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University of Agricultural & Horticultural Sciences Shivamogga

Proceedings of the National Conference on
Post Graduate Research in Farm Universities

(8th & 9th May, 2018)

Directorate of Post Graduate Studies
University of Agricultural & Horticultural Sciences
Shivamogga-577 204, Karnataka Sate


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FOREWORD

Dr. M. K. NAIK
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Revamping of post graduate research in farm universities is basic requirement to meet the emerging needs of agricultural development in the country. PG research in agriculture and allied sciences has to address new challenges being posed in the era of market led agriculture, demands of intellectual property rights, etc. Keeping this in view National conference on 'Post Graduate Research in Farm Universities' was organised at UAHS, Shivamogga on 8th and 9th May, 2018. It was a rewarding experience in which eminent educationists from different states delivered invited lectures. They spoke on some very relevant themes like 'Intellectual Property Rights and Agrienterpreunership' and 'Application of ICTs in Agriculture', Plant Viruses as programmable nano-particles', *etc.* At a time when ICAR has started the process of PG curriculum revision, it is hoped that recommendations of this national conference can be an important input to the national core committee. It is indeed a pride moment that our University encouraged the Ph.D. students to do quality research by holding a competition for best Ph.D. thesis award across farm universities in different states.

It is earnestly hoped that this publication will be of immense help for the teachers as well as PG students who are involved in PG research activities related to Agriculture, Horticulture & Forestry. Heartfelt thanks to Dr. T. S. Vageesh, Dean (PGS) and his team for their sincere efforts in organizing the conference and bringing out this publication.

Date: 10-07-2018 (M. K. NAIK)
Place: Shivamogga VICE CHANCELLOR

PREFACE

Dr. T.S. VAGEESH
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The University of Agricultural and Horticultural Sciences, Shivamogga endeavors to keep pace with new frontiers of science & believes that there is a strong need for reforms in PG Research in Farm Universities to suit the changing demands. In pursuit of this goal a national conference on 'Post Graduate Research in Farm Universities' was organized at UAHS, Shivamogga on 8th and 9th May, 2018'. The conference provided a platform for scientific discussions involving educational experts and PG students on various aspects of higher agricultural education. The presentation of 109 research papers by M.Sc. & Ph.D. students provided an opportunity for them to sharpen their communication skills. Seventeen Ph.D. scholars across farm universities from different states participated in the best Ph.D. thesis award competition. Dr. Ramasamy, Hon'ble Vice Chancellor TNAU inaugurating the National conference suggested for interdisciplinary approach in PG research for solving the need based problems of farmers. The participants witnessed invited lectures by eminent educationists coming from different parts of the country viz., Dr D. Rama Rao (Ex-Director, ICAR-NAARM, Hyderabad), Dr. (Mrs). R .Kalpana Sastry, Tata Institute of Social Sciences, Hyderabad, Dr. M.R.N. Murthy Scientist, Molecular Biophysics Unit, Indian Institute of Science, Bengaluru. Overall the conference was a rewarding experience.

It is my pleasure to place on record the hard work done by all the staff of Directorate of PG studies in organizing the national conference. Special thanks are also due to Dr. S. B. Salimath & Mr. N.D. Punitkumar for their unreserved help in editing and bringing out this publication.

Date:10-07-2018 (T.S. VAGEESH)
Place: Shivamogga Dean (PGS)

CONTENT

Information and Communication Technology Use in Agriculture

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1. Information and Communication Technologies (ICTs)

1.1 Definition

Information and Communication Technologies (ICTs) are an assembly of technologies that can be used to collect, store and share information between people using multiple devices and multiple media. ICTs use information technology devices (such as computers, digital cameras, radio and television) with telecommunication technologies.

World wide, ICTs are gaining prominence in all professions and play a crucial role in development. Better management, which involves higher degrees of information and knowledge, is widely seen as a way to address challenges faced by the country. Information and Communication Technologies (ICTs) are an excellent way to deliver knowledge-intensive management because this management strategy is information-based and dynamic.

The ICTs are potential tools for poverty alleviation, marketing, agricultural technology transfer and sustainable development. ICTs promise bountiful options in providing cost effective access to the latest information on technologies, and thereby play a pivotal role in food security and empowering the citizens to better manage their livelihoods to attain improved socio-economic status and prosperity (Bertolini, 2004; Sandeep Krishna, 2004; Roger Harris & Rajesh Rajora, 2006; Sonam Jakhar, 2015). There is vast scope for trained human resources in ICTs to deliver knowledge-intensive management strategies directly to citizens in villages.

1.2 Indian Scenario

For India, the IT sector is valued at US143 billion in 2015-16 with a Compound Annual Growth Rate (CAGR) of 8.3 per cent on year−on− year basis and contribute 9.5 per cent to Gross Domestic Product (Nawawy and Morshedy, 2017; www.ibef.org).

A number of public and private initiatives like e-Choupal of ITC, Reuters Market Light, Coromandel Gromor webinars, IKSL of IFFCO, mkrishi of TCS, Haryali, agmarknet & iKisan of GoI, Digitalgreen, etc. are providing agri-related services to millions of farmers across the country. Similarly, numbers of startup innovations like Agrihub are providing learning and agribusiness services on commercial basis.

Most of the initiatives are providing information about agriculture, weather, insurance, pest-management, markets, storage, inputs, etc and connect companies, distributors, retailers and farmers along the agri-chains. Impact studies show ICTs provide quick access to information resulting in yield gain 4-5 %, reduction in cultivation cost by 2-14 %, save travel time & transaction costs up to 80%.

Mobile phones have shown remarkable usage by small and illiterate farmers and workforce. In fishermen's study in Kerala, Jensen (2007) reported increase in their profits by 9%, access to new markets, and reduction in price dispersion from 70% to less than 15%, adherence to the law of one price. It also benefited customers by reduction in prices by 4% and about 2% increase in per capita GDP.

2. Information Technologies

The preferred ICT technology, or technology mix, for data communication varies with the particular local requirements, conditions and circumstances. The two important segments of information technology (IT) for data transmission being the backbone and the local loop transmission.

The backbone is the part of the network for long-haul transmission from a central exchange that is usually located in a city to an access distribution node, while the local loop (last mile) transmits information from the distribution node to end users. The back bone constitutes the major investment component. The three most important alternatives for backbones are terrestrial access, satellite access via VSAT (Very Small Aperture Terminals) and microwave systems.

The local-loop, "last mile" transmission to end-users could be either land-line-based local loops or wireless systems. Wireless technologies have several advantages that make them more appropriate for rural areas than fixed-line systems (Purbo, 2004 and Panos, 2006). The main wireless information technologies with potential for rural areas are described below.

2.1 WiFi (Wireless Fidelity)

WiFi technology allows devices to communicate wirelessly (without internet cords) within a fixed location. In todays' world, it is the most popular means of communication as many devices like mobile phones, tablets, laptops and other computing devices are equipped with wireless data cards. It complies with IEEE standard 802.11. WiFi connectivity provides up to 54 Mb/sec. Tests in rural settings show that, given line-of-sight, with the addition of antennas and repeaters, it is possible to get point to point connectivity at distances of up to 20 km.

A number of WiFi devices can be linked together, creating a mesh network or wider networked area.

2.2 WiMAX (Worldwide Interoperability for Microwave Access)

WiMAX complies with IEEE standard 802.16. It is suitable as a cheap replacement for fibre optic backbones because it has a higher bandwidth. It can deliver broadband connectivity from a fixed-base station to thousands of users over a distance of 50 km, without line-of-sight.

2.3 Orthogonal Frequency Division Multiplexing (OFDM)

This emerging technology can transmit large amounts of data, by splitting a radio signal into smaller sub-signals and sending them to the receiver simultaneously on different frequencies. Many believe it will prove one of the best technologies for mobile wireless Internet access, including for voice over internet protocol (VOIP)[1] telephone services.

[1] VOIP has significance from a development point of view because it allows convergence of two services, voice (telephone) services and data transfer via the Internet.

2.4 Fourth Generation (4G) Mobile Telephones

The 1G, 2G and 3G mobile systems (developed from the mid-1980s onwards) provided principally voice telephone services and had low capacity for transmitting data. Today's 4G systems have enough capacity to provide fast data transmission over wide areas and networks, allowing mobile users to access the Internet, email, and other applications.

With data transmission rates capable up to 120 kbit/s, 4G cellular phones could play an important role in traceability applications at farm level, e.g. for scanning or taking a digital photograph of a bar coded label, performing first-level verification and authentication on the spot, and transmitting the label image and basic information about a shipment to an application or receiver further up the chain.

2G/3G systems can be used for SMS applications to meet the requirements of small and medium enterprises (SMEs) for banking services, querying databases holding commodity prices and for performing various other services.

Lower frequencies degrade less with distance, which makes them fundamentally cheaper for low-density areas as there can be fewer cells or more bandwidth for a given distance. A good rule of thumb is to use lower frequencies such as 450 MHz for CDMA450, or 700 MHz for rural connectivity (often stationary endpoints) and higher frequencies for mobility.

2.6 Satellite Radio

Digital direct-to-receiver satellite radio technology was used by World Space Corporation in India. The specially manufactured portable radio receivers could catch audio as well data signals, yet priced as little US$50 or less. These receivers are fitted with data ports which can be connected to a computer via adapter cards for downloading web-based text and images. There is, therefore, the possibility of using satellite radio receivers for exchanging traceability data in the supply chain. While, global negotiations on telecommunications policies and pricing grind on, digital radio can provide many of the services needed for rural development.

2.7 Packet Radio

Packet radio is a form of digital data transmission used in amateur radio to construct wireless computer networks. A packet radio network uses a transceiver, a terminal node controller (TNC), an antenna and a power source as a basic repeater configuration. The radio transceiver used in packet radio is the same as that used in voice communication. Several manufacturers now produce TNCs at prices ranging from approximately US$50 to US$400. The data transfer capabilities of packet radio technology indicate can be used for providing traceability in supply chains.

2.8 End User Access Devices

A key question concerning Internet access in rural areas is in relation to user interfaces that offer the best technical solution at an affordable price. A range of low cost ICT devices and applications are available for users, especially in cases where the full functionality of a PC is not required.

Hand-held smart mobiles, tabs and personal digital assistants (PDAs), represent an intermediate tool with all the portability and added functionality of a computer or laptop without the costs, size, weight and complexity. The main limitation in using them is likely to be bandwidth limitations and costs of mobile communications networks.

Hand-held sets include a touch-screen, icon-driven interface that does away with input devices like a mouse or keyboard. A high level of computer literacy is, therefore, not essential for using such devices. The device can inter-work with PCs and peripherals such as printers and can connect to the Internet through a modem.

2.8 Convergence of Computing and Telecommunications

In simple terms, convergence means ICT devices can be linked to each other to share and exchange information, i.e. convergence of "carriage and content". Thus, the devices such as digital cameras, digital video cameras and players, personal digital assistants, slide projectors and mobile telephones are also compatible with traditional media such as radio (digital, satellite), television (cable, digital, satellite). Conceptually, convergence enhances communication across a broad spectrum of actors and activities which opens up tremendous possibilities empowering consumer to choose, use and control voice data and images delivered through a common device.

3. Development of Learning Organizations

3.1 Knowledge Management

Knowledge is one of the main drivers of prosperity and well-being. Knowledge includes information in any form, know-how and know-why. It involves the way we interact, as individuals and as a community. Knowledge can be embodied in people, as 'human capital', and in technology.
Every organization need to transform into knowledge organizations with a capability to use new information and communication technologies in learning, assimilating and disseminating knowledge as rapidly and efficiently as possible. The universities/institutions would need to adapt this technology not only for formal but also informal and non-formal education, especially in-field professionals. In the process, farmers and common people would also benefit from the Internet (KPMG, 2000).

Information technology (IT) has potential to deliver knowledge-intensive management to the agricultural sector. Knowledge is information put to work; it requires an application. IT can help to facilitate the creation and sharing of knowledge. The basic challenge is to find ways of capturing and sharing knowledge with others who need it.

Intangible knowledge is increasingly important in the evolving market- and knowledge- driven society. Farmers knowledge, practices evolved over time form tacit information need a tool to aggregate them and provide access to farmers. Employing IT to make explicit use of such tacit information is an example of technology enhancement of transaction information fueling the knowledge spiral. This means knowledge creation and use could be a breakthrough of monumental proportions.

The current phase of Smart phone adaptability and available connectivity there are better chances to deliver knowledge to agriculture professionals, students and enthusiasts. There is a significant growth in mobile learning in past few years and it is likely to grow rapidly. Learners will use mobile apps, videos for formal and informal learning to improve and master various skills. Currently, many soft skill trainings, professional skill development trainings are moving to mobile learning. BSNL has set up a world class multi-gigabit, multi-protocol convergent IP infrastructure that provides convergent services like voice, data & video through the same Backbone & Broadband Access Network. Similar efforts are being made by other telecom companies like Airtel, Reliance Jio, etc. As per TRAI subscriber data, total number of broadband subscribers (by the end of March 2017) is

276.52 million; comprising of 93.4 per cent wireless (mostly mobile) and the remaining 6.6 per cent wired subscribers (https://telecomtalk.info/total-broadband-subscribers-in-india-reaches-276-52-million-trai/163842/).

With improvement in ICT infrastructure and human resource development, the agri-professionals will be at the forefront of delivering knowledge-intensive management skills directly to a variety of end users through e-learning and m-learning.

E-learning, uses network technologies to create, foster, deliver, and facilitate learning, any time, anywhere through almost any device. For example, e-mail, e-mail newsletters, discussion groups, chat, instant messaging, and internet broadcasts can be used for communication (White, 2001), while hyperlinked web pages, downloadable documents, multimedia, interactive forms, and simulations are used to engage and involve learners with content. A Multi-sectoral partnership works well to proceed and manage e-learning process.

3.2 Electronic Journals

Electronic journals are expensive and there are serious connectivity problems in workplaces. But the global changes in information exchange demand e-journals as an important and unavoidable component of research and education. There are some isolated instances of overcoming cost and technology barriers in some parts of developing world.

Considering its strategic importance in agri-knowledge, ICAR has been providing access to electronic journals to NARS personnel through CERA. Further, it is supporting a variety of digital repositories and data bases like e-granth, krishikosh, etc.
(http://www.icar.org.in/content/consortium-e-resources-agriculture-cera)

3.3 Social Media

Young farmers began using social media on a personal basis to tell their farm's story, give updates during the harvest season, promote upcoming farmers markets, answering consumer questions and many more.

3.4 ICTs in Governance

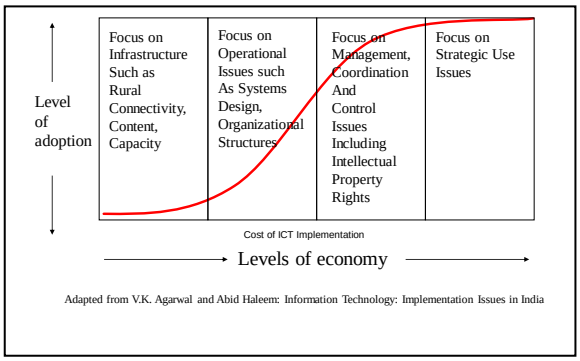
Development projects like Soil health card, Crop insurance, Farm mechanization, Land records, agri-marketing (e-NAM), Food security mission, Horticulture mission, etc. are being implemented through respective scheme specific ICT portals.

3.5 Growth of ICTs in NARS

Experience gained in Asia, Africa, and Latin America indicates that a bottom-up, participatory approach to using ICTs is most fruitful for sustainable development. The community use of information for learning helps bridge the communication gap for information sharing and exchange between developers and users of research.

The experiences indicate four phases in increasing the effectiveness of ICTs use in the research.

i. Innovations in building the infrastructure,
ii. Operationalizing information systems using ICT,
iii. The coordination and control mechanisms of these systems, and
iv. The ability to use information strategically for strengthening research to benefit the stakeholders.



In India, agri-research system, is now in the fourth stage of ICTs use for development and agri-business. Simultaneous to globalization, it must be realized that information and knowledge are also available globally. For example, scientists in tropical horticulture would benefit not only from sharing information rapidly and more efficiently within their own national agricultural systems but also across other national and international organizations and individuals where the crops are grown, held in transit or marketed. This would open avenues for international cooperation in research and development at a scale not witnessed yet.

