I. INTRODUCTION

Higher productivity, resource use efficiency, increased cropping intensity, vertical expansion, urban-forestry, diversification, value addition are the most viable options to enhance the growth in agriculture and doubling farmers income. Productivity of most of the crops is below world average and much lower than agriculturally advanced countries. Production constraints specific to each zone have to be identified and tackling the same would reduce the gap in yield to a major extent.

University with a focus on climate resilient agriculture addresses the issues that are specific to given location and the issues emerging both at zonal and national by developing the technologies that bridge the technological gaps through multi-disciplinary approach for sustainable development in food, nutrition and economic security and thus improve the farmers livelihood status.

UASB has a vision to generate cutting edge farm technologies to address the challenges of agriculture sector in the state by orienting research activities from basic to advanced research. The emphasis on demand-driven and farmer-centric research has helped the university to develop technologies that are readily accepted by farming community.

Karnataka being highly dependent on rainfed agriculture, crop production mainly depends on successful implementation of the soil, water, and nutrient management technologies. University has developed around 251 crop production technologies. It includes practices from defining spacing, seed rate, intercropping, irrigation and fertigation, optimal levels of fertilizer usage specific to each crop, micro-nutrient application, agro-forestry, integrated nutrient management and farming systems modules, efficient weed management practices and farm mechanization to setting vertical expansion solutions like hydroponics.

Insects, plant disease, nematodes and rodents are among the many enemies that reduce crop yields. They destroy the crop in a relatively short time. Climate change aggravates pests and diseases by increasing temperatures, which expands their geographic ranges, and altering precipitation and humidity, which can lead to more frequent and intense outbreaks. Control measures for many years have engaged the attention of farmer and scientist, yet full success has not been achieved, and the battle continues. The problem is further complicated by the fact that control measures not only kill unwanted insects, but also may harm honey bees as well as the parasites and predators that destroy insect pests. University has developed 102 crop protection technologies with the chemicals being updated over time as per its efficacy while some are integrated in its approach.

The diverse agro-climatic conditions prevailing in the state are quite congenial for growing different horticulture crops, successfully, almost throughout the year.

The usefulness of Horticulture has been specially felt in scanty rainfall and drought prone areas of the state, as several perennial horticulture crops provide an effective drought proofing against the odds of the nature and assure the farmers satisfactory returns even during the years of deficit rainfall. This is the reason why horticulture crops are fast replacing agriculture crops in dry tracts of the state. Considering the response to the increasing awareness for nutritional security, consumption of protective foods such as fruits and vegetables, UASB, has developed 129 technologies that have helped to hike production process.

The contribution of agri-allied sectors viz., sericulture, livestock (including dairy, sheep, goat, poultry and piggery) and fisheries (marine, inland and aqua farming) sector has high potentiality to double the income of the farmers. Urban beekeeping and knowledge on significance of apiary in cross pollinated crops is expanding. UASB has developed 29 such technologies that boost the contribution of agri-alied sectors towards sustainability.

Efficient storage practices reduce major part of losses due to pest infestation and improper storage bags. UASB has developed 19 such technologies that reduce the loss at storage. Irrespective of crop production, protection, horticulture or other agricultural activities, abstract on number of technologies other than crop varieties developed by scientists of different departments of the university and included in PoP of UASB from 2000 to 2025 are presented in Table-1. Over the last 25 years, university has developed 530 technologies (Figure-1) that has uplifted the status of the farmers and has significantly enhanced the contribution of agriculture towards the state's growth.

The University of Agricultural Sciences, Bangalore is not only a hub for innovation but a catalyst for commercialization and rural entrepreneurship. In its vast portfolio of over 330 high yielding crop varieties and hybrids, the university has successfully commercialized 23 elite varieties and hybrids, empowering seed companies and farming communities with reliable, high performance genetic material. Beyond the field, UAS Bangalore has developed over 86 value-added food products (37 ready-to-cook and 49 ready-to-eat formulations) such as nutrient-rich bakery and confectionery items. Sugar & maida free bakery products developed are tailor-made for health-conscious consumers and are ideal for startup ventures in food processing. 44 of these products have already entered commercial markets, creating new opportunities in agri-food enterprises. In the domain of farm mechanization, UASB has engineered 31 innovative and cost-effective machineries and implements designed specifically for small and medium-scale farmers.

Table-1: Abstract of technologies developed (2000-2025) by different departments

Department	Agronomy	SS & AC	Physiology	Microbiology	Seed technology	Entomology	Pathology	Sericulture	Apiculture	Horticulture	Food & Nutrition	Forestry & Envi. Science	Animal science	Agri. Engineering	Total
2000	5	0	0	0	0	1	2	0	0	0	0	0	0	0	**8**
2001	2	2	0	0	0	0	0	0	0	1	0	0	0	0	**5**
2002	8	0	0	0	0	3	2	0	0	0	0	0	9	0	**22**
2003	1	0	1	0	0	1	0	0	0	1	0	0	0	3	**7**
2004	4	3	1	0	0	2	12	1	0	0	0	1	0	0	**24**
2005	3	2	1	0	0	2	5	1	0	0	0	0	0	0	**14**
2006	9	7	1	0	0	4	3	0	0	1	0	0	0	0	**25**
2007	7	6	0	0	0	9	2	0	0	0	0	0	0	0	**24**
2008	4	3	1	0	0	10	5	0	0	2	2	0	0	0	**27**
2009	12	2	0	0	2	5	1	0	0	2	0	0	0	1	**25**
2010	10	1	0	0	0	5	0	0	0	0	0	0	0	0	**16**
2011	3	3	1	0	0	6	3	0	0	1	1	0	0	5	**23**
2012	9	1	0	0	0	3	5	0	0	2	0	0	0	1	**21**
2013	0	4	1	0	0	3	1	1	0	0	0	0	0	1	**11**
2014	4	0	0	0	0	0	4	1	0	0	0	0	2	2	**13**
2015	10	1	0	0	1	2	3	1	0	0	0	0	0	0	**18**
2016	7	3	0	0	0	0	3	0	0	6	0	0	0	0	**19**
2017	12	9	0	0	0	5	5	0	0	2	0	1	0	0	**34**
2018	6	0	0	0	0	3	5	1	0	0	0	0	0	1	**16**
2019	8	0	0	1	0	5	3	0	0	1	0	0	0	0	**18**
2020	9	0	0	0	0	3	5	0	0	0	0	0	0	1	**18**
2021	4	5	0	0	4	3	7	3	1	0	0	0	0	1	**28**
2022	10	6	0	0	0	7	11	1	2	0	0	0	0	0	**37**
2023	8	3	0	2	0	10	5	0	0	2	0	0	0	2	**32**
2024	10	0	0	0	1	3	1	0	2	0	0	0	0	2	**19**
2025	13	2	0	0	0	5	3	1	0	2	0	0	0	0	**26**
Total	**177**	**74**	**7**	**3**	**7**	**100**	**98**	**10**	**5**	**22**	**2**	**2**	**11**	**19**	**530**

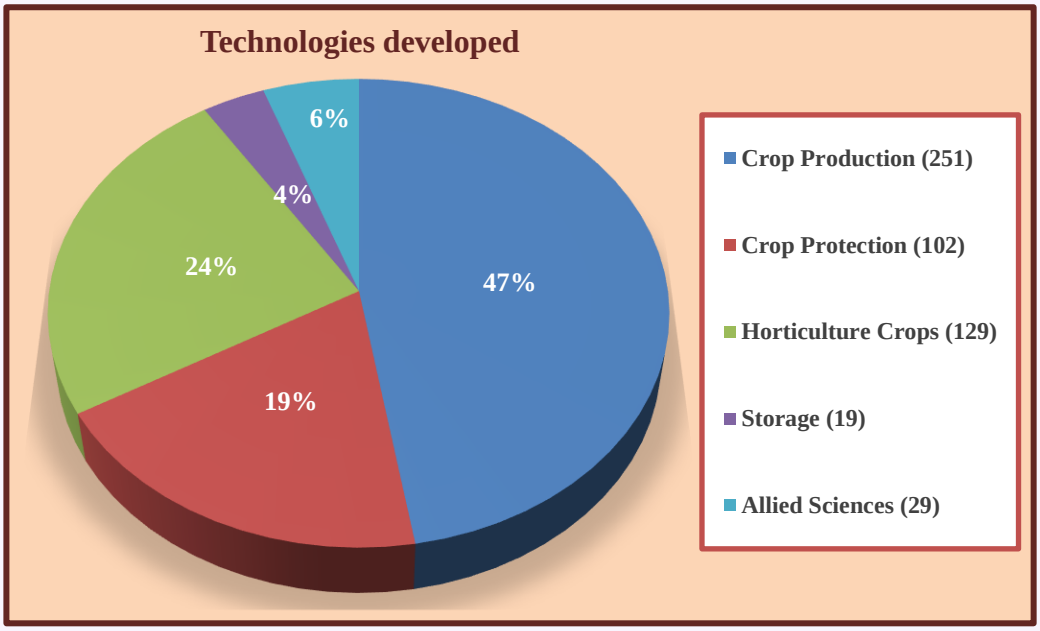


Fig-1: Technologies developed & included in PoP of UASB (2000-2025)

Best Practices led to policy formulation

- ✓ **Redefined the Drought Declaration Criteria:** GOI has Updated Manual for Drought Management 2016 and revised the criteria for declaration of drought in the country based on recommendations from UASB (research during the period 2011-2017)
- ✓ **Silicon in Soil and Plant Nutrition:** UASB has established crop response to external application of Silicon. This enabled more than 50 companies in India to produce and make silicon products suitable for Indian agriculture. Accordingly, the Central Fertilizer Committee, GoI, included Silicon components in Fertilizer Control Order
  - Diatomite Amorphous Silica in S. O. 1446 (E) dated 2017
  - Orthosilicic acid (2.0% WSL) in S. O. 5887 (E) dated 2018 & FCO, 2019b
- ✓ **Agro-climatic Atlas of Karnataka:** Atlas serves as baseline and presents detailed climate & soil information and agricultural scenario at micro and meso scale in 176 taluks of Karnataka. It serves as dictionary of weather that could be used by line departments
- ✓ University has generated detailed Land Resource Inventory (LRI) Atlas in both Kannada and English for 1398 micro-watersheds, covering an area of 8.9 lakh hectares under Sujala-3, Watershed Development to Prevent Drought Program (WDPD) and

Rejuvenating Watersheds for Agricultural Resilience through Innovative Development (REWARD) projects in Karnataka

- ✓ UAS-Bangalore has generated 10,47,356 LRI card's comprising information on permanent land features, soil fertility, land capability classification, land suitability for crops for increasing the productivity of the land/soil. Through such impactful interventions, UAS Bangalore continues to bridge the gap between research, practice, and policy

High impact break through interventions

- ✓ Occurrence of Fall Army Worm, *Spodoptera frugiperda* on Maize crop, a New Invasive Pest in Karnataka was first reported by UASB. In Karnataka incidence was also noticed on Sorghum and finger millet, the preferred host plants include Popcorn and Sweet corn. The Adhoc recommendation issued by UASB reduced the incidence (12-48%) in Bangalore Rural and Chikkaballapur districts during 2018
- ✓ Ten villages (Jyothimallapura, T.Kodihalli, Huvinahalli, Nagenahalli, Talaluru, Thalaluthore, Balenahalli, Kinnarahalli, Halenahalli and Malligevalu) are considered as smokeless villages. 472 farmers associations were formed, 123972 farmers were trained, 270 biogas units were established, 2500 training programs were conducted. 25 biogas-based power generation units have been established in the farmers land as a PPP model by Biofuel unit of UASB
- ✓ Karnataka state's maiden hatchery of Genetically Improved Farm Thilapia (GIFT) is established at UASB. It is the only all male seed production hatchery for GIFT, in the state
- ✓ UASB is the only SAU in the state, offering hands-on training on freshwater pearl culture

Genome sequencing

UASB has the credit of pioneering in sequencing both crop plants and pathogens/Microbes which are available for the Scientific community to improve the traits and thereby increase the production. The increasing availability of DNA sequence information enables the discovery of genes and molecular markers associated with diverse agronomic traits creating new opportunities for crop improvement.

- ✓ Finger Millet (ML-365): Sequenced for the first time in the world
- ✓ Horsegram (PHG-9): Horsegram Genome was decoded for the first time in the world
- ✓ Finger millet (PR-202): 1.2 Gb of Genome (118.8 Crore Base) & 62,348 genes were predicted

- ✓ Dolichos bean: 350 Mb of Genome that has good synteny with Mung bean & soybean
- ✓ Predicted 44,495 genes in the Neem genome, of which 32,278 genes were expressed in Neem tissues
- ✓ Sandalwood: 38,119 genes were identified, Santalol biosynthesis genes are cloned in the lab and DNA biomarkers for onset of oil formation are identified
- ✓ Whole genome sequence of four virulent Magnaporthe isolates in Pearl millet, Barnyard millet, Finger millet and Foxtail millet were sequenced using the Illumina HiSeq platform in paired-end (PE) mode. *Sequencing of Magnaporthe infecting barnyard millets & foxtail millets is first time in the world*
- ✓ Metagenome sequencing of GPU 28 and Uduru Mallige (local variety) of Ragi helped to identify 1029 species (includes obligate endophytes) of microbiota
- ✓ Genome sequencing of pathogens responsible for Blast infestation *Magnaporthe oryzae* in Indica Rice -56,284 genes were identified for the first time in the Country
- ✓ Yellow Mite was attempted for the first time with good qualitative & quantitative genomic DNA and necessary genomic libraries of appropriate size have been created.
- ✓ Total of 723 DNA sequences (ITS2 - 493; Mitochandria: Mt.COI - 230) of 76 species of mites are submitted to NCBI - GenBank database. It paves a way to study the genetic variability of plant associated mite species across host plants and geographical locations. All the submitted sequences have been reviewed & released into the public domain of NCBI-GenBank and other linked databases of Europe & Japan, also now available for bioinformatics and computational research studies

Water saving technologies

- ✓ Discovery of genes regulating constituent physiological traits of Water Use Efficiency in paddy: Automated mini-lysimeter and imaging technologies were used to identify the genes responsible for water use efficiency in paddy. Four genes viz., OsRLK5, OsHXK4, OsGSTU12 and OsYUCCA4 were identified and they can be used to improve WUE in paddy through molecular breeding and/or genetic engineering
- ✓ Reduced Runoff Farming: Conceptualizing drylands with rainfall above 750 mm as irrigated ecosystem, a water and energy secured polyhouse based rainwater harvesting and sustainable production system. This module supports commercial crop under protected cultivation for 220-250 days annually with only harvested rain water
- ✓ Drip Irrigation in aerobic rice saves water (45-55%) apart from reducing methane emission (18 to 20 kg/ha) almost five times less over surface flooded irrigation (95 to 100 kg/ha)

- ✓ Drip Fertigation: Irrigation with nitrogenous and potassic fertilizer in different splits at weekly / fortnightly interval upto flowering enhanced nitrogen use efficiency upto 65 % & Potassium use efficiency upto 80%
- ✓ Alternate wetting and drying method of water management in transplanted Paddy saves 37% total water used as compared to conventional irrigation, 70% higher water use efficiency and reduces 25% greenhouse gas emission in transplanted paddy.
- ✓ Hydroponic systems are customized and modified according to recycling and reuse of nutrient solution and supporting media. Various soilless agriculture models are demonstrated at GKVK viz., aquaponics, dutch bucket system, EBB and flow method, nutrient film technique, ginger/turmeric vertical farming, mixed cropping with dragon fruit and sweet pepper precision farming in grow bags. Higher yields can be obtained since the number of plants per unit is higher compared to conventional agriculture.
- ✓ Research results on microgreens by UASB is promising enough to change the microgreens cultivation scenario from niche culinary ingredients to a global superfood grown in urban balconies, rooftops, and vertical farms. UASB has designed the training programme to empower participants *viz.*, farmers, students, entrepreneurs, and nutrition enthusiasts with practical knowledge and skills in the fast-evolving domain of microgreens cultivation.

II. CROP PRODUCTION TECHNOLOGIES

Introduction

Crop production depends on the successful implementation of the soil, water, and nutrient management technologies. World resource institute, USA has reported in 2018 that by 2050 the food production needs to be increased by 50% more than the present levels to satisfy the needs of around 10 billion people. Much of the increase would have to come from intensification of agricultural production. Importance of wise usage of water, nutrient management, and tillage in the agricultural sector for sustaining agricultural growth and slowing down environmental degradation calls for urgent attention of researchers, planners, and policy makers.

University over the past 25 years have developed around 251 crop production technologies that enhances the yield, quality of produce and safety while also taking into consideration the increasing demand for food, diminishing water and land resources, and the agricultural consequences of climate change on crop production.

University has oriented its research activities in such a way that not just the cereals, pulses and oilseeds even millets, commercial crops, fodder crops have got their due weightage (Fig-2). Technologies developed over the years specific to irrigated (33) and rainfed (54) or under both (164) situations have been enlisted in the Table-2. The emphasis has been on providing the details of the technologies over the vast principles of each topic as enlisted in the Table-3.

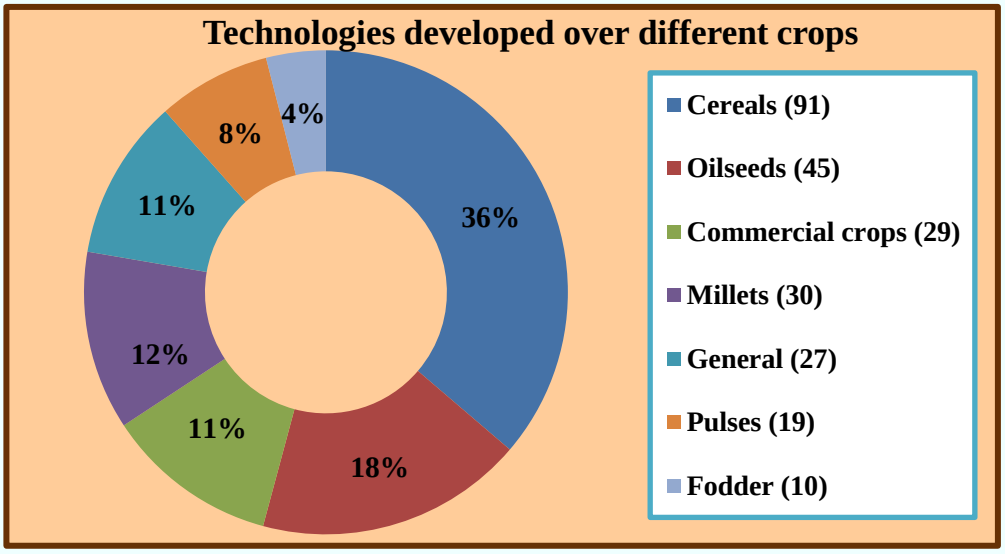


Fig-2: Crop production technologies developed over different crops

Note: Figure in parenthesis indicate number of technologies

Table-2: Crop production technologies developed during 2000-2025

Year	Both	Irrigated	Rainfed	Total
2000	3	0	2	**5**
2001	1	3	0	**4**
2002	5	0	2	**7**
2003	4	1	0	**5**
2004	4	0	4	**8**
2005	5	0	1	**6**
2006	3	1	9	**13**
2007	1	4	8	**13**
2008	2	2	0	**4**
2009	2	4	7	**13**
2010	5	1	4	**10**
2011	9	1	1	**11**
2012	7	0	4	**11**
2013	5	0	0	**5**
2014	5	0	0	**5**
2015	8	3	0	**11**
2016	9	0	0	**9**
2017	13	2	3	**18**
2018	4	0	1	**5**
2019	8	1	0	**9**
2020	7	1	0	**8**
2021	11	1	0	**12**
2022	16	0	0	**16**
2023	8	1	6	**15**
2024	9	3	1	**13**
2025	10	4	1	**15**
Total	**164**	**33**	**54**	**251**

Table-3: Abstract of crop production technologies developed for inclusion in PoP

Sl. No.	Particulars	No.
1	Nutrient management	95
2	Weed management	52
3	Farm mechanization	19
4	Intercropping	14
5	Newer additions/ modifications in package of practices	16
6	Problematic Soil	14
7	Other practices	10
8	Seed rate/ spacing/ planting geometry	8
9	Irrigation	5
10	Hydroponics	3
11	Microbiology	5
12	Sowing Window	3
13	Seed Priming	3
14	Integrated farming system module	2
15	Drone Usage	1
16	Rain water harvesting/ Runoff Farming	1
	Total	**251**

2.1 Sowing window

2024

- **Revalidation of date of sowing and varieties of paddy for late transplanting under delayed monsoon in the context of climate change:** In transplanted rice for extended sowing due to delayed monsoon in the context of climate change, the nursery sowing taken up to 30 days delayed condition for rice varieties viz., IR 64, MTU 1010 and Jyothi recorded statistically similar yield (4296 to 5928 kg/ha) as compared to their normal dates of sowing. Similarly, the nursery sowing taken upto 15 days delayed condition for rice varieties viz., raksha, hamsa, rasi and KMP-175 recorded statistically similar yield (4943 to 5858 kg/ha) as compared to their normal dates of sowing.

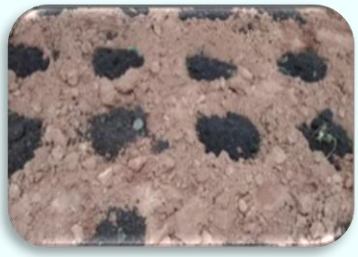
2023

- **Suitable sowing windows in foxtail millet in the context of climate change:** Sowing foxtail millet in the first fortnight of July compared to the current recommendation (August: grain: 11.8 q/ha; fodder: 2.2 t/ha) recorded 19.5% higher grain yield (14.1 q/ha), 20% higher fodder yield (2.6 t/ha) with B:C ratio of 2.35:1.
- **Suitable sowing windows in browntop millet in the context of climate change:** Sowing browntop millet in the first fortnight of July compared to current recommendation (June: grain: 9.7 q/ha & fodder: 2.1 t/ha) recorded 18.6% higher grain yield (11.5 q/ha), 16.5% higher fodder yield (2.4 t/ha) with B:C ratio of 2.3:1.

2.2 Seed rate/ spacing/ planting geometry

2024

- **Effect of planting geometry and planting on growth and yield of finger millet in guni method:** Guni method of Ragi cultivation: Guni method of cultivating (transplanting finger millet in guni(pit) with 30 cm x 30 cm spacing, farmyard manure application at 12.5 t/ha equally distributed among all pits followed by planking operation at 20 and 40 days after transplanting) has resulted in 23% higher grain (31.6 q/ha) and 18.8 % higher straw yield (61.5 q/ha) with a benefit cost ratio of 2.99:1 as compared to the recommended practice (7.5 t/ha farm yard manure and transplanting - grain yield: 25.6 q/ha and straw yield: 51.71 q/ha).



Formation of Guni / Pits and filling with FYM

Root growth in ragi sown using seed drill

Root growth in guni method

2023

- **Suitable spacing for enhance yield in browntop millet:** Sowing seed with 18 inch row to row spacing and 4 inch plant to plant spacing compared to current recommendation (12 inch spacing: grain: 11.7 q/ha & fodder: 2.3 t/ha) resulted in 20% higher grain yield (14.1 q/ha) and fodder yield (17.9%, 2.7 t/ha) with B:C ratio of 2.74:1.

18" x 4"

12" x 4"

2022

- **Optimization of seed rate for tractor operated drill sown finger millet:** Seed rate of 8 kg/acre is found to be optimum for sowing finger millet using tractor drawn seed drill compared to 20 kgs/acre seed rate in broadcasting method saving 12 kg/acre seeds.

- **Spacing under organic farming of nutri-cereals:** Spacing of 30x75cm for organic production of foxtail millet, little millet, kodo millet, browntop millet, proso millet and barnyard millet is found to be optimal.

2021

- **Suitable planting geometry and intercrops in top feeds for higher green forage yield & quality:**
  - ✓ Cultivation of top feeds like sesbania, erythrina & drum stick with a row spacing of 6 ft. and 1.5 ft. from plant to plant recorded additional green forage (67.1 q/ha), dry matter (16.7q/ha) & crude protein yield (2.9 q/ha) with additional net returns (Rs. 14,000/ha).
  - ✓ Cultivation of 2 rows B x N hybrid with a row spacing of 3 feet & 2 feet from plant to plant in between rows of top feeds recorded additional green forage yield (429.6 q/ha), dry matter (77.5 q/ha) & crude protein (7.9 q/ha) yield with additional net returns (Rs. 52,100 /ha).

2012

- **Paired row planting of sorghum for higher yield:** Paired row (30-60-30 cm) planting and opening of a furrow in wide rows (60 cm) at 35 DAS improves *rabi* sorghum yield, due to moisture conservation in Zone-4
- **Economize the seed rate for paddy:** Based on test weight (size of the seeds) and two seedlings / hill, seed rate in paddy has been revised as 33 kg/ha for coarse / bold varieties, 28kg/ha for medium & 18 kg / ha for fine grain varieties in Zone-6.

2011

- **Studies on spacing in castor:** Sowing of castor in July with 120x60 cm spacing recorded higher yield under rainfed situation in Zone-7.

2007

- **High planting density of maize under rainfed situation:** Under rainfed situation, it is recommended to cultivate maize for grain purpose with spacing of 45 x 30 cm with high planting density to realize increased grain yield (77 q/ha) and straw yield (83 q/ha). High planting density results in thin stems which are more palatable to animals.

2006

- **Wide row spacing in sugarcane:** Wide row spacing cultivation with 20% saving in seed rate in sugarcane gives on par cane yield, sugar yield and juice quality

2.3 Seed priming

2024

- **Priming technology in Paddy:** Priming the seeds for 30 hrs in water then drying it for 24 hrs after that coating uniformly with *Trichoderma harzianum* @ 15g/Kg and drying for 30 minutes before sowing has increased the plant stand (85.25%) and seed yield (43.07 q/ha) with B:C ratio of 1.31:1.

2021

- **Validation of suitable pre-sowing seed treatment to improve plant establishment in dry direct seeded rice method:** Seeds are to be soaked in either $ZnSo_4$ @ 3 % (25.8 q/acre) or $CaCl_2$ @ 2 % (25.4 q/acre) for 16 hours and shade dried before sowing to get higher field emergence, plant population and higher grain yield.

Control

$CaCl_2$ (2 %)

$ZnSo_4$ (3 %)

- **Biological seed treatment of proso millet for higher yield and quality enhancement:** Proso millet seeds primed with 20% liquid *Pseudomonas fluoresces* (adopting 1:1 seed solution ratio) for 6 hrs and dry for 8 hours under shade before sowing enhances seed vigor (10%), seed germination (8%) and seed yield (12%).

2005

- **Pre-sowing treatment of groundnut kernels for better yield:** Pre-sowing treatment of groundnut kernels in water (1:1 weight: volume) for 16 h followed by shade drying and dressing with thiram @2.5g/kg of kernels gives better yields in Zone-5.
- **Mechanical scarification of dormant seeds in *Stylosanthes* sp:** Mechanical scarification of dormant seeds for 10 minutes can be practices to break the seed dormancy in *Stylosanthes* sp.

