit rainfall, declining groundwater table due to insufficient recharge, late and limited release of irrigation water from canals or poor inflows into tanks. Land preparation for nursery and main field require copious amounts of water and involve labour for nursery raising of seedlings and subsequent transplanting. Water shortage at the Water and labour saving technique of drum seeding of rice is a feasible option to farmers.

What is drum seeding?

Paddy Drum Seeder is **for sowing germinated paddy seed directly in wetland field**. There is no need for transplantation. It is a manually pulled implement. It covers 8 rows of 20cm row-to-row spacing at a time. It is made up of plastic materials.

Working of seed drum :

Drum seeding technique involves direct seeding of pre-germinated paddy seeds in drums made up of fibre material to dispense seeds evenly in lines spaced at 20 cm apart in puddled and levelled fields. About 35 to 40 kg paddy seed/ha is soaked overnight in water and allowed to sprout. The sprouted seed is air-dried in shade briefly (<30 minutes) prior to sowing for easy dispensing through the holes in the drum seeder.Excess water in puddled field is drained out ensuring the soil surface is moist. Drums are filled with sprouted seeds (3/4th full) and pulled across the field maintaining a steady speed for evenly sowing. Number of drums could



for better weed control. Intermittent irrigation is given till the panicle initiation stage.

Advantages of seed drum:

- **Uniformity in seed sowing**
- Reducing thinning cost
- Hill dropping of the seed can be achieved with this improved system of planting.
- Farmers can take up paddy cultivation at any time, right away, as there is no requirement or delay of raising a nursery.
- Better weed control
- Better fertilizer and sunlight distribution

Differences between conventional and direct-seeding with drum seeder methods:

S.No.	Particular	Direct seeding with drum seeder	Normal transplanting
1.	Seed rate	25 to 30 kg/ha	80 to 100 kg/ha
2.	Cost of nursery raising	0	Rs.3500/-

3.	Days to transplantimg	0	25 to 30 days
4.	Labour requirement to planting /seeding (mandays/ha)	2	12
5.	Spacing	22.5X8cm	Zig-Zag
6.	Water management	No standing water after seeding, the field is kept at saturation up to maximum tillering and there after 2- 3 cm standing water till 10 days before harvesting	5 cm or more standing water from the day of transplantation to 10 days before harvesting
7.	Weed management	Application of herbicide is a must once or twice. Oxadiargyl 75g/ha or pyrazosulfuan @ 200 g/ha 3 days after seeding, and if necessary 2.4-D. Sodium salt application at 30-35 days after seeding. Conoweeder is run in one direction only, either E-W or N-S.	Manual weeding twice (or) application of herbicide 1st time and manual weeding 2nd time.

Using a drum seeder to sow pre-germinated seed

1. Puddle the land and level thoroughly.

2. Drain out excess water before sowing, but do not let the soil surface become dry.


3. Pre-germinate the rice seeds - do not let shoots become too long. Growth for 24 h is usually sufficient.

4. Air-dry the sprouted seeds in the shade for about 10-15 minutes before sowing to facilitate singling/separation of seeds.

5. Sow the seeds with drum seeder:

- Do not fill drums more than about 2/3 full.
- Walk at steady speed.

6. Increase the depth of water gradually as the seedlings grow but do not completely submerge seedlings.

7. Do not irrigate for 2-3 days after sowing to allow roots to anchor.

Take care during the wet season as rainfall immediately after seeding may wash away the newly sown seeds.

8. Floodwater can rise as the seedlings grow to give better control of weeds.

Conclusion :

Based on the results of the study, it can be summarized that direct seeding provides more yield than broadcasting and transplanting system. The direct seeder technique can provide definitely more sustainable production in those areas where labour is costly. However, careful water management and proper leveling of the field would be required in the direct seeded crop.

Reference: Abedin M.Z. and Chowdhury M.K. 1982. Procedures for Data collection in Major Field Crops. Extension andResearch project, BARI, Ishurdi, Pabna, Bangladesh. pp. 5-12.