4. Agribusiness Opportunities

Agriculture start-ups is an emerging area, which can unleash umpteen opportunities for start-ups and strengthen the supply chain in India agriculture. A number of government of India schemes from different ministries, non-governmental organisations, trusts, international agencies, corporates (through their corporate social responsibility) and angel funders are providing a new channel for promotion of innovations in agribusiness (Shalendra et al, 2011). The major entry points are in agriculture development, farming, value addition, marketing, logistics, skill development and knowledge sharing through education & training.

Govt. of India introduced a new programme called AGRI-UDAAN with an aim to boost innovation and entrepreneurship in agriculture to mentor start-ups and to enable them to connect with potential investors. (https://www.ibef.org/industry/agriculture-india.aspx).

4.1 IT in Breeding

The use of biotechnology to isolate specific desired traits in crops is akin to techniques used in the pharmaceutical industry. A combinatorial approach is used to identify novel genes for traits, such as insect resistance, herbicide tolerance, and drought tolerance. This information is then coupled to large-scale trials for determining the most viable candidates. The process generates many terabytes of data each day that must be sifted through, correlated, and used in a decision-making process to cull less effective options. IT is a crucial enabler for turning these data into useful product-development decisions.

(https://www.nae.edu/Publications/Bridge/52548/52555.aspx).

4.2 Farm Mechanization

The ICT-integrated systems started on machines (tractors, combines, etc.) but are rapidly spreading to the entire agricultural production chain. Machine-to-machine communication and machine-to-field communication have become current practice. The future farm-site will be automated and information rich with agricultural mechanization systems acting as both information gatherers and physical implements. This level of information would influence the production value chain – at pre- and post-harvest stages.

4.3 Precision Farming

Usually Precision farming is described as a farm management system based on various information and other technological tools. Using precision farming, farmers can manage their crop and field conditions like fertigation, moisture, pest control, etc. Precision farming involves integrated use of three technologies, namely, geographic positioning system (GPS), remote sensing and integrated communication system. As an extension, present trend focusses on developing and using sensors and integrating the same with robots for achieving high efficiency and precision in farming. The same is further expanded to the concepts like IoT (Internet of Things) where the objects can be connected and controlled remotely.

Geographic positioning system: Soil type and its conditions are analysed and assigned to a particular location on geo-map. With the help of navigation and positioning capabilities offered by GPS, farm equipment can perform various tasks on the field.

Remote sensing: Sensors are mounted on stationary or moving machines (like tractors or drones) to capture crop and its ambience conditions (temperature, humidity, moisture, etc).

Integrated Communication System: Various farm equipment and mobile devices are inter connected, enabling data capture and its transmission for storage and analysis for action.

Utilizing ICT-based innovations, various startups are trying to provide agribusiness solutions to improve crop production, soil conditions, market linkage, integration of farmers to supply chains, etc. Some potential innovations that are employing precision farming technologies are illustrated under agri-tech startups, separately.

A number of research labs in Agricultural Universities, ICAR institutes, IITs and international institutions like ICRISAT, IFPRI are developing ICT-based solutions to farming. Their primary focus is on land use planning, natural resources management and farm advisory. For example, the Picture-Based Insurance project of IFPRI provides an innovative way of predicting weather-related crop yield losses by combining crop growth modelling, satellite and smartphone imagery of crop growth status, and high-resolution gridded estimates of spatial weather variability. It relies on using visible crop characteristics derived from farmers' own smartphone pictures (https://www.ifpri.org/project/PBInsurance).

4.4 Value Chains

Information is used to track and trace food in a supply chain. The benefits accrue when the "physical" world meets the "digital" world. Usage of ICT will definitely have a great impact on agricultural business productivity and efficiency throughout the value chain.

4.5 Skilling

Out of about 230 million people engaged in agriculture, about 173 million are to be skilled by 2022. This includes about one million vocational trained youth at secondary school and diploma level. GoI envisages providing variety of skill development avenues through formal and informal education and training to develop rural youth so as to move the skilled : unskilled mix from 65: 35 (in 2013) to 80 : 20 by 2022 (www.skilldevelopment.gov.in).

4.6 Start-ups

Startups in agriculture sector are a recent entrants in to the rapidly growing innovation led business space. A number of startup initiatives are piloting innovative models connecting famers to markets. In 2017, Indian agritech startups raised about $36 Mn (https://inc42.com/features/watchlist-agritech-startups-2018/). They are evolving fast and making farming a profession of opportunity. Some potential startups are illustrated below.

- Aarav Unmanned systems (www.aus.co.in) , Incubated at IIT Kanpur and Aibono (www.aibono.com) founded by IIT Madras graduate are two such pilots. They offer farm management-as-a-service. They use precision agriculture technology with unmanned aerial vehicle (drones) providing solutions to optimise irrigation, fertilisation, pesticide distribution and crop failure warnings.
- Crofarm (crofarm.com) is an F2B (Farm to Business) venture, which has over 10,000 farmers networked to its retail business partners such as Reliance Retail, Grofers, Big Basket, Jubilant Food works, Big Bazar and Metro Foods. The company procures products from farmers and built a digitised agri-supply chain for fruits and vegetables that is efficient and has zero wastage.
- Crop In (www.cropin.com) integrates the agricultural sector with ICT through a network of ERP (Enterprise Resource Planning) and BI (Business Intelligence) in 12 countries including India. Crop In offers information on a cloud-based platform. Its Android mobile app, Smart Farms, allows large food companies to track the growth of crops on farms around the country with details about what the crop is and the conditions it is grown in to help companies remotely monitor farms, interact with farmers and make every crop transparent and traceable. It also aids farmers in adopting global agricultural practices and improves productivity by offering productivity insights and harvest forecasts. The startup digitised about 2.1 Mn acres of land. It captures real-time data throughout the growing season. It employs big data analytics, artificial intelligence, geo-tagging & satellite monitoring and provide solutions to improve financial, operational, and agronomy aspects.
- Intello Labs `DIGITAL AGRI' (www.intellolabs.com/digital-agriculture/) product employing artificial intelligence and deep learning on crop quality parameters like crop infestation, nutrient deficiency harvest quality evaluation of fruits, vegetables, grains and other crops and farm to fork commodities to grade agricultural commodities. The startup use satellite and drone images for yield estimation, and water requirements. Besides, it can provide precise quality insights from the images obtained by farmers and others. It is recognized as one of the India's most innovative and top 50 emerging software product by NASSCOM.
- Gold Farm and EM3 Agri Services (www.em3agri.com) are in farm mechanization services, on pay per use logic. They partner with local entrepreneurs, who invest in tractors and other agricultural machinery, in turn, renting out at the village level on an hourly basis. Gold Farm

aggregator platform has a user base of 25,000 farmers in Karnataka and Andhra Pradesh. EM3 Agri has serviced more than 8,000 farms across central India.

- Ninjacart (ninjacart.in) and Waycool (waycool.in) from Bangalore and Farm Link from Bombay (farmlink.in) are end-to-end B2B marketing startups in perishable produce value chains. They link farmers to organized retail business cutting out the middlemen from the supply chain. They have a cost-efficient, reliable and scalable supply chain model. Waycool serves over 20,000 farmers. Ninjacraft operation in Bengaluru is capable of handling 300+ tonnes a day with over 2,000 farmers to sell more than 80 vegetables and fruits every day to 800+ retailers and restaurants with less than 4% wastage in the entire supply chain. Farm Link procure supplies from more than 700 farmers from Maharashtra, Karnataka and Telangana.
- Gramco Infra tech Pvt Ltd (www.gramco.in), a Indore-based startup, operates in leasing full service agri-infrastructure and extension services to the farmers. The infrastructure it provides spans across inputs, warehousing, collateral finance and contract farming/seed production, fully automated handling/cleaning/grading and procurement of agri-commodities by creating market links for farmers. It has been offering value-added services to more than 3,000 farmers every season in Madhya Pradesh.
- Tessol (https://www.tessol.in), an agri startup from IIT-Delhi alumnus, provides fuel-free cold storage and transportation technology that eliminates the use of fossil fuels. Tessol customised 200 cold chain vehicles for bakeries, fruit and vegetable vendors, dairy and ice cream manufacturers and e-commerce, food processing, poultry and seafood companies in India and Other countries.
- Eruvaka Technologies (https://www.eruvaka.com) by an organisation based in Vijayawada in Andhra Pradesh, helps farmers monitor and control water health in aquaculture ponds. Its solar-powered flouting buoys measure different water parameters, such as oxygen levels, temperature and pH range, crucial for the growth and survival of fish and shrimp. The collected information is uploaded on the cloud and transmitted to individual customers through an Android app, SMS, voice call or the internet. Farmers can also remotely control automated equipment such as aerators and feeders.
- Skymet (https://www.skymetweather.com) is India’s largest weather monitoring and agri-risk solutions startup company. It offers services such as weather forecast, crop insurance and agri-risk management. It processes raw weather data using cutting edge methods and software to cater to the specific needs of farmers in micro-geographies. It can provide predictions at the village level for any crop. Farmers and agribusiness companies access this information through mobile platforms.
- Ekgaon Technologies (https://www.ekgaon.com), a Gujarat-based IT network integrator. It has mobile phone enabled services delivery in Hindi, Gujarati and Tamil languages. Its platform uses voice recognition, interactive voice response system (IVRS) and web technologies to provide information on weather, commodity market prices, soil nutrient management and crop management. It provides information on microfinance institutions and banks for delivery of door-step services such as credit, savings, remittance, insurance, investment and mortgage.
- AgroStar (https://www.agrostar.in) is a Pune-based ‘direct to farmer’ m-commerce platform. It strives to provide quality agro inputs such as seeds, crop nutrition, crop protection and agri-hardware products by simply giving a missed call on the company’s 1800 number or through their mobile app at the farmers’ doorstep.
- Farm2Kitchen (www.farm2kitchen.com) is one of India's oldest online business dealing in organic foods. It offers only certified organic foods and lifestyle products. Certification helps assure quality, prevent fraud, and promote commerce. It delivers food in more than 250 cities across the country. They work closely with organic farmers.

- Ecofrost provides micro cold storage developed by Ecozen Solutions (http://www.ecozensolutions.com). It is the first on-farm solar-powered cold storage. It delivers small scale to community level solar powered products for irrigation, cold storage, etc.
- Driptech (www.driptech.com) is an international water technologies company founded in Silicon Valley and currently based in Pune, India. Driptech produces affordable, high-quality irrigation systems designed for small-plot farmers. Business Week featured Driptech as one of the top five most promising social enterprises of 2010, and as one of the 25 most intriguing new startups of 2009.
- Stellapps Technologies Private Limited (www.stellapps.com) is incubated by IIT Madras. It is India's first dairy technology solutions company, building automation tools integrated with cloud, mobility, and data analytics for dairy farms, cooperatives, and private dairies. As an end-to-end solution initiative Stellapps provides dairy farm optimization and monitoring services with special focus on small and medium herd size farm. Its farm herd management system (Smart Farms) helps farms to record animal performance, health, breeding and health care. http://www.stellapps.com/
- Kisan Raja is a venture by Vinfinet Technologies (http://www.kisanraja.com). It provides a 'GSM based controller', which allows farmers to control the agricultural motor using his mobile or landline. The product operation using IVRS, and send messages back to farmer on the state of motor operation ensuring safety of motor pumps set and smart controller.
- Khethinext, a product of M/s PALS AGRI eCONNECT Private Limited, enables digital agriculture transformation. This platform supports small farm holding farmers to reduce their cultivation costs, connect with financial institutions and to improve their crop productivity through virtually connecting with rest of the agriculture ecosystem. Currently around 65,000 farmers are deriving benefits from the services of KHETHINEXT platform (http://khethinext.com).
- e-Krishak Sahyogi firm helps farmers to exchange information on real time basis. This is an applet on tab offering gateway to solution of farm-specific queries of small farmers). Farmers can learn cropping techniques with modern technologies using high definition 3-D animation videos or multimedia slideshow videos. They can access timely information in the audio, picture and text format. Besides, farmers can also do live conferencing with experts and can watch live auctioning of vegetables in mandis by using tablets with data access through 3G technologies. It is working with 5000 vegetable growers as pilot with the help of ISAP in Rajasthan (http://www.isapindia.org).

5. Issues in Use of ICTs

As IT being new and still emerging, there are continuous changes in the technology, products and services. For non-IT organisations, this dynamism poses many issues and challenges. A number of significant issues and barriers in use of IT include:

Access

The issue of access has two dimensions. The first, and most basic is physical access to computers, telephones and internet. In many institutions the IT systems are not accessible to all and internet access and other technology resources are spread unequally. A major second dimension to this issue of access is analytical skills, i.e. ability to find and evaluate information and then use it effectively to influence decisions and behaviors.

Information quality and reliability

There are concerns about the quality and reliability of information that can be accessed online such as databases, advisories, content, and the like. The system lacks professionalism and hence the content is not properly peer reviewed. There are multiple ways for data to be corrupted: through incorrect initial entry, problems with hardware and software, and malicious tampering. Most efforts are personal and not institutionalized. The increased public availability of unfiltered information also can complicate scientists relationships with farmers and peer group. In absence of reliable information from the public system, farmers may come armed with incorrect information and cockeyed ideas they picked up in obscure web sites.

IP concerns

Information technology products and services attract intellectual property (IP). India is one of the first few countries to enact the IT law in 2000. Software is protected as copyright and IP infringements of software and information content are big concern. In certain cases law permits IP protected items use for academic and research purposes without any commercial intent.

Data published or unpublished can be placed on web for dissemination. Such information gets copyright protected automatically. As most institutions use services of private sector in development and maintenance of information systems, it is important to understand the contract law together with cyber law to safe guard their intellectual property.

Compatibility/standardization

Compatibility among both hardware and software, and to the need for common standards across the system are of significant concern. There are no centralized efforts and hence one sees a very diverse and decentralized efforts marked as solutions to local problems.

Digital information

As technology, rate of creation of knowledge and information is rapid. Institutions and libraries, therefore, must take advantage of the opportunities offered by IT in providing access to online information. Facilitators need to be careful on who are accessing and the type of use in view of prevailing copyright law.

Broadcast

Like all literary works, broadcasts are protected under copyright act, but the issue of copyright has not surfaced so far. In the past, a service provider (of broadcast channels or internet services) is regarded as conventional publisher and hence responsible for users acts. The new digital millennium copyright act provides safe 18arbor to service providers due to infringements from users. As many public R&D institutions provide content for broadcast, they need to be aware of this.

Training

The changes in IT are at fast pace. As agri-organizations can not have the full benefit of IT expertise, periodic trainings in this area is the only alternative. Every institution must have a comprehensive training and development plan, with focus on IT.

7. *End note*

ICTs are defined as all available technical facilities and all available knowledge and skills that allow the organization to use these facilities for executing business activities, chain processes and communication. Globally ICTs such as data communications, value added applications, broad brand services, e-services and wide range of content applications are viewed as key to economic prosperity. Institutions that identify and adapt to future trends will achieve the most success.

This new technology greatly facilitates the acquisition and absorption of knowledge, offering developing countries unprecedented opportunities to enhance educational and research systems, improve policy formation and execution. Within a few years the Internet is going to pervade all activities of life and dominate communication among people and ICT devices. Further, there is a convergence of telephony, TV and digital communications. People are now able to choose and customize their information needs. Universities and research institutions need to adapt to the emerging changes in ICTs to become relevant so as to provide efficient and effective services.

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Sesbania Mosaic Virus like Particles (VLPs) as Nano carriers for Medical Applications

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Viruses are minute marvels of nature and represent the most elegant and symmetric molecular assemblies of proteins. The molecular framework of viruses is simple yet elegant and constitutes of a small genome which is protected by a mostly proteinaceous shell or capsid. Viruses infect hosts in all domains of life including bacteria, archaea, fungi and eukaryotes like plants and animals. Viruses have served as model systems for studies on a variety of cellular processes. The genomic material, which could be ss RNA, ds RNA, ss DNA or ds DNA. With ssRNA viruses, the genome could be positive or negative sense or ambisense meaning that part of the chain is of sense positive while the other part is negative sense. The capsid architecture of viruses, which could be helical, icosahedral, complex combination of helical and icosahedral structures, naked or enveloped, is as diverse as their genomic organization and host range. The construction principles of viral capsids have become the hallmarks of biological assembly.