2.4 Nutrient management

2025

- **Effect of fertigation on yield of maize under paired row planting system:** The paired row planting system in maize (30 cm between paired row as well as plants and 60 cm between rows) enhances water and nutrient efficiency by optimizing root zone coverage through drip irrigation. Irrigation is to be provided once in 2-3 days considering the (0.8 Epan value) prevailing climatic condition. 25% of the recommended phosphorus is applied as basal dose through conventional fertilizers.

Complete dose of N&K along with 75% of recommended P applied through fertigation scheduled from 15th day to 85th days after sowing at four days interval enhances the grain (70-76 q/ha) and by 14% and fodder yield (21-23 t/ha) by 10% with 2.46:1 B:C ratio as compared to soil application of conventional fertilizers (yield: 62-65 q/ha, fodder: 19-20 t/ha, B:C ratio – 2.43:1).

Soil Application

Drip Fertigation

- **Effect of fertigation on yield of baby corn under paired row planting system:** The paired row planting system in baby corn (30 cm between paired row and 15 cm between plant to plant and 60 cm between rows) enhances water and nutrient efficiency by optimizing root zone coverage through drip irrigation. Irrigation is to be provided once in 2-3 days considering the (0.8 Epan value) prevailing climatic condition. 25% of the recommended phosphorus is applied as basal dose through conventional fertilizers. Complete dose of N&K along with 75% of recommended P applied through fertigation scheduled from 10th day to 65th days after sowing at four days interval enhances the cob yield (12-13 t/ha) by 15% and fodder yield (27-30 t/ha) by 10% with 2.42:1 B:C ratio as compared to soil application of conventional fertilizers (cob yield: 10-11 t/ha, fodder: 21-26 t/ha, B:C ratio – 2.28:1).

Soil Application

Drip Fertigation

- **Application of organic manures in niger:** Under organic conditions, Basal application of two tons compost /farm yard manure + N equivalent of 8 kg Nitrogen through compost /farm yard manure, 500 litres of jeevamrutha should be applied before intercultivation and spraying 3% panchagavya during flowering stage (6 litres panchagavya can mix it with 200 litres water) recorded yield of 6.6-6.7 q/ha and B:C ratio of 1.94:1 **or** Basal application of Two tons compost /farm yard manure + N equivalent of 8 kg Nitrogen through compost /farm yard manure, 72 kg Cakes and 250 litres of jeevamrutha should be applied before inter cultivation and spraying 3% panchagavya during flowering stage (6 litres panchagavya can mix it with 200 litres water) recorded yield of 6.4-6.5 q/ha and B:C ratio of 1.89:1. This practice enhanced the organic carbon in soil from 0.45% to 0.82 per cent.
- **Application of organic manures in groundnut:** Under organic conditions, Basal application of Three tons compost /farm yard manure + N equivalent of 10 kg Nitrogen through compost /farm yard manure, 625 litres of Jeevamrutha should be applied before inter cultivation and spraying 3% panchagavya during flowering stage (6 litres panchagavya can mix it with 200 litres water) recorded yield of 23 q/ha and B:C ratio of 2.8:1 **or** Basal application of three tons compost /farm yard manure + N equivalent of 10 kg Nitrogen through compost /farm yard manure, 90 kg Cakes and 313 litres of jeevamrutha should be applied before inter cultivation and spraying 3% panchagavya during flowering stage (6 litres panchagavya can mix it with 200 litres water) recorded yield of 22 q/ha and B:C ratio of 2.74:1. This practice enhanced the organic carbon in soil from 0.41% to 0.89 per cent.
- **Application of organic manures in sunflower:** Under organic conditions, Basal application of three tons compost /farm yard manure + N equivalent of 15 kg Nitrogen through compost /farm yard manure, 938 litres of jeevamrutha should be applied before inter cultivation and spraying 3% panchagavya during flowering stage (6 litres panchagavya can mix it with 200 litres water) recorded yield of 21 q/ha and B:C ratio of 3.11:1 **or** Basal application of Three tons compost /farm yard manure + N equivalent of 15 kg Nitrogen through compost /farm yard manure, 134 kg cake and 469 litres of jeevamrutha should be applied before inter cultivation and spraying 3% panchagavya during flowering stage (6 litres panchagavya can mix it with 200 litres water) recorded yield of 20 q/ha and B:C ratio of 3:1. This practice enhanced the organic carbon in soil from 0.44% to 0.83 per cent.

- **Revalidation of nutrient management practices to achieve balanced nutrition for high yield castor:** Under rainfed conditions, application of recommended dose of fertilizer (40:40:25 - N:P:K kg/ha) + 20 kg/ha zinc sulphate followed by foliar application of 2% water soluble 19-19-19 during 35-40 days after sowing enhanced yield (15.9 q/ha) by 13% with higher gross returns (Rs. 86933/ha), net returns (Rs. 57550/ha), and B:C ratio (2.96:1).

- **Revalidation of recommended fertilizer dose for medium and long duration paddy varieties:** In transplanted paddy, application of 125% Recommended dose of fertilizer (*Kharif*- 125:62:62 and Summer- 150:75:75, N: P: K kg/ha) in medium and long duration varieties enhanced the grain yield (6.3 t/ha) by 10.1% and straw yield (7.74 t/ha) by 8.24% with B:C ratio of 2.1:1 as compared to application of 100% recommended dose of fertilizers (*Kharif*- 100:50:50 N: P: K kg/ha and Summer- 120:60:60) with yield (5.5 t/ha) and B:C ratio of 2:1.

- **Use of microbial consortia in small millets**
  - ✓ Little millet: Application of 100% RDF (20:20:20 kg/ha) along with seed treatment (5 ml/kg of seed) and soil application of liquid bio fertilizers (6.25 l/ha with 500 kg/ha of FYM applied in furrows during sowing) enhanced grain (15.3 q/ha) and

straw yield (3.4 t/ha) as compared to RDF alone (grain: 12.3 q/ha & straw: 2.7 t/ha).

- ✓ Proso millet: Application of 100% RDF (20:20:00 kg/ha) along with seed treatment (5 ml/kg of seed) and soil application of liquid bio fertilizers (6.25 l/ha with 500 kg/ha of FYM applied in furrows during sowing) enhanced grain (16 q/ha) and straw yield (2.8 t/ha) as compared to RDF alone (grain: 13.8 q/ha & straw: 2.4 t/ha).
- ✓ Barnyard millet: Application of 100% RDF (20:20:00 kg/ha) along with seed treatment (5 ml/kg of seed) and soil application of liquid bio fertilizers (6.25 l/ha with 500 kg/ha of FYM applied in furrows during sowing) enhanced grain (23.1 q/ha) and straw yield (5.2 t/ha) as compared to RDF alone (grain: 18.7 q/ha & straw: 4.3 t/ha).

2024

- ➢ **Revalidation of biofertilizer for transplanted rice:** In transplanted rice, application of microbial consortium (*Azospirillum* + *Bacillus* + *Pseudomonas* + *Trichoderma*) @ 5.0 kg/ha by mixing with 25kg FYM at 10 days after transplanting recorded 19.5% higher grain yield (6362 kg/ha) and B:C Ratio (1.99:1) as compared to treatment without microbial consortium.

- **Effect of micronutrients mixture application on growth and yield of maize under different methods of NPK management:** Foliar application of micronutrient mixture along with recommended fertilizers at 50 days after sowing recorded significantly 9.75% higher kernel yield (8691 kg/ha) and stalk yield (11877 kg/ha) with highest gross returns (Rs. 1,74,313) and net returns (Rs. 1,06,052) and B:C ratio (2.55:1) compared to recommended dose of fertilizers.

- **Impact of liquid biofertilizer consortium on system productivity of transplanted finger millet:** Soil application of liquid biofertilizer consortia (6.25 litre mixed with 500 kg FYM/ha and applied in furrows at sowing along with RDF) has yielded 15.32% higher grain (29.04 q/ha) and 14.86 % higher straw yield (62.77 q/ha) with a benefit cost ratio of 2.53:1 as compared to the recommended practice (application of 7.5 t/ha farmyard manure along with 50:40:37.5 $N:P_2O_5:K_2O$ kg/ha; grain yield: 25.18 q/ha and straw yield: 54.65 q/ha).

- **Foliar application of 19:19:19 fertilizer for yield enhancement in Cowpea:** Foliar application of water soluble 19:19:19 fertilizer @ 10 g/l during flowering and pod filling stage along with recommended dose of fertilizer (RDF: 25:50:25 N:P:K kg/ha) enhanced yield (1520 kg/ha) by 17%, net income (Rs. 53,027 /ha) and B:C ratio

(3.27:1) in cowpea compared to RDF with unsprayed treatment (1290 kg/ha, Rs. 44,399 /ha and 3.14:1 respectively).

2023

- **Fertigation in aerobic rice:** Recommended nitrogen (100kg/ha) and potash (50 kg/ha) fertilizers divided into 12 equal proportions & applied once a week starting from sowing to grain filling stage through fertigation enhanced B:C ratio (2.58:1 to 3.11:1), FUE from 40% to 75% & yield by 17% (58 q/ha to 68 q/ha).


- **Application of liquid biofertilizer through drip irrigation in sugarcane:** Application of liquid biofertilizer microbial consortia (Azotobacter + Azospirillum + Pseudomonas + Bacillus) @ 2 l/acre mixed in 200 l of water at 30 and 60 days after planting along with recommended 75% fertilizers through drip irrigation increased the nutrient availability and microorganisms in the soil and reduced the fertilizer requirement by 25% with 168 t/ha yield and 2.36:1 B:C ratio.
- **Utilization of Slag Based Gypsum for sustainable yield in maize:** Along with the recommended dose of fertilizer, application of slag-based gypsum @ 180 kg/acre enhanced the yield by 16.5% with B:C ratio of 2.38:1 or application of commercially available gypsum @ 180 kg/acre once a year in maize crop before sowing enhanced the yield by 12.1% with B:C ratio of 2.33:1.


- **Utilization of Slag Based Gypsum for sustainable yield in paddy:** Along with the recommended dose of fertilizer, application of slag-based gypsum @ 180 kg/acre enhanced the yield by 14.7% with B:C ratio of 1.88:1 or application of commercially available gypsum @ 180 kg / acre once a year in paddy crop before transplanting enhanced the yield by 9.9% with B:C ratio of 1.83:1.

2022

- **UASB Blackgram micronutrient mixture (MMF1 & MMF2) for enhanced growth and yield of blackgram:** Application of 750 g/acre of UASB black gram micronutrients mixture MMF1 (Fe + Mn + Zn + Cu + Mo) at 20 days and application of 1 kg per acre of UASB black gram micronutrient mixture MMF2 (Fe + Mn + Zn + Cu + Mo+ B) at 40 days after sowing will enhance black gram yield by 25.37% with the B:C ratio of 3.18:1.
- **UASB Greengram micronutrient mixture (MMF1 & MMF2) for enhanced growth and yield of greengram:** Application of 750 g/acre of UASB green gram micronutrients mixture MMF1 (Fe + Mn + Zn + Cu + Mo) at 20 days and application of 1 kg per acre of UASB green gram micronutrient mixture MMF2 (Fe + Mn + Zn + Cu + Mo+ B) at 40 days after sowing will enhance green gram yield by 34.33% with B:C ratio of 3.34:1.

Untreated Plot **Treated Plot**

- **Organic nutrient management under organic farming of Nutri-cereals:**

Crop	Nutrients
Foxtail millet	7.5 t/ha Farm yard manure as basal dose + 125% Nitrogen (50 kg N/ha) equivalent organic manure through compost (if compost has 0.8% N content then apply 6.25 t/ ha compost)
Little millet/ Kodo millet / Proso millet / Barnyard millet/ Browntop millet	7.5 t Farm yard manure as basal + 125% Nitrogen (25 kg N/ha) equivalent organic manure through compost (if compost has 0.8% N content then apply 3.125 t/ ha compost)

- **Schedule of water-soluble phosphorus for sugarcane crop through micro irrigation:** Providing recommended phosphorus through fertigation with water soluble phosphorus fertilizers @ 25% up to 60 days after planting and remaining 75% up to 180 days after planting enhances P use efficiency and increases the cane yield by 30%.

Untreated Plot

Treated Plot

- **Nitrogen Management in bajra napier hybrid grass for higher green forge yield and quality:** Application of nitrogen @ 315 kg /ha after each cut (6-7 cuts per annum) in equal splits significantly recorded higher green forage yield (1331 q/ha), dry matter yield (301 q/ha) and crude protein yield (23.2 q/ha) with high net monetary returns (Rs.82,926 /ha) and B:C ratio (2.73:1).

Untreated Plot

Treated Plot

- **Application of phosphorus enriched compost for improved soil properties and enhanced yield under finger millet –cowpea cropping systems:** Application of 100% nitrogen and potassium along with 50% phosphorus through enriched compost (P source used for the enrichment is rock phosphate) to phosphorus rich soil recorded B:C ratio of 2.90:1, highest finger millet grain (2483.1 kg/ha) & straw (3943.2 kg/ha) yield as compared to 100% recommended dose of fertilizers with FYM (Grain: 2276 kg/ha & straw: 3551 kg/ha).

2021

- **Application of minimally aerated compost tea (Compost Kashaya) for increased yield in groundnut crop:** The application of minimally aerated compost has been developed as an integrated technology for increasing pod yield (25-30%) in groundnut. Aerated compost tea is prepared by continuously aerating the compost – water suspension using an aerator for a period of four days. However, we have developed a simpler method of preparing compost tea. In this modified method, the suspension of compost and water is mixed once a day using a stick, resulting in minimal aeration during the preparation. Application of minimally aerated compost tea improves the plant biomass, chlorophyll content and induces defense priming in plants. It enhances the pods per plant, 100 seed weight and the shelling%. It is farmer friendly, economical (B:C ratio -13:1), eco-friendly and reduces fungicide usage by 50%.

Control NCT Fungicide Control NCT Fungicide

- **Effect of multi-micronutrients mixture application on growth and yield of Irrigated paddy:** Application of soil grade micronutrients mixture (Mn+Zn+B+Mo) @ 12 kg per acre at the time of transplanting and spraying of foliar grade micronutrients mixture (Mn+Zn+B+Mo) @ 0.2% at 30 and 45 days after transplanting to aerobic paddy enhances grain yield by 8.80% with B:C ratio of 1.8:1.
- **Utilization of slag based gypsum in groundnut cultivation:** Application of RDF + 625 kg slag based gypsum/ha as 50% at the time of sowing + 50% at 30 days after

sowing recorded higher pod (11.4%), haulm (19.1%), oil (18.9%) and protien (14.38%) yield of groundnut and higher benefit cost ratio (3:1).

- **Effect of multi-micronutrients mixture application on growth and yield of aerobic paddy**: Application of soil grade micronutrients mixture (Fe+Mn+Zn+B) @ 5 kg per acre at the time of transplanting and spraying of foliar grade micronutrients mixture (Fe+Mn+Zn+B) @ 1% at 20 & 40 days after transplanting recorded higher grain yield of 31.5 q/ acre with B:C ratio of 1.6:1 in aerobic paddy.

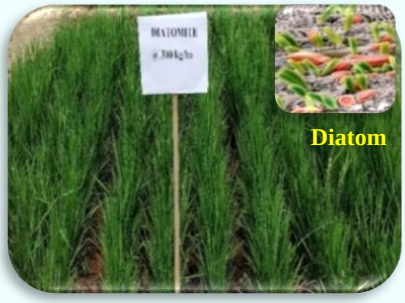
2020

- **Potassium management in little millet:** Application of 20 kg/ha potassium in little millet increased the grain yield by 17.85% and straw yield by 13.72 % with net return of Rs.22729/- per hectare and B:C ratio of 2.01
- **Potassium management in foxtail millet:** Application of 20 kg/ha potassium in foxtail millet increased the grain yield by 15 % and straw yield by 10.3 % with net return of Rs. 30495/- per hectare and B:C ratio of 2.33.

2019

- **Drip fertigation in groundnut:** Application of 100% recommended dose of N and P through drip irrigation in six equal splits at fortnightly intervals starting from sowing to 75days after sowing increases nutrient use efficiency apart from enhancing pod yield to the tune of 15 to 20 per cent.

- **Use of diatomaceous earth and rice hull ash for sustainable development of paddy:** Along with the recommended dose of fertilizer, application of 120 kgs/acre of diatomaceous earth as silicon source enhance the fertility of the soil and yield.



Untreated Plot **Treated Plot**

- **Use of Bio-K as an alternative to potassic fertilizers in hybrid maize:** Application of recommended potassium (16kgs/ac) in the form of Bio K @140 kgs/ac increases maize yield by 14.3% and straw yield by 17.1%.

125% RDF of K **100% RDF of K through Bio-K**

2018

- **Precision nutrient management in maize:** Application of recommended N and K in 6 equal splits at 15 days interval from sowing under drip irrigation realized higher yield (15-20%) in maize.

2017

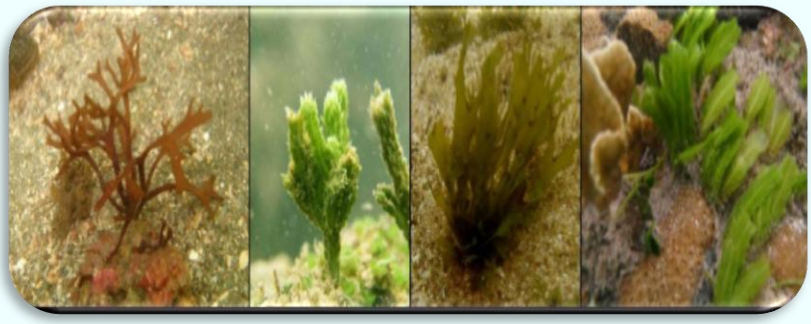
- **Foliar application of water soluble 19:19:19 fertilizer on chickpea:** Spraying of WSF 19:19:19 @ 1.5% at flowering and pod development stage in chickpea enhanced the seed yield (16 q/ha) of chickpea with B.C. Ratio of 2.84:1.

- **Precision nutrient management through grid approach in maize:** Precision farming comprising grid based nutrient management with LMH approach was found superior in Zone–6 and gave 18% higher yield with higher returns (Rs.25,000/ha.)

Precision farming

Farmer's Practice

- **Sea weed sap (K sap) application in paddy**: Spraying 15 % 'K' sea weed sap three times for paddy, one week prior to transplanting and at 25 and 60 days after transplanting along with RDF in Zone-6 gives higher economic yield.



- **Drip fertigation in sugarcane:** Application of water soluble NPK fertilizers through drip irrigation at 2 days intervals recorded 45.8% higher sugarcane yield with 40% saving of irrigation water in Zone-6.
- **Precision farming techniques in Sugarcane:** This technology saves water to the tune of 30-40% in drip irrigation compared to surface irrigated crop. The mean water use efficiency is 102.76 kg/ ha mm under drip fertigation with overall B:C ratio of 3.57 compared to 44.98 kg/ha mm in surface irrigated crop.

2016

- **Nutrient management practices for organic groundnut production:** Application of biodigested liquid manure or enriched biodigested liquid manure @ 25 kg/ha N equivalent + 3 sprays of 3% vermiwash or panchagavya to supplement nutrient demand of groundnut for realizing higher yield (14 q/ha) under organic cultivation.
- **Sea weed sap (K sap) application in maize:** Application of recommended NPK together with spraying of 10% 'K' seaweed sap on 20, 40 and 70 days after sowing of maize gives higher yields in and economic returns in Zone-6.

2015

- **Effect of preceding legumes on N economy in sunflower:** Growing of preceding leguminous crop of cowpea and soybean is found superior instead of growing maize with N @ 50 kg/ha which economizes N (25 kg/ha) with better B:C ratio (2.22:1).

***Kharif:* Legumes**

Rabi: Sunflower

- **Response of chickpea to sulphur application:** Application of 20 kg sulphur /ha is found beneficial in enhancing of chickpea yield to the tune of 15 % with B.C. ratio of 3.5:1.
- **Precision farming techniques in groundnut:** Precision farming techniques with soil test based NPK recommendations (±25%) recorded 46% and 22% higher groundnut pod yield compared to farmers practice and UASB package of practices with higher net returns (Rs. 38,686 /ha) and B:C ratio (2.83).

2014

- **Enhanced application of potassium for higher yield:** Enhanced application of potassium @ 37.5 kg/ha for rainfed finger millet along with recommended N (50 kg/ha) and P (40 kg/ha) resulted in higher grain yield (29q/ha) and straw yield (90q/ha) with high B: C ratio of 3.58 in Zone-5.

2013

- **Soil application of zinc and borax to groundnut in coastal zone:** Application of zinc sulphate at 12.5 kg/ha and borax at 7.5 kg/ha to the soil before sowing once in three years gave higher mean groundnut pod yield of 42.2 q/ha as compared to 36.1 q/ha in the check.
- **Soil application of zinc and borax to blackgram in coastal zone:** Application of zinc sulphate at 10 kg/ha and borax at 7.5 kg/ha to the soil before sowing gave higher mean seed yield of 8 q/ha as compared to 6.77 q/ha in the check.
- **Rice hull ash application for healthy tobacco seedlings:** Application of 23 kg of rice hull ash per tobacco nursery bed along with the recommended fertilizer helps in producing significantly more number of healthy transplantable tobacco seedlings in tobacco growing areas

2012

- **Nutrient management in sunflower for higher yield:** Application of 90 kg N, 90 Kg P_2O_5 and 60 kg K_2O per ha has been recommended to realize 32% higher seed yield of sunflower compared to RDF (60:75:60 NPK) in Zone-5.
- **Utility of press mud for nutrient recycling and to economize the use of fertilizer in transplanted paddy:** Integrated nutrient management in paddy based cropping system, use of 50% N through press mud (on N equivalent) + 50% NPK through inorganic fertilizer, gave consistent increase in yield over years (5472 kg/ha).
- **Bio-nutrient management in sorghum for higher yield:** Application of 50% N + 100% PK + FYM 2.5 t/ha + microbial consortia (*Azospirllum* + *Trichoderma* + PSB) 500g/ha gave *rabi* sorghum yield & similar to 100% RDF + FYM 2.5t/ha, saving 50% N, consequently the cost on "N" fertilizer is reduced.
- **Application of Rice hull ash in tobacco nursery:** Use of rice hull ash, 23 kg per nursery bed along with fertilizers will help in producing significantly more number of healthy, transplantable tobacco seedlings at Shimoga.

2011

- **Zinc and borax application in sesamum in zone-6:** Soil application of $ZnSo_4$ @ 5 kg/ha + borax @ 1 kg/ha with RDF to sesamum var. TMV-3 recorded 18.79% higher yield (3.45 q/ha) at Zone-6.
- **Nutrient management in sunflower:** Application of 30 kg N along with 75 kg P_2O_5 and 60 kg K_2O/ha together with seed treatment with 150 g *Azotobacter chrococum* /kg seeds gives higher yield of 16 q/ha in sunflower hybrids KBSH-41 & KBSH-53 in Zone-4 & 5.
- **Nutrient management in maize:** Spacing of 60 x 20 cm with 150% RDF and 7.5 t FYM/ha is recommended for high grain yield (47 q/ha) and straw yield (117 q/ha) in case of Nityashree hybrid maize. Further, application of $ZnSo_4$ @ 20 kg/ha enhanced the yields significantly.
- **Split application of potassium in transplanted paddy:** Split application of potassium @ 60 kg/ha in three equal splits i.e 20 kg/ha each at basal, 25 – 30 days after planting and 50 – 55 DAP along with nitrogen for transplanted paddy in midland and lowland conditions gave higher yields and monetary returns.
- **Spraying soluble silicic acid for higher paddy yield:** Spraying soluble silicic acid @ 4 ml /lt 4 times from 21st DAP and at an interval of 15 days from then, increases the grain & straw yield of paddy besides reducing the pest and disease incidence as well as chaffyness in paddy

2010

- **Application of Boron higher groundnut yield:** Application of both zinc sulphate at 10 kg/ha along with borax at 6 kg/ha gives higher groundnut kernel (8 kg/ha) and pod (13.6 q/ha) yield with B:C ratio of 3.34.
- **Bio digester liquid manure application for higher yield in field crops:** Application of bio-digester liquid manure together with FYM to crops such as paddy, finger millet, maize, groundnut & horticultural crops improves yields significantly, hence Bio-digester model has been recommended
- **Biofertilizer application for higher groundnut yield:** Application of 5 t/ha of enriched compost with Bio-fertilizers such as *Azotobacter*, phosphorous solubilizing bacteria and *Trichoderma virdae* along with 50% N & P and 100% potash in groundnut gives 38% higher pod yield with B:C ratio of 2.77 compared to control.

2009

- **Nutrient management in hybrid maize:** Application of 100:50:50 NPK kg/ha in two split doses i.e., 1st basal dose as 50% N, 100% P and 50% K at 30 days after sowing and the remaining 50% N and 50% K as top dressing recorded higher yields (41 q/ha) of hybrid maize in Zone- 7.
- **Nutrient management in hybrid paddy:** A modified fertilizer dose of 120:60:60 kg/ha is recommended for higher yields with 60:60:60 NPK as basal dose at the time of transplantation and the remaining 60 kg nitrogen in two equal installments i.e., 30 kg N each, as top dressing at 30 and 60 days after transplanting gave higher yields (7 t/ha) in hybrid paddy.
- **Split application of nitrogen in drum seeded paddy:** Application of 72 kg N in four splits (7.2 Kg N at sowing, 28.8 kg N at early tillering, 18 kg N at active tillering and the remaining 18 kg N at panicle initiation) with recommended P & K recorded 9.5% higher grain yield (57 q/ha) of paddy in case of drum seeded paddy compared to application of RDF in 3 splits in coastal zone.
- **Green manure crop incorporation in finger millet:** Growing of horse gram in early *kharif* and *in-situ* incorporation at pre-flowering stage (70 days) as a green manure crop in finger millet crop has recorded higher returns with a B:C ratio of 1.56 compared to the farmer's practice of growing only finger millet with a B:C ratio of 1.14 under dryland situations of Zone-5.
- **Application of black rice hull ash in paddy for high yield:** Application of black rice hull ash @ 2 t/ha before transplanting of paddy along with recommended NPK with P

as rock phosphate gave 54 q/ha of paddy yield (15% increased yield) and C:B ratio of 1:1.48 in Zone -7 & 10.

2008

- **Zinc and Borax application in sesamum in zone-5:** Application of zinc sulphate @ 5 kg/ha and borax@ 1 kg/ha to soil along with recommended dose of RDF gave 15% higher yield of sesamum in Zone-5.
- **Nutrient management in paddy in bhadra command area:** Application of 75% 'N' through inorganic fertilizer and 25% 'N' through paddy straw along with 10 t FYM/ha gave higher paddy yield (54 q/ha) with B:C ratio of 1.94 compared to the only recommended package with an yield of 52 q/ha and B:C ratio of 1.88 in bhadra command area of Zone-7. This saves cost of nitrogen fertilizer and also helps in maintaining the soil health.