1. Chandrasekhararao, C., Jintendra, S. and Murthy, T.G.K., Resource Optimization in Rice through Direct Seeding by Drum Seeder. Int J.Ag.and Food Sci.Tech., 4:239-46 (2013).
2. Devnani, R.S., Direct seeding options equipments developed and their performance on yield of rice crop. Agricultural Development of FIAT, TRATTORI, Italy (2002).
3. Srivastava, A.P. and Panwar, J.S., Technology for seeding and planting of paddy. Agric. Sci. Progress., 3: 13-14 (1985).

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Article Number : 010222-12

SEED FILM COAT TECHNOLOGY - AN INNOVATIVE APPROACH

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Seed film coating

Seed is the basic input in agriculture. Seed is a fertilized, matured ovule consisting of an embryonic plant together with endosperm (stored food), all surrounded by protective coat (testa and tegmen). Hence a seed with high vigour and germination percentage is very important for improved yield, to meet up the requirements of day-to-day life. In India the cultivation of high yielding varieties has increased food production from 52 million tonnes to more than 200 million tonnes over a period of 50 years. The farmers started showing more interest on safe, environment friendly and scientifically proven practises on seeds which can give seeds high germination and resistance to the pest and disease infections. The innovation of technology where crop protection agents are directly on the seed as a thin film coat layer, more effective due to direct contact with seeds this technology effectively known as seed film coat technology.

Seed coating

Seed coating is a process of applying specific amount of active ingredients dispersed in a liquid polymer, directly on the seed surface without altering the seed structure or shape. The required quantity of polymer is mixed with specific quantity of water, insecticide or fungicide and are fed into rotating drum containing seeds. The polymer required varies according to the crop and also the surface area to be coated. There are three types of seed coating followed;

Seed film coated seeds

Pelleted seeds

a. Polymer coating: Application of precise amount of active ingredients directly on seed surface along with liquid material without altering the shape.
b. Seed coating: Application of precise amount of dye or pigmenting agents to improve its brand identity or marketability. Mainly for identification.
c. Seed pelleting: Enclosing seeds within a small quantity of inert or filler materials to produce standard size to facilitate precision sowing.

Steps involved in seed coating techniques

Seed polymer coating → Polymer + active

Seed coating → ingredients (Fungicide +Insecticide)

Seed pelleting

Natural or synthetic dyes

↓

Polymer coated seed

Adhesives

↓

Coloured seed

↓

Filer materials

↓

Active ingredients

↓

Pelleted seed

Benefits of seed film coating

- Seed enhancement material placed directly on the seed, improving the seed vigour and germination.
- Smaller amount of chemical is used as compared to other techniques like broadcasting or surface dressing.
- It improves the seed performance and provides resistance against mechanical damage in the seed drill.
- Polymers regulates the water uptake and delaying seed germination until there is ambient conditions.
- Enables smooth flow of seeds in precision sowing.
- Reduces chemical residue accumulation in soil, due to accurate application and even dose of chemicals.

Usage of colourants on seed

- Seed as it can be used for consumption and also as agricultural input hence identification of treated seeds are important to prevent accidental consumption.
- Use of colourants are very useful to differentiate the seeds as a marketing strategy to improve seed sale.
- It is unique branding technology.
- Seed enhancement improves planting, seedling establishment and seed flow.
- Coating on seed is done, hence there is uniform distribution of pesticide on seed.
- Colourants are user friendly and environmentally safer technology.

Seed film coating technology innovative approach

There are many advancements in seed coating technology as it became the most effective seed treatment delivery system in the world. A link in broad knowledge in seed technology, seed physiology to the seed protectants and the efficiency of the polymer used for coating is analysed. With the main objective to produce seed of best quality.

The formulations used for seed coating are mixture of polymer and colorant. They are also available as ready to use liquids or as dry dusters. According to the type of coating there are two types;

- Hydrophilic coating: use of starch-based polymer and magnesium carbonate as seed coating, making it suitable for dry soils as ot improves movement of air and water.
- Hydrophobic coating: coating with hydrophobic polymer, it reduces the rate of water uptake and improves the emergence of seed making it suitable for wet soils.