The first X-ray photographs of tomato bushy stunt virus (TBSV) crystals provided evidence for the presence of multiple protein subunits organized with symmetry. It was observed that the subunits were probably present in multiples of sixty. Further investigations revealed that the particles confirmed to icosahedral 532 symmetry (Fig 1). It was realized that the small genome of viruses could encode for only a few and relatively small proteins. Therefore, it was apparent that most viruses protect their genome by encapsidating it in a protein shell made of multiple copies of identical smaller protein subunits. These shells are on the viral exterior and surround the core which is largely made up of nucleic acids. It was also suggested that the coat protein (CP) subunits should organize symmetrically with identical packing environment in order to achieve energetically stable arrangements. Initial structural studies on TBSV, turnip yellow mosaic virus (TYMV) and polio virus suggested that all these unrelated viruses had the shape of a regular icosahedron. Icosahedral arrangement also ensured the largest internal volume for a given size of protein subunit among all the closed geometrical objects. Strict icosahedral symmetry allows only 60 asymmetrical protein subunits to be present in the capsid. In such a capsid, all protein subunits are in an identical environment or in other words the subunits are held by identical sets on interactions.

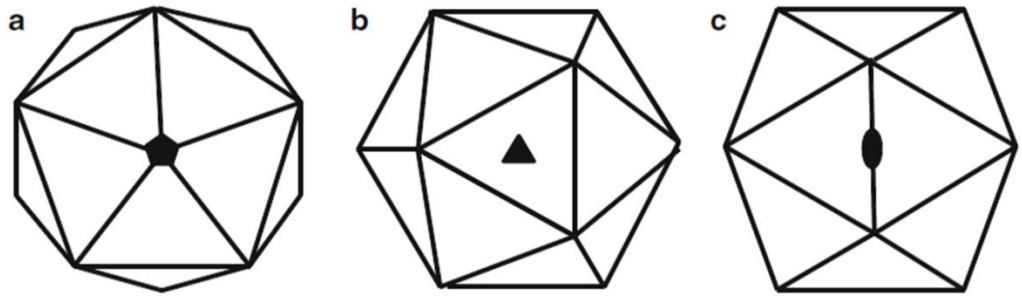

Figure 1. A schematic of an icosahedrally symmetric closed object. (a) five-fold, (b) three-fold and (c) two-fold axes. In a typical icosahedron there are 12 five-fold (passing through 12 vertices), 20 three-fold (passing through 20 triangular faces) and 30 two-fold (passing through 30 edges) axes.

Advances in electron microscopy provided detailed images of several viral capsids. It became apparent that the number of subunits that assemble to form the icosahedral shell of viruses was seldom sixty. Theoretical calculations also suggested that the icosahedral shells made up of only sixty protein subunits with an average molecular weight of 20 kDa would have a diameter of around 15-20 nm, the dimensions known for the smallest viruses and insufficient inner volume to accommodate the genomes of most viruses. Most commonly studied viruses were found to have diameters of around 28-30 nm. Based on these observations it was suggested that all coat protein (CP) protomers need not be present in an identical environment and a theory of quasi-equivalence was proposed for the architecture of icosahedral viruses. According to this theory, the protein subunits can be present in environments which permit equivalent (but not identical) bonding patterns with their neighbours. Self-assembly of protein subunits with quasi-equivalence results in the formation of icosahedral particles having subunits in multiples of sixty. The architecture can be described with the so called triangulation number (T) defined as $T=h^2 + hk + k^2$, where h and k are positive integers including zero. The icosahedron thus formed will have 60 (T) subunits. T=1 particles (h=1, k=0) have an architecture of a typical icosahedron consisting of 12 pentamers. Most commonly observed viruses are T=3 (h=1, k=1) and are made up of 180 subunits constituted by 12 pentamers and 20 hexamers. All the quasi-equivalent icosahedra described by permissible triangulation numbers consists of only 12 vertices, occupied by 12 pentamers, the remaining subunits 60 (T-1) forming hexamers in order to preserve the quasi-equivalent bonding environment with neighbours (Fig 2)

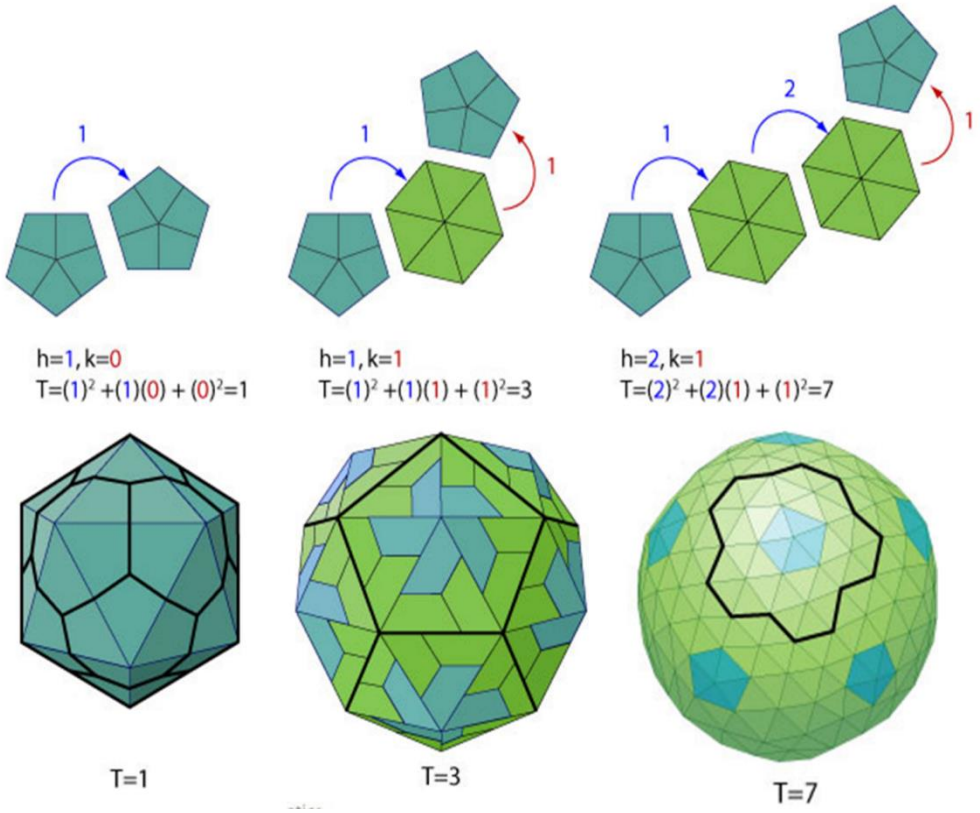

Figure 2. Architecture of T=1, T=3 and T=7 icosahedral capsids. Arrangement of pentamers and hexamers are shown in the top panel leading to the generation of T=1, T=3 and T=7 particles respectively. (Figure adopted from http://viralzone.expasy.org, SIB *Swiss Institute of Bioinformatics.* The figure is available under creative commons license.

Sesbania mosaic virus (SeMV) was isolated from farmer's field near Tirupati, Andhra Pradesh. It belongs to the sebamo virus genus. Sobemo virus is a floating genus, unassigned to any family and includes plant viruses with ssRNA genomes. The genome is around 4 Kb in size and acts directly as a mRNA inside the host cell. The genome is encapsidated in a non-enveloped T=3 icosahedral shell. A single copy of genomic RNA is encapsidated by the viral particle. Sobemo virus capsids have a sedimentation coefficient of 110-120 S and migrate as a single band in CsCl density gradient centrifugation. Sobemo viruses infect monocotyledonous or dicotyledonous plants and each virus species exhibits a comparatively narrow natural host range. These are easily transmitted through mechanical inoculation. Transmission through leaf-feeding beetles is also well established. Sobemo viruses such as *Rice yellow mottle virus* (RYMV) and *Papaya lethal yellowing virus* (PLYV) are important plant pathogens and lead to severe crop loss every year.

The three-dimensional X-ray crystal structure of SeMV has been determined at 3 Å resolution. Native particles consist of 180 copies of coat protein organized on a T=3 icosahedral lattice. These T=3 particles consists of 12 pentamers and 20 hexamers (Fig 3 a and b). Each subunit consists of two domains, the R domain (N-terminal 73 amino acids) and the shell domain (S-domain). The S domain

has a “jellyroll sandwich fold” consisting of eight antiparallel β- strands connected by loops and helices. The N-terminal arms of the C subunits are disordered till residue 44 while in the A and B subunits they are disordered till residue 73 residues. The ordered amino terminal arms of C type subunits (residues 48-59) form a characteristic β-annulus-like structure at the quasi 6-fold axes. The subunits in the capsids are stabilized by protein-protein, protein-RNA and protein and metal ion mediated interactions.

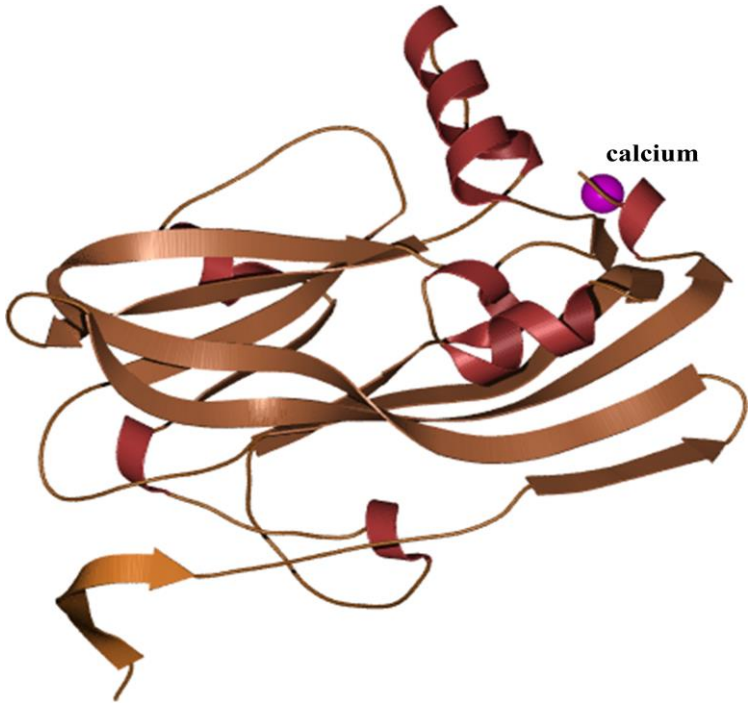

Figure 3a: Polypeptide fold of SeMV capsid protein. The N-terminal R-domain is completely disordered in A and B subunits while it is partially ordered in the C-subunits. Chimeric VLPs were generated by replacing the R-domain with other polypeptides of similar lengths.

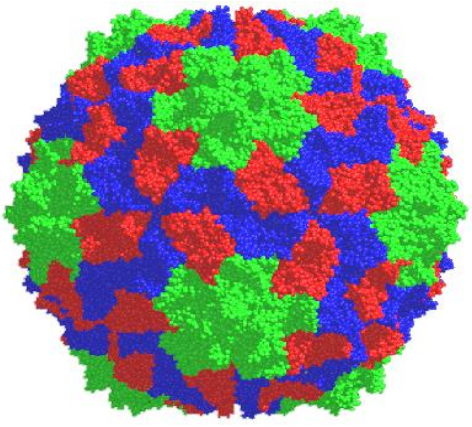

Figure 3b: Architecture of SeMV. The capsid consists of 180 protein subunits organized into 12 pentamers (shown in green) and 20 hexamers (blue and red).

Viral nanotechnology is an emerging field with a wide scope for applications in biology and medicine. Viruses are naturally occurring nano materials (virus nano particles; VNPs) with features

such as nanometer size, symmetry, poly valency, mono dispersity and inexpensive production. Virus like- particles (VLPs) are genome-free non-infectious protein cages that are structurally and morphologically similar to the wild-type particles. VNPs and VLPs can be designed and engineered using both chemical and genetic methods. VLPs derived from plant viruses are biocompatible and biodegradable and are likely to be non-infectious and nonhazardous making them excellent candidates for biomedical applications.

The full length coat protein of SeMV, when expressed in *E. Coli,* assembles in to T=3 icosahedral shells resembling native virus particles. These virus like particles (VLPs) encapsidate *E. coli* 23S ribosomal RNA, the size of which is approximately equal to that of SeMV genome. Substitution of positively charged N-terminal arginine residues of the R-domain with the negatively charged glutamate residues results in stable T=3 empty shells (devoid of RNA). Deletion of the entire R-domain leads to the assembly of T = 1 particles instead of T=3 VLPs, suggesting that the disordered R-domain plays a significant role in T=3 particle assembly. The role of N-terminal R domain in the assembly of VLPs and switching of the capsid architecture from T=3 to T=1 icosahedral organization was further systematically explored by replacing the disordered R domain with various structured and intrinsically disordered viral (SeMV-P8, SeMV-P10 and SeMV-VPg) and non-viral (B-domain of *Staphyloccocus aureus* protein A) polypeptides of size approximately the same as that of the R-domain. Various chimeric SeMV VLPs generated assembled into heterogeneous VLPs with diameters of 30 nm or more except when the R domain was replaced with the antibody binding B domain of *Staphylococcus aureus* protein A (ΔN65 CP-B, 58 aa). ΔN65 CP-B could be purified as dimers and could be crystallized. Surprisingly, its X-ray crystal structure revealed that the dimers had assembled into particles with 60 (T=1) subunits during crystallization. However, the B domain was disordered and unlike VLPs did not have bound calcium ions. Examination by ELISA showed that these particles could bind to IgG 50 times better than protein A. From these studies, it became apparent that a variety of VLPs could be generated by appropriately engineering SeMV coat protein. Another VLP was obtained by genetically engineering the B domain at the midpoint of the βH-βI loop in SeMV CP. Compared to protein A, these VLPs (SeMV loop B, SLB) exhibited 45 times higher affinity towards IgG. More importantly, both wild type (CP) and chimeric VLPs were able to enter various types of mammalian cells including HeLa, KB, B16-F10, BT-474 and HMEC cells. This property of SLB was used to deliver bound monoclonal antibodies targeting a plant toxin like abrin (D6F10), intracellular tubulin (anti-α-tubulin) and a surface exposed HER2 receptor (Herclon) into mammalian cells by a simple incubation method. Interestingly, all the three antibodies delivered via the SLB were found to be much more effective than antibodies alone. These results highlight the potential of SLB nano carrier as a universal antibody delivering agent.

Intellectual Property Rights and Agrientrepreneurship

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Abstract

The intellectual property rights landscape in India continues to evolve keeping in compliance with Trade-Related Aspects of Intellectual Property Rights (TRIPS) agreement and other obligations at global level. Consequent to the adoption of the National Intellectual Property (IP) policy by Government of India, institutions in agri-education need get engaged in implementing the enshrined tenets. This paper seeks to portray the available canvas for developing IP portfolios of technologies, products and processes in the specific sector of agriculture and the new opportunities available for building a strong entrepreneurial ecosystem in the National Agricultural Research and Education System (NARES).

Keywords: intellectual property, National Agricultural Research and Education System, IP Policy, Agri entrepreneurship

1. Introduction

Rising population and accelerating national economic growth require intensification of agricultural practices to meet the increasing demands for food and nutritional security. For a country like India it becomes a more complex challenge against a background of reports of continual receding in the Global hunger Index ranks. The 2017 ranking of the country in terms of GHI[2] is 100th; dropping to three positions as compared to 2016[3]. It is now well documented that, food insecurity appears to be particularly egregious relating to the "hunger index", in the case of India. While acknowledging the earlier successes in enhancing food production during the seventies, several of agricultural production practices adopted then have directly or indirectly contributed to stress the available natural resources. It is now identified that problems leading to the energy crisis, deterioration of soil health, and declining water resources are some of the critical areas needing more innovations and new approaches to make agriculture systems more sustainable[4]and make them remunerative. Keeping the guiding principle of inclusive growth in view, the current approach at the national level is to rebuild agriculture as an important source of livelihood generation[5] with a target to double incomes by 2022. The approach towards this enhancement has to be, both in the farm and non-farm sectors[6]and also ensure that there is adequate and nutritive food for the growing population of the country.

Therefore, new strategies for using available and emerging technologies more innovatively need to be devised. An enabling ecosystem for technology development and creating better concerted diffusion systems to benefit more stakeholders is an ideal solution. This paper primarily focuses on understanding the conceptualization of technology transfer system and agri-entrepreneurship opportunities in the national agricultural research and education systems. It also presents a brief of

[2]GHI is multidimensional measure that describes state of hunger situation on regional, national and global level

[3]The statement by IFPRI said, "*India is ranked 100th out of 119 countries, and has the third highest score in all of Asia — only Afghanistan and Pakistan are ranked worse*". It further stated, "*At 31.4, India's 2017 GHI (Global Hunger Index) score is at the high end of the 'serious' category, and is one of the main factors pushing South Asia to the category of worst performing region on the GHI this year, followed closely by Africa South of the Sahara* http://www.globalhungerindex.org/results-2017/

[4] Kalpana Sastry, R., H. B. Rashmi and N. H. Rao,.(2010). Nanotechnology for enhancing food security in India. Food Policy Volume 36 (3): 391-400.