2007

- **Green manure crop incorporation in finger millet under dryland situation:** Under dryland condition, incorporation of glyricidia @ 2.5 to 3 t/ha or eupatorium @ 9 to 9.5 t/ha, as green leaf manure serves as an alternate source for farm yard manure to finger millet gives on par yield compared to FYM.
- **Split application of potassium in FCV tobacco:** Split application of potassium in FCV tobacco with 40 kg as basal and 40 kg at 20 days after planting to soil gives 20% higher yield of top grade equivalent leaf (527 kg/ha) compared to single basal application (417 kg/ha).
- **Application of distillery spent wash for field crops under dryland conditions:** Distillery spent wash can be used as a liquid fertilizer in place of chemical fertilizers (N & K) by giving one time application to dryland one month before sowing, based on the nitrogen requirement of crops like finger millet, maize, sunflower and Groundnut for higher yields. With this farmer can save cost of nitrogen and potash fertilizer and 50% of cost on P fertilizer as they are present in spent wash.
- **Nutrient management in chickpea:** Spraying of urea or DAP @ 2% (20 gm of Urea / DAP dissolved in one lt. of water) at the time of flowering in chickpea gives 16% higher yield (14 q/ha) compared to the check RDF alone. This is a low cost, economically viable and easily adoptable technology for the farmers of Zone-4.
- **Green manure crop incorporation in groundnut:** Under dryland condition, incorporation of glyricidia @ 2.5 to 3 t/ha or eupatorium @ 9 to 9.5 t/ha, as green leaf manure serves as an alternate source for farm yard manure to groundnut gives on par yield compared to farm yard manure.

- **FYM, gypsum and zinc application in paddy:** Application of RDF with FYM and gypsum before transplantation coupled with zinc enriched compost @ 250 kg/ha to paddy field after 8 to 10 after transplantation in alkali soils gives higher paddy yield of 49q/ha. With this the marginal increase in grain yield is 6 to 8 % with saving on the cost of $ZnSO_4$ nearly Rs. 1200/ha and also improves soil properties at Mandya.
- **Zinc and Borax application in sesamum under dryland conditions in finger millet and groundnut:** Under dryland conditions, combined application of 12.5 kg zinc sulphate and 10 kg borax along with recommended dose of fertilizer at the time of sowing of finger millet recorded an higher grain yield of 38 q/ha with 24% higher yield compared to only NPK and in case of groundnut recorded higher pod yield of 11 q/ha compared to the check of only NPK (8 q/ha) registering 37% higher yield over the check.

2006

- **INM in sugarcane:** Application of press mud cake @ 4t/ha and *Azatobacter* @ 5kg/ha along with recommended NPK recorded cane yield (176 t/ha) with 2:1 B:C ratio
- **Application of enriched compost of *Chromolaena adorata* in groundnut/ finger millet:** Use of enriched compost of *Chromolaena adorata* (Communist weed) (90 % of *Chromolaena*, 10% cow dung+5kg roock phosphate+ mixed microbial culture of *Trichuros, spiralis, Paecedomyces fusisporous* and *Phanerochaete crysosporium* at 1.0kg/ton of biomass) at 7.5t/ha along with and application of enriched compost @ 7.5 t/ha along with recommended fertilizer dosage in groundnut/ finger millet crops, in situations of availability of weed biomass in plenty is recommended for Southern Transition, Eastern dry, southern dry and coastal zones.
- **Phosphorus solubilizing bacteria usage in transplanted paddy:** Use of phosphorus solubilizing bacteria after 6-7 days of transplanting of paddy with 100% NPK gives higher yield and returns compared to 100% NPK alone.
- **Zinc and Borax application groundnut:** $ZnSO_4$ @ 5 kg/ha and Borax @ one kg/ha as soil application gives higher yields of groundnut (16q/ha) in zone-5

2005

- **Usage of sodium molybdate and zinc in pigeonpea:** Soil application of ZnSO4 @ 15 kg/ha along with seed treatment of sodium molybdate @ 4g/kg of seed increased the grain yield of pigeonpea by 19 per cent. The additional benefit realized with the above treatment was Rs.2492/ha.
- **Use of rock phosphate with PSB seed inoculation in pigeon pea:** Use of rock phosphate with PSB seed inoculation was as effective as DAP in pigeon pea and is a

cheap source of P and increases the yield to an extent of 7%. Using rock phosphate with PSB seed inoculation, we can save nearly Rs. 300/ha on P fertilizer.

2004

- **Nitrogen management in FCV tobacco:** wherever pressmud is available application of only 25per cent of N(10kg/ha) along with 500 kg/ha of pressmud to planting hill before transplanting will result in significant increase in cured leaf yield and bright grade outturn in FCV tobacco. This to be followed by top dressing of N as per recommendations.
- **Nitrogen management in rainfed hybrid cotton:** Sowing one row of sunhemp in between two rows of cotton and subsequent incorporation at 50DAS with 75% recommended nitrogen (50% at sowing and remaining 50% one week after the incorporation of sunhemp *insitu*) has resulted in higher yield and saving of inorganic nitrogen in rainfed hybrid cotton.
- Usage leaf colour chart for nitrogen management in paddy.
- **Zinc management in maize:** Addition of ZnSo4 (10kg/ha) through enriched FYM, significantly increase the yield. 10kg ZnSO4 is to be mixed with 20kg well decomposed FYM, kept for at least 45 days for curing and applied to the soil before sowing . Optimum moisture level in the FYM is to be maintained
- **INM in paddy:** Application of coir pith based compost @ 5t/ha + 50% RDF is found to be more beneficial as compared to either 100% RDF or 50% RDF +FYM 5t/ha

2003

- **Application of growth regulators in hybrid paddy seed production:** Application of 200g/ha NAA could give seed yield more or less similar to those obtained with 45g/ha GA3. Thus NAA could be used as alternative of GA3 to minimize the cost of production in hybrid paddy seed production.

2002

- **Application of phosphorus solubilizing microorganism (PSM) in groundnut + pigeonpea intercropping system under rainfed situation:** Use of PSM in groundnut + Pigeonpea intercropping system under rainfed situation, to save cost on chemical fertilizer is recommended for zone 5, the system gives 24% increase in groundnut pod yield and 18% increase seed yield in pigeon pea over recommended dose of fertilizer.
- **Incorporation of sunhemp in cotton:** Introducing sunhemp as an additional crop in between two rows of cotton at1:1 ratio and subsequent incorporation gives higher kapas yield, saves 25% chemical Nitrogen(Rs.325/ha) and improves soil fertility and is

recommended for *insitu* N management in rainfed hybrid cotton growing areas of Zone-7.

2001

- **Application of phosphorous in tobacco:** Application of phosphorous at 30 kg P_2O_5/ha in tobacco once in three years is beneficial in soils where available phosphorous status is medium to low and recorded 11.34 q/ha of cured leaf yield of tobacco with B:C ratio of 17.0.

2000

- **Application of potassium for higher paddy yield:** Irrespective of the paddy variety, the increase in yield is significantly higher in 50% K application dose as basal at planting and 50% K application as top dress at panicle initiation stage over 100% K application as basal dose at transplanting.

2.5 Irrigation

2020

- **Alternate wetting and drying method of water management for enhancing water use efficiency in transplanted paddy:** 5 cm irrigation at 3 days after disappearance of ponded water up to panicle initiation (PI) and 3 ± 2 cm standing water after PI recorded average 6-11 % higher paddy grain yield & 37% water saving as compared to flooding throughout crop growth (3 ± 2cm). Further, lower total water used for irrigation (1165 mm) and higher water use efficiency (4.92 kg/ha-mm) were recorded with alternate wetting and drying method of water management as compared to flooding throughout crop growth (1852 mm & 2.90 kg/ha-mm, respectively) or saturation maintenance up to PI (1395 mm & 4.18 kg/ha-mm, respectively).

2015

- **Drip irrigation in sugarcane**
  - ✓ Subsurface drip irrigation recorded higher cane yield by 50-60% and recorded 45-61% water saving.
  - ✓ Drip irrigation scheduling @ 100% pan evaporation (E pan) recorded higher cane yield (220 t/ha).
  - ✓ Drip fertigation upto 8-9.5 months of planting recorded higher cane yield.
  - ✓ Cost on investment for drip irrigation can be realized within 1 season of crop harvest
- **Drip irrigation in direct seeded aerobic rice**
  - ✓ Recorded 15-17% higher grain yield
  - ✓ Saves 49-57% irrigation water compared to transplanted paddy.

- ✓ Majority of the released varieties & hybrids performed better under drip irrigation
- ✓ Irrigation scheduling 125% E pan during early stages + 150% from tillering to panicle emergence and 200% during grain filling recorded higher yield
- ✓ Drip fertigation scheduling at 2-4 days interval recorded higher grain yield.
- ✓ Cost on investment for drip irrigation could be realized within three seasons.

2009

- **Water management in transplanted paddy under bhadra command area:** Scheduling of irrigation one day after subsidence of pounded water recorded 12% higher yield and is found better than the recommended water management practice for transplanted paddy under bhadra Command Area in Zone-7. This practice helps us to save water in paddy cultivation without sacrificing the yield.

2003

- **Paddy under aerobic condition:** Growing paddy supplemental irrigation without puddling and submergence of water, with a saving of water to an extent of 50%

2.6 Weed management

2025

- **Pre or post emergence herbicide application for weed management in soybean:** Application of pre-emergence herbicide, diclosulam 84 WDG @ 26 g/ha reduces the weed count (30 DAS: 14 /m^2, 60 DAS: 21 /m^2) and dry weight of weeds (30 DAS: 1.44 g/m^2, 60 DAS: 3.47 g/m^2) and higher yield (18 q/ha), net returns (Rs. 39,918) and B:C ratio (2.38:1) **or** Application of post emergence herbicide fluazifop -p- butyl 11.1% + fomesafen 11.1% SL @ 676 g/ha effectively reduces the weed count (30 DAS: 21.6 /m^2, 60 DAS: 28.3 /m^2) and dry weight of weeds (30 DAS: 2.64 g/m^2, 60 DAS: 4.2 g/m^2) and higher yield (17.6 q/ha), net returns (Rs. 38,730) and B:C ratio (2.36:1).

- **Post-emergent herbicide application for weed management in sugarcane:** Application (when weeds are in 3-4 leaf stage) of 2,4-D sodium salt 44% + metribuzin 35% + pyrazosulfuron ethyl 1.0% WDG @ 1200 ml/ha effectively reduces the weed population count (1-3 /m^2) and total dry weight of weeds (1-2 g/m^2) and higher cane yield (193 t/ha), net returns (Rs. 3,56,543) and B:C ratio (2.87:1) when compared to application of presently recommended metribuzin 70% WP (yield: 185 t/ha, net returns: 3,29,496 and B:C ratio – 2.74:1) in sugarcane
- **Post-emergent herbicide application for weed management in cotton:** Application of post-emergent glufosinate ammonium 12.8% + metolachlor 30% EW @ 4100 ml/ha effectively reduces the weed count (4-8 /m^2) and total dry weight of weeds (3-10 g/m^2) and higher seed yield (22.3 q/ha), net returns (Rs. 73,988) and B:C ratio (2.32:1) as compared to hand weeding twice at 20 and 40 DAS (23.1 q/ha) when compared to application of presently recommended metolachlor 50% EC (yield: 15.1 q/ha, net returns: 32,647 and B:C ratio – 1.62:1) in cotton.

2024

- **Weed management through post-emergence herbicide in direct seeded rice:** Post-emergent application of triafamone + ethoxysulforon 30 WG (RM) @ 80 g/acre in 200 litres of water applied at 15 days after sowing followed by weeding through cycle weeder after 35 DAS recorded significantly higher yield (39.8 q/ha), lower total weed population during 30 (25.9 /m2) and 45 days (28.6/m2) after application with higher net returns (Rs. 35,226) and B:C (2.54:1) ratio.

- **Weed management through post-emergence application of Topramezone in maize:** Post-emergence application of Topramezone 33.6% SC @ 100 ml/ha recorded significantly lower total weed population during 30 (2.64 /m2) and 45 days (4.28/m2) after application with higher net returns (Rs. 88,753) and B:C (2.55:1) ratio while at par kernel yield (78.9 q/ha) as that of hand weeding twice at 20 & 40 DAS (80.28 q/ha).

2023

- **Weed management with post-emergence herbicides in kodomillet:** Spraying of metsulfuron methyl (10%) + chlorimuron ethyl (10%) WP-20 WP (2+2) powder @ 8g/acre as post-emergence herbicide or 2,4-D sodium salt 80 % powder (375 g/acre) mixed in 200 l of water when weeds are at two to four leaf stage reduced the weed density by 97% and 63% respectively compared to unweeded control with increase in yield by 92% and 61% and B:C ratio by 2.13 and 1.79 respectively.

Metsulfuron methyl + Chlorimuron ethyl

2,4-D Sodium salt 80% powder

- **Post-emergence chemical weed control in paddy wet nursery:** Spraying of bispyribac sodium (10% SC) @ 7.5 ml/15 l of water as post-emergence herbicide on 12th day after sowing in 3 gunta area of wet nursery bed when weeds are at 2-4 leaf stage reduced weed count by 99% and dependency on laborers.
- **Post-emergence chemical weed control in paddy dry nursery**: Spraying of bispyribac sodium (10% SC) @ 7.50 ml / 15 l of water as post-emergence herbicide on 12th day after sowing in 3 gunta area of dry nursery bed when weeds are at 2-4 leaf stage reduced weed count by 95-99 % and dependency on laborers.

- **Weed management with post-emergence herbicides in sunflower:** Whenever pre-emergence herbicides cannot be used, application of post-emergence herbicide, quizalofop-p-ethyl 5% EC @ 1.5ml/l at 15-20 days after sowing (when weeds are at two to three leaf stage) and intercultural operation at 30 days after sowing reduced the weed density by 75% and increased the yield by 13% with reduction in cost (B:C ratio of 3.11:1) of weed management by 60%.

2022

- **Pre-emergence chemical weed control in drum seeded paddy:** Bensulfuron methyl (0.6% G) @ 60 g + pretilachlor (6%G) @ 600 g ai/ha (10 kg/ha) at 5 days after sowing as pre-emergence sand mix (25 kg/ha) application in drum seeded paddy recorded statistically on par grain yield and weed control efficiency (4853 kg/ha and 95.72% respectively) as compared to two hand weeding (4871 kg/ha and 94.35% respectively).

2020

- **Weed management in transplanted finger millet:** Application of bensulfuron methyl + pretilachlor 6.6% G @ 1.20 kg per acre in 300 liters of water on the day of planting or within 3 days of planting effectively controls the weeds with higher B:C ratio (2.56).

2019

- **Weed management in groundnut:** 300ml of quizalofop-p-ethyl 5% EC or 500 ml Sodium aciflurofen @16.5 % + clodinafop - propargyl 8% EC (206.25 + 100 g ai/ha)

mixed in 200 l of water per acre at 2-4 leaf stage (20-25 DAS) resulted in higher yield (1548Kgs/ha) and B:C ratio (2.59) with lower weed index (3.4%).

Treated Plot

Hand Weeding

- **Weed management in blackgram:** Application of sodium acifluorfen 16.5 % + clodinafop-propargyl 8 % EC (206.25 + 100 g ai/ha) as a post emergent herbicide at 20-25 DAS was found to be effective in managing the weeds in blackgram with lower weed index (8.6%), higher yield (1412 kg/ha) and B:C ratio (2.80).

Treated Plot

Hand Weeding

- **Weed management in cowpea:** Post-emergence application of 35% imazethapyr + 35% imazamox WG @ 23g/ac in 200 ltr of water at 20-25 DAS (3-4 leaves stage of weed) was found effective in controlling weeds, improving seed yield (970-980 kg/ha) and profitability (save labour cost: Rs.2,788/ha) of the rainfed cowpea.

Treated Plot

Untreated Plot

- **Weed management in cotton:** Diuron 80% @ 100 g or 800 ml of fluchloralin 45EC or 1.3 l of pendimethalin 30% EC or 800 ml of butachlor 50% EC in 300 l of water per acre and sprayed on day of sowing or next day Or 400 ml of quizalofop-P-ethyl (5% EC) + 250 ml of pyrithiobac sodium 10EC is mixed in 300 l of water & sprayed at 2-4 leaf stage or 20 DAS. Sufficient moisture should be there at time of sowing

Treated Plot

Untreated Plot

2018

- **Weed management in field bean:** Application of alachlor 50 EC as pre-emergent herbicide at 1000 g ai/ha at 3 days after sowing followed by imazethapyr as post-emergent herbicide 10 SL at 62.5 g ai /ha at 20 days after sowing recorded significantly higher seed yield (1795 kg/ha) and controlled the weeds effectively with B:C ratio of 4.54. **Or** Application of pendimethalin 30 EC as pre-emergent herbicide at 750 g ai/ha at 3 days after sowing followed by imazethapyr as post-emergent herbicide 10 SL at 62.5 g ai/ha at 20 days after sowing recorded significantly higher seed yield (1730 kg/ha) and controlled the weeds effectively with B:C ratio of 4.21. This reduced the dependence on manual labour for weeding under present labour scarce situations.
- **Weed management in cowpea:** Application of alachlor 50 EC as pre-emergent herbicide at 1000 g ai/ha at 3 days after sowing followed by imazethapyr as post-emergent herbicide 10 SL at 62.5 g ai/ha at 20 days after sowing recorded significantly higher cowpea seed yield (1357 kg/ha) and controlled the weeds effectively with B:C ratio of 3.3. **Or** Application of pendimethalin 30 EC as pre-emergent herbicide at 750 g ai/ha at 3 days after sowing followed by imazethapyr as post-emergent herbicide 10 SL at 62.5 g ai/ha at 20 days after sowing recorded significantly higher seed yield (1305 kg/ha) and controlled the weeds effectively with B:C ratio of 3.0.

2017

- **Management of ambrosia weed:** Post emergent application of glyphosate was found very effective in controlling ambrosia weed.

- **Post-emergent herbicide mixture for weed control in maize:** Application of tembotrione 42 SC 105 g ai/ha + isoxadifen ethyl 21 SC 52 g ai/ha + safner mero adjuvant 2.5 ml/l at 15 DAS followed by one hand weeding gives broad spectrum control of weeds with Rs.3500/- saving (compared to hand weeding)

Tembotrione 42 SC 105 g ai/ha + Isoxadifen – ethyl 21 SC 52 g ai/ha

Unweeded plot

2016

- **Weed management in direct seeded dry paddy:** Spraying of pendimethlain 30 EC1000 g ai/ha at 2 DAS followed by bispyribac sodium 10 SC 25 g ai/ha at 25 DAS (41q/ha) gives on par yield compared to three hand weeding (42q/ha) with a considerable saving in weeding cost (Rs.2744 / ha.). Combination of herbicides controls wide range of weeds and will reduce crop - weed competition and further reduces the dependence on manual labour under labour scarce conditions.
- **Effect of herbicide mixture in transplanted paddy:** Application of pretilachlor 50 EC 750 g ai/ha at 3 DAP followed by ethoxysulfuron 15 WG 18.75 g ai/ha at 25 DAP recorded on par yield (5485 kg/ha) compared to two hand weeding (5539 kg/ha) with a considerable saving in weeding (Rs.3272/ha). Combination of herbicides will give broad spectrum control of weeds and will provide season long weed free situation and also reduce the dependence on manual labour under labour scarce conditions.

Treated Plot

Unweeded plot

- **Pre–emergence herbicide evaluation in sunflower:** Application of oxadiargyl 80 WP 240 g ai/ha at 3 DAS (22 q/ha) or pendimethalin 38.7 CS 562.5 g ai/ha at 3 DAS

(20q/ha) gives similar yield compared to two hand weeding (22q/ha) with a considerable saving in weeding cost (Rs.4350 to 5300/ha).

2015

- **Weed management in cowpea:** Pre-emergence application of pendimethalin 30 EC @ 2.5 litre/ha in 750 litre of water resulted in good weed control with higher cowpea seed yield (1,418 kg/ha) and saves labour cost.

- **Post-emergence herbicide for weed control in transplanted finger millet:** Post-emergence application of 2,4-D sodium salt 80% WP @ 938 g/ha at 15-20 days after planting (DAP) resulted in efficient control of weeds with similar yield (22 q/ha) compared to two hand weeding saving labour cost.
- **Post-emergence herbicide for weed control in maize:** Post-emergence application of pendimethalin 38.7 CS 1940 ml/ha at 3 DAS followed by 2,4-D sodium salt 80% WP 625g/ha at 30 DAS gave good control of weeds with on par kernel yield compared to two hand weeding with a considerable saving in weeding cost.
- **Integrated weed management in pigeonpea:** Application of Pendimethalin @ 0.75 kg ai/ha as pre-emergent + Imazethapyr applied @ 100 g ai /ha at 20-25 days after sowing as post emergent herbicide + one hand weeding at 50 DAS recorded significantly higher grain yield (12 q/ha) & B.C. ratio (1.75:1).
- **Pre and post emergence herbicides for weed control in aerobic rice:** Application of Pretilachlor @ 600g ai/ha+ bensulfuron methyl @ 660g ai/ha at 3 DAS or Oxyfluorofen 23.5EC@ 90g ai/ha at 3DAS followed by 2,4-D sodium 80% WP @ 500g ai/ha at 20DAS yields on par compared to 3 hand weeding (20, 40 & 60 DAS)
- **Post–emergence herbicide for control of weeds in soybean:** Use of Quizalofop-ethyl 10 EC @375 ml /ha at 15-20 DAS was effective in controlling all the dominant weed population and it was comparable to hand weeding.

2014

- **Post-emergence herbicide for weed control in groundnut:** Application of quizalofop-p-ethyl 5EC @750 ml/ha or imazethapyr 10SL@ 1250 ml/ha @ 15-20 Days After Sowing (DAS) for Groundnut crop at 2-3 leaf stage of weeds has given comparable yield (7.6q/ha) with that of two hand weeding (6.9 q/ha) at 20 & 40 DAS, resulting in saving of labour cost on weeding.

2012

- **Weed management in transplanted paddy:** Bensulfuron methyl 0.6% G 60g ai/ha + pretilachlor 6% G 600g ai/ha is very good as pre-emergent broad spectrum herbicide for control of weeds in transplanted paddy efficiently and yields are comparable to hand weeding in coastal zone.
- **Weed management in dry and wet paddy nursery:** Application of Butachlor 50 EC @ 1250g ai/ha or pyrazoslfuran ethyl @ 25g ai/ha or Bensulfuron methyl + Pretilachlor (6.6 GR) @ 10 kg/ha on 3rd day after sowing for effective weed control in wet & dry paddy nurseries.

2011

- **Weed management in paddy in coastal zone:** Weeds in sprouted paddy in coastal zone can be managed using pyrazosulfuron ethyl 10 WP 250 g /ha at 3 DAS in drum seeding or broadcasted paddy which gave higher yield and monetary returns compared to other weed management practices.

2010

- **Pre-emergence chemical weed control in transplanted paddy:** Application of Bensulfuron methyl (0.6%) + Pretilachlor (6.0% G) @ 10 kg/ha is mixed with 75 kg sand and broadcasted within 5 DAT can effectively control weeds in transplanted paddy compared to farmers practice ie., Butachlor (50 EC 1.5 kg ai/ha at 3 DAT) with B:C ratio of 2.38 compared to Butachlor with 2.15:1 B:C ratio.
- **Pre-emergence chemical weed control in cotton:** Pre-emergence herbicide Butachlor 50 EC @ 2.0 l/ha and pendimethalin 30 EC @ 3.25 l/ha have controlled the weeds effectively in cotton.

2009

- **IWM in aerobic rice:** Application of pyrazosulfuron ethyl 10WP @ 25g ai/ha at 5 DAS followed by hand weeding @ 20 & 40 DAS controls the weeds efficiently.
- **Pre-emergent spray for effective weed management in direct seeded or drum seeded paddy under puddled condition:** Pre-emergent spraying of herbicide with

pyrazosulfuron ethyl 5WP @ 500 g /750 lt. of water to soil between 3 to 5 DAS controls the weeds efficiently by recording an yield of 5.5 t/ha of paddy in case of direct seeded or drum seeded paddy under puddled condition in Zone-6.

- **Pre-emergent spray for effective weed management in transplanted paddy under puddled condition:** Mixing 85 g of Benzosulfuron methyl 60 DF with 70 kg sand and broadcasting the mixture to transplanted paddy between 3 to 5 days of transplantation gave higher yield (55 q/ha) of paddy under puddled condition compared to the recommended Butachlor (50 q/ha).

2008

- **Integrated weed management in FCV tobacco:** Pre-emergent spray of alachlor @ 0.75 kg ai/ha, two weeks before sowing and one hand weeding at 25 days helps to control annual weeds efficiently and makes more number of healthy seedlings in FCV tobacco nursery with 2.52 B:C ratio and saves the cost of labour on weeding.

2007

- **Weed management in finger millet under irrigated condition:** In finger millet, under irrigated condition application of oxyfluorofen @ 0.1 kg ai./ha at 2-3 days after transplantation. Further, crop should not be irrigated for 4 days after the spray of oxyfluorofen. With this, the average grain yield of finger millet recorded was 42 q/ha and straw yield of 63 q/ha with higher cost benefit ratio of 1:3.73.
- **Pre-emergent spray for effective weed management in SRI method of paddy cultivation:** Under aerobic cultivation, application of pyrozosulfuron ethyl 10 WP 250 g/ha at 3 DAS of paddy controls the weeds very effectively and recorded on yield of 52 q/ha and saves weeding cost of Rs. 3,030/- per ha.

2006

- **Nozzle sprayers for herbicide application:** Use of narrow orifice flood jet nozzle (0.8 mm) is recommended for spraying of herbicide for effective weed control with 30% reduction of spray volume.
- **Pre-emergent spray for effective weed management in transplanted paddy:** Pyrazosulfuron ethyl 5 WP @ 500 gm/ha at 3-5 DAS as pre-emergent spray for effective weed management in transplanted paddy in all major paddy growing areas saves the labour cost to the tune of Rs. 3,500/- by chemical weed control compared to hand weeding for direct / wet / drum seeded paddy.
- **Weed management in echinochloa dominant and sedge dominant transplanted paddy:** Application of pyrazosulfuron ethyl 5 WP @ 500 g/ha and clomazone 20 EC + 2,4D EE 30EC @ 1.25 l/ha as pre-emergence controls weeds in Echinochloa

dominant transplanted paddy and Application of with pretilachlor 50 EC @ 1.5 l/ha as pre-emergence controls weeds in sedge dominant transplanted paddy.

2005

- **Post-emergent spray for effective weed management in arecanut:** Spray of glyphosate @ 2 kg ai/ha controls weeds in arecanut garden in Zone-7.

2002

- **Pre-emergent spray for effective weed management:** Application of pyrazsoulfuran ethyl 5WP @25 g ai/ha (500g/ha formulated product) as pre-emergence spraying within 3DAP is effective in controlling weed compared to hand weeding and Butachlor.
- **Weed management in transplanted paddy in zone 7:** Application of pretilachlor 50EC @750 ai/ha (1.5l/ha) as pre emergence (to be applied within 3DAP) is very effective in weed management in transplanted paddy compared to hand weeding.
- **Pre-emergent spray for effective weed management in sprouted paddy under irrigated condition:** Application of new herbicides viz., prefilachlor + safener @ 1ltr/ha (Sofit 30 EC) as pre-emergence (to be applied within 3-5 days after sowing) using 750 l of water/ha or 62.5 kg of fine dry sand by broadcasting all over the field uniformly when there is thin film of water is very effective for weed management in sprouted paddy under irrigated condition.
- **Weed management in tobacco in zone 7:** Application of Metolachlor [0.75 kg ai/ha + one hand weeding- (30DAP)] on ridges prior to transplanting of FCV tobacco is effective in managing weeds. It reduces dependency on labor.