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Article Number : 010222-13

ARTIFICIAL INTELLIGENCE (AI): FUTURE OF INDIAN AGRICULTURE

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AI

Artificial intelligence (**AI**) refers to the simulation of human intelligence in machines that are programmed to perform like humans and imitate their actions. The term may also be applied to any machine that exhibits traits associated with a human mind such as learning and problem-solving aspects.

Need for Artificial Intelligence

According to UN Food and Agricultural Organization (FAO) the global population would reach 9.2 billion by the year of 2050.Global Agriculture sector is under more crisis with 2 billion more mouths to feed within the next 33 years. With existing acreage estimated at just an additional 4%, it seems it is no longer an option to simply plant more crop fields or breed more cattle. for the greater efficiency or precision within current farming methods as farmers will be required to do more with less. So, going for AI to obtain precision or accuracy will be a one of the option.

Overture of AI

AI stimulated, many new logics and method were invented and discovered which makes the process of problem- solving more simple. Such methods are listed below:.

1. Fuzzy logic
2. Artificial neural networks (ANN)

3. Neuro-fuzzy logic

4. Expert systems

The most widely used and constantly applied method for research purposes is ANN. Our human brain is the most composite part of the body. Based on the interlinked neural networks, electric signals traverse through the neurons with the help of axons. Synapses which are at the end of each node passes the signal ahead. ANN method was invented by keeping in mind the same concept of the working of the human brain.

Artificial neural networks (ANN)

ANN is a task- based method which tells the system to operate based on some inbuilt task rather than a conventional computational programmed task. The architecture of ANN consists of three layers: Input layer, Hidden (middle) layer, Output layer

Automated irrigation system

The moisture sensor is buried in the field at required depth. The moisture content in the field gets reduced to lower threshold limit, the signal is produced from the microcontroller to turn ON relay. The relay in turn opens the solenoid valve then water from the source is supplied to the field. Moisture level sensed from the sensor will be displayed in the LCD display. After reaching upper threshold limit, the sensor gives corresponding signal to the microcontroller and the relay is turned OFF and hence the solenoid valve gets closed.

Components

The components are Soil moisture sensor, Microcontroller, Relay, Solenoid valve, Liquid crystal display (LCD), Solar panel, NI-Cd Battery

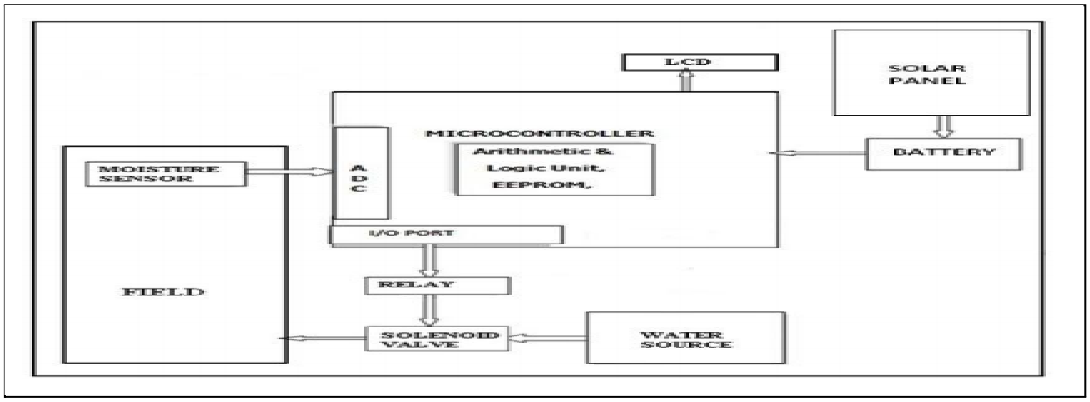

Fig .1 Automated Irrigation system diagrammatic representation

Uses

- Reducing production costs of vegetables, making the industry more competitive and sustainable.
- Maintaining (or increasing) average vegetable yields
- Minimizing environmental impacts caused by excess applied water and subsequent agrichemical leaching.
- Maintaining a desired soil water range in the root zone that is optimal for plant growth.
- Low labor input for irrigation process maintenance
- Substantial water saving compared to irrigation management based on average historical weather conditions.