[5]Chand, R (2017): "Doubling Farmers' Income–Rationale, Strategy, Prospects and Action Plan," NITI Policy Paper No 1, 2017, Niti Aayog, Government of India, New Delhi.

[6]Sukhpal Singh. 2018 Doubling farmers' incomes. Mechanisms and Challenges. Economic & Political Weekly EPW February 17, 2018 vol vol LIII no 7 Pages 15-19.

statutory legislations and instruments in place which help create a more enabling system of legal protection to innovations in agri-space. It finally suggests initiatives for implementation by higher education institutions in national agricultural research and education systems (NARES)for enhancing the innovation and enterprise building for agricultural sector.

2. Current Statutory IP Laws in India vis-vis Agri-based Technologies in India

The WTO-TRIPS agreement of 1995 (WTO,2016), which is binding on all member countries including India, provided for minimum norms and standards in respect of protection of IPR in several categories: patents, copyrights, trademarks, plant varieties, geographical indications, industrial designs, layout designs of integrated circuits, and trade secrets. This agreement led India to put in place a set of appropriate and compliant mechanisms and instruments. Some of the legal instruments passed by the Indian Parliament as part of compliance process to the TRIPS include The Patents Act, 1970 (39 of 1970), The Patents (Amendment) Act, 1999 (17of 1999), The Patents (Amendment) Act 2002 (38 of 2002), The Patents(Amendment) Act 2005 (15 of 2005), The Geographical Indications of Goods (Registration & Protection) Act, 1999 (Office of Controller General of Patents Designs and Trade Marks,2016) and The Protection of Plant Varieties and Farmers Rights Act, 2001 (PPV FR Act) (53 of 2001)(PPV&FR Authority. 2016.) Apart from these, the Government of India also enacted an umbrella legislation called the Biological Diversity Act,2002 (No.18 of 2003). (NBA,2008) as part of the country's commitment to Convention of Biological Diversity (CBD). There is no specific IPR Act to provide protection for undisclosed information (trade secret). The Indian Contract Act of 1872 and common law have provisions covering this with the Ministry of Law and Justice as the nodal agency[7]. A compilation[8] of the major types of IP assets in agriculture R&D with their qualifying attributes under relevant legislations in India indicates a wide canvas available to technology creators in agricultural sector. However, researchers need to be aware of provisions and legal mechanisms for use of bio resources and traditional knowledge (TK) in agriculture, the various these are also enumerated[9].

3. Regulatory Mechanisms for Technologies based on use of Agrobiodiversity and Traditional Knowledge

In India, apart from the legal framework described in section above, there are some special provisions in some of the laws which aim to protect traditional knowledge (TK). In a country with rich heritage which is based on several practices and processes linked with agricultural sector, establishment of stronger regulatory frameworks for protecting the traditional knowledge and use of agro biodiversity[10] would be essential. The three such legislative acts/amendments with specific provisions related to access, regulation of agro biodiversity and TK are summarized in Table 1.

[7] Kochhar, Sudhir. 2008. Institution and capacity building for the evolution of IPR regime in India: Protection of Plant Varieties and Farmers Rights. Journal of Intellectual Property Rights.Vol. 13, January 2008, pp.51-56.

[8]Samuel, M.P., Sastry, Kalpana. R., Venkattakumar, R,.2014. Status and prospects of IP regime in India: Implication for Agricultural Education". Journal of Intellectual Property Rights, Vol. 19, pp. 189-201.

[9] Kalpana Sastry, R. and Singh, Vikram. 2017. Intellectual property rights for crop protection technologies in agriculture. Pages 470-482.In: Chattopadhyay, C.; Tanwar, R.K.; Birah, A.; Bhagat, S.; Sehgal, M.; Ahmad, N.; Mehta, N. (eds.). Handbook of Integrated Pest Management. Indian Council of Agricultural Research.

[10]Ramanna, Anitha and Melinda Smale.2004. Rights and Access to Plant Genetic Resources Under India's New Law. Development Policy Review, 22(4): 423-442.

Table 1: Legal provisions for regulation of access and use of agro biodiversity and TK

Legislation/Act	Salient features
Drug and Cosmetics Act, 1940	✓ Regulate the import, manufacture, distribution and sale of drugs. It contains provisions on traditional knowledge (TK). ✓ Subject matters protected: Patents (Inventions), Traditional Knowledge (TK)
Biological Diversity Act, 2002[i]	✓ Covers conservation, use of biological resources and associated knowledge occurring in India for commercial or research purposes or for the purposes of bio-survey and bio-utilisation ✓ Provides a framework for access to biological resources and sharing the benefits arising out of such access and use ✓ Includes the transfer of research results and application for intellectual property rights (IPRs) relating to Indian biological resources … ✓ Foresees the protection of "knowledge of local people relating to biological diversity" (Sec36(5)); "Biological diversity" is defined as "the variability among living organisms from all sources and the ecological complexes of which they are a part, and includes diversity within species or between species and of eco-systems," (Sec2(b)). ✓ Scope of rights granted by measures for protection, including *sui generis* systems, shall be "as recommended by the National Biodiversity Authority" (Sec.36(5)). ✓ Mandatory approval from National Biological Authority (NBA) for access and use of biological resource occurring in India (Sec.3) ✓ Regulation of transfer the results of any research relating to any biological resources occurring in, or obtained from, India for monetary consideration or otherwise to any person who is not a citizen of India or citizen of India (Sec.4) ✓ Transfer does not mean publication of research papers or dissemination of knowledge in any seminar or workshop, if such publications as per Central Govt. ✓ Sections 3 and 4 not to apply to certain collaborative research projects ✓ Application for any IPR resulting from invention based on research or information on biological resource obtained from India not to made without approval of NBA (Sec.6) ✓ Provision of benefit sharing fee or royalty or both or conditions including the sharing of financial benefits arising out of the commercial utilization of such rights.(Sec 6(2)); No applicable to any person making an application for any right under any law relating to protection of plant varieties ✓ Committed to oppose grant of IPRs in any country outside India on any Indian Biological resource, Sec 18 (4) ✓ Prior intimation to State Biodiversity Board for obtaining biological resource for certain purposes viz commercial purposes (Sec 7) ✓ Guidelines on Access to Biological Resources and Associated Knowledge and Benefits Sharing Regulations, 2014 now in operation
Patent (Amendment) Act, 2005	✓ Extends the product patent protection to the areas of pharmaceuticals and agricultural chemicals. ✓ In case of applications mentioning a biological material in the specification, the application shall be completed by depositing the material to an international depository authority under the Budapest Treaty and by fulfilling the following conditions: The deposit of the material shall be made not later than the date of filing the patent application in India and a reference thereof shall be made in the specification within the prescribed period; all the available characteristics of the material required for it to be correctly identified or indicated are included in the specification including the name, address of the depository institution and the date and number of the deposit of the material at the institution; access to the material is available in the depository institution only after the date of the application of patent in India or if a priority is claimed after the date of the priority; disclose the source and geographical origin of the biological material in the specification, when used in an invention.[[Sec 10 Section 10(4]
PPV&FRA Act ,2001	✓ PPV&FR Authority to take steps to recognize farmers who have at any point of time made contribution in conserving, improving and making available plant genetic resources for the development of new varieties ✓ Establishment of Plant Varieties Registry (Sec. 12) ✓ Maintain national register of Plant Varieties (Sec.13) ✓ Ensure Farmers Rights (Sec.39) and Rights of communities (Sec. 41)

Registration of Germplasm	✓ "Registration of Plant Germplasm" mechanism was established at the National Bureau of Plant Genetic Resources (NBPGR) by the Indian Council of Agricultural Research (ICAR) in 1996; Followed by establishment of other bureaus for genetic resources (livestock, microbes, insects, fishes) ✓ An authentic national documentation system of valuable sovereign genetic resource with known characteristics ✓ Provides a system for recognition of those associated with the development and identification of improved or unique germplasm and genetic stocks ✓ Provide soft protection under the present IPR scenario

Source(s): Samuel et al, 2014 and Kalpana Sastry, R. and Singh, Vikram. 2017.

4. Current Initiatives in Technology Transfer at pan-India level

While technology transfer[11] is likely to be a more complex, interactive, and iterative process than the term implies, the NARES including agricultural universities have primarily focused their efforts on improving the translation of university research into commercial success. Experience has shown that most higher education institutions undertake this process of commercializing university-owned 'intellectual property' (IP[12]), that can be protected through patents, trademarks and copyright. Commercialization is done through the licensing of IP to existing companies or through setting up new, 'spin-out' companies. To facilitate this transaction, many universities have established 'technology transfer offices' (TTOs). Though the exact remit of a TTO varies between universities, they are generally responsible for identifying, protecting and transferring knowledge created in universities "out to business where it can be developed into products and services that benefit society"[13].

In India, the concept of commercialization of technology from R&D is relatively new in most sectors; especially in agriculture[14]. In 2016, the Government of India announced the "National Intellectual Property Rights (IPR) policy[15]. This policy advocates promotion of a holistic and conducive ecosystem for catalysing the intellectual property for economic, socio-cultural development and protecting public interest. The policy document put forth seven objectives namely, i) IPR awareness: outreach and promotion, ii) generation of IPRs, iii) legal and legislative framework, iv) administrative management, v) commercialization of IPR,vi) enforcement and adjudication and vii) human capital development. Adoption of this policy would enable stakeholders to undertake the several initiatives being offered under the other programmes like Make in India"[16], "Skill India" [17], "Start Up India"[18].The flagship programme under Start Up India aims at building a strong ecosystem for nurturing innovations and Start-ups in the country. More specifically, Atal Innovation Mission (AIM) is the action plan envisaged under this programe with a focus on promotion of entrepreneurship and innovation in sectors such as manufacturing, agriculture, health and education. It is expected though these initiatives, self-employment opportunities[19] in all sectors including agriculture and rural areas can be enhanced. A recent initiative of the Government of India through Self-Employment and Talent Utilization (SETU) under National Institution for Transforming India (NITI Aayog) is one such

[11] Technology transfer describes 'the movement of knowledge, or technology, from one organisation to another'.

[12]World Intellectual Property Organization. 2017. What is Intellectual Property? Source: http://www.wipo.int/about-ip/en/

[13] Brady, C et al,.2015. UK University Technology Transfer: behind the headlines. A note from the UK's leading university technology transfer professionals. April 2015 https://www.imperialinnovations.co.uk/media/uploads/files/Technology_Transfer_in_The_UK.pdf

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[16]Government of India.2016b. Make in India, Available online on http://www.makeinindia.com/home. Accessed on 14-04-2016.

[17]Government of India.2016c. Skill India, Available online on http://skillindia.gov.in/. Accessed on 14-05-2016.

[18]Government of India.2016d, Action Plan: Start Up India, Available online on http://startupindia.gov.in/. Accessed on 05-05-2017.

[19]Self-Employment and Talent Utilization (SETU) under National Institution for Transforming India (NITI Aayog) is one such step with several opportunities for support of start-up businesses, and other self-employment. http://niti.gov.in/content/self-employement-talent-utilization

step with several opportunities for support of start-up businesses, and other self-employment activities, particularly in technology-driven areas including those impacting agriculture-production systems (PCS).

5. IP and Technology Management in NARES System

The National Agricultural Research and Education System (NARES) in India employs about 4000 researchers in Indian Council of Agricultural Research (ICAR) and almost 15,000 academic faculty members in the 71-plus State Agricultural Universities (SAUs) and Central Agricultural Universities. The Intellectual Property &Technology Management (IP&TM) scheme launched by the Indian Council of Agricultural Research (ICAR) during 2008 has been the main driver towards implementation of the policy[20]. A three-tier IP management mechanism has been established towards developing an institutional setup for commercialization of agriculture research products/technologies generated from public research institutions. The National Agricultural Innovation Fund (NAIF)[21]under ICAR has been schematized for agribusiness incubation across the NARES. Support and services needed by bigger firms and investors for technology transfer as well as for incubation and funding can also be addressed through the new flexible business innovation-incubation centres like "Agrinnovate India" [22] and Technology Business Incubators [23] under the National Science & Technology Entrepreneurship Development Board (NSTEDB).In the current ecosystem, start-up trend in India is picking up in academic and R&D institutions[24], where researchers are looking beyond just publishing or licensing technologies to the industry.

6. Epilogue

Some of early successes in transferring technologies as businesses signal positive returns on R&D investments in agricultural sector. These efforts are gaining a fillip given through several initiatives on innovation, incubation. A vibrant ecosystem can trigger start up culture in agriculture sector creating more employment opportunities for several stakeholders engaged in agri-rural sector. Higher Education institutions in this sector need to build strong systems to motivate and later help researchers, innovators, students and other technology generators including farmers, agri-preneurs to capitalize the outputs from their creativity and innovative approaches. While formulating technology transfer plans, a few check-list points summarized as below may be considered:

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[20]ICAR, (2006), ICAR Guidelines for Intellectual Property Management and Technology Transfer/Commercialization. Indian Council of Agricultural Research, New Delhi. Refer: https://www.icar.org.in/files/ICAR-GuidelinesIPM&T-2014.pdf.

[21]Intellectual Property &Technology Management (IP&TM) Unit. Details at :https://www.icar.org.in/node/131

[22]Agrinnovate India Ltd. (AgIn) was incorporated under the Companies Act, 1956 (No. 1 of 1956) on 19th October 2011. It is a "for profit" Company owned by Department of Agricultural Research & Education (DARE), Ministry of Agriculture, Government of India.. Source: http://www.agrinnovateindia.co.in/. Accessed on 05-05-2017.

[23]The National Science & Technology Entrepreneurship Development Board (NSTEDB), established in 1982 by the Government of India under the aegis of Department of Science & Technology, is an institutional mechanism to help promote knowledge driven and technology intensive enterprises. The Board, having representations from socio-economic and scientific Ministries/Departments, aims to convert "job-seekers" into "job-generators" through Science & Technology (S&T) interventions. At: http://nstedb.com/institutional/tbi-2016.htm

[24]Srinivas, K., Sibin, CB., Vijay, N., Krishnan, P., Kalpana Sastry, R. 2017. An enchiridion on Agri-Startups in India - A glimpse of licensees of ICAR technologies. ICAR-National Academy for Agricultural Research Management, Hyderabad.40p+v.

[25] ICAR 2017 FIFTH DEANS' COMMITTEE REPORT. Complied by Rathore,N.S; Venkateshwarlu, G.and K.L. Khurana. Agricultural Education Division. Source: https://education.icar.gov.in/FifthDeansCommiteeReport-22022017.pdf

i. Current legal framework India affords several opportunities for R&D outputs to be protected. Multiple IPs and portfolio building measures need to be put in place for building business models for technology developers.
ii. Compliances with regulatory bodies on use of agro-biodiversity and related knowledge is mandatory. These should form part of standard operating practices (SOPs) for due diligence during the entire process of technology development and its transfer.

iii. Capacity building for R&D professionals in IP and technology commercialization should be intensified and best practices mode be adopted.
iv. Encouragement of cross-disciplinary translational research in partnership with other stakeholders along with best practices protocols in place.
v. Technology developers or seekers should be encouraged towards establishing start-ups. New teaching programmes should be designed at University level in line with National IP Policy.
vi. Experiential Learning programmes planned under Vth Dean Recommendations[25] need to be taken forward with innovative entrepreneurship programmes by SAUs and other institutions engaged in agri-education.
vii. Use of IP informatics for research projects proposals and execution should be mandatory as part of best practices in project management.
viii. Creation of Incubation platforms and reaching to all stakeholders of the value chain
ix. Scouting and Documentation of traditional knowledge, biological resources, and associated processes and creating prior-art repositories at institutional level.
x. Community engagement at local levels and building awareness towards enterprise building in agri-sector.