2000

- **Weed management in maize:** Spraying of pendimethalin @ 2.5 l in 750 l/ha of water and oxyfluofen @ 0.425 lt/ha as pre-emergent application (3 days after sowing) was effective in controlling weeds in maize crop.
- **Weed management in drill sown paddy:** Spraying Anilafos @ 1.0 l/ha and oxyflurofin @ 425 ml/ha and Butachlor @ 2.0 lt/ha as post emergence in 75 l/ha of water or sand mixed application at 50 kg fine sand/ha was effective in controlling weeds in drill sown paddy.
- **Weed management in finger millet:** Isoproturon a pre-emergence spray at 0.5 kg ai/ha was found to be more effective in wettable form than emulsion form, in controlling weeds in finger millet crop as well as in increasing grain yield.

2.7 Intercropping

2025

- **Intercropping system in cotton:** The intercropping systems, cotton + cluster bean (1:2) recorded higher seed equivalent yield (15.8 q/ha), net return (Rs.68473/ha) and BC ratio (1.80:1) and cotton + groundnut (1:2) recorded seed cotton yield of about 14.8 q/ha with net returns of Rs.67028 and 1.84:1 B:C ratio as compared to sole cotton (1206 kg/ha, Rs. 47071 and 1.65:1 respectively) crop.

Cotton + Cluster Bean (1:2)

Cotton + Groundnut (1:2)

2024

- **Intercropping of fodder grasses in Teak:** Intercropping of CO-5 Napier fodder grass under teak (12m × 3m spacing) based agroforestry system with spacing of 12m x 3m, recorded higher fodder yield (132.52 t/ha), Gross returns (Rs. 1,32,519 /ha), Net returns (Rs. 75,719 /ha) and Benefit:Cost ratio (2.3:1).

- **Hedge lucerne intercropping with B x N hybrid in paired row system for higher yield:** Hedge lucerne intercropping with B x N hybrid in paired row system (2:5) recorded higher Green fodder yield (1873 q/ha), Dry matter yield (368.5 q/ha), Crude protein yield (11.2 q/ha) and net monetary returns (205875 Rs./ha) with B:C ratio of 3.18 as compared to sole crop B x N hybrid [Green fodder yield: 1548.2 q/ha/year, Dry matter yield: 301.1 q/ha/year, Crude protein yield: 27.8 q/ha/year, net returns:

Rs.143534/ha/year and B:C ratio: 2.62:1]. The improvement in green forage yield to the tune of 21% increase over sole crop.

2020

- **Agase (*Sesbania grandiflora*) based intercropping system:** Intercropping of Bajra Napier hybrid in agase in 2:1 ratio recorded higher green forage yield (602q/ha), net returns of Rs.52975/ha and B:C ratio 2.23.

- **Intercropping in maize:** Intercropping of 2 rows of greengram / blackgram in between 45/75 cm spaced paired row of maize resulted in improvement in maize equivalent yield (18%), net returns (Rs. 62,000/ha) and B:C ratio (1.95) in addition to improvement in soil fertility.

45 x 75 cm paired Maize rows with 2 rows of greengram as intercrop

60 x 30 cm spaced pure Maize crop

45 x 75 cm paired Maize rows with 2 rows of blackgram as intercrop

2017

- **Melia dubia based agroforestry system** has been developed for sustainable farm income.
- **Nipped castor and finger millet intercropping system:** Intercropping finger millet in nipped castor in 2:1 row proportion improved the castor yield (18 q/ha) with B.C. Ratio of 3.41.

2014

- **Transplanting pigeonpea in finger millet + pigeonpea intercropping System:** Transplanting of 4-5 weeks old seedlings of pigeonpea in finger millet + pigeonpea intercropping (8:2) as well as main crop, recorded significantly higher pigeonpea grain yield (58%) and finger millet yield (70%) compared to drill sown finger millet and pigeonpea with a B: C ratio of 2.46:1.

2012

- **Intercropping of castor and cluster bean:** Paired row sowing (60-120-60cm) of Castor + Cluster bean (4 rows) is recommended for higher income as compared to sole crop of Castor in Zone-4.

2010

- **Intercropping cowpea / horsegram in hybrid napier:** Cultivation of cowpea / horsegram – Lucerne, as intercrop in hybrid Napier recorded highest green biomass yield around 150 t/ha with additional crude protein yield ranging from 6.7 to 9.9 q/ha.

2009

- **Intercropping of finger millet and pigeonpea:** Growing of one row of finger millet as an additive intercrop in pigeonpea (1:1) gave highest pigeonpea grain equivalent yield (16 q/ha) and also gave higher monitory returns compared to sole crop of pigeonpea. This helps small farmers in getting additional yield of finger millet grain as well as fodder, besides providing food security under dryland situations of Zone-5.

2007

- **Intercropping of groundnut and pigeonpea/ cowpea:** Growing of groundnut, redgram, groundnut and cowpea in 4:2:4:1 row ratio with cowpea as a trap crop in the affected areas of red headed caterpillar gives higher yield of groundnut and reduces further spread of pest. All the crops in the system need to be sown simultaneously during July month.
- **Intercropping of maize with greengram and blackgram:** Intercropping of maize with 1:1 row proportion of greengram and 2:2 row proportion of blackgram recorded higher average maize yield (56 q/ha), greengram yield (2.4 q/ha) with b:c ratio of 1:2.2 and blackgram yield (4.5 q/ha) with B:C ratio of 3.06 in Bhadra Command area during kharif / summer.

2006

- **Rice-pulse cropping system:** Rice-pulse cropping system is recommended for Cauvery Command Area for sustainable soil health and increased rice yield.

2002

- **Line sowing of fodder maize and fodder cowpea:** Line sowing of fodder maize (African tall) + fodder cowpea at 3:1 ratio for higher fodder yield and nutrient as against sowing maize and cowpea seeds is recommended for Zone-4.

2.8 Hydroponics

2020

- **Hydroponic fodder maize and cowpea production system:**

✓ Fodder maize seeds sown @ 2.5 kg/sq.ft. in hydroponic system yielded 4-7 kgs green fodder/kg of seed at 10^{th} to 14^{th} days after sowing.

✓ Fodder cowpea seeds sown @ 2.5 kg/sq.ft. in hydroponic system yielded 5-5.5 kgs green fodder/kg of seed at 11^{th} to 13^{th} days after sowing.

4th Day

Transfer to tray on 3rd day

9th Day

13th Day

5th Day

Transfer to tray on 3rd day

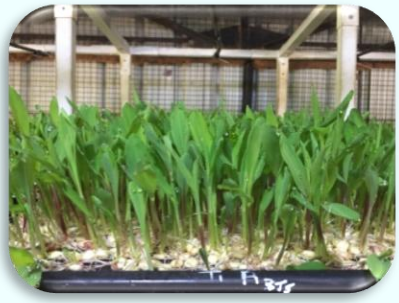
9th Day

15th Day

2018

- **Agro-techniques for hydroponic fodder production** have been developed to realize higher fodder yield mainly to meet the fodder requirement during the critical period (dry months) to realize good milk yield in dairy animals. Cost of establishment of

farmer friendly unit is Rs. 10 to 20 thousand. Fodder yield of 4-7 kgs can be harvested from 1 kg seeds with 4-6 times enhanced nutrient availability.



2.9 Recent additions/ modifications in package of practices

2022

- **Chapter on browntop millet:** Chapter on Browntop millet is included in the package of practices with details on variety, soil, land preparation, seed rate, time of sowing, method of sowing, nutrient requirement, intercropping, weed management, plant protection and harvest.

2021

- **Chapter on rice bean crop:** Chapter on Rice Bean crop is included in the package of practice with details on variety, season and soil, land preparation, seeds and sowing methods, manures and fertilizers, thinning of seedlings, inter-cultivation & earthing up, weed Control, water management, plant protection, yield and low cost technologies.
- **Recasting of Chapter-12: Crop production systems in different zones (*Vividha Krishi Valayagalalli Bele Utpaadana Vyavasthe:* *Zone-4, 5 & 6*)**: Concepts on Rain star wise rainfall quantity, Optimum sowing windows for pre-monsoon season, Crops and agricultural activities for pre- monsoon season based on long term rainfall analysis

(30 and 50 Years) and Agro-climatic onset of sowing date were included by modifying the present monthly rainfall details, cropping pattern and sowing window.

2019

- **Chapter on grain amaranth crop:** A chapter on "Agro-techniques for Grain Amaranth" is included in the book of Package of Practice under cereals section with sub heading Pseudo cereals.

2017

- **Organic management practices for finger millet** has been developed
- **Organic management practices for paddy** has been developed
- **Organic management practices for maize** has been developed
- **Organic management practices for redgram** has been developed
- **Organic management practices for groundnut** has been developed

2016

- **Developed protocol for standardization of agro –techniques for Mechanized System of Rice Intensification (MSRI):** Planting 15 days old seedlings through transplanter at wider row spacing (23X23 cm.) with seedlings raised under tray method @25 kg seed/ ha resulted in better yield and returns.

- **Developed protocol for standardization of agro-techniques for System of Rice Intensification (SRI):** With this 24-30% increase in grain yield and economic returns can be achieved besides saving 39-40% water over conventional transplanting.

- **Developed protocol for standardization of nursery techniques for System of Rice Intensification (SRI):** Seedlings raised under tray method with vermicompost + soil (1:1) + DAP spray (2%) at 10 DAS resulted in vigorous seedlings.

2012

- **Package of practice for fodder oats:** Cultivation practices for fodder oat with spacing of 25 x 10 cm with seed rate of 100 kg /ha and Nutrient level of 100: 40:40 kg NPK /ha was found optimum and economical at Mandya.

2010

- **Production package of fodder cowpea:** Fodder cowpea (KBC-2) with spacing of 30 x 10 cm between rows with seed rate of 35 kg/ha and nutrient requirement of 25:50:25 NPK kg/ha is found optimum, economical with green forage yield of 250 q/ha.

2.10 Problematic soil

2022

- **Use of newly formulated micronutrient mixture for enhanced growth and yield of paddy in alkaline soil:** Foliar spray of micronutrients mixture @ 10g/l at 30 and 45 days after transplanting along with recommended fertilizer reduces chaffyness by 38.4%, enhances grain (15.2%) and straw yield (20.5%) with B:C ratio of 1.4:1.

2021

- **Subsoil manuring for enhancing crop productivity in rainfed farming regions of southern Karnataka for both sodic & red soil situations:**

- ✓ Subsoil manuring in dry land sodic soils / dry land red soils having subsoil hardpan to be taken up immediately after 1st showers during May – June with recommended doses of fertilizers and double dose of organic manure (poultry manure or press mud or sheep manure) through sub-soil ripper having manuring tank attached to tractor at 1mt apart and at 45-50 cms depth. After getting good rains during monsoon season, crops can be grown.
- ✓ In the similar way next year also in the same field recommended dose of NPK for the crop to be grown along with double dose of organic manure should be applied through subsoil ripper at 1mt apart between earlier 1mt ripper space to depth of 45-50 cms depth. After getting good rains in monsoon, crop decided earlier is grown, so that soil sodicity / subsoil hardpan will be reduced, due to breaking of subsoil hardpan & adding organic manures, thereby water and nutrient holding capacity will be enhanced. This enhances soil fertility & over the years better crops can be harvested.

2017

- ➢ **Effect of agricultural lime to improve maize productivity and soil health**: Application of 200 kg of agricultural lime to acid soils along with recommended dose of FYM + NPK improved maize grain and stover yield apart from maintaining sustained soil health

2010

- **Agronomic practice to overcome crust problem in cotton**: Dibbling of bold seeded French bean on either side of cotton seed sown with recommended dose of fertilizers would facilitate better germination in the event of heavy rainfall immediately after sowing of cotton seeds followed by dry spell. This results in higher yield as compared to recommended (25%) and farmers practice.
- **Application of lime sludge to soils with pH < 6.0 for increased groundnut yield:** Application of lime sludge to soils with pH < 6.0 increases pod yield of groundnut upto 36%. It also significantly enhances shelling percentage by 7.3 %. Thus, lime sludge can be used as a cheaper source of liming material in acid soils instead of agricultural lime (based on soil test) at Zone-7.

2007

- **Application of zinc sulphate in zinc deficit soils:** For zinc deficit soils, application of zinc sulphate @ 10 kg/ha to soil along with recommended dose of fertilizer (25:50:0 NPK/ha) recorded 16.7% higher yield of greengram compared to RDF only with C:B ratio of 1:2.2 and the same trend is observed with blackgram with 24% increase in yield and C:B ratio of 2.02.

2006

- **Usage of boulder and tile drainage in alkali soils:** Boulder and tile drainage is recommended for irrigated paddy alkali soils for higher yields.
- **Lime application to acid soils:** Lime application to acid soils based on 45% calcium saturation gives higher pod yield of groundnut (16 q/ha) at GKVK.
- **Application of zinc sulphate in zinc deficit soils for higher tobacco yield:** For soils deficit in zinc, application of zinc sulphate to tobacco nursery @ 2 g/sq.m before sowing gives 33% higher & superior quality leaf yield of tobacco (2.5 q/ha).
- **Application of zinc and boron in deficit soils for higher groundnut yield:** For soils deficit in zinc and boron in zone-7 area, application of zinc sulphate @ 10 kg/ha through enriched FYM to the soil followed by foliar spray of 0.1% borax at flowering stage gives higher pod yield of groundnut (25 q/ha).

2004

- **Amendment for alkali soils:** Sulphitation pressmud acts as an amendment for paddy alkali soils @ 15t/ha.

2001

- **Sub-soiling with sub-soiler:** Sub-soiling with sub-soiler in crop row after normal plough and before ridge formation recorded higher cured leaf of tobacco.

- **Application of sulphur for higher paddy yield:** Application of sulphur @ 20 kg/ha to sulphur deficient soils of Cauvery command area increases paddy yield by 5-7 q/ha

2000

- **Application of zinc for higher groundnut yield:** Application of $ZnSO_4$ @ 10 kg/ha at the time of sowing once in two crops of groundnut results in 18% higher yield over that of control. Technology was accepted for release in zinc deficient soils of Zone-7.

2.11 Integrated farming system modules

2025

- **Integrated farming systems:** Sixty integrated farming systems models that are specific for irrigated, rainfed and semi-irrigated conditions suitable for one hectare and one acre of land in the 10 districts under the jurisdiction of the University of Agriculture, Bangalore have been developed. Adopting Integrated farming systems enhances livelihood and economic sustainability (farmers can earn Rs. 4.36 as profit for every rupee invested) by balancing the agricultural / horticultural crop yield loss due to aberrant weather situations with the income from the subsidiary farming components such as dairy, sheep/ goat rearing, pig farming, beekeeping, mushroom farming, and sericulture.

2017

- **Integrated farming system modules for 1 ha and 2 ha area under rainfed and irrigated conditions have been developed:** Area = 1 ha, Five blocks in One ha - each block 20 guntas

✓ I Block (Agri + Horti system): sustainable annual income and nutrition

- ✓ II & III Block (20 + 20 guntas): improved crops and cropping systems for food security
- ✓ IV Block (20 guntas): Forage production and commercial crops 10 guntas for forage crops Co-4, 10 guntas for Seri Suvarna mulberry production
- ✓ V Block (20 guntas): vegetables, flower crops & farm pond
- ✓ Livestock components: for sustainable income, manure production, employment generation and upscaling water productivity
- ✓ Fisheries: Assured water availability – Composite fish culture (150-200 fingerlings)
- ✓ Bee keeping - 4 bee units
- ✓ Biogas: recycling animal waste for sustainable and self sufficient energy production
- ✓ Compost and vermicompost production: effective and efficient use of farm waste, production of manures and reducing cost of production
- ✓ Biogas slurry and farm waste: 3-4 ton of vermicompost, 10-15 tons of compost

2.12 Farm mechanization

2024

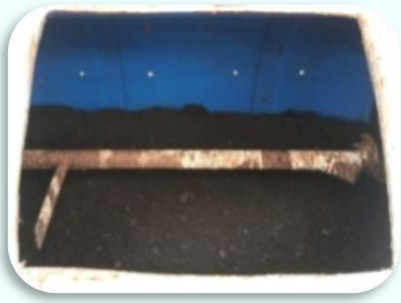
- **Manually operated Ragi seed cum fertilizer drill:** Manually operated Ragi seed cum fertilizer drill (Drum type) is very much suitable to small farmers with fragmented land holdings. By utilizing seed drill two farmers can able to sow 1.5 acres of land per day using 20 kgs of seeds and 70 kgs of fertilizer. It approximately saves Rs. 2000/- per hectare in cost of cultivation by reducing human drudgery and labour dependency.

- **Multi-Crop Processing Machine:** Machine is operated with 1hp, single phase electric motor. It is compact and easy to operate with minimum skill and higher efficiency (98%). It can be used for separation of pods (40-50kg/h) from groundnut crop (groundnut stripping), separation of seeds (110-115 kg/h) from groundnut pods (groundnut decortication), separation of seeds (216-234/h) from sunflower ear head (Sunflower threshing) and separation of seeds (217-223/h) from maize cobs (Maize shelling). Separated seeds had recorded less than 4% seed breakage with 95%

germination. It would cost 3-4 times less as compared to the total cost of four separate machines that are required for groundnut stripping, groundnut decortication, sunflower threshing and maize shelling. It is suitable for small to medium scale farmers/ processors, startup entrepreneurs and cottage industry.

2023

- **Mechanized Drum Composter– A simple method of composting waste:** In this method, wet and dry organic waste materials generated should be mixed in 1:3 ratio all the time. At the time of filling the waste material into the drums, it should be mixed with microbial consortia or cow dung slurry to speed up the decomposition and 60% moisture should be maintained. Later, 15-20 rotations of the drums twice a day with a hand-rotating device will speed up the decomposition process by facilitating aeration. By doing this, compost will be ready in about 75 days. While, if drums are mechanically motored & rotated 2-3 times a day for 5 minutes, compost will be ready in about 4 weeks duration. In this system, liquid waste produced during the decomposition can be collected in trays below the drums and could be sprayed to the crops in 1:10 ratio of liquid and water. Mechanized drum composter of 50 liter capacity can produce about 30 kg of compost in about 30-35 days.



- **Improved hand weeder for row crops:** This tool is designed for one-foot (30 cm) row spacing crops. It has a total of five tynes, three in front and two in back. It is suitable for all types of soil and crops. Its shovels are made of high carbonated iron and each shovel is 4 cm wide. Working width between the rows is 20 cm, where in simultaneous removal of weeds, loosening the top soil and opening the small furrows between the rows can be done. It can be pulled by rope by one person in the front and another person can hold it with both hands from behind. Weeding efficiency of the improved hand weeder is around 95% while efficiency of cycle weeder is around 80%. Cost of the hand weeder is around Rs.3,300/-


- **Sugarcane deskinner tool:** Food grade SS 304 material is used for the fabrication of sugarcane deskinning tool. It consists of a cylindrical shaft, curved blade, frame, hinges, and handle. A cylindrical shaped shaft (5cm) is divided into three parts to accommodate the varying circumferences and joined by hinges and the height of the knives is 15 cm, 8 cm and 5 cm respectively. While operating the tool, it should be held in right hand with four fingers come on left side and thumb on right side. At present most of the automatic and semi-automatic deskinning machines are available, but they are very expensive and making it difficult for small scale roadside vendors and consumers to use. As compared to manual peeling with knife, this developed deskinner at different diameters showed reduction in deskinning time and increase in juice quantity and quality.


2021

- **Tractor drawn automatic seed-cum-fertilizer drill for intercropping /monocropping system of multi-crops:** Monocrops like finger millet, pigeon pea, groundnut, soyabean, field bean, horse gram, cowpea, kodo millet, foxtail millet, bajra, jowar, maize etc., seeds could be sown by this improved seed drill. Inter cropping system such as 10 rows of groundnut with 2 rows of pigeon pea (10:2) and 10 rows of finger millet with 2rows of pigeon pea (10:2) can be taken up by this improved seed drill. This seed drill also found suitable to take up strip cropping like finger millet 21 rows and 21 rows field bean/cowpea/horse gram. This method of sowing helps to take up harvesting by using combined harvester. Strip cropping system having runoff permitting and runoff resistant crop helps to conserve more moisture. This can be driven by 35 to 50hp tractor. The cost of improved seed drill is Rs.95,000/-

2018

- **Animal drawn automatic seed drill for finger millet based inter cropping system:** Animal drawn automatic seed drill for finger millet based cropping system has been developed. The implement weighs 23 kg with 5 coulters of 30 cm spacing with a provision of additional row for pigeonpea sowing as an inter-crop (8:2). The seed drill is useful for small and marginal land holding farmers.

2014

- **Drum seeder method for sowing hybrid paddy:** Drum seeder method of sowing hybrid paddy has been recommended as an additional method to the existing one.
- **Drum Composter viz., Drum Vermi Composting and Drum Bio Composting:** Drum Composter a simple technology for managing urban waste and its use in agriculture.

2013

- **Power Operated Groundnut Decorticator (M-6):** Power Operated Groundnut Decorticator (M-6) can shell 326 kg pods / day with Rs.100 as per day labour charge, but the same labour could shell only. 100 kg pods per day, manually. There is a saving of Rs. 226 per day. It proves viable under large acreage where labour is scarce. The approximate cost of the machine is Rs.10,000/-

2012

- **Modified hand operated groundnut pod grader machine:** Grader could grade 480 kg pods/day with Rs. 100/- per day labour compared to Manual grading (111 kg pods/day) at the same labour cost.

2011

- **Hand operated Cycle weeder:** Hand operated cycle weeder has been modified & redesigned to save labour cost and reduce drudgery. 1 labour will be able to weed area of 0.4ha/day compared to 12 women laborers required to cover same area.
- **Medium size hand operated groundnut decorticator:** Medium size hand operated groundnut decorticator (Model 4) can shell on an average 150 kg pods / day with least damage of 1.98 per cent.
- **Hand operated UAS (B) groundnut decorticator cum castor sheller:** Hand operated UAS (B) groundnut decorticator cum castor sheller reduces the drudgery and saves labour cost. On an average a laborer can shell 222 kg/day with least percentage of damage of 0.8% as compared to local method of stone rolling (194 kg/day and damage 1.77%).
- **Hand operated groundnut decorticator:** Hand operated groundnut decorticator (Model 5) has been designed and recommended for adoption. This model can shell 200 kg pods/day with labour costs saved to a great extent.

2009

- **Hand operated groundnut decorticator:** An efficient labour saving and viable, hand operated groundnut decorticator which can shell upto 99 kg of groundnut pods per day by a single woman labour has been developed for use in Zone-4.

2003

- **Modified hand operated tubular maize sheller:** This sheller recorded shelling efficiency of 5.12 times more than hand shelling and 1.55 times more than tubular maize sheller and recorded higher efficiency of 3.3 times more than the bare hand shelling with no damage to seeds.
- **Groundnut digger:** Highest number of pods was uprooted with Central Institute of Agricultural Engineering model groundnut digger followed by manual hand pulling & modified wooden plough methods.
- **Pedal operated arecanut dehusker:** Pedal operated arecanut dehusker (Rs.2,400) was found to be better (88 kg/h/4laboure) compared to motorized dehusker.

2.13 Microbiology

2023

- **Acetic acid for increasing the storage life of oyster mushroom:** Treating 1 kg of oyster mushroom with 480 ml of 1% acetic acid for 10 minutes then air dry for 2 minutes and packed in tight High Density Polyethylene (HDPE) bags and storing in

refrigerator at 4°C enhanced the shelf life of oyster mushroom by 6 days with an expenditure of Rs. 3.7 per kg mushroom.

2022

- **Sugarcane trash decomposition using microbial consortium:** Spread the trash after the harvest in alternate rows & irrigate the field. Spread 10kg/acre of urea & microbial consortium (10% cowdung + 4 kgs/acre of microbial consortium: *Phanerochete* + *Aspergillus* + *Pleurotus* + *Trichoderma* + *Pseudomonas* + *Bacillus* + *Cellulomonas in* 400 l of water) over the irrigated trash. After 30 days, turn the trash and repeat the same application. Within 75-90 days of application, trash decomposes & supplies nutrients to ratoon crop. It saves 25-30% of chemical fertilizer application & enhances soil fertility.

2019

- **Local crop waste as substrate for oyster mushroom cultivation:** Chopped maize stalk possess higher bio efficiency. It can be used as better alternate substrate for enhanced production of oyster mushroom.

2.14 Other practices

2021

- **Identification of Rice hybrid and varieties suitable for cultivation under direct seeded rice method:** Rice hybrid KRH-4 and varieties viz., Gangavathi sona,

Thanu, MAS-26 and MAS- 946-1 are also suitable for cultivation under direct seeded rice method.

2017

- **Staling of Sugarcane on jaggery yield & quality:** Cane harvested shall be crushed within 24 hours found ideal for the preparation of jaggery. To overcome this problem. The harvested sugarcane be kept under shade and water to be sprayed at regular interval to retain freshness and moisture to get good quality jaggery**.**
- **Use of plant based clarificant soybean milk extracted from soaked seeds in organic jaggery production has been developed.**

2016

- **Technology for organically processed chemical free jaggery preparation:** Addition of organic materials such as lime @ 300 g/1000 liters of juice and bhendi mucilage @ 0.75 kg/ 1000 juice before boiling to get high sucrose, low reducing sugars and low Ash percentage for good quality jaggery.

Chemically Processed

Organically Processed

2013

- **Unique polymorphic primers for testing of hybrids purity in sunflower:** Identified unique polymorphic primers for testing of hybrids purity in sunflower. This technique is quick compared to the conventional Grow-Out-Test (GoT).

2010

- **Greengram- sunhemp cropping system:** Growing of greengram during pre-monsoon and sunhemp during rabi season in paddy-paddy system during fallow period under residual moisture, helps in realizing higher yield in Zone-7.

2009

- **Staggered nipping in castor:** Staggered nipping i.e., removing auxillary buds by retaining one bud per branch until five to six branches in castor has given 21% higher seed yield (12 q/ha) compared to the non-nipped control (9.6 q/ha) at Zone-5.

2005

- **Contingent plan of crops for zone-7:** Contingent plan of crops for zone-7 to mitigate drought situations was developed.

2004

- **Method of establishment of hybrid cotton under rainfed condition:** Sowing of hybrid cotton seeds on the top of the ridges in high rainfall areas of Zone-7, results in better crop stand and higher kappas yield with higher benefit cost ratio compared to traditional method of flatbed sowing.
- **Wood lot system for non-arable lands of central dry zone:** Bengali jali, casuarina and eucalyptus are the suitable tree species for fuel wood production under wood lot system in non-arable lands of central dry zone of Karnataka. Bengali jali is to be planted at a spacing of 3x2m while casuarina and eucalyptus are to be planted at 2x2m for higher fuel wood yield. The trees are to be harvested for fuel wood after 8 years of planting.