Crop health monitoring

Hyperspectral imaging and 3D Laser scanning, are capable of rapidly providing enhanced information and plant metrics across thousands of acres with the spatial resolution to delineate individual plots and/or plants and the temporal advantage of tracking changes throughout the growing cycle.

AI for weeding

The Hortibot is about 3-foot-by-3- foot, is self-propelled, and uses global positioning system (GPS). It can identify 25 different kinds of weeds and eliminate them by using its weed- removing attachments. HortiBotis eco-friendly, because it sprays exactly above the weeds .As the machine is light between 200 and 300 kilograms so it will not hurt the soil behind it. It is also cheaper than the tools currently used for weed-elimination as it can work during extended periods of time.

Fig 2. Hortibot- AI used for detecting and eliminating weeds

Software development

The required algorithm is developed in Linux operating system using LTI Library image processing platform. The single leaf image processing technique consists of four stages.

i) Image acquisition and pre-processing,

ii) Edge detection,

iii) Comparison of two images,

iv) Reliability assessment.

AI for harvesting vine crops

Conventional methods are often time consuming and generally categorical in contrast to what can be analyzed through automated digital detection and analysis technologies categorized as remote sensing tools. The trained use of hyperspectral imaging, spectroscopy and/or 3D mapping allows for the substantial increase in the number of scalable physical observables in the field. In effect, the multi sensor collection approach creates a virtual world of phenotype data in which all the crop observables become mathematical values.

Fig 3 Harvesting of vine crops using AI without labour

AI -driver less tractor

Using ever-more sophisticated software coupled with off-the-shelf technology including sensors, radar, and GPS, the system allows an operator working a combine to set the course of a driverless tractor pulling a grain cart, position the cart to receive the grain from the combine, and then send the fully loaded cart to be unloaded.

Fig 4 Driver less tractor using AI

Challenges in AI

Response Time and Accuracy

A major attribute of an intelligent or expert system is its ability to execute tasks accurately within short span of time. Most of the systems fall short either in response time

or accuracy, or even both. A system delay affects a user's selection of task strategy. Strategy selection is hypothesized to be based on a cost function combining two factors:
(1) The effort required to synchronize input system availability,
(2) The accuracy level afforded. People seeking to minimize effort and maximize accuracy, choose among three strategies: automatic performance, pacing, and monitoring.

Big Data Required

The strength of an intelligent agent is also measured on the volume of input data. A real-time AI system needs to monitor an immense volume of data. The system must filter out much of the incoming data. The development of an agricultural expert system requires the combined efforts of specialists from many fields of agriculture, and must be developed with the cooperation of the growers who will use them.

Method of Implementation

The beauty of any expert system lies on its execution methodology. Since it uses big data, the method of looking-up and training should be properly defined for speed and accuracy.

High Data Cost

Most AI systems are internet-based which in turn reduces or restricts their usage, particularly in remote or rural areas. The government can support farmers by designing a web service enabling device with lower tariff to uniquely work with the AI systems for farmers. Also, a form of "how to use" orientation (training and re-training) will really help farmers adapt to the use of AI on the farm.

Flexibility

Flexibility is a strong attribute of any sound AI system. It is perceived that much progress has been made in applying AI techniques to particular isolated tasks, but the important theme at the leading edge of the AI-based robotics technology seems to be the interfacing of the subsystems into an integrated environment. It should also have expansive capabilities to accommodate more user data from the field expert.

Conclusion

- AI can be appropriate and efficacious in Indian agriculture sector as it optimises the resource use and efficiency.
- It solves the scarcity of resources and labour to a large extent. Adoption of AI is quite useful in agriculture.

- Artificial intelligence can be technological revolution and boom in agriculture to feed the increasing human population of world.
- Artificial intelligence will complement and challenge to make right decision by farmers.