II. RECOMMENDATIONS OF THE CONFERENCE

1. Many Alumni of SAUs are engaged in quality R and D activities abroad. Their talents need to be harnessed by encouraging them to serve as an adjunct professors for short periods in their parent Universities.
2. ICT to be used to restructure traditional models of higher learning. Video conferencing facility to be strengthened in all the SAUs to make use of satellite based PG education and sharing of experts lectures etc.
3. Skill development should be an integral part of M.Sc. and Ph.D. programs. In addition to infusing knowledge to students, teachers should infuse skills and empower students with creativity, so that they will be competitive in the market.
4. Provision for Inter- University movement to Ph.D students for course work/research will reduce inbreeding & improve their quality of PG research.
5. M.Sc. and Ph.D. students should compulsorily prepare a review article on the topic of their research, before finalising their thesis research programme.
6. Multidisciplinary group research is always more useful than individual work and collaborative research needs to be encouraged in Universities.
7. PG research in farm Universities should focus on generic and methodological competence instead of contents and descriptive approaches, enabling graduates to tackle novel complex problems.
8. Research on frontier areas of Science in Agriculture like nanotechnology needs to be strengthened eg. Research on Sesbania virus in drug delivery systems to cure diseases.
9. Ph.D. Scholars and PDFs need to go for innovative research leading to patents which will go a long way in promoting agriculture
10. Placement of Sr. M.Sc. and Ph.D students for 3 months duration in R&D institutions of public and private sector can be introduced as a part of skill development process. Skill development and start-ups in newer agricultural areas need encouragement as the students operate in open and demanding markets after completion of their degrees.
11. The courses on Intellectual Property Rights, communication skills, technical writing skills, etc. presently being offered as non-credit courses are not effective. They need to be converted into mandatory credit courses.
12. Research on application of ICTs in agriculture input supply chain, e-marketing of agricultural produce, value chain model development etc., need be strengthened.

III. RESEARCH PAPERS PRESENTED BY PG STUDENTS

One hundred and twenty six M.Sc. & Ph.D. students participated in the National conference held at UAHS, Shivamogga and presented their research papers in the field of Agriculture, Horticulture, and Forestry. The research papers covered a range of current topics on Crop Production, Crop Improvement, Crop Protection, Post Harvest Technology, Value Addition, ICTs, Nanotechnology etc., The research papers were peer-reviewed by panel of experts and only the accepted papers were presented in the conference.

PAPERS ON PG RESEARCH IN UAHS, SHIVAMOGGA (M.Sc. STUDENTS)

A. Agriculture

1. Biology of Spotted pod borer, *Maruca vitrata* (Geyer) (Lepidoptera: Crambidae) infesting Pigeon pea

   Jahantaj, K.A., Hanumanthaswamy, B. C., Shivanna, Sharanabasappa, B. K., Narayanaswamy, H. and Adivappar, N.
   Department of Agricultural Entomology, College of Agriculture, Shivamogga

2. Identification of potato leafhopper species complex using morphological and molecular approach

   Meghana, N., Kalleshwaraswamy, C. M. and Asokan, R.
   Department of Agricultural Entomology, College of Agriculture, Shivamogga

3. Biology of bean aphid, *Aphis craccivora* Koch in Field bean

   Namitha, N. V., Kencharaddi, R. N., Jayalaxmi Narayan Hegde, Girijesh, G.K., SridharaHarle, P.
   Department of Agricultural Entomology, College of Agriculture, Shivamogga

4. Seasonal incidence of leaf webworm, *Omiodes indicata* (Lepidoptera:pyralidae) on field bean

   Niranjankumar, K. V., Onkarappa, S., Kalleshwaraswamy, C. M., Narayan, S. Mavarkar, Ganga Prasad, S.
   Department of Agricultural Entomology, College of Agriculture, Shivamogga

5. Safety evaluation of different insecticides against the predatory coccinellid, *Chilomenes sexmaculata* on Cowpea aphid, *Aphis croccivora*

   Pooja Karane, Sharanabasappa, Shivanna, B. K., Nagarajappa Adivappar and Satish, K. M.
   Department of Agricultural Entomology, College of Agriculture, Shivamogga

6. Evaluation of different insecticides against Red Spider Mite *Tetranychus* sp. Infesting Rose

   Priyanka, Patil, S.U., Shivanna, B. K., Nagarajappa Adivappar and Shashidhar, K. C
   Department of Agricultural Entomology, College of Agriculture, Shivamogga

7. Evaluation of newer acricides against red spider mite (*Tetranychus macfarlanei* Baker and Pritchard.)on soybean

Satish, S. B., Pradeep, S., Manjunatha, M., Narayanaswamy, H. and Sridhara, S.
Department of Agricultural Entomology, College of Agriculture, Shivamogga

8. Evaluation of different insecticides against chrysanthemum aphid, *Macrosiphoniella sanbornii* (Gillette).

   Smitha,O. R., Manjunatha, M., Kalleshwaraswamy, C. M., HemlaNaik, B.and GangadharaNaik,B.
   Department of Agricultural Entomology, College of Agriculture, Shivamogga

9. Efficacy of different insecticides against semilooper, *Thysanoplusia orichalcea* (Fab.) in sunflower.

   Swathi G. Hegde, Shivanna, B. K., Sharanabasappa, GaneshaNaik, R. and Veeranna, H.K.
   Department of Agricultural Entomology, College of Agriculture, Shivamogga

10. Efficacy of different insecticides against mealy bug, *Planococcus lilacinus* (Cockerell) in Cocoa

    Venugopal, H. M., Jayalaxmi Narayana Hegde, Shivanna, B. K., Narayanaswamy, H. and Mavarkar, N. S.
    Department of Agricultural Entomology, College of Agriculture, Shivamogga

11. Seasonal incidence of Sciothrips cardamom Ramk. on M2 and M3 varieties of cardamom

    Venukumar, S., Hanumantharaya, L., RevannaRevannavar., Lakshmana, D., SadashivNadukeri and SuchithraKumari, M. H.
    Department of Agricultural Entomology, College of Agriculture, Shivamogga

12. Effect of fodder maize based intercropping on the growth and yield parameter of the crop in Southern Transitional Zone

    Ashwini, A. Y., Basavaraj, Naik, Dinesh Kumar, M., Ganapathi, and Ganesh, Naik.
    Department of Agronomy, College of Agriculture, Shivamogga

13. Performance of maize as influenced by integrated drought management options under rainfed conditions

    Chaithra, G. M. and Sridhara, S.
    Department of Agronomy, College of Agriculture, Shivamogga

14. *Effect of date of transplanting on yield components of* rice under different methods of establishment
    Chandrashekhar, Hanumanthappa, M. and Sridhara, S.
    Department of Agronomy, College of Agriculture, Shivamogga

15. Effect of foliar application of major and boron nutrition on growth and yield of rice

    Gajanana, Kuri, SudhirKamath, K.V., Dinesh Kumar, M., Jayaprakash, S. M. and Jayaprakash, R.

    Department of Agronomy, College of Agriculture, Shivamogga

16. Effect of herbicides and herbicides combination in transplanted rice with special reference *to Vaucheria* species of Yellow Green Algae under Coastal Karnataka

    Manjunatha, U. B., Naveen, N. E., Dinesh Kumar, M., Jayaprakash, S. M. and Chaitanya, H. S.
    Department of Agronomy, College of Agriculture, Shivamogga

17. Effect of integrated nutrient management practices on growth and yield of aerobic rice

    Megha, B., Sridhara, C. J, Mavarkar, N. S., Gurumurthy, K.T. and Nandish, M.S.
    Department of Agronomy, College of Agriculture, Shivamogga

18. Performance of groundnut genotypes under different sowing windows

    Raagavalli, K.,Soumya, T. M. and Veeranna, H.K.
    Department of Agronomy, College of Agriculture, Shivamogga

19. Effect of humic substances on yield and economics of soybean

    Savita, S.P., Girijesh, G. K., DineshKumar, M., NagarajappaAdivappar and Thippeshappa, G.N.
    Department of Agronomy, College of Agriculture, Shivamogga

20. Yield and quality of Potato (*Solanum tuberosum* L.) as influenced by graded levels of nitrogen and potassium

    Shruthi, G., Shivprasad, M. and Dinesh Kumar, M.
    Department of Agronomy, College of Agriculture, Shivamogga

21. Performance of groundnut (*Arachis hypogaea*L.) based millets intercropping system in Central Dry Zone of Karnataka

    Shwethanjali, K.V., Kumar Naik, A. H., Dinesh Kumar, M,.Chandrappa, D. and Dhananjaya, B.C.
    Department of Agronomy, College of Agriculture, Shivamogga

22. Estimation of LD_{50} for EMS treated population of Groundnut (*Arachis hypogaea* L.)

    Avinash Kumar, Mohan Kumar, H. D., Dhushyantha Kumar, B.M., Gurumurthy, B. R. and Kumar Naik, A.H.
    Department of Genetics and Plant Breeding, College of Agriculture, Shivamogga

23. Association of yield with component traits in gamma irradiated population of groundnut (*Arachis hypogaea* L.)

    Bheemareddy, Mohan Kumar, H. D., Gangaprasad. S., Nataraj and Kumar Naik, A. H.
    Department of Genetics and Plant Breeding, College of Agriculture, Shivamogga

24. Inter relationship among characters contributing to pod yield, their direct and indirect effect on pod yield in M_2 generation of Okra

    Bhuvaneshwari, Gangaprasad, S. and Dushyantha Kumar. B. M.
    Department of Genetics and Plant Breeding, College of Agriculture, Shivamogga

25. Physiological and molecular studies in rice genotypes for submergence tolerance

    Chandana, B. R., Dushyantha Kumar, B. M., Gangaprasad, S., Gurumurthy, B. R. and Usha, T. N.
    Department of Genetics and Plant Breeding, College of Agriculture, Shivamogga

26. Evaluation of groundnut germplasm for *in-vitro* seed colonizationby *Aspergillus flavus (IVSCAF)*

    HasanaliNadaf, B.N.,Harish Babu, B.M.,Dushyantha Kumar, B.M.,GangadharNaikand Naik, M. K.
    Department of Genetics and Plant Breeding, College of Agriculture, Shivamogga

27. Assessment of Genotype x Environment interaction for grain yield in advanced breeding lines of rice

    Mutturaj, Dhavaleshvar, Malleshappa, C., Dushyanth Kumar, B. M., Basavaraj, I. H. and Girijesh G. K.
    Department of Genetics and Plant Breeding, College of Agriculture, Shivamogga

28. Genetic variability studies for yield and yield contributing traits in finger millet [*Eleusine coracana* (L.) Gaertn] genotypes

    Prashantha, B. N., Gowda, T. H., Gangaprasad, S., Nataraju, S. P. andVeeranna, H. K.
    Department of Genetics and Plant Breeding, College of Agriculture, Shivamogga

29. Evaluation of rice genotypes for resistance against *Pyricularia oryzae*(Cavara) the cause of rice leaf blast and neck blast in Hilly Zones of Karnataka

    Rangaswamy, D. M. Dushyantha Kumar, B. M.,Gangaprasad, S.,Hosagoudar, G. N. and Gurumurthy, B. R.
    Department of Genetics and Plant Breeding, College of Agriculture, Shivamogga

30. Morphological and molecular characterization of traditional rice varieties collected from Hilly Zone of Karnataka

    Sachin Kumar, H. M., Dushyantha Kumar, B. M., Natraju, S.P., Basavaraj, I.Halingali and Narayanaswamy, M.
    Department of Genetics and Plant Breeding, College of Agriculture, Shivamogga

31. Correlation studies and path analysis for yield and attributing characters in brinjal(*Solanummelongena*L.)

    VinuthaPatil, S., Gangaprasad, S. and Dushyantha Kumar. B. M.
    Department of Genetics and Plant Breeding, College of Agriculture, Shivamogga

32. Management of root-knot nematode (*Meloidogyne incognita*) in Flue Cured Virginia tobacco (FCV) under nursery condition

    Ashwini, B. N., Ravindra, H. and Karegowda, C.
    Department of Plant Pathology, College of Agriculture, Shivamogga

33. Survey for the intensity of leaf spot disease of Cinnamon caused by *Colletotrichum gloeosporioides* in Southern Hilly Zone of Karnataka

    Kavay Mashaldi, D. and Narayanaswamy, H.
    Department of Plant Pathology, College of Agriculture, Shivamogga

34. *In vitro* compatibility studies of *Trichoderma* with fungicides

    Maheshwary, N. P., GangadharaNaik, B., Naik, M. K., Satish, K. M. and Nandish, M.S.
    Department of Plant Pathology, College of Agriculture, Shivamogga

35. Survey for the incidence of false smut of rice (*Oryza sativa* L.) incited by *Ustilaginoidea virens* (Cooke) Takahasiin Hilly and Coastal zones of Karnataka

    Manjunath, B., Hosagoudar, G. N. and Narayanaswamy, H.
    Department of Plant Pathology, College of Agriculture, Shivamogga

36. *In vitro* evaluation of fungicides and bioagents against *Alternaria alternta* causing brown spot in FCV tobacco

    NailaShohrat., Karegouda, C. and Narayanswamy, H.
    Department of Plant Pathology, College of Agriculture, Shivamogga

37. Survey for the incidence of C*hilli veinal mottle virus* in major chilli growing areas of Karnataka

    Nandappa Chorgasti and Ganesha Naik, R.
    Department of Plant Pathology, College of Agriculture, Shivamogga

38. Survey for the fungal fruit spot/fruit rot of pomegranate in Central Dry Zone of Karnataka

    Pruthviraj and Suresh D. Ekabote
    Department of Plant Pathology, College of Agriculture, Shivamogga

39. Survey for the incidence of collar rot of cluster bean in Shivamogga, Davanagere and Chitradurga districts

    Sannajambanna, B. and Narayanaswamy, H.
    Department of Plant Pathology, College of Agriculture, Shivamogga

40. Effect of levels of fertigation on growth and yield of Tomato under polyhouse condition

    Ananda Sajjan, Ashok, L. B., Gurmurthy, K.T., Basavalingaiah and Vasudev, K.L.
    Department of Soil Science & Agricultural Chemistry, College of Agriculture, Shivamogga

41. Mapping of soil chemical properties and available NPK status of Hebbalagere micro-watershed in Channagiri taluk, Davangere district of Karnataka using GIS technique

    Harshitha, S., Ganapathi, Gurumurthy, K. T., Mavarkar, N. S. and Sowmya, T. M.
    Department of Soil Science & Agricultural Chemistry, College of Agriculture, Shivamogga

42. Impact of land use on soil organic carbon fraction in Central parts of Western Ghats of Virajpettaluk.

    Pradeepa, K. L., Ravikumar, D.,Chidanandappa, H. M., Jadeye Gowda, M. andShoba,S.
    Department of Soil Science & Agricultural Chemistry, College of Agriculture, Shivamogga

43. Adsorption of zinc by soils under paddy land use cover of Bhadra command, Karnataka
    Ranjitha, P., Chidanandappa, H. M., Dhananjaya, B. C., Girijesh, G. K. and Basavarajappa, H. Bhogi
    Department of Soil Science & Agricultural Chemistry, College of Agriculture, Shivamogga

44. Effect of phosphorus levels and phosphorus solubilizers on phosphorus status of paddy

    Shobha , T., Dhananjaya, B. C., Chidanandappa, H, M., Veeranna, H. K. and BasavarajNaik, T.
    Department of Soil Science & Agricultural Chemistry, College of Agriculture, Shivamogga

45. Characterization of ground water in Dasarahalli-1 micro watershed of Chikkamanglore district, Karnataka

    Sushmitha, C.V., Gurumurthy, K. T., Ganapathi, Shridhara, C.J. and Basavarajappa, H. Bhogi
    Department of Soil Science & Agricultural Chemistry, College of Agriculture, Shivamogga

46. Effect of calcium enriched FYM through eggshell powder on soil properties and yield of brinjal

    Sushmitha. N. Swamy, Thippeshappa, G. N.,Parashuram Chandravamshi, Girijesh, G. K. and Nandish, M. S.
    Department of Soil Science & Agricultural Chemistry, College of Agriculture, Shivamogga

47. Effect of levels and split application of potassium on yield and yield related traits of paddy

    Yashawanthkumar, S. M., Jayaprakash, S. M., Chidanandappa, H. M., Sudhir, V.Kamath and Nandish, B.
    Department of Soil Science & Agricultural Chemistry, College of Agriculture, Shivamogga

48. Knowledge level of vegetables and fruits growers on institutional market interventions

    Gayathri, G. N., Sahana, S., Amaresh Kumar, K. and Basavaraj I. Halingali.
    Department of Agricultural Extension, College of Agriculture, Shivamogga

49. Constraints faced and suggestions offered by the paddy farmers of Shivamogga district

    Kavyashree, C., Basavaraj Beerannavar, Dhananjaya, B., Girijesh, G. K. and Mallikarjuna, H. B.
    Department of Agricultural Extension, College of Agriculture, Shivamogga

50. Knowledge level of input dealers of DAESI programme

    Mamata, V. N., Sudheendra, M., Sahana, S. and Basavaraj, I. Halingali.
    Department of Agricultural Extension, College of Agriculture, Shivamogga

51. Farmer's opinion about regularity and practicality of agricultural information in selected ICT tools

    Sagar, S. Pujar, Amaresh Kumar, K., Sahana, S. and ShashikalaBai, D.
    Department of Agricultural Extension, College of Agriculture, Shivamogga

52. Marketing behavior of tomato growers in Chikmagaluru district

Shrikant Krishnamurthy, A. T., BasavarajBeerannavar, Nagarajappa, A. and Mallikarjuna, H. B.
Department of Agricultural Extension, College of Agriculture, Shivamogga

53. Problems in mechanized paddy cultivation faced by the farmers of Udupi district

SubhashKalagi, Dhananjaya, B., Sudheendra, M., Shashidhar, K.C. and Mallikarjuna, H. B.
Department of Agricultural Extension, College of Agriculture, Shivamogga

B. Horticulture

1. Study on rooting of stem cutting in Barbados cherry (*Malphighia glabra* L.) in polyhouse under hill zone of Karnataka

   Alam Khan Samim, Shivakumar, B. S.,Ganapathi, Shivaprasad, M. M. and Yallesh, Kumar.
   Department of Fruit science, College of Horticulture, Mudigere

2. Effect of different plant growth regulators on rooting and shooting of stem cuttings in Dragon fruit (*Hylocereus undatus* (Haworth) Britton & Rose)

   Ayesha Siddiqua, Thippesha, D., Shivakumar, B. S., Nagarajappa Adivappar and Ganapathi, M.
   Department of Fruit science, College of Horticulture, Mudigere
3. Effects of different mulches on yield of pomegranate (Punicagranatum L.)