2.15 Drone usage

2025

- **Standardizing drone-based operations for finger millet and pigeonpea:** The height of spray is 1.5 meter above crop canopy with a forward speed of 3 meter per second. Spray volume of 35 l/ha and 55 l/ha for early and later stages of the crop respectively against 500 l/ha in conventional spray for both the crops. About 15% of the chemicals can be saved in drone spray over conventional method. Foliar spray of water-soluble fertilizer and growth hormones (Finger millet: 19-19-19 and KNO_3, Pigeonpea: 19-19-19, pulse magic and KNO_3) through drone distributed them uniformly throughout the crop and resulted in 4-8% higher grain yield compared to conventional spray.

Drone spray in Fingermillet

Drone spray in Pigeonpea

2.16 Rain water harvesting/ runoff farming

2025

- **Polyhouse based rain water management for sustainable agriculture:** Rain water harvesting mechanism installed over the polyhouse using gutter and down pipe connected to storage tank is an ideal rain water conservative measure and further stored water could be used for cultivation. Storage tank of 7,20,000 litres capacity (24m length, 10m width and 3m depth) can be constructed using RCC material over the roof top of poly houses built on 15 guntas area. Irrigation can be scheduled through drip while water soluble fertilizers can be supplied through fertigation for the entire crop growth period. High value crops like french-bean, brinjal, broccoli, capsicum, pole beans, cherry tomato, lettuce, and spinach are recommended to be grown under this protected practice. This has proved to be a valuable tool especially in dryland areas to increase crop yields by making best use of available water resources for 280-300 days through solar enabled drip irrigation system. Overall, a net income of Rs. 2,71,500 and a B:C ratio of 4.57:1 (from broccoli, capsicum and beans) can be obtained from a 15-gunta polyhouse.

Crops that are grown in rain water harvesting mechanism installed over the polyhouse roofs in an area of 15 gunta

III. CROP PROTECTION TECHNOLOGIES

INTRODUCTION

UN Food and Agricultural Organization has reported that globally, farmers lose atleast 40 percent of their crops due to pests and diseases every year. More than 50,000 pathogenic diseases and 10,000 species of pests have been documented as potential threat to the crops produced around the world leaving them damaged and inedible.

Climate change aggravates plant pests and diseases by enabling pests to expand their geographic ranges and complete more life cycles in a single season, while warmer temperatures and altered humidity favor the growth and spread of many pathogens. Extreme weather events like droughts and floods also stress plants, making them more vulnerable to infestations and infections. These effects lead to increased crop damage, potential food security challenges, and the emergence of new or previously controlled pests and diseases. Crop protection has tremendously improved in the last 50 years and will continue to do so. Crop protection is equally important as crop production in attaining sustainably higher yields. It's a broad spectrum of measures and strategies that's complex enough to decide upon.

The ideal solution to pest and disease control problems is to plant crop varieties that are resistant to attack. The only difficulty is that such varieties are not universally available, and development entails a very long process. Most plant virus diseases are transmitted by insect carriers, so control of insects is linked to control of disease. University has developed and released 157 varieties (Table-4) that are pest and disease resistant / tolerant and it's a continuous process.

Chemicals i.e Inorganic way of control measures are by and large user friendly, cheap and effective while they leave back toxic residues. Eco-friendly biological controls cannot replace insecticides entirely, because nature provides for survival of both beneficial and destructive insects. Chemical based technologies developed by the university are found effective enough in controlling the menace. Over the years persistent search for new and safer chemicals are on track to avoid pests / diseases building up resistance to them. Efforts on finding out eco-friendly solutions is the top priority of the university.

Integrated approach is practically possible and feasible solution. Though chemical synthesis has remained the most important source for managing pest and

disease, in the recent years research programmes have been re-oriented towards integrated pest and disease management. University has oriented its research towards developing Integrated pest and disease management practices.

Abstract of crop protection technologies developed by UASB are enlisted in Table-5. Crop protection technologies developed over different crop categories are presented in Figure-3. Description of these management practices are further presented in detail.

Table-4: List of pest and disease resistant crop varieties

Sl. No.	Crop Varieties	Important features	Year of release
	Paddy		
1.	1. 11356-7 (Suma)	Tolerant to blast	1970
2.	2. Intan	Resistant to blast disease	1976
3.	3. GMR-2 (Vikram)	Resistant to gall midge	1976
4.	4. GMR-17	Resistant to gall midge	1976
5.	5. IET-3232 (Shakti)	Resistance to gall midge and blast tolerant	1978
6.	6. IET-1444 (Rasi / Suraj)	Resistant to blast	1978
7.	7. IET-2911 (Palguna)	Resistant to gall fly	1979
8.	8. IET-4699 (Scented variety)	Blast and *Helminthosporium* tolerant Resistant to leaf spot disease	1979
9.	9. KMS-5914 A-6 (Mandya Vijaya)	Tolerant to blast	1986
10.	10. IET-7191	Tolerant to blast	1987
11.	11. IET-7575	Tolerant to brown plant hopper	1989
12.	12. IR-10781 (KHP-2)	Tolerant to blast	1990
13.	13. DWR-4107 (Hemavathi)	Tolerant to leaf and neck blast	1994
14.	14. IET-7956 (Latha)	More resistant to gall midge and tolerant to blast	1994
15.	15. KRH-1	Resistant to blast	1995
16.	16. MO-4 (Bhadra)	Tolerant to gall midge	1996
17.	17. CTH-3	Tolerant to cold and blast	1996

Sl. No.	Crop Varieties	Important features	Year of release
18.	18. IET-8116	BPH resistant	1997
19.	19. KHP-5	Tolerant to blast	2000
20.	20. Sharavathi (IR-57773)	Tolerant to blast	2000
21.	21. BR-2655	Highly tolerant to leaf blast and moderately tolerant to neck and sheath blast	2001
22.	22. KCP-1	Tolerant to leaf and neck blast and gall midge	2001
23.	23. IET-13901	Tolerant to temporary submergence Tolerant to blast and bacterial leaf blight diseases	2002
24.	24. IET-14758 (Champaka)	Tolerant go gall midge and blast disease	2003
25.	25. FARO-37 (Kadamba)	Tolerant to major pests and disease	2003
26.	26. KMP-101 (Tanu)	Tolerant to blast and sheath rot disease	2004
27.	27. IET – 14845	Resistant to gall midge	2005
28.	28. MTU-1001	Tolerant to both BPH and blast	2005
29.	29. MTU-1010	Tolerant to both BPH and blast	2005
30.	30. KHP-10	Tolerant to blast	2007
31.	31. PUBM-8	Tolerant to blast	2007
32.	32. KMP-105	Tolerant to blast	2010
33.	33. KHP-11	Blast tolerant	2011
34.	34. KHP-12 (BKBM-23)	Tolerant to blast	2011
35.	35. Paustic – 9	Resistant to blast	2016
36.	36. Paustic – 7	Resistant to blast	2016
37.	37. KMP-175	Resistant to Blast	2016
38.	38. KMP-220	Moderately tolerant to Blast	2021
39.	39. KMP-225	Moderately resistant to leaf and neck blast diseases	2022
	Jowar		
40.	1. RSH-1	More tolerant to shoot fly	1975

Sl. No.	Crop Varieties	Important features	Year of release
41.	2. SB-1079	Resistant to downy mildew and major grain moulds	1978
42.	3. SB-905(KDS-1)	Rust resistance Tolerant to charcoal rot	1982
43.	4. KDRSH-1 (SPH-218)	Tolerant to charcoal rot	1985
44.	5. SPV-462	Tolerant to earhead smut	1998
	Wheat		
45.	1. Bijaga yellow	Resistant to prevalent races of rust (except 42B)	1965
46.	2. NI747-19	Resistant to the prevalent races of rust	1967
47.	3. CC 464	Moderately resistant to all rust disease	1978
48.	4. HD-2189	Resistant to all rust disease	1978
49.	5. DWR 16	Resistant to all rust	1979
50.	6. D 118-5-5-10	Resistant to rust	1979
51.	7. KDW-16 (Keerthi)	Resistant to all races of black and brown rust disease	1982
52.	8. KDW-137 (Kiran)	Highly resistant to race 42B2 Moderately resistant to 117A of black rust	1982
53.	9. DWR-39	Resistant to both black and brown rust disease	1984
	Finger millet		
54.	1. Indaf-8 (Chethana)	Resistant to drought and blast	1982
55.	2. HR-911 (KBR-1)	Moderately resistant to diseases	1985
56.	3. HRC 50-5	Blast resistant	1993
57.	4. Indaf-15	Tolerant to neck and finger blast	1994
58.	5. GPU-28	Blast tolerant	1997
59.	6. GPU-26	Tolerant to neck & finger blast	1998
60.	7. L-5	Tolerant to rust and blast disease	1999
61.	8. GPU-45	Resistant to blast disease	2001

Sl. No.	Crop Varieties	Important features	Year of release
62.	9. MR-6	Highly tolerant to neck and finger blast	2004
63.	10. GPU-48	Tolerant to blast	2005
64.	11. ML-365	Moderately tolerant to neck blast and finger blast	2008
65.	12. GPU-66	Tolerant to neck blast and finger blast diseases	2009
66.	13. KMR-301	Tolerant to neck blast and finger blast	2009
67.	14. KMR-204	Resistant to blast	2012
68.	15. KMR-340	Resistant to blast and blight diseases Tolerant to Stem borer and Aphids	2016
69.	16. KMR-630	Resistant to neck blast and rust disease Tolerant to aphids	2018
70.	17. KMR-316	Resistant to blast and foot rot	2021
71.	18. ML-322	Resistant to neck and finger blast and is drought tolerant	2023
	Maize		
72.	1. Deccan - 101	Tolerant to sorghum downy mildew	1967
73.	2. Ganga-II	Tolerant to downy mildew and leaf blight	1989
74.	3. NAC-6004	Resistant to downy mildew and *Turcicum* leaf blight	1998
75.	4. NAC-6002	Resistant to downy mildew and *Turcicum* leaf blight	1999
76.	5. NAH-2049	Tolerant to *Turcicum* leaf blight, downy mildew and stem borer	2006
77.	6. NAH-1137	Tolerant to downy mildew, *Turcicum* leaf blight and polysora rust	2010
78.	7. MAH-14-5	Resistant to *Turcicum l*eaf blight Moderately resistant to downy mildew Moderately susceptible *to Fusarium* stalk rot	2017

Sl. No.	Crop Varieties	Important features	Year of release
79.	8. MAH-14-138	Resistant to *Turcicum* leaf blight Moderately resistant to sorghum downy mildew	2022
80.	9. MAH-15-84	Resistant to leaf blight Moderately resistant to downy mildew	2024
	Minor millets		
81.	1. Foxtail millet: GPUF-3	Moderately resistant to rust & leaf blight	2021
82.	2. Little millet: GPUL-6	Moderately resistant to brown spot and leaf blight	2021
83.	3. Little millet: GPUL-11	Highly resistant to grain smut and leaf blight disease	2023
84.	4. Proso millet: GPUP-28	Moderately resistant to leaf blight Resistant to brown spot	2021
85.	5. Proso millet: GPUP-32	Highly resistant to grain smut and brown spot disease	2023
86.	6. Browntop millet: GPUP-28	Resistant to leaf blight	2022
	Pseudo cereals		
87.	1. KBGA-4	Resistant to leaf rust and phyllody	2017
88.	2. KBGA-15	Tolerant to leaf rust, leaf spot & phyllody	2021
	Pigeonpea		
89.	1. GS-1	Resistant to pod borers	1980
90.	2. PT-221	Tolerant to most disease	1980
91.	3. KGT-1 (Maruthi)	Suitable for wilt is endemic region	1985
92.	4. TTB-7	Highly tolerant to sterility mosaic	1987
93.	5. BRG-1	Resistant to major diseases and pests	2004
94.	6. ICP-7035	Resistant to Sterility Mosaic	2005
95.	7. BRG-5	*Fusarium* wilt resistant	2014
96.	8. BRG-3	Resistant to both *Fusarium* wilt and sterility mosaic	2017

Sl. No.	Crop Varieties	Important features	Year of release
	Cowpea		
97.	1. KHCW-2	Tolerant to bacterial blight	1979
98.	2. TVX-944-02F	Tolerant to leaf blight and rust diseases	1987
99.	3. KBC-1	Tolerant to pests, leaf blight and rust	1988
100.	4. KBC-2	Resistant to rust & yellow mosaic	1998
101.	5. IT-38956-1	Tolerant to spot & rust disease	2006
102.	6. KM-5	Tolerant to rust disease	2007
103.	7. AV-6	Tolerant to rust disease and resistant to bacterial leaf blight	2017
104.	8. KBC-12	Resistant to dry root rot, bacterial leaf blight and viral disease	2024
	Chickpea		
105.	1. Annigeri-1	Tolerant to wilt	1968
106.	2. KGB-1(Bheema)	Fairly resistant to root rot & pod borers	1985
107.	3. Vishal	Wilt resistant	2006
108.	4. JG-11	Wilt and drought tolerant	2006
	Soybean		
109.	1. KB-79 (Sneha)	Resistant to *Alternaria* and yellow soybean mosaic	1996
110.	2. GC-002009-4-1-1 (Karune)	Tolerant to major pests and disease	2009
111.	3. MAUS-2 (Pooja)	Tolerant to major pests and diseases	2010
	Blackgram		
112.	1. LBG-625	Resistant to powdery mildew	2002
113.	2. LBG -791	Resistant to Yellow mosaic virus	2019
	Greengram		
114.	1. PDM-84-178	More tolerant to powdery mildew and yellow mosaic disease	1994
115.	2. KKM -3	Resistant to yellow mosaic virus and powdery mildew	2008

Sl. No.	Crop Varieties	Important features	Year of release
	Sunflower		
116.	1. BSH-1	More tolerant to drought and diseases	1980
117.	2. DH-8	Tolerant to leaf spot disease	1984
118.	3. KBSH-1	Moderately resistant to rust and other foliar diseases	1987
119.	4. KBSH-41	Tolerant to downy mildew, alternaria rust and necrosis	2000
120.	5. KBSH-42	Tolerant to downy mildew, *Alternaria* rust and necrosis	2000
121.	6. KBSH-44	Tolerant to downy mildew, *Alternaria* rust and necrosis	2002
122.	7. KBSH-53	Highly tolerant to powdery mildew disease	2008
123.	8. KBSH-78	Better resistance to necrosis, *Alternaria* leaf spot and powdery mildew	2018
124.	9. KBSH-85	Resistant to downy mildew	2023
125.	10. KBSH-88	Resistant to downy mildew	2024
	Groundnut		
126.	1. GPBD-4	Resistant to tikka, leaf spot & leaf rust	2005
127.	2. Chintamani-2 /KCG-2	Moderately tolerant to major diseases like leaf spot, rust and peanut stem necrosis and for pests like leaf miner	2010
128.	3. Chintamani-6 /KCG-6	Tolerant to leaf spot disease	2014
129.	4. GKVK-5	Moderately resistant to rust and late leaf spot disease	2015
130.	5. GKVK-27	Moderately resistant to rust and late leaf spot disease	2020
	Sesamum		
131.	1. KDSe-1	Moderately resistant to powdery mildew and bacterial leaf blight	1983
132.	2. Navile-1	Tolerant to *Alternaria* leaf spot and mildew disease	1990

Sl. No.	Crop Varieties	Important features	Year of release
133.	3. T7	Tolerant to phyllody & powdery mildew disease	1996
134.	4. GT	Moderately tolerant to powdery mildew and phyllody	2012
	Castor		
135.	1. Jyothi	Resistant to wilt	2005
136.	2. DCH-177 (Hybrid)	Resistant to *Fusarium* wilt and white fly	2011
137.	3. ICH-66	Wilt resistant & green hopper tolerant	2021
	Sugarcane		
138.	1. CO-7804	Tolerant to *Heliminthosporium*	1990
139.	2. CoVC-2003-165	Resistant to woolly aphid	2008
	Cotton		
140.	1. Hampi (Strain 5110)	Tolerant to black arm and red leaf blight	1967
141.	2. Mysore vijaya	More tolerant to black arm	1969
142.	3. Bhagya (Strain GS-23)	Red leaf blight tolerant	1973
143.	4. Sharada	Tolerant to jassids and angular leafspot	1980
144.	5. DCH-32 (Jayalaxmi)	Tolerant to black arm and red leaf blight	1982
145.	6. DS -59 (Soubhagya)	Tolerant to bacterial and red leaf blight	1982
146.	7. KDCd-1	Resistant to *Fusarium* wilt	1983
	Tobacco		
147.	1. NPN-190	Resistant to black shank	1979
148.	2. Bhavya	Moderately resistant to black shank and root knot nematodes	1991
149.	3. Thrupthi	Moderately resistant to black shank and root knot nematodes	1998
150.	4. KST-28	Tolerant to nematodes, leaf eating caterpillar and moderately resistant to black shank	2008
	Fodder		
151.	1. BH-18: Napier Grass	Resistant to *Helminthosporium*	1987
152.	2. Fodder Bajra: Deena Bhandhu	Tolerant to foliar disease and pests	1990

Sl. No.	Crop Varieties	Important features	Year of release
153.	3. Fodder Cowpea: MFC-08-14	Resistance to rust	2015
154.	4. Guinea grass: JHGG-08-01*	Resistant to stem borer and leaf caterpillars & webber	2015
155.	5. Forage Cowpea: MFC-09-1	Moderately resistant to rust	2017
156.	6. Forage Cowpea: MFC-09-3	Resistant to yellow mosaic virus, rust and leaf spot	2017
157.	7. Fodder Oats: RO-11-1	Moderately tolerant to leaf blight, root rot and less susceptible to aphids	2021

Table-5: Abstract of crop protection technologies developed (2000-2025)

Particulars	Pest management	Disease management	Total
Chemical	27	40	67
IDM	0	15	15
IPM	15	0	15
Organic	1	3	4
Safety Guidelines	1	0	1
Total	**44**	**58**	**102**

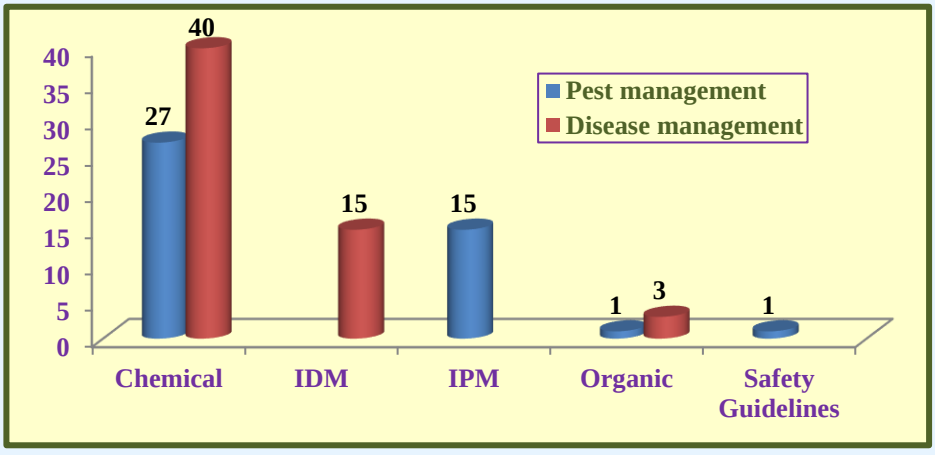


Figure-3: Crop protection technologies developed for different crop (2000-2025)

3.1 Pest management

2025

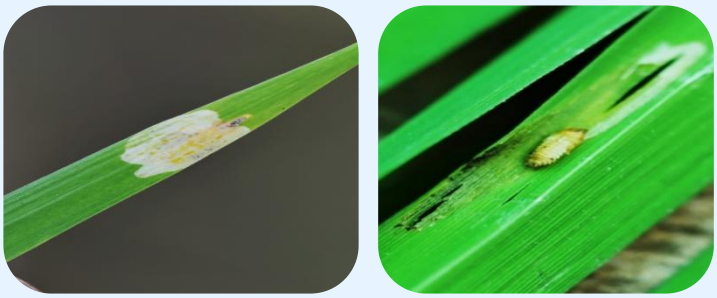
- **Rodent management in paddy and sugarcane:** Placement of Brodifacoum (0.005% BB) wax blocks in burrows and sides of the bunds (10g wax blocks at 40 places per acre) at tillering and panicle formation stage in paddy crop reduced the rodent population by 83 per cent with B:C ratio of 3.56:1 while twice per month with a duration gap of 15 days from first application (10g wax blocks at 40 places per acre) in the month of August and November in sugarcane crop (or two months after the first month of application) significantly reduced the rodent population by 84 per cent with B:C ratio of 4.9:1.

- **Management of rice gall midge in paddy:** Foliar spray of fipronil 5 SC @ 2 ml/l was highly effective in reducing the gall midge population over presently recommended chemicals (140% better than monocrotophos and 86% better than carbofuran) and enhanced yield (61.6 q/ha) by 17-21 per cent with B:C ratio of 3.25:1 **or** Spray of carbosulfan 25 EC @ 2 ml/l water was proved to be highly effective for the management of Asian rice gall midge over presently recommended chemicals (130% better than monocrotophos and 77% better than carbofuran) and enhanced yield (57.2 q/ha) by 9-13 per cent with B:C ratio of 2.94:1

Healthy plant

Infested Plant: Leaf apperars as onions leaf. It is known as sterile tiller/ silver shoot

- **Management of rice hispa beetle in paddy:** Foliar spray of carbosulfan 25 EC @ 2 ml/l water was highly effective in managing rice hispa beetle over presently recommended chemicals (92% better than monocrotophos) and enhanced yield (62 q/ha) by 15-19 per cent with B:C ratio of 3.3:1



White and yellowish white spots made by caterpillars on leaves

- **Management of pod borers in pigeonpea:** Spraying of indoxacarb 14.5 SC @ 0.8 ml/l at bud formation and flowering stage, chlorantraniliprole 18.5 SC @ 0.3 ml/l at pod setting stage and lufenuron 5.4 EC @ 1 ml/l at pod development stage reduces pod borer complex infestation with least per cent pod damage of 9.33 at harvest and enhanced economic yield (2172 kg/ha) with highest Incremental Cost Benefit Ratio (ICBR) of 7.13.

Larvae of Pod borer **Maggots of Podfly** **Larvae with webbing**

2024

- **Management of rodents in organic cropping system:** In natural / organic farming taking up the cultural practices such as deep ploughing before sowing and regular trimming of weeds along with the spraying of botanical product (500g of neem leaves, 500g of glyricidia leaves, 500g of vitex leaves, 250g of garlic bulbs are boiled in 10 L of water for 30 min and filtered, to this 250g chilli powder and 2 L of cow urine is added and kept for 3 days and the mixture is diluted to 20 per cent and sprayed) in the vegetative stage (40 DAG) and in the peg formation stage and placing

the snap traps @ 50 per hectare for 3 nights continuously, significantly reduced the rodent population by 70.8 per cent with a B:C ratio of 4.4:1. This rodent management module can be used for other crops. Spray the botanical product when the rodent population exceeds the threshold (50 LBC/ha).

Spraying botanical solution

Rodenticide baiting

Burrow fumigation with chili powder

Placement of snap traps

- **Pink bollworm (PBW) management in Cotton:** Spraying of Spinoteram 11.7 S.C @ 0.75 ml/l at boll development stage reduced the number of PBW larvae (95.23%), green boll damage (98.03%), open boll damage (89.80%) and locule damage (86.99%) and enhanced seed cotton yield (20.71 q/ha) with 15% increase in yield over recommended chemical and maximum B:C ratio (3.45:1).

2023

- **Management of yellow stem borer in paddy:** Broadcasting of granular insecticide, chlorantraniliprole 0.4% GR @ 4 kg/ acre at 20 days after planting reduced the incidence of yellow stem borer by 93% with 75 % enhanced yield (53.2 q/ha) over control and B:C ratio of 2.02:1.

Treated Plot

Untreated Plot

- **Management of brown plant hopper in paddy:** Foliar spray of triflumezopyrim 10 SC @ 0.40 ml/l when 5-10 grasshoppers per stem is

observed, reduced the pest incidence to the extent of 99% with B:C ratio of 2.87:1 and 6% to 15% higher grain yield (60 q/ha).

Treated Plot

Infested Plot

- **Management of ear head bug in paddy:** Foliar spray of fipronil 5% SC insecticide at 2 ml/l of water when 1-2 bugs per plant is observed during milk filling stage reduced the incidence by 96% with 64% enhanced yield (60 q/ha) and B:C ratio of 3.09:1.

Eggs

Earhead Bug

Infested earhead

Chaffy seeds

- **Management of mirid bug in cotton:** Spraying dinotefuran 20 SG @ 0.3 g/l of water at bud setting and fruit development stage reduces mirid count to an extent of 87% & enhanced the yield by 60% (24.4 q/ha) with 3.41:1 B:C ratio

Mirid bug

Damaged plant

Damaged bud

- **Management of peafowl in agricultural crops:**

✓ Arranging the reflective ribbons of 2inch width in grid format with spacing of 6 ft x 6 ft with a twist towards north to south direction around crop area and 2 feet above the crop canopy significantly reduced the peafowl menace and enhanced the crop yield by 11.5 and 17.8 per cent in ragi and groundnut crop, respectively with B:C ratio of 1.19:1 and 1.62:1.


✓ Arranging the coconut fiber ropes in grid format with spacing of 6 ft x 6 ft around crop area and 2 feet above the crop canopy significantly reduced the peafowl menace and enhanced the crop yield by 9.6 and 14.9 per cent in ragi and groundnut crop, respectively with the B:C ratio of 1.17:1 and 1.6:1.


Note: Ropes/ribbons must be placed immediately after sowing (up to 15-20 days) & during grain formation stage till harvest, depending on the crop and infestation

- **Management of pod fly in pigeonpea:** Spraying of lufenuron 5.4 EC @ 1ml /l of water, twice at an interval of 15 days at pod setting & pod development stages reduced pod damage by 56% & seed damage by 77% with 3.63:1 B:C ratio



Pod Fly **Damaged Pod** **Damaged seeds**

2022

- **Spraying of flonicamid for management of sucking pest in cotton:** Spraying of flonicamid 50% WG @ 0.3g/l at 45 days after sowing and 2nd spray when the sucking pests crosses the ETL recorded least population of sucking pests (whiteflies, thrips, leafhoppers & aphids), higher seed cotton yield (20.20 q/ha) and B:C ratio (3.14).




- **Management of wild boar in groundnut field:** Fixing of nylon net around the border of the groundnut field up to 4 feet height from the ground and trailed on the ground up to 2 feet and covered with soil significantly reduced the wild boar menace with B:C ratio of 4.3:1. **OR** Fixing of used sarees around the border of the groundnut field up to 3 feet height & trailed on the ground up to 3/4 feet & covered with soil significantly reduced wild boar menace with B:C ratio of 3.7:1.


2021

- **Pre-harvest management of pulse beetle in pigeonpea:** Spraying emamectin benzoate 5 SG @ 0.3g/l at pod maturity controls the field infestation of pulse beetle (*Callosobruchus sp).* The seed can be stored upto a month without any treatment. This reduces the loss and B:C ratio of 7.2:1 can be obtained.
- **Management of fall armyworm in maize:** For management of fall armyworm in maize when infestation is noticed, apply spinetoram 11.7 SC @ 0.5ml or emamectin benzoate 5 SG @ 0.4 g or chlorantraniliprole 18.5 SC @ 0.4 g or thiodicarb 75 W.P. @ 1g/ l of water to the infested leaf whorl. As larvae of fall armyworm feed inside the leaf whorl, spray should be targeted only to leaf whorl.

Treated Plot

Worm infestation

- **Management of rodents in paddy**: Place Snap traps @ 50/ha (Continuously 3 nights) at tillering stage and apply 2 per cent bromadiolone CB (0.25 %) bait in burrows and bunds at Panicle formation stage of the crop. For preparation of 1.0kg poison bait, add 450g rice, 450g ragi, 50g groundnut kernels, 50g groundnut oil and mix thorouly with 20g of bromadiolone powder. Prepare paper pockets containing 10g poison bait to be placed in field.

2020

- **Chemical control of fall army worm, *Spodoptera frugiperda* in maize:** Application of spinetoram 11.7 SC @ 0.5 ml/ chlorantraniliprole 18.5 SC @ 0.4 ml or emamectin benzoate 5 SG @ 0.4 grams per liter water reduces the incidence of fall army worm.
- **Management of rodents in groundnut:** For management of rodents in groundnut apply 2% Zinc phosphide bait (@ 1kg/ha) during germination stage followed by inserting one aluminium phosphide (12g) tablet in to the burrow (50 tablets/ha)

during peg formation stage of the crop. **OR** Fix the snap trap @ 50 traps/ha continuously for 3 days during germination stage followed by application of 2% zinc phosphide bait (@1 kg/ha) during peg formation stage of the crop (When the live burrow counts are more than 50/ha).



Note: For preparation of 1 kg poison bait, add 450g rice, 450g ragi, 40g groundnut kernels, 40g groundnut oil and mix thoroughly with 20g of zinc phosphide powder. Prepare 50 paper pockets containing 20g poison bait.

2018

- **Management of giant african snail, *Achatina fulica* Bowd:** Bait is prepared by mixing 10 kg of wheat or rice bran and 2 to 4 kg of jaggery in 4 ltr of water and leave the mixture for 18 to 36 hours. Mix bait with thiodicarb 75WP. Spread or sprinkle the mixture after 6 pm in the border of the field, basin of the tree, around the plant or in the nursery lightly. This attracts & destroys all pests.



2017

- **Management of early shoot borer in sugarcane** Soil application of chlorantraniliprole 0.4 G @ 25 kg/ha or fipronil 0.3 G @ 22.5kg /ha at planting and 60days after planting controls early shoot borer in Sugarcane effectively.

2015

- **New insecticides for the management of pod borers in pigeonpea:** Spraying of flubendiamide 20 WG 50g ai/ha before flowering controls pod borer & maruca.

2013

- **Management of Bud worm control in tobacco:** Application of flubendiamide 480 SC @ 0.25 ml/l found effective in control of bud worm in Zone-7.

2012

- **Management of capitulum borer, *Helicoverpa armigera* in sunflower:** Two sprays of spinosad 45 SC (0.0045%), first spray at star bud stage and the second spray 15 days later is effective in managing for management of capitulum borer.

2011

- **Management of giant african snail**: Poison bait made of 400 ml of water+1 kg rice bran + 200 g jaggery + 10 g methomyl, mixed thoroughly and allowed for one and half days for fermentation. Bait so prepared will be more effective when spread around the plots during evening hours for control of giant african snail.
- **Management of yellow stem borer & leaf folder in paddy**: Flubendiamide 20% WG @ 150 g/ha and 48SC @ 50 ml/ha was found effective against paddy stem and leaf folder with a cost benefit ratio of 4.20 to 4.16 respectively.

2010

- **Management of brown plant hopper in paddy:** Application of buprofezin 25 SC @ 700 ml/ha effectively controlled hopper population with B:C ratio of 5.2:1.
- **IPM in chickpea**: Intercropping with coriander (10:2) + 5 pheromone traps per hectare + endosulfan 35EC 2ml /l or indoxacarb 0.3 ml /l + NPV 250 LE/ ha+ NSKE (5%) at vegetative, flowering & pod formation stage + 20/ha Bird perches.

2009

- **Management of leaf folder in paddy**: Indoxiacarb 14.5 per cent SC @ 30 g ai/ha gave good protection against leaf folder in paddy and also higher yield of 39 q/ha compared to the untreated check (30 q/ha).
- **Modified Boar traps** has been developed and introduced in Zone-7.

2008

- **Management of defoliators in sunflower:** One need based application of profenophos @ 0.05% during flowering is effective for the management of defoliators in sunflower for higher yields with 1:18.52 C:B ratio.

2007

- **Management of red headed caterpillar in Groundnut:** Growing of groundnut, redgram, groundnut and cowpea in 4:2:4:1 row ratio with cowpea as a trap crop in the

affected areas of red headed caterpillar gives higher yield of groundnut and reduces further spread of pest. All the crops in the system need to be sown simultaneously during July month.

- **Integrated management of red headed caterpillar:**
  - ✓ Deep plough to expose pupae after 1st harvest of crop or after early rains in summer
  - ✓ Attract and kill moths by setting up bonfires or using gas lighters between 7 to 10 pm after the good rains.
  - ✓ Sowing of trap crops (cowpea, sesamum, greengram) as inter crops and along border.
  - ✓ Hand collection of and destruction of egg masses of I –III instar larvae.
  - ✓ Spraying of *Amsacta albistriga* NPV on early larval instars. Apply insecticide dusts to trap and kill migrating larvae also.
  - ✓ Plant calotrophis or jatrophato attract larvae. Then collect and kill.
  - ✓ Chemical control
    - Insecticide Dusts: Fenvalerate -0.4D 10 kg/ha or Methyl parathion - 2D 10 kg/ha or Malathion – 5D 10 kg/ha on trap crop or along border or band application.
    - Insecticide sprays: 1.6 g/l Methomyl 40 SP or 4 g/l Carbaryl 50 WP or 2 ml/l Endosulfan 35 EC or 1 ml/l Fenvalerate 20 EC
    - Insecticide bait for grown up larvae: Mix 10 kg rice bran, 1 kg jaggery and water thoroughly and keep the mixture for 24 hrs. Mix insecticide [Methomyl 40 SP – 150 gm or Monocrotophos 36 SL – 150 ml] and apply during evening hours. Apply 13-15 kg bait / acre and along borders / rows of trap crop.
- **Management of pod borer in Chickpea:** Sowing of one row of coriander as a trap crop after every 6 rows of chickpea is found promising in reducing the infestation of gram pod borer H. *armigera* to an extent of 20% as compared to sole cropping of chickpea with additional yield of coriander
- **Guidelines for the safe use of pesticides:** For safety of farmers and their benefit, a set of guidelines for the safe use of pesticides is added as a special chapter.

2006

- **Integrated management of pest complex of sunflower:** The IPM module in sunflower, comprising of seed treatment with imidacloprid 70 WS @ 5 g/kg seed +

two foliar applications of 5% neem seed kernel extract at 40 and 55 DAS + two foliar applications of 250 LE helicoverpa NPV (@ 0.5 ml/lt) at 55 and 65 DAS proved to be superior over chemical control (existing practice).

2005

- **Management of pigeonpea pod borer:** Spinosad @ 75g ai/ha was found to be very effective in controlling pigeonpea pod borer and resulted in higher B:C ratio.
- **Integrated management of pest complex of sunflower:** An eco-friendly IPM module consisting of seed treatment with imidacloprid 70 WS @ 5g/kg seed +5% neem seed kernel extract (NSKE) application at 40 DAS and 5% NSKE and 250 LE of HaNPV/ha spray at 55 DAS and at 65 DAS was developed to manage pest complex & safeguard the predators viz. *Coccinellids and spiders* in sunflower.

2004

- **Management of pigeonpea pod borer:** New insecticide molecule indoxicarb against pod borers in redgram.

2003

- **Management of BPH:** Topical application of imidacloprid 200SL under field conditions recorded mean of 80-90 per cent BPH mortality compared with treated check monocrotophos 36 WSC (mean of 38 to 36 per cent mortality) and untreated check (mean of 29.5 to 2 per cent mortality).

2002

- **Management of tobacco budworm *Helicoverpa armigera:*** Spraying of NPV-250LE/ha or Bt. at 1.5kg/ha which helps in self perpetuation of NPV particles in tobacco, is very effective in the management of tobacco budworm *Helicoverpa armigera*. It also reduces the toxic residues of the insecticides in the cured leaf and it is an eco-friendly way management of tobacco budworm.
- **Integrated management of pest complex of cotton:** Sowing of bhendi all along the border of cotton plot and one row of bhendi after every 25 rows of cotton attracts the shoot weevils and bell worms towards it and thus reduces the pest population on cotton and it is recommended for Zone-7.
- **Management of sucking pest in cotton:** Cotton seed treatment with imidacloprid 70WS 10g/kg of cotton seed is most effective in controlling the cotton sucking pests during early stages of crop growth in Zone-7.

3.2 Disease management

2024

- **Management of Maydis Leaf Blight of Maize:** Azoxystrobin 18.2% + Difenoconazole 11.4% SC w/w @ 1ml/l (15ml/15l water) reduced the disease by 82.4% and increased the yield by 102.8% compared to the inoculated control, with a benefit-cost ratio of 2:1.

Untreated plot

Treated plot

2023

- **Management of bacterial blight in paddy:** Seed treatment with 0.5 g streptocycline + copper oxychloride 1 g/l of water (soak whole seeds overnight) along with spraying 0.2g streptocycline + copper oxychloride 1g/l water as soon as the disease is observed will reduce the disease by 79% with enhanced yield (38 q/ha) & B:C ratio (3.11:1)

Treated Plot

Untreated Plot

- **Management of rust disease in foxtail millet:** Seed treatment with 10g *Pseudomonas fluorescens* talc based powder per kg of seed and spraying with azoxystrobin 23% SC @ 1ml/l water at 40-45 DAS followed by spraying with *Pseudomonas fluorescens* talc based powder 10g/l water at 50-55 days after sowing will reduce the disease by 89% with enhanced yield (15 q/ha) & B:C ratio (2.86:1)

Treated Plot

Untreated Plot

2022

- **Spray of chitosan for management of sheath blight disease in rice**: Two sprays of chitosan 1 g/l of water at 30 and 60 days after transplanting reduced the rice sheath blight incidence by 62.90 per cent. The yield increased by 35-40 per cent with 52 per cent reduction in grain chaffiness and B:C ratio of 2.46:1.

- **Soil drenching of bleaching powder and application of streptocycline sulphate for management of bacterial stalk rot of maize:** Soil drenching of bleaching powder @ 0.1 g/l + streptocycline sulphate @ 0.4 g/l around the infected plants reduced the disease incidence by 74 per cent and increased the yield up to 141.4 per cent with B:C ratio of 2.18:1.

- **Seed treatment with *Pseudomonas* and spraying trycyclazole & mancozeb for management of neck and finger blast in finger millet:** Seed treatment with *Pseudomonas fluorescens* talc formulation @10g /kg of seed followed by spraying of trycyclazole 18%+ mancozeb 62%@ 0.5g/l water at the time of flowering and if required, second spray at 10-15 days interval was effective in the management of neck and finger blast. It also enhanced the grain yield (2691 kg/ha) and fodder yield (3900 kg/ha) with B:C ratio of 2.45:1.

Treated Plot

Untreated Plot

- **Integrated disease module for management of turcicum leaf blight in maize:** Seed treatment with *Trichoderma harzianum* @ 10g/kg seed + foliar application of nimbicidine @ 5ml/l @ 35 DAS, followed by azoxystrobin 18.2% + difenoconazole 11.4% (Amistar top) spray @ 1 ml per litre of water at 45 days after sowing reduced the disease incidence by 65 per cent and increased yield by 75% with 3.8:1 B:C ratio.

Treated Plot

Untreated Plot

- **Spraying of propiconazole for management of leaf blight in brown top millet:** Spraying of propiconazole 25% EC @ 1 ml/l at 35-40 days after sowing (when the leaf blight symptoms are observed) was effective in reducing leaf blight incidence by 65.43 per cent and increased grain yield by 191.1 per cent with 2.28:1 B:C ratio.

Treated Plot **Untreated Plot**

- **Spraying of mancozeb + carbendazim for management of rust in cowpea:** Spraying of mancozeb 63% + carbendazim 12% WP @ 2g/l at 35-40 days after sowing (when rust symptoms are observed: 2-3 rust pustules) was effective in reducing rust incidence by 65.8% & increased yield by 81.5% with 3.17:1 B:C ratio.

Treated Plot **Untreated Plot**

- **Spraying of hexaconazole for management of cercospora leaf spot in cowpea:** Spraying of hexaconazole 5% SC @ 2ml/l at 35 days after sowing (when leaf spot symptoms are observed) was effective in reducing cowpea leaf spot by 64 per cent & increased yield by 78.39 per cent with 3.87:1 B: C ratio.

Treated Plot **Untreated Plot**

- **Management of *Alternariaster* leaf spot:** Seed treatment with 12% carbendazim + mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with difenconazole 25% + propiconazole 25% @ 0.25ml/l (First spray at the onset of incidence or 45 days after sowing and if required second spray should be given 15 days after 1st spray) reduces the disease by 64.38 per cent over check, with 28.4 per cent increase in yield and 18.31:1 B:C ratio. In addition, it also controls powdery mildew disease

2021

- **Management of blast disease in paddy:** Isoprothiolane 40%EC @ 1.5 ml/L was effective in 65.2 per cent disease reduction and enhanced yield by 26 per cent with cost benefit ratio of 1:1.92. Spraying of isoprothiolane 40% EC @ 1.5 ml/l at 5% panicle emergence stage was effective against neck blast by recording 80-81 per cent disease reduction & 80-81 per cent increased yield with 1.98:1 B:C ratio.


- **Management of Turcicum leaf blight of maize:** Spraying twice one at 35 & 50 DAS of azoxystrobin 18.2% w/w + difenoconozole 11.4% w/w SC @ 0.10% reduced disease incidence of 75-78 % and increased the yield by 75-78% with B:C ratio 3.2:1


Treated Plot **Untreated Plot**

- **Management of blast disease in finger millet:** Seed treatment with chitoson 2g/kg of seed followed by spraying of *Pseudomonas fluorescens* talc formulation 10g/l of water at panicle initiation stage & grain filling stage was effective against neck & finger blast by recording 75% disease reduction & 55-60% increased yield with 2.74:1 B:C ratio

Treated Plot **Untreated Plot**

- **Management of alternaria leaf spot disease in cotton:** Foliar spray with pyraclostrobin 20% WG @ 500 grams/ha has reduced the disease incidence of 64.1 per cent and increased the yield of 187 per cent over the untreated control and recorded the B:C ratio of 2.56:1. Hence pyraclostrobin 20% WG @ 500 grams/ha is recommended to manage the *Alternaria* leaf spot disease in cotton.

Treated Plot **Untreated Plot**

- **Management of Pigeonpea sterility mosaic disease:** Fenpyroximate 5% E. C. @1 ml/L at 25 and 40 days after sowing controlled the disease upto 41% and the increase in yield was 67% compared to the unsprayed control with B:C ratio of 2.08:1.

Aceria cajani Mite **Diseased plant**

- **Management of downy mildew disease in maize:** Seed treatment with metalaxyl M 31.8 ES @ 2.4 ml/kg of seed and foliar spray with azoxystrobin 18.2% w/w + difenoconazole 11.4% w/w SC @ 0.1% at 30DAS has reduced disease incidence by 98.3% & increased yield up to 4.8 times over untreated control and recorded 1.71:1 B:C ratio

Untreated Plot **Treated Plot**

2020

- **Management of brown spot disease in paddy:** Spraying of fungicide hexaconazole 5 SC @ 2ml/l as soon as the symptoms are observed and if necessary at 15 days interval reduces disease by 48% & increases yield by 30% with B:C ratio of 1.69:1
- **Management of blast disease in paddy**: Spraying of tricyclazole 75% WP + Sea weed extract LBD1 (0.4g+2ml/l) as soon as the blast symptoms are seen and if necessary at 15 days interval reduces blast disease of paddy with B:C ratio 1.41:1.
- **Fungicidal seed treatment in finger millet to manage nursery blast disease:** Seeds treatment with tricyclazole 75%WP @ 3.0 g/kg or tebuconazole 50% + trifloxystrobin 25% WG @ 1.0 g/kg can be used for the control of nursery blast

Tricyclazole **Tebuconazole + Trifloxystrobin**

- **Management of maize downy mildew:** Seed treatment with mancozeb + metalaxyl@3 g/kg of seed before sowing and foliar spray of azoxystrobin + difenoconazole @ 1ml/l at 30 DAS.

Treated Plot

Untreated Plot

2019

- **Management of *Fusarium* wilt in pigeon pea:** Seed treatment with *Trichoderma viridae* @10g/kg + soil application at 1kg in 200kg of FYM applied in rows at the time of sowing manages wilt with additional yield of 950 kgs/ha & 3.5:1 B:C ratio.

Treated Plot

Untreated Plot

- **Management of mung bean yellow mosaic virus disease in green gram:** Seed treatment with imidacloprid 48 FS @ 5ml/kg seed and one spray of imidacloprid 17.8 SL @ 0.50ml/l at 20 days after sowing reduces mung bean yellow mosaic virus infection with an additional yield (1010kgs/ha) and B:C ratio of 3.3:1.

Treated Plot

Untreated Plot

2018

- **Management of peanut bud necrosis virus disease:** Grow 4 rows of pearl millet on bunds + use 10-15% more seed rate + seed treatment with imidacloprid 600 FS at 1.0 ml/kg seed + use sticky traps at 8 nos/ac + spray dimethoate (1.7 ml/l) at 20-25 days after sowing + spray lambda-cyalothrin (1.0 ml/ltr) at 40 days after sowing + spray imidacloprid 17.8% SL (0.5 ml/l) at 60 days after sowing. This practice reduces thrips infestation by 200 per cent and 67% lesser incidence of peanut bud necrosis virus

- **Management of sorghum downy mildew in maize:** Seed treatment with azoxystrobin @ 2 g/kg of seeds could be used as an alternative chemical to manage downy mildew of maize. This practice enhances green fodder and grain yield by 85.3% with B:C ratio of 2.03. Chemicals used in this practice are comparatively least.
- **Eco-friendly management of foot rot of finger millet:** Dip Seedling root with bioagents *Pseudomonas* and *Trichoderma* @ 5 g/l water followed by Soil application of incubated (15 days) mixture of 1.25 kg talc of *Trichoderma* + 1.25 kg talc of *Pseudomonas* formulation with 50-60 kg of compost and applied over an hectare at the time of planting or sowing. It reduces disease incidence by 91.9% while enhances grain yield by 45.3% and straw yield by 41.8% with B:C ratio of 3.39.

Treated Plot **Untreated Plot**

- **Management of sheath blight and neck blast in paddy:** Spray 45% tricyclazole + 10% hexaconazole WG (impression) @1g/l as soon as the sheath blight symptoms are noticed and at 5 per cent panicle emergence to manage neck blast. This practice reduces disease incidence by 84 per cent while enhances yield by 48.5 per cent with B:C ratio of 2.23.

Treated Plot

Untreated Plot

2017

- **Effective seed treatment method for management of seed borne nursery disease of Paddy:** Soak 25 kg of paddy seeds in 25 litre of fungicide solution (carbendazim 50WP 4g/l or tricyclazole 75WP 3g/l or carbendazim 25% WS 4 g/l + mancozeb 50%WS 4g/l) for 12 hours and incubate for 24-48 hours in wet gunny bag till seeds just started sprouting before sowing for effective management of seed borne fungal diseases in nursery.

- **Management of stem rot and leaf spot in groundnut:** Seed treatment with tebuconazole @ 2g/kg and spray with chlorothalonil 2g/l effectively manages stem rot and leaf spot diseases respectively in groundnut.
- **Management of seed borne nursery diseases through seed treatment:** Seed treatment with trifloxystrobin 25% + tebuconazole 50% @ 0.5g/kg (fungicide

suspension prepared in 1 litre of water) by following dry or wet methods for the effective management of blast & brown spot diseases in paddy nursery.

Blast

Brown spot

2016

- **Bio-management of sheath blight of paddy:** Dipping paddy seedlings with *Pseudomonas fluoroscens* for 30 minutes @ 10 ml/l of water prior to transplanting and as foliar application 2.50 l/ha (5ml/l of water) at 45 & 55 days after transplanting gives good control of the disease.

- **Management of foot rot disease in Finger Millet:** Soil application of value added compost prepared by addition of 500g of *Trichoderma viride* and 500 g of *pseudomonas fluorescens* in 25 kg FYM incubated for 15 days and applied over an acre before transplanting give good control of foot rot disease in finger millet.

2015

- **Management of root rot disease in chickpea:** Seed treatment with tebuconazole 2g/kg of seed recorded lower root rot incidence of 24 per cent with higher yield of 736 kg/ha followed by ST with carbendazim 2g + Captan 1 g/kg of seed with disease incidence of 40 per cent and yield of 580 kg/ha compared to control it recorded higher disease incidence of 97% and lower yield of 320 kg/ha.

- **Management of sterility mosaic virus disease in pigeonpea:** Two sprays of 0.1% propargite 57 EC or fenazoquin 10 EC one spray at 20-25 DAS and another spray at 40-45 days after sowing is effective in managing pigeonpea sterility mosaic.

- **Management of sheath blight of paddy:** Sheath blight in paddy can be managed effectively by spraying carbedazim 25% + flusilazole 12.5% SE (NS) @ 960 ml/ha when symptoms are seen & if necessary at 15 days interval with 2.07 B:C ratio

2014

- **Management of important diseases of paddy**: spray trifloxystrobin 25% tebuconazole 50% (Nativo 75 WG) (0.4 ml/l) as soon as the symptom of leaf blast, sheath blight, sheath rot and neck blast in paddy is seen. repeat the same fungicide spray 15 days after the 1st spray for effective management of disease in paddy growing areas of Zone-6.

Treated Plot

Untreated Plot

- **Control of wilt disease in pigeonpea:** Seed treatment with carbendazim 12% together with mancozeb 64% @ 3 g/kg of seed is effective in the management of wilt disease in pigeonpea and results in reduction (59%) in incidence of wilt.

2013

- **Management of sheath blight in paddy:** Application of thifluzamide 24 SC @ 1ml/l is effective in control of sheath blight (up to 80%) in paddy in Zone-6.

2012

- **Management of udabatta disease of paddy:** Seed treatment with carbendazim 25% + mancozeb 50% WS @ 4g/kg of seed to dry seeds or to sprouted paddy seeds one day before sowing is effective to manage udabatta disease of paddy.
- **Management of leaf blast disease in paddy:** Seed treatment with tricyclazole 75% WP at 3g/kg of seeds is efficient to manage leaf blast disease in paddy nursery.
- **Management of sheath blight of paddy:** Spraying of propiconazole 25% EC @ 1ml/l as soon as the symptoms of blight are seen & if necessary at 15 days interval to manage sheath blight of paddy.
- **Management of black shank disease in tobacco:** Mix 2.5 kg of *trichoderma* biocontrol agent in 250 kg of farm yard manure 20 days before transplanting and apply this enriched mixture to one hectare plot around the root zone during planting

of tobacco seedlings for the effective management of black shank disease in tobacco in Zone-7.

2011

- **Management of powdery mildew of sunflower:** Spraying of wettable sulphur 80WP @ 0.3% or difenoconazole 25 EC @ 0.05% as soon as the symptoms are seen and if necessary at 15 days interval thereafter effectively controls powdery mildew in sunflower.
- **Management of nematode in tobacco:** Spot application of well decomposed poultry manure at 50 g/plant, 4 inches (4″) away from the plant at the time of planting effectively controls root knot nematode in FCV Tobacco (main field).

2008

- **Management of nematode infestation in paddy nursery:** Use of *Pseudomonas fluorescens* @ 20 g/m^2 in dry paddy nursery helps in control of nematode infestation in paddy nursery at Zone-6.
- **Management of wilt disease in chickpea:** Seed treatment with carbendazim @ 2 g/kg seed reduced 63 per cent of wilt incidence and increased grain yield by 52 per cent compared to untreated check. Bio-agent treatment: Seed treatment with *Trichoderma Viridae* @ 5 g/kg seed reduced wilt incidence by 56 per cent and increased grain yield by 40 per cent compared to untreated check.

2006

- **Management of root knot nematode in rice:** Root knot nematode in rice can be effectively managed by application of carbofuran 3 G @ 15 g/m^2 to the rice nursery at Zone-7.
- **Management of neck and finger blast in finger millet:** Neck and finger blast in finger millet can be controlled by giving two sprays of *Pseudomonas flurescense* @ 0.2% i.e. first spray at 50% flowering followed by second spray after 15 days and is recommended for Zone-5.
- **Management of bacterial leaf stripe disease of arecanut:** Spraying of streptocycline @ 500 ppm + copper oxychloride @ 0.2% is effective against bacterial leaf stripe disease of arecanut at Zone-7. Two sprays at an interval of 15 days are recommended.

2005

- **Management of sett rot disease in sugarcane:** Sugarcane sett treatment in 0.1 per cent carbendazim 50 WP for 5 minutes for the control of sett rots disease.

- **Management of blight disease in ragi:** Spraying of 0.1 per cent combination fungicides carbendazim @ 12 per cent and mancozeb @ 63 per cent (Saaf) controls blight disease in ragi. Spraying is a must for later sown conditions.
- **Management of damping-off and leaf blight in FCV tobacco:** Damping-off and leaf blight in FCV Tobacco nursery can be effectively managed through soil solarization for 4 weeks with clear LDPE plastic film (25 µ m) + neem cake application (400 g/m^2) + ridomil (0.2%) with incremental B:C ratio of 1:4.

2004

- **Management of powdery mildew of green gram:** Powdery mildew of green gram due to *Acrosporium* sp. can be controlled successfully through prophylaxis using wettable sulphur 0.2 percent spray on young seedlings in 5-6 leaves stage.
- **Chemical control of blast in ragi:** Chemical control of blast in ragi by using carbendazim + mancozeb.
- **Mangement of root knot nematode in FCV tobacco nursery:** Poultry manure @100g/m^2 with solarisation of FCV tobacco nursery beds for 4 weeks with LDPE 25µ will produce maximum number of transplantable seedlings with minimum root knot index.
- **Management of neck blast and finger blast in ragi:** Control of neck blast and finger blast in ragi by seed treatment with carbendazim @ 2g/Kg of seed and spray of mancozeb + carbendazim.
- **Management of root knot nematode in paddy**: In paddy nursery bed through seed treatment with neem seed kernel powder, castor cake, neem cake, FYM is very effective in the management of root knot nematode in paddy. *Pseudomonas fluroscence* or *Trichoderma viridae* in nursery bed is recommended for Zone-6 and Zone-7.

2000

- **Management of yellow mosaic virus (YMV) in greengram:** Two sprays of triosophos @ 1.5 ml/l of water at two leaf stage and after 25 days of sowing was effective in the management of whitefly transmitted yellow mosaic virus (YMV) in greengram.