   Lokesha, R., Narayanaswamy, P., Suresh, D. Ekabote, Girijesh, G. K. and Shivakumar, B. S.
   Department of Fruit science, College of Horticulture, Mudigere

4. Influence of liquid plant growth promoting rhizo microbial consortia on growth and yield of strawberry (*Fragaria* x *Ananassa* Duch.) under naturally ventilated polyhouse

   Nisarga, G., Madaiah, D., Shivakumar, B.S., Dinesh Kumar, M. and Nandish, M.S.
   Department of Fruit science, College of Horticulture, Mudigere

5. Evaluation of qualitative and quantitative characters of tamarind genotypes

   Pooja, G. K., Nagarajappa Adivappar, Shivakumar, B. S. and Lakshmana, D.
   Department of Fruit science, College of Horticulture, Mudigere

6. Studies on the effects of application of silicon on yield attributes of banana cv. Grand naine in the hill zone of Karnataka

   Rakesh, S. H., Yalleshkumar, H. S., Shivaprasad, M. and Ravikumar, D.
   Department of Fruit science, College of Horticulture, Mudigere

7. Performance of strawberry (*Fragaria x Ananassa* Duch.) as influenced by humic acid and water soluble fertilizers on growth and yield under naturally ventilated polyhouse

   Sampada, C.M., Madaiah, D., Shivakumar, B.S., Dinesh Kumar, M. and Dhananjaya, B.C.
   Department of Fruit science, College of Horticulture, Mudigere

8. Evaluation of exotic macadamia (*Macadamia* spp.) genotypes for morphological and yield attributing traits

   Usha, D. S., Nagarajappa Adivappar, Shivakumar, B. S., Thippesh, D. and Lakshmana, D.
   Department of Fruit science, College of Horticulture, Mudigere

9. Effect of foliar application of nutrients and growth regulators on post-harvest quality of sapota under hill zone of Karnataka

   VaniKumbar, Shivakumar, B. S., Kantharaj, Y., Ganapathi, M. and Chaitanya, H. S.
   Department of Fruit science, College of Horticulture, Mudigere

10. Morphological characterization of wild Orchids of Western Ghats

    Akshata, A. S., Nataraj, S.K., Jadeyegowda Madegowda., Sujatha, A. Nair and Kantharaj, Y.
    Department of Floriculture and Landscape Architecture, College of Horticulture, Mudigere

11. Efficacy of different Biostimulants on growth and yield of chrysanthemum cv. Kolar local

    Bhargavi, S. P., Hemla, B. Naik., Chandrashekar, S. Y., Ganapathi, M. and Kantharaj, Y.
    Department of Floriculture and Landscape Architecture, College of Horticulture, Mudigere

12. Effect of Benzyl Adenine and Gibberellic Acid on growth and flowering of Gladiolus (*Gladiolus hybridus* L.)

    Priyanka, S. Holkar, Chandrashekar, S.Y, Hemanth Kumar, P., Ganapathi, M. and Basavalingaiah.
    Department of Floriculture and Landscape Architecture, College of Horticulture, Mudigere

13. Genetic variability studies in F_2 segregating population of China aster [*Callistephuschinensis*(L.) Nees.] for growth parameters

    Ramya, H. M., Nataraj, S.K., Lakshmana, D., Rajiv Kumar, Chandrashekar, S.Y. and Kanthraj, Y.
    Department of Floriculture and Landscape Architecture, College of Horticulture, Mudigere

14. Characterization of Chrysanthemum (*Dendranthemagrandiflora*Tzvelev) genotypes under Hill Zone of Karnataka

    Roopa, S., Chandrashekar, S.Y., Shivaprasad, M., Hanumantharaya and Hemanth Kumar.
    Department of Floriculture and Landscape Architecture, College of Horticulture, Mudigere

15. Morphological characterization of fern flora of Western Ghats

    Vidyashree, Chandrashekar, S. Y., Hemla, B. Naik., Revanna Revannavar and Jadeyagowda, M.
    Department of Floriculture and Landscape Architecture, College of Horticulture, Mudigere

16. Effect of foliar nutrition on flowering and flower yield of marigold var. Arka Agni

    Vibha V. Rao., B. Hemla Naik, Chandrashekar, S.Y., Ganapathi, M. and Kantharaj, Y.
    Department of Floriculture and Landscape Architecture, College of Horticulture, Mudigere

17. Quantification of total phenolic and total flavonoid content in *Moringa concanensis Nimmo*

Anitha, T. M., RavirajaShetty. G., Rajasekharan, P. E., KeshavaRao, V., Sadashiv Nadukeri and Ganapathi, M.
Department of Plantation, Spices, Medicinal and Aromatic crops College of Horticulture, Mudigere

18. In vitro antifungal activity of aqueous leaf extract of *Embeliaribesburm*f. threatened medicinal plant.

Pallavi, C. R., Raviraja Shetty, G., Rajasekharan, P. E., Bhoomika, H. R. and Ganapathi, M.
Department of Plantation, Spices, Medicinal and Aromatic crops College of Horticulture, Mudigere

19. Yield and yield attributes in mango ginger (Curcuma amadaRoxb) as influenced by rhizome weight and nutrient levels

Priyanka, B. M., Bhoomika, H. R., Shivaprasad M., Sadashiv Nadukeri and Hanumanthray, L.
Department of Plantation, Spices, Medicinal and Aromatic crops College of Horticulture, Mudigere

20. Effect of hydrogel on fresh yield of ginger (*Zingiberofficinale*Rosc.) under Southern Transition Zone of Karnataka

Rakshith Kumar, R., Sadashiv Nadukeri., Shashikala, S. Kolakar., Raviraja Shetty, G., Shivaprasad, M. and Dhananjaya, B.
Department of Plantation, Spices, Medicinal and Aromatic crops College of Horticulture, Mudigere

21. Effect of integrated nutrient management on growth and yield of French basil (*Ocimumbasilicum* L).

Saif Ali Khan, Ravi Kumar, M., Raviraja Shetty, G., Ganapathi and Nandish, M. S.
Department of Plantation, Spices, Medicinal and Aromatic crops College of Horticulture, Mudigere

22. Rooting in lateral cuttings of black pepper (*Piper nigrum*) as influenced by different growth stimulating substances

Sannidhi, H. S., Bhoomika, H. R., Nandish, M. S., Raviraja Shetty, G. and Ganapathi, M.
Department of Plantation, Spices, Medicinal and Aromatic crops College of Horticulture, Mudigere

23. Ovipositional preference of *Chrysoperlazastrowi*sillemi (EsbenPetersen) and *Helicoverpaarmigera* (Hubner) on genotypes of okra

Apoorva, J. J., Hanumantharaya, L., Bakthavatsalam, N., SuchitraKumari, M. H.and Srinivasa, V.
Department of Horticultural Entomology, College of Horticulture, Mudigere

24. Efficacy of ethyl alcohol attractant trap against coffee shot-hole borer, *X. compactus* in rubusta coffee plantation

    Avinash and Revanna Revannavar
    Department of Horticultural Entomology, College of Horticulture, Mudigere

25. Efficacy of acaricides against two spotted spider mite, *Tetranychusurtiace* Koch. (Acari: Tetranychidae) on tomato in field conditions

    Meghan, J., Rajashekharappa, K. and Prakash Kerure.
    Department of Horticultural Entomology, College of Horticulture, Mudigere

26. Bio-efficacy of insecticides against fruit fly, *Bactroceracucurbitae*(Coquillett) in cucumber.

    Srinivas, M. P., Suchithra Kumari, M. H., Hanumantharaya, L. and Yallesh Kumar, H. S
    Department of Horticultural Entomology, College of Horticulture, Mudigere

27. Seasonal incidence of Scio thrips cardamom Ramk. on M2 and M3 varieties of cardamom

    Venukumar, S., Hanumantharaya, L., Revanna Revannavar., Lakshmana, D., Sadashiv Nadukeri and Suchithra Kumari, M. H.
    Department of Horticultural Entomology, College of Horticulture, Mudigere

28. Development of mass multiplication technique for stingless bee *Tetragonulairidipenis* queen

    Mythri, P. G., Kencharaddi. R. N., Hanumantharaya, L., Shivaprasad, M. and Hosagoudar, G. N.
    Department of Horticultural Entomology, College of Horticulture, Mudigere

29. Performance of cucumber (*Cucumis sativus*. L) genotypes for growth and yield characters

    Anusha Bhagwat, Srinivasa, V., Devaraju, Hanumantharaya, L., Shashikala, S. Kolakar and Anjanappa, M.
    Department of Vegetable Science, College of Horticulture, Mudigere.

30. Genetic studies on yield and yield related traits in F_2 segregating populations of okra [*Abelmoschus esculentus* (L.) Moench]

    Kavya, V. N., Prakash Kerure, Srinivasa, V.and Pitchaimuthu, M.
    Department of Vegetable Science, College of Horticulture, Mudigere.

31. Effect of Boron and Copper foliar nutrition on growth and yield of brinjal (*Solanum melongena* L.) under Hill Zone of Karnataka.

    Manasa, G. D., Umamaheshwarappa, P., Srinivasa,V., Sarvajna, B. Salimath, Kumar Naik, A. H.and Devaraju.
    Department of Vegetable Science, College of Horticulture, Mudigere.

32. Effect of nutrients and mulching on growth and yield of pole bean (*Phaseolus vulgaris* L.) under polyhouse

    Sahana, P., Nagarajappa Adivappar.,Srinivasa, V., Girijesh, G. K. and Ganapathi, M.
    Department of Vegetable Science, College of Horticulture, Mudigere.

33. Effect of foliar application of nutrients on growth and yield of potato (*Solanum tuberosum* L.)

Shanwaz, A., Devaraju.,Srinivasa. V., Shivprasad.M. and Ganapathi, M.
Department of Vegetable Science, College of Horticulture, Mudigere.

34. Evaluation of sweet potato [*Ipomoea batatas* (L.) Lam] genotypes for quality parameters

Sharavati, M.B., Srinivasa, V.,RamachandraNaik, K., Devaraju, Shashikala, S. Kolakar and Kantharaj, Y.
Department of Vegetable Science, College of Horticulture, Mudigere.

35. Effect of integrated nutrient management on growth, yield and quality of potato

Shubha, A. S., Srinivasa, V., Devaraju, Shivaprasad, M. and Nandeesh, M. S.
Department of Vegetable Science, College of Horticulture, Mudigere.

36. Diallel studies for growth and earliness in ridge gourd [*Luffa acutangula* (L.) Roxb.]

Chandan, B. M., Lakshmana, D., Devaraju, Harish Babu, B. N. and Ganapathi, M.
Department of Crop Improvement and Biotechnology, College of Horticulture, Mudigere

37. Genetic and *In-silico* investigation of salt tolerance in Eggplant (*Solanumm elongena* L.)

Rakshith, M., Harish Babu, B. N., Lakshmana, D. andGanapathi, M.
Department of Crop Improvement and Biotechnology, College of Horticulture, Mudigere

38. Heterosis studies for growth traits in local brinjal (*Solanum melongena* L.)

Santosh Kumar, P., Lakshmana, D., Devaraju, Shashikala, S. K. and Ganapathi, M.
Department of Crop Improvement and Biotechnology, College of Horticulture, Mudigere

39. Performance of Bitter gourd genotypes for its growth attributes under Hill Zone of Karnataka

Sowmya, H. M., Shashikala, S. Kolakar, Lakshmana, D., SadashivNadukeri, Srinivasa, V. and SrideviJakkeral.
Department of Crop Improvement and Biotechnology, College of Horticulture, Mudigere

40. Assessment of genetic variability in Okra (*Abelmoschus esculentus* L.) for growth and yield characters

Sunil, G., Usha, T. N., Lakshmana, D., Hanamantharaya, L. and Devaraju.
Department of Crop Improvement and Biotechnology, College of Horticulture, Mudigere

C. Forestry

1. Effect of IBA on Sprouting of *Diospyros ebenum* Koenig through Air layering: an endangered tree species

Vilaskumar, Maheswarappa, V., Ramakrishna Hegde, Kencharaddi, R. N.and Vasudev, L.

Department of Silviculture and Agroforestry college of Forestry,Ponnampet

PAPERS ON PG RESEARCH IN UAHS, SHIVAMOGGA (Ph.D STUDENTS)

1. Morphological and biochemical basis of resistance in rice genotypes against lepidopteran pests

   Ashrith, K. N., KalleshwaraSwamy, C. M., Dushyantha Kumar, B. M. and Dhananjaya, B.C.
   Department of Agricultural Entomology, College of Agriculture, Shivamogga

2. Evaluation of organic pesticides against Areca nut mite *Raoiella indica* Hirst

   Indhusri Chavan, Pradeep, S. and Narayanaswamy, H.
   Department of Agricultural Entomology, College of Agriculture, Shivamogga

3. In vitro biology of red spider mite, *Tetranychus macfarlanei* Baker and Pritchard on Cucumber

   Latha, M., Manjunatha, M. and Chinnamadegowda, C.
   Department of Agricultural Entomology, College of Agriculture, Shivamogga

4. Efficacy of botanicals and animal origin bio products for the management of lesser grain borer *Rhyzopertha dominica* (Fab.) in stored maize

   NarayanaSwamy, K.C. Hanumanthaswamy, B.C.,Manjunatha, M. Shivanna, B. K., Narayana, S. Mavarkar. and Ravikumar G.H.
   Department of Agricultural Entomology, College of Agriculture, Shivamogga

5. Effect of planting geometry and nutrient management on performance of pigeon pea+baby corn intercropping system

   Mamathashree, C. M., Girijesh, G. K. and Dinesh Kumar, M.
   Department of Agronomy, College of Agriculture, Shivamogga

6. Studies on integrated nutrient management in paddy-groundnut cropping sequence in Coastal Zone of Karnataka

   Nagaraj, R., Hanumanthappa, M.,Narayana, S. Mavarkar and Girijesh, G. K.
   Department of Agronomy, College of Agriculture, Shivamogga

7. Performance of Foxtail millet (*Setaria italica* L.) genotypes to sowing dates in Southern Transition Zone of Karnataka

   Nandini, K. M. and Sridhara, S.
   Department of Agronomy, College of Agriculture, Shivamogga

8. Effect of fertilizer levels on growth and yield of castor hybrids in Central Dry Zone of Karnataka

   Umesha, C., Sridhara, C. J. Mavarkar, N. S., Kumar Naik, A.H., Chandrappa, D. and Gurumurthy, K. T.
   Department of Agronomy, College of Agriculture, Shivamogga

9. Genetic variability and association study of grain iron and zinc concentrations in diverse Pearl millet (*Pennisetum glaucum* (L) r. Br.) inbred lines

Mahesh Pujar, Gangaprasad, S.and Govindaraj, M.
Department of Genetics and Plant Breeding, College of Agriculture, Shivamogga

10. Development of productive and high shelf life hybrids by utilizing variability for fruit bio-chemical and morpho-physiological traitsin tomato (*Solanum lycopersicum*L.)