IV. HORTICULTURE TECHNOLOGIES

Introduction

Horticulture has been one of the fastest growing sectors within the larger agriculture activities in India, and the State of Karnataka. Horticulture sector has a tremendous potential to directly address food security issues and inturn poverty. Horticulture sector is diversified and rich enough to push agricultural contribution towards countries GDP. Perhaps, it is most profitable among all farming systems with vide employment opportunities.

Considering the fact that the growth of horticulture sector and the demand for its products after the liberalization period has gone up, University has made an attempt to develop technologies regarding its production, protection and value addition (Fig-4). Pest and disease menace are the major threats to attain higher yield. In this regard, University has developed more number of crop protection technologies than crop production technologies. List of sale of technologies regarding training and preparation of value added products of horticultural crops are presented in Table-6. List of pest and disease resistant/ tolerant varieties/ hybrids are presented in Table-7.

Vegetables are grown by and large among the horticulture crops in the jurisdiction of the University. In the last 25 years around 129 technologies specific to horticulture crop are developed. Of these, 77 technologies are specific to vegetables. Details regarding horticultural technologies are explained further. Abstract on number of technologies developed for different horticultural crops are depicted in Figure-5.

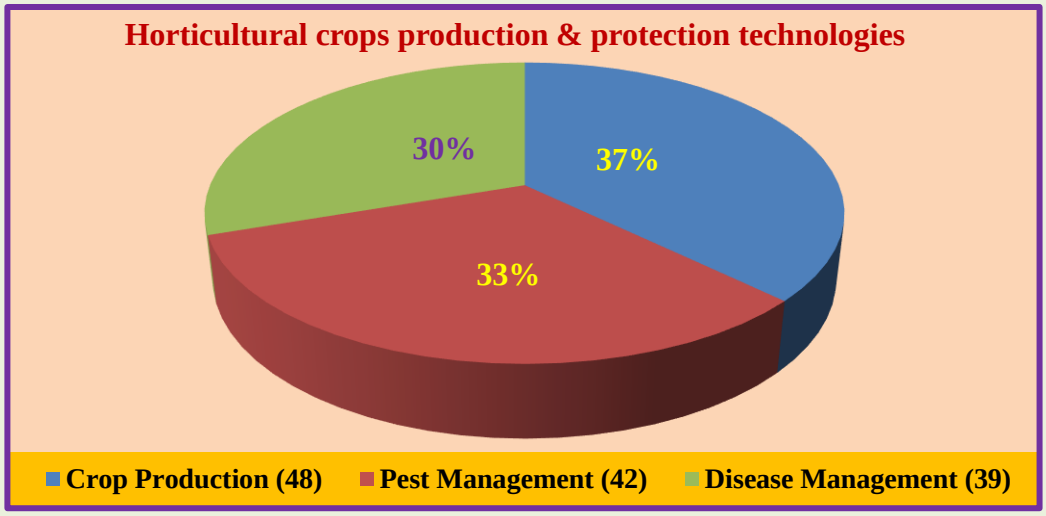


Fig-4: Horticultural crops production and protection technologies developed & included in PoP of UASB (2000-2025)

Table-6: List of value added products preparation available for commercialization

Sl. No.	Name of the Technology
A	**Ready to Cook**
	1. Tender Jackfruit as Vegetable
	2. Jackfruit Milkshake Mix
	3. Moringa (Drum Stick) Rosemary Tea
	4. Moringa (Drum Stick) Tulsi Green Tea
	5. Banana flour-based cake premix
	6. Jackfruit flour-based cake premix
B	**Ready to Eat**
	1. Coconut Flour Cookies
	2. Coconut Flour Masala Biscuit
	3. Coconut Flour Cake
	4. Coconut Flour Rusk
	5. Coconut Flour Salt Biscuit
	6. Coconut Flour Nutri- Strips
	7. Coconut Flour Ladoo
	8. Jackfruit Jam
	9. Jackfruit Chips
	10. Jackfruit Squash
	11. Coconut Flour Sweet and Salt Biscuit
	12. Jackfruit Bulb Flour and its Products
	13. Jackfruit Seed Flour and its Products
	14. Jackfruit Peda
	15. Jackfruit Ice-Cream
	16. Jackfruit Shrikand
	17. Jackfruit Juice
	18. Moringa (Drum Stick) Green Chocolate
	19. Moringa (Drum Stick) Dark Chocolate
	20. Green Stevia based white finger millet Biscuits (Sweet and Salt)
	21. White Stevia based white finger millet Biscuits (Sweet and Salt)
	22. Green Stevia based white finger millet Cookies
	23. White Stevia based finger millet Cookies
	24. Green Stevia based white finger millet Rusk
	25. White Stevia based white finger millet Rusk

Table-7: List of pest and disease resistant horticultural crop varieties

Sl. No.	Crop	Varieties	Important features	Year of release
1	Cardamom	Mudigere-3	Tolerant to leaf spot with least incidence of capsule rot and capsule borer	2009
2	Tamarind	GKVK-17	Moderately tolerant to leaf spot, rust and leaf miner	2015
3	Chilli	DH-7-6-6	Resistant to leaf mosaic and tolerant to leaf curl virus	1979
4	Tomato	NTDR-1	Resistant to root-knot nematode	1978
5	Tomato	Nandi	Highly resistant to tomato leaf curl virus and tolerant to bacterial wilt	2001
6	Tomato	Sankranthi		2001
7	Tomato	Vaibhav		2001
8	Medicinal coleus	M-7 (Isiri)	Moderately resistant to bacterial wilt Low incidence of root knot nematode	2008
9	Stevia	GKVK Stevia-1	Tolerant to most of the insect pests	2017

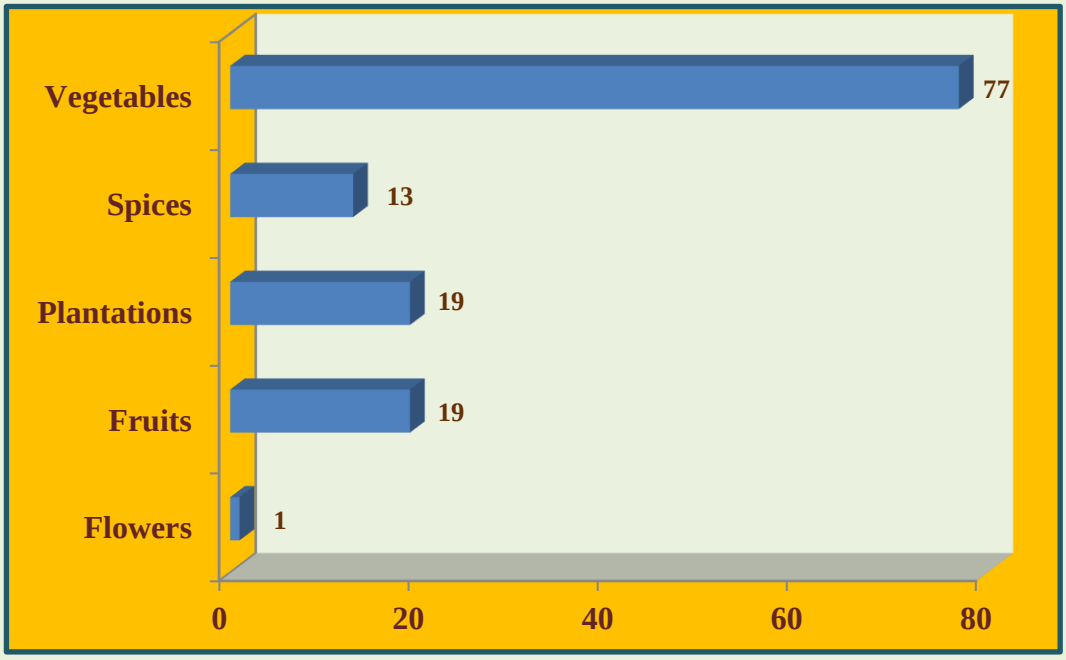


Fig-5: Technologies developed (2000-2025) by UASB for different horticulture crops

4.1 Crop production

2025

- **Plant nutritional recommendations for better plant growth, yield and quality of broccoli:** In broccoli planted during October – November months, application of 50% of Nitrogen (75 Kg),100 kg Phosphorous and 75 kg Potassium fertilizers at the time of transplanting and remaining 50% of nitrogen (75 Kg) applied 30 days after transplanting found to have better vegetative growth, quality (head compactness 21.60 g/cm^3), flower head yield (203 q/ha) of broccoli and B:C ratio of 3.41:1 as compared to recommended fertilizer dose (100:63:100 kg NPK/ha: yield: 154 q/ha, B:C ratio – 2.66:1).

100:63:100 kg NPK/ha

150:100:75 kg NPK/ha

- **Optimal plant spacing for better plant growth, yield and quality of broccoli:** Broccoli planted during October – November months at a spacing of 45 cm between rows and 45 cm plant to plant within a row (45 cm x 45 cm) was found to have better vegetative growth, quality (head compactness 22.93 g/cm^3), higher yield (178.35 q/ha) and B:C ratio 3.22:1 as compared to other plant spacings (45 cm x 30 cm spacing: yield: 137 q/ha, B:C ratio – 2.31:1).

Spacing: 45 cm x 30 cm **Spacing: 45 cm x 45 cm**

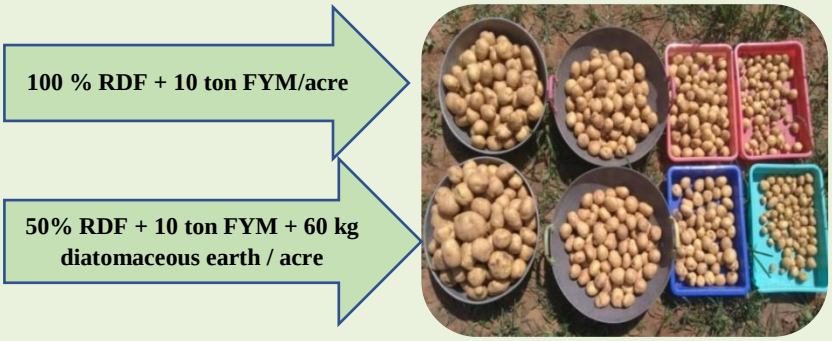
2023

- **Apical Rooted Cuttings of potato for seed tuber production:** Disease-free saplings grown in Tissue Culture bottles are selected and roots are carefully separated from culture media. Dip the saplings in 2% fungicide and then transplant to mother bed (a bed prepared with coco-peat). 21 days after transplantation, the first apicals are available to cut. The cut apicals are again transplanted to the mother bed for further multiplication up to two months. Where, each tissue culture sapling produces 100 saplings by the end of two months. After two months and based on the farmers need, apicals are cut and transplanted to portrays. After fourteen days of nourishment, rooted saplings are ready for transplantation in open field conditions. Later, saplings are transplanted by following 60x20 cm spacing and other cultivation practices mentioned in the Package of Practices. Harvesting can be done at 90-110 days and harvested potato tubers are used as Germination-0 seed material for sowing. This can be used as seed material for three generations. While using rooted cuttings for planting provide recommended chemical fertilizer in four splits at ten days interval in raised beds with need based plant protection measures as in Package of Practices.

- **Mechanization in Potato Cultivation:**
  - **Tractor operated potato planter -** In modern mechanized potato farming, whole tubers can be planted with a tractor-driven potato planter. About 1 quintal of sowing tubers can be loaded in this planter and it forms one feet raised beds. Two people can sit behind the planter and put the tuber into the measuring wheel where tubers will be placed at a depth of 10-12 cm by covering the tuber with the soil about 4-5 cm, simultaneously using soil cover plate. Through this, sowing of 1 acre area can be done in 2 hours. Germination to the extent of 88% and tuber yield of about 12.6 t/ha can be obtained through this planter while germination to the extent of 72% and tuber yield of about 8.52 t/ha can be obtained through manual sowing.
  - **Boom sprayer** - Plant protection chemicals can be sprayed in less than 1 hour/acre there by controlling pest and diseases.

2020

- **Use of Diatomaceous earth for increased yield in potato:** Application of diatomaceous earth @ 150 kg/ha along with 25 t FYM/ha and 50 % of recommended dose of fertilizer as per package of practice increases potato tuber yield (16.80 t/ha) by 24.90 % and B:C ratio of 2.03.



2019

- **Patch budding technique in jackfruit:** Latex of Jackfruit poses problems in soft wood grafting hence has low success rate. Patch budding is practically adoptable technique with 60 to 70 per cent success. The root stocks of 2 to 8 months old with a pencil thickness stem gives better success. The scions which are 6 months old and green are suitable for budding. The best season for higher success is February to September.


2018

- **Amla based agri-horti system involving cereals and pulses:** Significantly higher amla equivalent yield (1427 kg/ha) was observed in intercropping with finger millet and was on par with that of cowpea (1355 kg/ha). Finger millet proved to be better intercrop in amla and registered higher net returns (Rs.2,90,446 /ha) and B:C ratio (2.07) than sole amla crop.



- **Custard apple based agri-horti intercropping system:** Significantly higher custard apple equivalent yield (2346 kg/ha) was observed in intercropping with fodder maize, followed by ragi (1628 kg/ha) compared to other intercrops in custard

apple based agri-horti system. Higher net returns (Rs. 1,19,672 /ha), B: C ratio (6.67) & rain water use efficiency (3.43) were recorded with fodder maize.



2017

- **Nutrient management practices for organic production of onion:** Application of biodigested liquid manure or Enriched biodigested liquid manure @ 125 kg/ha (N equivalent) + 3 sprays of 3% vermiwash can supplement nutrient demand for onion under organic production.

- **Nutrient management practices for organic production of hybrid chilli:** Application of biodigested liquid manure or enriched biodigested liquid manure @ 125 kg/ha (N equivalent) + 3 sprays of 3% panchagavya can supplement nutrient demand of hybrid chilli under organic cultivation.

- **Nutrient management practices in pole bean**: Higher pod yield of 25 t/ha can be obtained under optimum fertilizer dose of 75:125:90 NPK kg/ha compared to the recommended dose of 64:100:75 kg NPK/ha (22 t/ha).

75:125:90 NPK kg/ha

64:100:75 NPK kg/ha

- **Rapid multiplication of turmeric:** This technique reduces the seed requirement rate by 30%. With this, only 200 kg seed rhizome is sufficient for one acre unit area instead of 800 to 1000 kg seed rhizome.

- **Micronutrient mixture for higher potato yield:** Foliar spray of vegetable special as micronutrient mixture @ 5 g/litre at 30 DAS & 45 DAS has increased the tuber yield of potato by 10% compared to RDF.

2016

- **Nutrient management practices for organic production of dry chilli:** Application of biodigested liquid manure or Enriched Biodigested liquid manure @ 125kg N equivalent per ha+ 3 sprays of 3% vermiwash or panchagavya to supplement nutrient demand of dry chilli for higher yield (20.6 q/ha) under organic cultivation**.**

- **Management of dendrophthoe (Loranthus) in sapota:** Cotton padding of 4 g copper sulphate + 0.5 g 2,4-D sodium salt 80% WP was found safer to the sapota tree without any phytotoxicity symptoms and gives satisfactory control of the parasite dendrophthoe (Loranthus).

- **Use of plant trainers to realize higher yield and economic returns:** Use of single row of GI wire mesh per row of plants is useful in the reduction of cost of cultivation due to less labour and training materials costs (*Eucalyptus* poles, plastic and jute thread). Yield is higher in GI wire mesh trained treatments due to long crop stand and healthiness of the crop. GI wire mesh staked plants are easier for cultivation *viz.*, harvesting and plant protection operations.GI wire mesh can be used for training vegetables like Bitter Gourd, Yard Long Bean, Pole Bean & tomato and other creeper vegetables. GI wire mesh can be used for a minimum

period of ten years (*Eucalyptus* sticks last for two years). Higher yields realized in different crops are as follows:

Bitter Gourd
14 t/ha

Yard Long Bean
23.18 t/ha

Pole Bean
28.67t/ha

Tomato
70 t/ha

- **Foliar spray of micronutrient mixture for ginger:** In ginger cultivation, spraying of micronutrients mixture @ 5g per litre of water after transplanting at 60th, 90th &120th days 20% higher yields over farmers' method & 8.18 per cent higher yield compared to the existing recommendation of NPK in Zone-6.

2014

- **Post emergence herbicide in onion:** Application of quizalofop-p-ethyl 5EC @ 750 ml/ha or fenoxaprop-p-ethyl 9EC 750 ml/ha @ 2-3 leaf stage of weeds at 15-20 days of sowing / transplanting (DAS/DAT), followed by one hand weeding @ 45 DAS/DAT in onion resulted in similar yield obtained with 3 hand weeding practice at 20, 40 and 60 DAS/DAT. The present technology helps in saving on labour cost.

2013

- **Potash application for enhanced yield of ashgourd:** Application of potash at 70 kg/ha along with RDF and FYM to Ash gourd gives increased yield to the tune of 12 % in coastal zone.

2012

- **Inter cropping in french bean:** Inter cropping in french bean with baby corn has revealed increased yield by 6 – 12 per cent in french bean.
- **Biological nutrient management in chilli:** Combined application of *Azatobacter chroococcum* + *Bacillus megatherium* (PSB) + *Trichoderma harzianum* with 75% N and P with 100% K has resulted in obtaining higher yield, saving 25% N and P without affecting higher yield of chilli.

2011

- **Limb pruning in cashew:** Limb pruning at 1.5 m height from main stem to rejuvenate cashew, gave significantly higher nuts of 3.15 kg /tree. August and September are the ideal months to take-up limb pruning in maidan area.
- **Mango Harvester (Model-2)** has been recommended for harvesting of more mango fruits per unit time. Fruits can be harvested along with the stalk. It can be used to harvest at different heights with minimum damage to fruits minimizing fatigue and drudgery.

2010

- **Intercropping in coconut garden:** Cultivation of cowpea / horsegram – lucerne as intercrops in coconut garden recorded green forage yield of 556 q/ha to 651 q/ha and also improves soil fertility

2009

- **Intercropping in chilli with fodder maize:** Growing fodder maize in early *Kharif* and transplanting chilli (Cv. Samrudhi) after harvesting maize for fodder purpose at

65-70 days after sowing gave higher B:C ratio of 1.62 compared to farmer's practice of only finger millet with B:C ratio of 0.97 under dry land situations of Zone-5.

- **Irrigation in coconut:** Drip irrigation at 100 per cent evaporation is ideal for coconut as it gave higher nut and copra yield. Water to be provided during summer months (Feb–May) is 65 – 75 litres /palm /day while for winter and rainy months (June-January) it is 40 – 50 litres /palm /day. This resulted in higher water use efficiency and net returns when compared to basin irrigation in maidan tracts.
- **Intercropping in chilli with french bean:** Cropping system involving three rows of French bean (for vegetable purpose) in between paired rows of chilli (4 feet between paired rows) is recommended for FCV tobacco growing areas as an alternate cropping system. After harvest of French beans, two rows of field bean resulted in better net returns in Zone-7.
- **Fertilizer recommendation in coconut:** Application of 1000: 250: 1000 g of N, P_2O_5, K_2O / palm / year is found optimum for releasing higher nut yield, copra yield and net returns in hybrid coconut in Zone-4.

2008

- **Growth regulators in grapes:** Dipping or spraying each bunch of green grapes varieties such as thompson seedless, anab-e-shahi, dilkush with 12-15 DAA or when the berry was of Jowar size gave 17.9% higher yield with B:C ratio of 11:1 and saves labor cost. The use of growth regulators in green grapes has been recommended for practice in Zone-5.
- **Nutrient management in chilli:** Use of pressmud @12.5 t/ha along with 50% recommended NPK gave higher yield of dry chilli (15.5q/ha) with B:C ratio of 6.8 in shimoga area.
- **Intercropping of banana in coconut gardens:** Intercropping of banana in coconut gardens of maidan tract under assured irrigation is recommended. Under limited source of irrigation, crops like French bean and ladies finger having medium water requirement are recommended as intercrops in coconut garden.
- **Agri-Horti system for drylands of Zone-4**: Groundnut, horsegram and *Stylosanthus hamata* have performed well in mango, sapota, tamarind, pomegranate and amla gardens.
- **Nutrient management in coconut:** The composted coir pith @ 25 to 50 kg can be applied to coconut palms to supplement 50-100% of recommended dose of nitrogen. This not only saves cost of nitrogen fertilizer and also gave higher 3.08:1 B: C ratio

- **Nutrient management in potato:** After 20 days of potato planting, application of bio-fertilizers like *Azatobacter chroococcum* and *Pseudomonas striata* @ 10 kg each/ha both mixed in 100 kg FYM and applied to soil gave higher yields and quality potatoes. This saves 30 kg nitrogen and 25 kg phosphorus in irrigated crop and 18 kgs of nitrogen and phosphorus in rainfed crop. This technology is recommended for practice in Zone-6.
- **Nutrient requirement for organic cultivation of stevia:** Application of FYM @ 25 t/ha, vermicompost @ 2 t/ha and neem cake @ 1 t/ha per annum in four equal splits. The first split to be applied at the time of planting and one fourth quantity after each harvest. Bio-fertilizers viz. *Azospirillum brasilense*, PSB (*Bacillus megaterium*) and VAM (*Gloumus bhagyaraji*) each @ 10 kg/ha to planting holes gave a dry leaf yield of 13.2 t/ha with glycoside content of 11.2%.

2007

- **Weed management in Onion:** Use of pendimethalin or oxyflurofen @ 0.1 kg a.i/ha as pre-emergent spray three days after sowing controls weeds effectively in direct seeded Onion at Hiriyur. Care should be taken to spray the herbicide at the optimum soil moisture condition.

2006

- **Nutrient management in cashew:** Application of 50% recommended NPK together with 50% N as compost (40 kgs) gave an cashew yield of 5.55 kg/tree with B:C ratio of 1.40 at coastal zone.
- **Nutrient management in onion:** Application of coir pith based compost @ 30 t/ha two weeks before sowing save 50% RDF with B:C ratio of 1.9 compared to 30 t/ha FYM with 100% RDF and B:C ratio of 1.41 for onion crop.
- **POP for spike dropping in pepper has been developed**
- **Intercrops in areca garden:** In areca garden, during initial 3 years, in the absence of adequate irrigation facility short duration vegetable crops with high B:C ratio such as french bean (1.9:1), bhendi (3.1:1), cluster beans (2.7:1) and green chilli (2.33:1) can be raised profitably utilizing the available soil moisture during monsoon to increase the income of farmers.
- **Weed management in carrot:** Efficient weed management in carrot can be achieved by the use of herbicides – pendimethalin 30 EC @ 2.5 l/ha, alachlor 50 EC @ 2 l/ha and oxyfluorfen 23.5 EC @ 400 ml/ha as pre-emergence.

2004

- **Agricultural - Horticultural systems comprising jackfruit / mango / tamarind with field crops like ragi and horsegram**: Agricultural - Horticultural systems are recommended to Zone – 4 as the system is more profitable compared to component crops/trees and covers risk to farmers in the years of drought. A spacing of 16m X 8m for jack while a spacing of 8m X 8m and 12m X 8m for mango and tamarind respectively, have been recommended.

2003

- **Management of ratoon cropin banana:** In the ratoon crop of banana cv. robusta retaining two suckers per hill with application of 125 per cent of recommended dose of fertilizers (225 g N, 135 g P and 280 g K per hill) is profitable.

2002

- **Weed management in transplanted onion:** Application of oxyflurofen 23.5 EC 500 ml per hectare and metachlor 50 EC 2 ltr per hectare as pre emergence (within 3 days after planting) using 750 l of water /ha is very effective in managing weeds in transplanted onion in Zone-4.

2001

- **Agri-horti systems for Central dry zone:** The agri-horti systems of growing ragi and horsegram with fruit trees like jack, mango and tamarind increased the productivity of the land and provide stability in production with spacing of 16x8 m is ideal. It also serves as insurance against crop failure in Zone-4

4.2 Crop protection: Disease management

2025

- **Management of root-knot nematode in capsicum under protected condition:** Spot application of *Glomus mossae* @ 1 kg along with 5 kg of farm yard manure and soil application of *Pochonia chlamydosporia* @ 1 kg along with 5 kg of farm yard manure at 45 days after transplanting suppresses nematode infestation, enhances yield (300 q/ha) by 84% in capsicum under protected cultivation with B:C ratio of 2.94:1.
- **Management of root-knot nematode in cucumber under protected condition:** Enrich *Bacillus amyloliquefaciens* @ 10 kg/ha with the recommended dose of farmyard manure (24-30 t/ha) and allow it to incubate for 15 days. Application of this enriched bioagent mixture to the soil at the time of transplanting and reapply (45 days

after transplanting) the bioagent around the basin of each plant suppress the root-knot nematode population and promote healthy root establishment, enhances yield (261 q/ha) by 9.5% in cucumber under protected condition with B:C ratio of 2.56:1.

Untreated **Treated**

- **Integrated management of tomato leaf curl virus disease:** Grow two rows of multi-cut fodder sorghum (CoFS-29) as live barrier around the main field, 45 days before planting tomato. Plant 30 days old tomato seedlings raised over silver reflective row mulch under 50X nylon mesh. Spray Imidacloprid 17.8 % SL @ 0.5ml/l during 2nd & 8th week after transplant, spray seaweed bio molecule LBD-12 (AGFORT/ Tomotough) @ 1 ml/l @ 3rd, 5th and 7th week, spray neem soap @ 8gm-l / neemark 5000 ppm @ 5ml/l during 4th week and thiamethoxam 25 WG @ 0.5 gm/l during 6th week after transplanting. These management practices significantly reduces the disease incidence to the maximum extent (71% higher than present pop) with only 1.9 per cent disease incidence, higher yield (30.4 t/ac) and B: C ratio of 7.74:1

2023

- **Integrated management of leaf curl virus disease in chilli:** Two rows of multi-harvest fodder maize should be grown before 45 days along the borders of the field. Chilli seedlings grown for 35 days under 50X nylon mesh net should be transplanted in the mid of the silver reflective mulch row cover. Spray Imidacloprid (17.8% SL) @ 0.5 ml/l or Afidophyropen (50 g/L DC) 2 ml/l at 15th and 70th day after planting. Sea plant biomolecule (*Kappapycus alviraizi:* LBD-12/ AGFORT/ TOMOTUFF) @

1.5ml/l of water should be sprayed on 21st, 35th, 49th and 63rd day of transplanting. Neem oil (5000 ppm) @ 5ml/l should be sprayed on 28th and 56th day of transplanting. Thiamethoxam (25 WG) @ 0.5 g/l water should be sprayed at 6th week after transplanting. This technology, the severity of the disease is around 3 to 7.3% with 44.3% higher yield (5.7 t/ha) and B:C ratio of 6.3:1.



- **Management of anthracnose in chilli:** Spraying tebuconazole 50% + trefloxystrobin 25% @ 0.4 g/ l of water as soon as the disease is observed and 2nd spray at an interval of 15 days reduces the disease incidence by 80% and enhances yield (34.8 q/ha) with 2.35:1 B:C ratio

- **Management of early blight in tomato:** Spray azoxystrobin 18.2% + difenconazole 11.4% SC @ 1 ml /l of water as soon as the disease is observed and the second spray at an interval of 15 days reduces the disease incidence by 70% and yields 31.2 q/ha with B:C ratio of 2.26:1.