    Pavan, M. P., Gangaprasad, S.,Dushyanth Kumar, B. M., Mohan Kumar, H. D., Halingali, B. I. and NagrajappaAdivappa.
    Department of Genetics and Plant Breeding, College of Agriculture, Shivamogga

11. Exploitation of salinity tolerance in rice landraces through morphological, physiological and molecular characterization with farmer's participatory

    Raghavendra, P., Dushyantha Kumar, B. M., Gangaprasad, S., Halingali, B. I., Dananjaya, B. C. and Shailaja, Hittalmani.
    Department of Genetics and Plant Breeding, College of Agriculture, Shivamogga

12. Screening of chrysanthemum popular and new cultivars against *Alternaria* leaf blight under natural condition
    Divyajyothi, U., Suresh, D. Ekabote and Narayanswamy, H.
    Department of Plant Pathology, College of Agriculture, Shivamogga

13. Biological and molecular characterization of GBNV infecting solanaceous vegetable crops

    Renuka, H. M., Ganesh Naik, R. and Krishnareddy, M.
    Department of Plant Pathology, College of Agriculture, Shivamogga

14. Effect of different levels of borax application on yield and yield attributes in rice

    Prashanth, K. M., Chidanandappa, H. M., Vishwanatha Shetty, Y., Ravikumar, D., Parashuram Chandra Vamshi and Basavaraj,Naik.
    Department of Soil Science & Agricultural Chemistry, College of Agriculture, Shivamogga

15. Assessment of major and secondary nutrient status in Sigehadlu micro-watershed of southern transition zone of Karnataka by using geographic information system technique

    Rajashekhar, L.,Gurumurthy, K.T., Vageesh, T. S., Dhananjaya, B.C.,Ganapathi and Sridhar,C. J.
    Department of Soil Science & Agricultural Chemistry, College of Agriculture, Shivamogga

Poster Papers from Ph.D scholars Outside the University

1. SNP based linkage mapping and qtl analysis for fibre quality and yield traits in (*Gossypium barbadense*) L. Cotton
   Mohan Kumar N.V, Dept. of Genetics & Plant Breeding, UAS, Dharwad

2. Studies on off season production of field beans (*Lablab purpureus* L.) in coastal Andhra Pradesh
   Ede Padma, Dept. of Horticulture, Y.S.R Horticultural University, Andhra Pradesh

Best Research Paper Awards:

Best research paper awards were given in the following four categories

Name of the student	College
A. M.Sc. (Agri.) Best research papers	
Swathi G. Hegde	CoA, Agriculture, Shivamogga
Pradeep K. L.	CoA, Agriculture, Shivamogga
B. M.Sc. (Hort./Forestry) Best research papers	
Anusha R. Bhagawat	CoH, Horticulture Mudigere
Avinash	CoH, Horticulture Mudigere
C. Ph.D. (Oral Presentation) Best Research paper	
Pavan M. P.	CoH, Horticulture Mudigere
D. Ph.D. (Poster paper presentation) Best Research paper	
Mohan Kumar N. V.	University of Agricultural Sciences, Dharwad

IV. Theses Presented for Best Ph.D. Thesis Award and the Awardees

Following seventeen theses were received for the competition on Best Ph D Thesis Award

Sl. NO.	Name of the University	Name of the Student	Thesis title	Dept.
1	University of Agricultural & Horticultural Sciences, Shivamogga, Karnataka	Nishanth G.K.,	Studies on submergence tolerance mechanism in rice germplasm lines with relation to genetic, molecular and physiological aspects	Genetics & Plant Breeding
2		Adarsh S. K.,	Reproductive Status, Burrowing Behaviour And Non Chemical Management Of Leucopholis Spp. (*Scarabaeidae: coleoptera*) infesting arecanut	Agricultural Entomology
3	University of Agricultural Sciences, Bengaluru, Karnataka	M S Harish	Influence of seed treatment with nanoparticles on morpho physiological and biochemical changes in Groundnut (*Arachis hypogaea L.*)	Seed Science & Technology
4		A. Madhushree	Development of readability formula for kannada language and its application on farm publication	Agril. Extension
5	University of Agricultural Sciences, Dharwad, Karnataka	Mohan Kumar N.V	SNP based linkage mapping and qtl analysis for fibre quality and yield traits in (*Gossypium barbadense*) L. Cotton	Genetics & Plant Breeding
6		Shilpa p. Chowti	Agro-socio-economic dimensions of solid waste management in Karnataka-an economic analysis	Agricultural Economics
7	Tamilnadu Agricultural University, Coimbatore, Tamilnadu	S. Anandhi Lavanya	Induced Mutagenesis In Blackgram (*Vigna mungo* (L). Hepper) for isolation of early and synchronized mutants using gamma rays and electron beam	Genetics & Plant Breeding
8		S. Arivarasan	Economics of cassava production system and the livelihood security of farmers in hill areas of western Tamil Nadu	Agricultural Economics
9	Acharya N G Ranga Agricultural University, Guntur, Andra Pradesh	L. Suryanarayana	Studies on heterosis, gene action and stability of f1 hybrids in maize (*Zea mays L.*) for yield and yield components	Genetics & Plant Breeding

10		M. Sunil Kumar	Molecular diagnosis, biological and genetic diversity of tobacco streak virus	Plant Pathology
11	University of Agricultural Sciences, Raichur	Raghavendra	Studies on soil test based nutrient management approaches in Dry Direct Seeded Rice - Mustard Cropping System	Soil Science And Agricultural Chemistry
12		Jyothi Patil	Influence of morphometrics, biochemical parameters and flight behaviour on migration of *Helicoverpa armigera* (Hübner)	Agricultural Entomology
13	Kerala Agriculture University, Vellanikkara, Thrissur Kerala	Naveen Leno	Evaluation of a customised organic fertilizer in relation to labile carbon dynamics, nutrient release characteristics and productivity of banana	Soil Science And Agricultural Chemistry
14	Y.S.R Horticultural University, Venkataramannagudem, Andhra Pradesh,	B. Babu Rao	Morphological and molecular characterization of cassava (*Manihot esculenta Crantz*) genotypes	Horticulture
15		Ede Padma	Studies on off season production of field beans (*Lablab purpureus* L.) in coastal Andhra Pradesh	Horticulture
16	University Horticultural Sciences, Bagalkote Karnataka	Rahul S. Phatak	Studies on propagation and nutritional management along with pgpr in sarpagandha (*Rauvolfia serpentina* Benth.)	Horticulture
17		Raveendra Choudhari	Studies on effect of photoperiod, growth regulators, preservatives and chemical mutagen on chrysanthemum (*Dendranthema grandiflora Tzevelev*.) Cultivars	Horticulture

Best Ph.D thesis awards:

Following three theses were adjudged as best & received the awards

Sl No.	Name	University
1	S. Anandhi Lavanya	Tamilnadu Agricultural University, Coimbatore, Tamilnadu
2	Nishanth G.K.,	University of Agricultural & Horticultural Sciences, Shivamogga
3	Shilpa P. Chowti	University of Agricultural Sciences, Dharwad

V. NATIONAL CONFERENCE ON PG RESEARCH: THE PROGRAMME

National Conference on PG Research in Farm Universities
(8th & 9th May 2018)

Programme

8th May, 2018

(09.00 am to 10.00 am) : Registration

Inaugural session
Venue: MP Hall
(10.00 am to 11.30 am)

Chairman	:	**Dr. M. K. Naik** Hon'ble Vice Chancellor, UAHS, Shivamogga
Rapporteur	:	**Dr. Kalleshwara Swamy C. M.** Assistant Professor of Agri. Entomology, CoA, Shivamogga
Invocation (10.10 am to 10.15 am)	:	**PG Students, UAHS, Shivamogga**
Welcome & About the Conference (10.15 am to 10.20 am)	:	**Dr. T. S. Vageesh** Dean (PGS), UAHS, Shivamogga
About UAHS, Shivamogga (10.20 am to 10.25 am)	:	**Dr. P. Narayanaswamy** Registrar, UAHS, Shivamogga
Inauguration (lighting of the lamp) & Inaugural Speech (10.25 am to 10.55 am)	:	**Dr. K. Ramasamy** Hon'ble Vice Chancellor, TNAU, Coimbatore
Release of Booklet 'National PG Conference : Compendium of Research papers' (10.55 am to 11.10 am)	:	**Dr. D Rama Rao** (Former Director, ICAR-NAARM, Hyderabad) ICAR Emeritus Scientist, PJTSAU, Hyderabad
Guests of Honour	:	**Dr. (Mrs). R. Kalpana Sastry** (Former Joint Director, NAARM, Hyderabad), Tata Institute of Social Sciences, Hyderabad **Dr. M.R.N. Murthy** Scientist , Molecular Biophysics Unit, Indian Institute of Science, Bengaluru
Chairman Remarks (11.10 am to 11.20 am)	:	**Dr. M. K. Naik** Hon'ble Vice Chancellor, UAHS, Shivamogga
Vote of thanks (11.20 am to 11.30 am)	:	**Dr. M. Manjunath** Director of Education, UAHS, Shivamogga
(11.30 am to 11.40 am)	:	High Tea

Technical Session-1

Invited lectures by external experts in PG research

Venue: MP Hall
(11.30 am to 01.30 pm)

Chairman	:	**Dr. M. Manjunath** Director of Education, UAHS, Shivamogga
Co-Chairman	:	**Dr. T. H. Gowda** Director of Extension, UAHS, Shivamogga
Panelists	:	**Dr. C. G. Kushalappa** Dean (Forestry), CoF, Ponnampet
		Dr. M. Hanumanthappa Dean (Hort.), CoH, Mudigere
		Dr. H. M. Chidandappa University Librarian, UAHS, Shivamogga
		Dr. Dinesh Kumar M Professor & Univ. Head, Agronomy, CoA, Shivamogga
Rapporteur	:	**Dr. Usha T N** Asst. Professor of Seed Technology, CoA, Shivamogga

Presentation by external experts followed by discussions

(11.30 am to 12.30 pm)	:	**'Plant viruses as programmable nano-particles'** **Dr. M.R.N. Murthy** Molecular Biophysics Unit, Indian Institute of Science, Bengaluru
(12.30 pm to 01.30 pm)	:	**'Intellectual Property Rights and Agrientrepreneurship'** **Dr. (Mrs). R. Kalpana Sastry** (Former Joint Director, NAARM, Hyderabad) Tata Institute of Social Sciences, Hyderabad
Remarks by Chairman	:	**Dr. M. Manjunath** Director of Education, UAHS, Shivamogga
(01.30 pm to 02.30 pm)	:	Lunch

Technical Session-2

Invited lectures by external experts in PG research

Venue: MP Hall
(2.30 pm to 03.30 pm)

Chairman	:	**Dr. M. K. Naik** Hon'ble Vice Chancellor, UAHS, Shivamogga
Co-Chairman	:	**Dr. K. Manjappa**. Director of Research, UAHS, Shivamogga

Panelists : **Dr. B. R. Gurumurthy**
Dean (Student Welfare), UAHS, Shivamogga

Dr. R. Basavarajappa
Dean (Hort.), CoH, Hiriyur

Dr. B. Hemla Naik
Professor & Univ. Head, Horticulture, CoA, Shivamogga

Dr. H. Narayana Swamy
Professor & Univ. Head, Plant Pathology, CoA, Shivamogga

Dr. B. K. Shivanna
Professor & Univ. Head, Entomology, CoA, Shivamogga

Rapporteur : **Dr. A. Y. Hugar**
SFS, AHRS, Honnavile

Presentation by external expert followed by discussions

(2.30 pm to 03.30 pm) : **'Application of ICTs in Agriculture Research'**
Dr. D. Rama Rao
(Ex-Director, ICAR-NAARM, Hyderabad)
ICAR Emeritus Scientist, PJTSAU, Hyderabad

Remarks by Chairman : **Dr. M. K. Naik**
Hon'ble Vice Chancellor, UAHS, Shivamogga

Poster Conference

(Venue: New Examination Hall)

(3.30 pm) : Inauguration of poster conference on PG research
Dr. M. K. Naik
Hon'ble Vice Chancellor, UAHS, Shivamogga

(3.30 pm to 06.00 pm) : Presentation of research papers by PG students
- PG Research in UAHS, Shivamogga (for M.Sc. Students)
- Poster papers from theses received for best Ph.D. thesis award

9th May, 2018

Technical Session-3

Presentation of Ph.D. theses for best thesis award

Venue: MP Hall
(9.00 am to 12.00 noon)

Chairman : **Dr. H. V. Nanjappa**
Former Registrar, UAS, Bengaluru

Jury : **Dr. R. Siddaramappa**
Former Dean (PGS), UAS, Bengaluru

Dr. B. M. Khadi
Former Director of Education, UAS, Dharwad

Dr. N. T. Yaduraju
Former Director, Directorate of Weed Research, ICAR, New Delhi

Dr. T. Thangaraj
Former Dean, TNAU, Coimbatore

Dr. P. C. Hiremath
Former Dean Student Welfare & Professor (Plant Pathology), UAS, Dharwad

Dr. Chakravarthy A K
Former Head, Agril. Entomology, IIHR, Bengaluru

Dr. Balakrishna B
Principal Scientist, Div. of Social Sciences and Training, IIHR, Hessaraghatta, Bengaluru

Dr. Gajanana
Principal Scientist, Div. of Agril. Economics, IIHR, Bengaluru

Rapporteur : **Dr. Bhoomika**
Asst. Prof. & Head, Dept. of PSMAC, Shivamogga

(9.00 am to 12.00 noon) : **Presentation of Ph.D. theses for best thesis award (8 students)**

Remarks by Chairman : **Dr. H. V. Nanjappa**
Former Registrar, UAS, Bengaluru

Technical Session-4

Oral Presentation of research papers by Ph.D. scholars of UAHS

Venue: MP Hall

(12.00 noon to 02.00 pm & 03.00 pm to 04.30 pm)

Chairman : **Dr. R. Siddaramappa**
Former Dean (PGS), UAS, Bengaluru

Jury : **Dr. R. S. Kulkarni**
Former Director of Extension, UAS, Bengaluru

Dr. Chakravarthy A. K.
Former Head, Dept. of Entomology, IIHR, Bengaluru

Panellists : **Dr. K. T. Gurumurthy**
Professor & Univ. Head, SS&AC, CoA, Shivamogga

Dr. B. M. Dushyantha Kumar
Professor & Univ. Head, GPB, CoA, Shivamogga

Dr. Sharanappa Janagandi
Professor & Univ. Head, Agril. Engineering, ZAHRS, Hiriyur

Dr. G. M. Devagiri
Professor & Univ. Head, Forestry Management, CoF, Ponnampet

Rapporteur : **Dr. B. C. Dhananjaya**
Asst. Professor of SS&AC, CoA, Shivamogga.

(12.00 noon to 02.00 pm)	:	**Oral Presentation of research papers by Ph.D. scholars (15 students) of UAHS**
(02.00 pm to 03.00 pm)	:	Lunch Break
(03.00 pm to 04.30 pm)	:	**Oral Presentation of research papers by Ph.D. scholars of UAHS**

Plenary Session

Venue: MP Hall
(04.30 pm to 05.30 pm)

Chairman	:	**Dr. M. K. Naik** Hon'ble Vice Chancellor, UAHS, Shivamogga
Co-chairman	:	**Dr. P. Narayanaswamy** Registrar, UAHS, Shivamogga
		Dr. T. S. Vageesh Dean (PGS), UAHS, Shivamogga
Rapporteur	:	**Dr. Sahana S.** Assistant Professor of Agri. Extension, CoA, Shivamogga.
Announcements/ Presentation of awards (04.30 pm to 05.10 pm)	:	**Dr. H. V. Nanjappa** Former Registrar, UAS, Bengaluru
		Dr. R. Siddaramappa Former Dean (PGS), UAS, Bengaluru
		Dr. T. Thangaraj Former Dean, TNAU, Coimbatore
		(Awards presentation by dignitaries on Dias)
Concluding remarks by Chairman (05.10 pm to 05.20 pm)	:	**Dr. M. K. Naik** Hon'ble Vice Chancellor, UAHS, Shivamogga
Vote of thanks (05.20 pm to 05.30 pm)	:	**Dr. S. B. Salimath** Technical Assistant, Dean (PGS) office, UAHS, Shivamogga

*****

VI. LIST OF PARTICIPANTS

A. The list of Guests/ Experts/ Delegates from Other Universities/ Institutions

1.	Dr. K. Ramasamy, Hon'ble Vice Chancellor TNAU, Coimbatore	2.	Dr. M. R.N. Murthy Molecular Biophysics Unit, Indian Institute of Science, Bengaluru
3.	Dr. (Mrs). R. Kalpana Sastry Former Joint Director, NAARM, Hyderabad) Tata Institute of Social Sciences, Hyderabad	4.	Dr. D. Rama Rao (Ex-Director, ICAR-NAARM, Hyderabad) ICAR Emeritus Scientist, PJTSAU, Hyderabad
5.	Dr. H. V. Nanjappa Former Registrar, UAS, Bengaluru	6.	Dr. R. S. Kulkarni Former Director of Extension, UAS, Bengaluru
7.	Dr. T. Thangaraj Former Dean, TNAU, Coimbatore	8.	Dr. P. C. Hiremath Former Dean Student Welfare & Professor (Plant Pathology), UAS, Dharwad
9.	Dr. B. M. Khadi Former Director of Education, UAS, Dharwad	10.	Dr. N. T. Yaduraju Former Director, Directorate of Weed Research, ICAR, New Delhi
11.	Dr. Balakrishna, B. Principal Scientist, Div. of Social Sciences and Training, IIHR, Hessaraghatta, Bengaluru	12.	Dr. Gajanana Principal Scientist, Div. of Agril. Economics, IIHR, Bengaluru
13.	Dr. Chakravarthy A. K. Former Head, Agril. Entomology, IIHR, Bengaluru	14.	Dr Mukund G. K. Professor of Horticulture, CoA, UAS, Bengaluru
15.	Dr. Giddanavar, Former Professor, Agronomy, UAS, Dharwad	16.	Dr. C. S. Police Patil Former Dean (Forestry), UAS, Bengaluru

B. List of Guests/ Delegates from UAHS, Shivamogga.

1.	Dr. M. K. Naik Hon'ble Vice Chancellor, UAHS, Shivamogga	2.	Dr. P. Narayanaswamy Registrar, UAHS, Shivamogga
3.	Dr. T. S. Vageesh Dean (PGS), UAHS, Shivamogga	4.	Dr. K. Manjappa, Director of Research, UAHS, Shivamogga
5.	Dr. T. H. Gowda Director of Extension, UAHS, Shivamogga	6.	Dr. M. Manjunath Director of Education & Dean (Agri.), UAHS, Shivamogga
7.	Dr. H. M. Chidanandappa University Librarian, UAHS, Shivamogga	8.	Dr. M. Hanumanthappa Dean (Hort.), CoH, Mudigere
9.	Mr. K. Ganeshappa Comptroller, UAHS, Shivamogga	10.	Dr. B. R. Gurumurthy Dean (Student Welfare) & University Head, Dept. of SS&AC
11.	Dr. R. Basavarajappa Dean (Hort.), CoH, Hiriyur	12.	Mr. Gangadharappa Estate Officer, UAHS, Shivamogga
13.	Dr. B. M. Dushyantha Kumar Professor & Univ. Head, GPB, CoA, Shivamogga	14.	Dr. H. Narayana Swamy University Head, Dept. of Plant Pathology, CoA, Shivamogga
15.	Dr. B. Hemla Naik University Head , Dept. of Horticulture, CoA, Shivamogga	16.	Dr. K. T. Gurumurthy Professor & University Head, SS & AC CoA , Shivamogga
17.	Dr. G. M. Devagiri Professor & Univ. Head, Forestry Management, CoF, Ponnampet	18.	Dr. M. Dinesh Kumar Professor & University Head, Agronomy CoA, Shivamogga
19.	Dr. G. N. Thippehappa HoD, Dept. of SS&AC CoA, Shivamogga	20.	Dr. B. K. Shivanna University Head & HoD, Dept. of Agril. Entomology CoA, Shivamogga
21.	Dr. S. Gangaprasad HoD, Dept. of GPB, CoA, Shivamogga	22.	Dr. Narayana S Mavarkar Professor & Head, Agronomy, CoA, Shivamogga

23.	Dr. Gangadhar Naik HoD, Dept. of Plant Pathology CoA, Shivamogga	24.	Dr. Madaiah Professor of Horticulture, CoH, Mudigere
25.	Dr. D. Thippesha Prof. & Head, Dept. of Horticultlure, CoA, Shivamogga	26.	Dr. B. S. Shivakumar Prof. & Head, Dept. of Fruit Science, CoH, Mudigere
27.	Dr. D. Lakshmana Prof & Head, Dept. of Crop Improvement & Biotechnology, CoH, Mudigere.	28.	Dr. Bhoomika H R Asst. Professor & Head, PSMAC, CoH, Mudigere
29.	Dr. V. Srinivasa Prof. & Head, Dept. of Vegetable Science, CoH, Mudigere.	30.	Dr. Ramakrishna Hegde Assoc. Prof. and Head, Dept. of Plantation Technology, CoF, Ponnampet.
31.	Dr. Raghupathi N. Kencharaddi Asst. Professor, Dept. of Entomology, CoF, Ponnampet	32.	Dr. Nataraj S K Asst. Professor & Head, Floriculture and Landscape Architecture, CoH, Mudigere.
33.	Dr. B. Chinnappa, Former Professor & Head, Dept. of Agricultural Economics UAHS, Shivamogga	34.	Dr. H. K. Veeranna Professor of Agronomy, CoA, Shivamogga
35.	Dr. K. C. Shashidhar Professor & Head, Agril. Engineering, CoA, Shivamogga	36.	Dr. G K. Girijesh Professor of Agronomy, CoA, Shivamogga
37.	Dr. Jayalakshmi Hegde Assosc. Professor & Technical Officer to DoE, UAHS, Shivamogga	38.	Mr. H. B. Mallikarjun Asst. Professor of Agril. Statistics, CoA, Shivamogga
39.	Dr. Nandish M. S Asst. Prof. of Agril. Microbiology, CoA, Shivamogga	40.	Dr. Jayashree S Asst. Professor of Food Sci. & Nutrition, CoA, Shivamogga
41.	Dr. Jayalakshmi K Asst. Prof. of Plant Pathology, ZAHRS, Shivamogga	42.	Dr. M. Hanumanthappa ADR, ZAHRS, Brahmavar
43.	Dr. Nagarajappa Adivappar Asst. Professor of Horticulture, CoA, Shivamogga	44.	Dr. B. C. Hanumanthaswamy Head, KVK, Shivamogga
45.	Dr. Sunil C. Farm Superintendent & PG Coordinator, AHRS, Bavikere	46.	Dr. Basavaraj Beerannavar Asst. Professor of Agril. Extension. CoA, Shivamogga
47.	Dr. R. Ganesh Naik Professor of Plant Pathology CoA, Shivamogga	48.	Dr. C. Karegowda Professor of Plant Pathology, CoA, Shivamogga

49.	Dr. S. P. Nataraju Professor Crop physiology, CoA, Shivamogga	50.	Dr. S. Pradeep Professor & Coordinator, AHRS, Bavikere
51.	Dr. H. Ravindra Nodal officer & Professor of Plant Pathology, ZAHRS, Shivamogga	52.	Dr. S. Sahana Asst. Professor of Agril. Extn., CoA, Shivamogga
53.	Dr. H. D. Mohan Kumar Prof. & Special officer (Seeds), UAHS, Shivamogga	54.	Mr. T. S. Lohith Prashant Kumar Store Purchase officer, Estate office, UAHS, Shivamogga
55.	Mr. Manjappa Asst. Engineer, Estate officer, UAHS, Shivamogga	56.	Dr. K.M. Sathish Asst. Prof. of Bio-Technology, CoA, Shivamogga
57.	Dr. Basavaraja Naik, Farm Superintendent ZAHRS Shivamogga	58.	Dr. T. M. Soumya Asst. Professor of Agronomy, CoA, Shivamogga
59.	Dr. H. Ravindra Chief Scientist (Tobacco), ZAHRS, Shivamogga	60.	Dr. Basavaraja I. Hallingali Professor of Statistics, CoA, Shivamogga
61.	Dr. C. J. Shridhar Prof.& Controller of Examination, UAHS, Shivamogga	62.	Dr. Nagarajppa Adivappar Asst. Professor of Horticulture, CoA, Shivamogga
63.	Dr. S. Shivanna Professor of GPB, CoA, Shivamogga	64.	Dr. Jayalaxmi Narayan Hegde Technical Officer to Director of Education, UAHS, Shivamogga
65.	Dr. Suresh D. Ekbote Professor of Plant Pathology, CoH, Hiriyur	66.	Mr. R. Krishna Naik Asst. Professor, Computer Science, CoA, Shivamogga
67.	Dr. S. Sridhara Associate Professor of Agronomy, CoA, Shivamogga	68.	Dr. Satish Naik Asst. Professor, Dept of Agricultural Engineering, CoA, Shivamogga
69.	Dr. Annappa Y Hugar Farm Superintendent, AHRS, Honnavile	70.	Dr. Kalleshwara swamy Asst. Prof. of Agril. Entomology, CoA, Shivamogga
71.	Mr. Basavaraj H. Bhogi Asst. Prof. of Agril. Engineering, CoA, Shivamogga	72.	Dr. B.C. Dhananjaya Asst. Professor of SS&AC, CoA, Shivamogga
73.	Dr. Sarvajna B. Salimath Technical Assistant Dean PGS Office UAHS Shivamogga	74.	Mr. R. Nagaraja Training Assistant, KVK, Shivamogga
75.	Dr. Kantharaj.Y Asst. Professor,Mudigere	76.	Dr. Sharanabasappa Assistant Professor of Agri. Entomology, CoA, Shivamogga

C. List of PG students who presented research papers in the Conference

i. Ph.D. students from CoA, UAHS, SHIVAMOGGA

Sl. No.	Name	Department
1.	Ashrith, K. N	Agricultural Entomology
2.	IndhusriChavan	Agricultural Entomology
3.	Latha, M	Agricultural Entomology
4.	NarayanaSwamy, K.C	Agricultural Entomology
5.	Mamathashree, C. M	Agronomy
6.	Nagaraj, R	Agronomy
7.	Nandini, K. M	Agronomy
8.	Umesha, C	Agronomy
9.	Mahesh Pujar	Genetics and Plant Breeding
10.	Pavan, M. P	Genetics and Plant Breeding
11.	Raghavendra, P	Genetics and Plant Breeding
12.	Divyajyothi, U	Plant Pathology
13.	Renuka, H. M	Plant Pathology
14.	Prashanth, K. M.	Soil Science and Agricultural Chemistry
15.	Rajashekhar, L	Soil Science and Agricultural Chemistry

ii. M.Sc students from COLLEGE OF AGRICULTURE, SHIVAMOGGA

Sl. No.	Name	Department
1.	Jahantaj, K.A	Agricultural Entomology
2.	Meghana, N	Agricultural Entomology
3.	Namitha, N. V	Agricultural Entomology
4.	Niranjankumar, K. V	Agricultural Entomology
5.	PoojaKarane	Agricultural Entomology
6.	Priyanka Patil S.U	Agricultural Entomology
7.	Satish S. B	Agricultural Entomology
8.	Smitha O. R	Agricultural Entomology
9.	Swathi G	Agricultural Entomology
10.	Venugopal H. M	Agricultural Entomology
11.	Venukumar S	Agricultural Entomology
12.	Ashwini A. Y	Agronomy

13.	Chaithra .G. M	Agronomy
14.	Chandrashekhar	Agronomy
15.	Gajanana Kuri	Agronomy
16.	Manjunatha. U. B	Agronomy
17.	Megha B	Agronomy
18.	Raagavalli K.	Agronomy
19.	Savita S.P	Agronomy
20.	Shruthi. G	Agronomy
21.	Shwethanjali. K. V	Agronomy
22.	Gayathri, G. N	Agricultural Extension
23.	Kavyashree, C	Agricultural Extension
24.	Mamata, V. N	Agricultural Extension
25.	Sagar, S. Pujar	Agricultural Extension
26.	Shrikant	Agricultural Extension
27.	SubhashKalagi	Agricultural Extension
28.	Avinash Kumar	Genetics and Plant Breeding
29.	Bheemareddy	Genetics and Plant Breeding
30.	Bhuvaneshwari	Genetics and Plant Breeding
31.	Chandana B. R	Genetics and Plant Breeding
32.	HasanaliNadaf B.N	Genetics and Plant Breeding
33.	Mutturaj	Genetics and Plant Breeding
34.	Prashantha, B. N	Genetics and Plant Breeding
35.	Rangaswamy D. M	Genetics and Plant Breeding
36.	Sachin Kumar H. M	Genetics and Plant Breeding
37.	VinuthaPatil, S	Genetics and Plant Breeding
38.	Ashwini, B. N	Plant Pathology
39.	Kavay Mashaldi	Plant Pathology
40.	Maheshwary N. P	Plant Pathology
41.	Manjunath B	Plant Pathology
42.	NailaShohrat	Plant Pathology
43.	Nandappa Chorgasti	Plant Pathology
44.	Pruthviraj	Plant Pathology

45.	Sannajambanna	Plant Pathology
46.	Ananda Sajjan	Soil Science and Agricultural Chemistry
47.	Harshitha S	Soil Science and Agricultural Chemistry
48.	Pradeepa K. L	Soil Science and Agricultural Chemistry
49.	Ranjitha P	Soil Science and Agricultural Chemistry
50.	Shobha T	Soil Science and Agricultural Chemistry
51.	Sushmitha C.V	Soil Science and Agricultural Chemistry
52.	Sushmitha. N. Swamy	Soil Science and Agricultural Chemistry
53.	Yashawanthkumar. S. M	Soil Science and Agricultural Chemistry

iii. M.Sc. students, COLLEGE OF HORTICULTURE, MUDIGERE

Sl. No.	Name	Department
1.	Chandan, B. M	Crop Improvement and Biotechnology
2.	Rakshith, M	Crop Improvement and Biotechnology
3.	Santosh Kumar, P	Crop Improvement and Biotechnology
4.	Sowmya, H. M	Crop Improvement and Biotechnology
5.	Sunil, G	Crop Improvement and Biotechnology
6.	Apoorva, J. J	Entomology
7.	Avinash	Entomology
8.	Meghan, J	Entomology
9.	Srinivas, M. P	Entomology
10.	Venukumar, S	Entomology
11.	Mythri, P. G	Entomology
12.	Akshata, A. S	Floriculture & Landscape Architecture
13.	Bhargavi, S. P	Floriculture & Landscape Architecture
14.	Priyanka, S. Holkar	Floriculture & Landscape Architecture
15.	Ramya, H. M	Floriculture & Landscape Architecture
16.	Roopa, S	Floriculture & Landscape Architecture
17.	Vidyashree	Floriculture & Landscape Architecture
18.	Vibha V Rao	Floriculture & Landscape Architecture
19.	Alam Khan Samim	Fruit Science
20.	Ayesha Siddiqua	Fruit Science
21.	Lokesha, R	Fruit Science
22.	Nisarga, G	Fruit Science

23.	Pooja, G. K	Fruit Science
24.	Rakesh, S. H	Fruit Science
25.	Sampada, C.M	Fruit Science
26.	Usha, D. S	Fruit Science
27.	VaniKumbar	Fruit Science
28.	Anitha, T. M	Plantation, Spices, Medicinal and Aromatic Crops
29.	Pallavi, C. R	Plantation, Spices, Medicinal and Aromatic Crops
30.	Priyanka, B. M	Plantation, Spices, Medicinal and Aromatic Crops
31.	Rakshith Kumar, R	Plantation, Spices, Medicinal and Aromatic Crops
32.	Saif Ali Khan	Plantation, Spices, Medicinal and Aromatic Crops
33.	Sannidhi, H. S	Plantation, Spices, Medicinal and Aromatic Crops
34.	Anusha Bhagwat	Vegetable Science
35.	Kavya, V. N	Vegetable Science
36.	Manasa, G. D	Vegetable Science
37.	Sahana, P	Vegetable Science
38.	Shanwaz, A	Vegetable Science
39.	Sharavati, M.B	Vegetable Science
40.	Shubha, A. S	Vegetable Science

iv. *M.Sc. students* , COLLEGE OF FORESTRY, PONNAMPET

Sl. No.	**Name**	**Department**
1.	Vilaskumar,	Silviculture & Agroforestry


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