2022

- **Spraying of tebuconazole & trifloxystrobin for management of powdery mildew in mango:** Spraying of tebuconazole 50% + trifloxystrobin @ 0.4 g/l during flowering and if disease persists 2nd spray in the interval of 30 days was found to be effective in reducing the disease incidence by 85 per cent with B:C Ratio of 13.11:1.



- **Spraying of azoxystrobin & difenconazole for management of powdery mildew in chilli:** When symptoms are observed, spraying of azoxystrobin 18.2% + difenconazole 11.4 % @ 1.2 ml/l two times at an interval of 15 days was found to be effective in reducing disease incidence by 83 per cent with 2.03:1 B:C Ratio.
- **Spraying of fungicides for management of black spot of papaya:** Spraying of mancozeb 50 WP 2g/l, difenoconazole 25 EC 1ml/l and tebuconazole 50 + trifloxystrobin 25 WG 0.5 g/l after disease initiation at 15 day interval was found effective in reducing 83.95 and 88.44 per cent black spot symptoms on leaves and fruits respectively with B:C ratio of 3.25:1 and the fruits could be harvested fifteen days after the spray for edible purpose.

2021

- **Integrated management of yellow mosaic virus in ridge gourd:**

Time	Chemical /product	Quantity /dosage
Before sowing	Intercropping with two rows of border crops of maize 30 days before sowing	1 kg
	Soil application of *Pseudomonas* along with neem cake	1 kg *Pseudomonas* in 100 kg neem cake
Sowing time	Seed treatment with Thiomethaxam 25 WS Mulching with black silver mulch	5g/ kg seeds
20 Days After Sowing (DAS)	Spraying of seaweed extract Installation of yellow sticky traps	1.5 ml/1itre of water 10 traps/acre
30 DAS	Thiamethoxam 25% WG	0.5 g/litre of water
45 DAS	Imidacloprid 17.8 SL	0.5ml/litre of water

2020

- **Integrated management of yellow mosaic virus in pole beans:**
  - ✓ Before sowing: Sowing of 2 rows of African tall maize all-round the field 30 days before sowing the main crop, mulching with black silver mulch, soil application of *Pseudomonas fluorescens* along with neem cake (1kg/100kg neem cake).
  - ✓ At the time of sowing: Seed treatment with thiomethaxam 25 WG – 5g/kg seeds
  - ✓ After sowing: Installation of yellow sticky trap @ 10 no/acre and spraying of seaweed extract (1.5ml/l) 20 days after sowing. Spraying of thiamethoxam 25% WG (0.5 g/l) and Imidacloprid 17.8 SL (0.5ml/l) 30 and 45 days after sowing respectively.

Untreated

Treated

2018

- **Use of compost tea for control of late blight and higher yield in potato:** One spray of compost tea is recommended from 25 days of planting upto 5 weeks. One spray of fungicide is recommended (1 g/l of dimethomorph + 2 g/l of mancozeb) when the late blight symptoms are noticed. This practice is both eco-friendly and economical. When compared to the present recommended practice it decreases late blight disease severity by 45.6%. It enhances tuber yield (25.7 t/ha) by 25 per cent with B:C ratio of 4.41 against the check (20.5 t/ha & 3.1:1 B:C ratio).

- **Integrated management of Papaya Ring Spot Virus disease in papaya:** Grow two rows of fodder maize Co-FS 29 as live barrier around the main field 60 days before planting. Plant 60 days old seedlings raised under insect proof 50X nylon mesh in the centre of silver reflective row mulch. Spray cultivated tropical red sea plant, *Kappa phycusalvarezii* extract @ 4ml/l @ 15 days after transplanting (DAT), imidacloprid 17.8 % SL@ 0.5 ml/l at 20 DAT followed by spray of neem oil 5000 ppm @ 5ml/l @ 30 DAT. Repeat the above treatments every month. This practice reduces disease incidence by 27 per cent and enhances yield by 85 per cent with B:C ratio of 4.18:1.

Before treatment

After treatment

2017

- **Management of Downy mildew disease in cucumber:** Soil application of *Trichoderma harzianum* through farm yard manure (enrichment- 1kg/100kg for 15days), seed treatment with metalaxyl (2g/kg seeds), prophylactic spray with mancozeb (2.5 g/l) 3weeks after planting followed by sprays of metalaxyl + mancozeb (2.5 g/l) and dimethomorph (1 g/l) + mancozeb (2 g/l) based on disease severity at 5^{th} and 7^{th} week after planting effectively manages the downy mildew disease in cucumber.

- **Management of *Ganoderma* wilt of coconut:** Root feeding with tebuconazole 25.9 % EC @ 1.5 ml in 100ml water/palm at quarterly interval + soil application of 5kg neem cake enriched with *Trichoderma* + *Pseudomonas* (talc formulated) @ 50 g/ palm/ half yearly.

2016

- **Integrated management of late blight in Potato:** Soil application of *Trichoderma harzianum* and *Pseudomonas fluorescens* through farm yard manure (enrichment- 1kg/100kg for 15days), tuber treatment with mancozeb (2g/l). Prophylactic spray – mancozeb (2.5 g/l)–5 weeks after planting followed by sprays of fenamidone + mancozeb (3g/l), iprovalicarb +propineb (4g/l) and dimethomorph (1g/l) + mancozeb (2g/l) based on disease severity at 7th, 9th and 11th weeks after planting is effective in the management of late blight disease.

2014

- **Management of late blight in tomato:** Soil application of 1.0 kg of Trichoderma viridae and 1.0 kg Pseudomonas fluroscens in 100 kg FYM and prophylactic spray of Mancozeb 0.2%@ 60 DAT, Metalaxyl + Mancozeb both of 0.2% @ 74 DAT + Dimethomorph (0.1%) +Polyram (0.2%) @ 81 DAT is effective in the management of late blight in tomato.
- **Management of yellow mosaic virus disease in polebean: Sowing** African Tall Maize as border crop 35-40 days before sowing polebean + seed treatment with Imidacloprid 70% WG @ (5 g/kg seed) + Reflective Mulch + Imidacloprid 17.8% SL (0.05%) @ 30 DAS + Spray with Thiomethaxam 25 WDG (0.05%) @ 45 DAS controls yellow mosaic virus disease in polebean.

2012

- **Management of Septoria leaf spot disease in tomato:** Spraying with carbenbdazim 12% + mancozeb 63% is recommended for the effective control of Septoria leaf spot disease in tomato in Zone-7.

2011

- **Management of late blight disease of potato**: Prophylactic spray of mancozeb @ 2.5 g/l at 30 DAP, followed by dimethomorph (1g) + mancozeb (2g) in one litre of water 40 DAP, followed by mancozeb 2.5 g/l, 50 DAP is effective in control of late blight of potato at Zone-6.

2009

- **Management of Anthracnose disease of black pepper:** In hill zone, anthracnose disease of black pepper has been managed effectively by taking two sprays with 0.1 per cent propiconazole 25 EC during last week of june and august as an alternate to three sprays of 1 per cent bordeaux mixture during last week of may, july and august for control of the disease cutting costs on fungicide with a B:C ratio of 1.41:1.

2008

- **Management of tip over disease in banana:** Dip the suckers / plantlets before planting in *Streptocycline* or Kcycline @ 0.5 g/l water + copper sulphate @ 2.5 g/l of water for 30 minutes and also apply the same to the pits around the sucker thrice at 30 days intervals
- **Management of Bacterial spot in tomato:** For the management of Bacterial spot in tomato, spray the plants with *Streptocycline* or Kcycline @ 0.5 g/l water + Dithane M-45 @ 2 g/l water or copper oxychloride @ 2 g/l of water thrice on 35, 55 and 75 days old plants in Zone-5.
- **Management of root rot of Anthuriums:** Dip the roots of Anthuriums seedlings for 30 minutes in streptocycline alone @ 0.5 g /litre or mixed with copper oxychloride @ 3 g/litre water twice at 15 days interval (as soon as the disease is noticed). Apply about 300-500 ml of the suspension to each plant for the effective management.

2007

- **Management practices for yellow leaf disease for arecanut:** Management practices for yellow leaf disease for arecanut has been developed. It includes proper drainage, measures to prevent damage to roots, application of 500 g of lime in case of acidic soil, application of organic manure and 2 splits of chemical fertilizer dose during may-june and 2nd during sept-oct besides, need based micronutrient and protective irrigation during summer.
- **Integrated disease management practices for bacterial blight of pomegranate:** The practices include pruning the affected part followed by application of 1%

bordeaux mixture, after 3 days give ethrel spray @ 2 ml/l and application of bleaching powder of 150 gm/pl. (soil drench) followed by spraying with antibiotics such as *Streptocycline* or Kcycline (0.5 g) with bacterium and ampilox. A total of 12 sprays are to be given at an interval of 12-15 days for the effective control of disease and to obtain good yield.

2006

- **Management of pepper mussel scale:** Application of fipronil 5 SC and carbosulfan 25 EC effectively controls pepper mussel scale disease at hill zone.
- **Management of bacterial leaf stripe disease of arecanut:** Spraying of *Streptocycline* @ 500 ppm + copper oxychloride @ 0.2% is effective against bacterial leaf stripe disease. Two sprays at an interval of 15 days are recommended.

2005

- **Management of bacterial wilt incidence in potato:** Growing of potato + castor combination should be discouraged in Zone-6 to reduce the bacterial wilt incidence in potato.
- **Management of chilli anthracnose fruit rot:** chilli anthracnose fruit rot can be managed through soil mulching of Eupatorium leaves for 30 days after planting + carbondazim spray (0.1%) at 50% fruit maturity stage and 15 days after 1st spray at Navile for higher yields (15 q/ha) of chilli and minimum incidence of disease (3.9%) with incremental cost benefit ratio of 1:5.3.

2004

- **Management of basal stem rot disease of coconut:** Combined application of Hexaconazole (1%-100ml) root feeding at quarterly interval along with soil application of neem cake (@ 5Kg/ palm/ year) + *Trichoderma viridae* (@50g/ palm/ half yearly) for a minimum of two years.
- **Management of anthracnose in mango:** Endosufan 0.02% spray successfully controlled mango anthracnose due to *Colletotrichum gloeosporiodes* and scale insects combining together when sprayed on leaves and twigs of occurrence.
- **Management of root knot nematodes in tomato:** Management of root knot nematodes in tomato through nursery treatment with bacterial bioagent *Pasteuria penetrans* @ 10g of culture ($1x10^8$ spores/m^2) as against neemark @ 1.25l or carbofuran 3G @ 0.3g ai/m^2 for Zone-5 and Zone-6.
- **Management of root knot nematodes in brinjal nursery:** Management of root knot nematodes in brinjal through nursery treatment with bacterial bioagent

Pasteuria penetrans @ 10g of culture ($1x10^8$ spores/sq) as against neemark @ 1.25l or carbofuran 3G @ 0.3g ai/m^2 for Zone-5 and Zone-6.

- **Management of root knot nematodes in tomato:** Management of root knot nematodes in tomato through nursery treatment with bio agent VAM *Glomus fasciculatus* @100 spores/ m^2 as against carbofuran 3G @ 0.3g ai/m^2.
- **Management of root knot nematodes in brinjal:** Management of root knot nematodes in brinjal through nursery treatment with bio agent VAM *Glomus fasciculatus* @ 100 spores/m^2 as against carbofuran 3G @ 0.3g ai/m^2.
- **Agronomic management of root knot nematodes in brinjal:** Intercropping with sweet potato as against the sole crop of brinjal

2002

- **Management of fruit –rot in chilli:** Application of eupatorium leaves as mulch and carbendazim at 0.1 per cent spray on foliage of chilli resulted in least fruit rot disease (24%) and recorded 15q/ha of yield with C:B ratio1:5.3. It is comparable with coconut coir as mulch and copper oxychloride @ 0.3 per cent for management of fruit–rot in chilli in Zone-7.
- **Management of alternaria leaf blight in onion:** Application of ziram @ 2.5ml/l reduces alternaria leaf blight disease (21%) over control and gives higher yield of 122 q/ha and is very effective on this disease in onion with a B:C ratio of 1:14.

2000

- **Management of murda disease in chilli:** One spray each of neem seed kernel extract (4%) and triozophos (1.5 ml/l) at 2 leaf stage in the nursery and 3 sprays alternatively in the main field is very effective in the control of murda disease.

4.3 Crop protection: Pest management

2023

- **Management of thrips in chilli:** When the infestation of thrips is noticed in chilli, spraying of broflanilide 30% SC @ 0.16 ml/l of water (B:C ratio- 3.31:1 and pest incidence reduction: 92.7%) or fluxametamide 10% EC @ 0.8 ml/ l of water (B:C ratio- 3.22:1 and pest incidence reduction: 87.2%) or spinetoram 11.7% SC @ 1 ml / l of water (B:C ratio- 3.01:1 and pest incidence reduction: 84.9%) or tolfenpyrad 15% EC @ 2ml / l of water (B:C ratio- 2.96:1 and pest incidence reduction: 83.6%) is

found effective in minimizing the damage. It is suggested not to use any of the above-mentioned pesticides for a second application on the same crop.



- **Management of diamond backmoth in cabbage:** When the incidence of diamondback moth is noticed on cabbage, spraying of broflanilide 30% SC @ 0.08 ml/l of water reduced incidence by 97% and enhanced yield (23 t/ha) by 13% with B:C ratio of 3.3:1 or Spraying fluxametamide 10% EC @ 0.8 ml/l of water when we observe the diamond backmoth in cabbage reduced incidence by 96% and enhanced yield (21 t/ha) by 12% with 3.1:1 B:C ratio



- **Management of fruit fly in ridgegourd:** When fruit fly damage is found in ridge gourd, spraying the mixture of cyantraniliprole 10.26 OD @ 1.8 ml and 10 g jaggery/ l of water, followed by need based second application with the mixture of spinosad 45 SC @ 0.3 ml and 10 g jaggery /l of water after 15 to 20 days of first spray reduced the incidence by 92% and enhanced yield by 22% (81q/ha) with B:C ratio of 3.6:1.



2022

- **Spraying spinetoram or chlorantraniliprole for management of tomato pinworm, *Tuta absoluta:*** Spraying of spinetoram 11.7 SC @ 0.75 ml/l of water (1st spray: when the incidence is observed and second spray if required at 15 days after 1st spray), reduced the pinworm incidence by 80 per cent and enhanced the yield by 62 per cent with B:C ratio of 2.19:1 compared to untreated control or Spraying of chlorantraniliprole 18.5 SC @ 0.3 ml/l of water (1st spray: when the incidence is observed; 2nd: spray if required at 15 days after 1st spray), reduced the pinworm incidence by 72 per cent and enhanced the yield by 56 per cent with B:C ratio of 2.11:1 compared to the untreated control.
- **Management of rugose spiraling whitefly on coconut using bio rational insecticides:** Spraying on lower surface of coconut palm leaves with azadirachtin 1% @ 2 ml recorded 41.92 and 54.64 per cent reduction in nymphal population of spiraling whitefly at 5 and 10 days after spraying and 39.55 and 63.96 per cent reduction in adult population **OR** Spraying with neem oil @10 ml + soap 10 gram recorded 55.12 and 58.11 per cent reduction in nymphal population of spiraling whitefly at 5 and 10 days after spraying and 51.79 and 61.57 per cent reduction in adult population.
- **Spraying of entomopathogenic fungi, *Lecanicillium lecanii* for management of rugose spiraling whitefly in coconut ecosystem:** Spraying eco-friendly entomopathogenic fungi, *Lecanicillium lecanii* @ 5g/l (cfu $2x10^8$/g) of water on lower surface of coconut leaves recorded 40.23 and 64.32 per cent reduction in nymphal population of spiraling whitefly at 5 and 10 days after spraying and 44.73 and 90.37 per cent reduction in adult population.

- **Spraying of spinetoram for management of thrips on chilli:** Spraying of spinetoram 11.7 SC @ 1 ml/l of water (1st spray: when the incidence is observed and second spray if required at 15 days after 1st spray), reduced the thrips incidence by

86 per cent and enhanced the yield by 35 per cent with B:C ratio of 3.07:1 compared to untreated control.

2019

- **Management of serpentine leaf miner in tomato:** Spraying of 1.8 ml cyantraniliprole 10.26 OD per liter of water (360 ml/acre) when the incidence of miner is noted effectively reduced the pest incidence by 95 per cent and increased yield by 6 per cent.

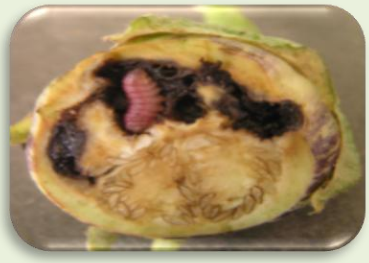
- **IPM for managing diamond back moth in cabbage:** Schedule of insecticide application for the management of DBM and other lepidopteron pests in cabbage

Time of Application	Chemical/product	Dosage
Sowing time	Two rows of mustard after 25 rows of cabbage	
7 Days after Transplanting	WOTA-T (DBM traps)	5 Nos./acre
15 Days after Transplanting	Neem Soap	10 gm/l
18 Days after Transplanting	Spinosad 2.5SC	1.25 ml/l
21 Days after Transplanting	Emamectin benzoate 5SG	0.5 g/l
35 Days after Transplanting	Spray of Bt (Dipel)	1g/l
50 Days after Transplanting	Chlorfenapyr 10SC	1.5 ml/l
65 Days after Transplanting	Spinosad 2.5SC	1.25 ml/l
80 Days after Transplanting	Emamectin benzoate 5SG	0.5 g/l

- **Chemical control of thrips *Scirtothrips dorsalis* infesting chilli:** Spray application of spinosad 45 SC (0.3 ml/l of water) at 10 to 14 days interval in nursery/ standing crop resulted in more than 80% reduction in population of thrips and accounted for B:C ratio of 15:1.



- **Management of shoot and fruit borer in brinjal:** During vegetative stage (Incidence is observed on wilted shoots), spraying chlorantraniliprole 18.5 SC @ 0.3 ml/l (60-75ml/acre) and at fruit setting stage, spraying of emamectin benzoate 5 SG @ 0.4gm/l (80-100g/acre) effectively controlled the borer to an extent of 95% and increases yield by 59%.




2018

- **Chemical control of red spider mite on french bean:** Application of buprofezin 25SC at 1ml/l **OR** propargite 57 EC at 2ml/l between 30 and 45 days after sowing was effective in controlling spotted spider mite on French bean. This practice nullifies the pest incidence (reduces by 100%) in 14 days with 10.18 B:C ratio

2017

- **Management of fruit borer in tomato:** Foliar application of chlorantraniliprole 18.5 SC @ 0.3ml /l is effective in control of fruit borer in tomato.

- **Management of white fly in tomato:** Spraying of imidacloprid 17.8 SL @ 0.3 ml or hostathion 40 EC @ 2 ml per liter of water effectively controls the white fly.

2015

- **Evaluation of new acaricides against red spider mites infesting brinjal:** Application of newer acaricides like propargite/ fenazaquin/ fenpyroximate or spiromesifen resulted in significant reduction in red spider mite population (94 to 98%) on brinjal crop and recorded higher marketable fruit yield of brinjal (77 to 83 q/ac) compared to dicofol and untreated control.

2013

- **Management of ginger shoot borer:** Application of Lambda cyhalothrin @ 1 ml/l is effective in management of ginger shoot borer.

2012

- **Management of two spotted spider mite *Tetranychus urticae* on bhendi:** Spray application of fenazaquin 10EC @ 1.7 ml/lit or propargite 57 EC @ 1.5 ml/l or fenpyroximate 5 EC @ 1.5 ml/l as single spray at 45-60 days after sowing is effective for the control of two spotted spider mite *Tetranychus urticae* on bhendi.

- **Management of two spotted spider mite *Tetranychus urticae* on tomato:** Spray application of fenazauin 10EC @ 1.7 ml/lit or propargite 57 EC@ 1.5 ml/lit or fenpyroximate 5 EC @ 1.5ml/lit, two sprays at 15 days interval starting from 75 days after planting for the control of two spotted spider mite *Tetranychus urticae.*

2011

- **Management of yellow mite in Potato:** Application of Fenazaquin 10EC @ 1.7 ml/l followed by wettable sulphur 80 WP @ 3 g/l was found effective in management of yellow mite in potato in Zone-6.
- **Management of Arecanut bug:** Pentatomid bug in Arecanut can be effectively managed by the application of chloropyriphos 20 EC, 3 ml/l and monocrotophos 36 SL 1.5 ml/l in Zone-7.
- **Management of Arecanut borer:** Arecanut borer can be managed effectively by giving a spray of othiodicarb 75 WP 2 g/l or indoxicarb 14.5 SC @ 0.5 ml/l during August - September in Zone-7.

2010

- **Management of Arecanut mites:** Diafenthuiran 50 WP 1.2 g/l. and propargite 57 EC 0.5 ml/l are proposed to be included in package of practice in addition to dicofol 20 EC ml/l and wettable sulphur 4 gm/l for control of arecanut mites.

2009

- **Management of thrips, shoot and capsule borers in cardamom:** Thrips, shoot and capsule borers in cardamom can be effectively managed by spray application with acetamaiprid @ 0.4 g/l. The treatment also recorded less number of damaged capsules (2.57) and least damage by pests (0.61%) compared to an alternate pesticide carbosulfan during march in hill zone.
- **Management of Cardamom shootfly:** Cardamom shootfly can be managed effectively by taking 1st spraying with thimethoxam @ 1 g/l at the onset of pest infestation and second spray after 20 days of first spray. With this, least number of 5 dead hearts per clump.

2008

- **Management of *Spodoptera litura* in potato:** Application of methomyl 40 SP @ 1 g/l effectively controls when the population is infesting leaves as well as tubers.
- **Management of yellow mite on chilli:** Application of dicofol 2.5 ml or Fenpyroximate 0.8 ml (30 g ai/ha) or buprofezin 0.8 ml (150 g ai/ha) per litre of

water twice at two weeks interval between 8 and 10 weeks after planting controls the yellow mite on chilli crop in Zone-5.

- **Integrated pest management schedule for coconut eriophid mite:** Integrated pest management schedule for coconut eriophid mite has been developed for Zone-4. The schedule is as follows: 50 kg of FYM, 500:320:1200 g NPK, 5 kg neem cake, 50 g borax, 500 g Magnesium sulphate / palm / year. Apply NPK in two equal splits during pre and post monsoon and other nutrients as single dose during pre-monsoon. Root feeding with econeem plus (1%), neemazol (1%) @ 10 ml/palm. Three times in a year during Jan-Feb., April-May and Sept.-Oct. is advocated.
- **Management of mussel scale in pepper:** Mussel scale in pepper can be managed with 3 sprays of neem oil @ 5 ml/l or fish oil @ 3 g/l once in 15 days from onset of pest infestation. The population of mussel scale ranged from 3 to 16 numbers with these organics.
- **Management of *Spodoptera litura* in potato:** Application of S.I. NPV @ 1 ml/l + 5g jaggery during evening hours effectively controls *Spodoptera litura* in potato (early infestation).
- **Management of white fly in cardamom:** Spraying with acetamiprid @ 0.4 g/l during onset of pest infestation reduces the population of the pest.
- **Management of cardamom shoot fly:** Use of 10 g. phorate or 0.5 kg neem cake during onset of pest infestation & during november controls the cardamom shoot fly.
- **Management of cardamom shoot borer and hairy caterpillar:** Spraying with carbosulfan 2 ml/l in november controls shoot borer and hairy caterpillar.

2007

- **Management of Yellow mite on chilli:** Yellow mite on chilli crop can be controlled effectively by two times application of diafenthiuran @ 300 g ai/ha or fenazaquin @ 125 g ai/ha or buprofezin @ 75 g ai/ha or Dicofol @ 2.5 ml/l These should be applied between 8 and 10 weeks after planting at 14 days interval.
- **Management practices for pseudostem weevil on banana (Elakki variety):** Management practices for pseudostem weevil on banana (elakki variety) has been developed which includes pseudostem injection with monocroptophos (3 ml. in 5 ml. of water/plant) followed by dimethoate, chloropyriphos, imidacloprid each (3 ml in 5 ml) and econeem plus (2ml in 5ml of water per plant) at flowering stage along with soil application of phorate (40 gm), carbofuron (20 gm) and neem cake (500 gm) per

plant and injection should be given to stem at one metre above the ground level and it should be pricked 2-3 cm deep in the stem.

- **Management of spindle bug in arecanut:** In arecanut, spindle bug can be controlled effectively by placing new insecticides 5g of phorate granules at the base of spindle and spraying with lambda cyhaluthrin 1 ml/l (3.06 g/pl) and azadirachtin 1% @ 2 ml/l to the spindle during summer / whenever bugs are noticed in large numbers.
- **Management of thrips and borer in cardamom:** Spraying of 20 ml. of carbosulphon 25 EC dissolved in 10 lt. of water as an alternate to monocrotophos 36 EC controls the thrips and borer in cardamom. Four sprays have been recommended for effective control.

2006

- **Management of thrips in capsicum:** Thrips in capsicum can be effectively managed by fipronil 5% SC @ 2ml/l of water at 35-45 days after transplanting to main field.
- **Management of pseudostem weevil in banana:** Pseudostem weevil in banana can be managed effectively through injection of monocrotophos 36SL @2 ml in 4ml water per plant at the time of flowering in Zone-7.
- **Management of pepper mussel scale:** Application of fipronil 5 SC and carbosulfan 25 EC effectively controls pepper mussel scale disease at hill zone.

2004

- **Management of diamond back moth on cole crops:** Application of spinosad / indoxacarb / novaluran for cabbage and cauliflower in nursery and NSKE in field.

2000

- **Management of African giant snails in beetlevine:** Application of metaldfehyde @ 10 kg/ha as band placement around the base of beetlevines was effective in management of African giant snails in beetlevine gardens.

V. SEED STORAGE TECHNOLOGIES

Post-harvest losses are highly variable with losses can be over 90 per cent. Storage pests are the main source of legume insufficiency. Storage losses in pulses are caused by insect infestation, high moisture and temperature, microbial growth, and poor handling, resulting in both quantitative loss (e.g., weight reduction) and qualitative degradation (e.g., loss of nutritional value and seed viability). The pulse beetle (*Callosobruchus* spp.) is a major pest, with losses estimated between 10% and 30% or higher, depending on storage conditions. Storage materials and physiology related technologies are emerging and university has charted out its research programme towards development of such technologies. University has developed 19 storage technologies that reduce the pest incidence and in turn the loss. Details of these technologies are described below

2025

- **Management of Rice weevil in paddy seeds during storage:** Paddy seeds should be dried to bring down the seed moisture below 10 per cent then Treat the paddy seeds with Azadirachtin 10000 ppm @7.50 ml/kg seeds. Shade dry the treated seed for 3 to 4 hours and store the seed in gunny bag. It protect the treated paddy seeds from rice weevil infestation up to 6 months of storage by retaining the germination percentage of about 96% after 3 months of storage and 92% after 6 months of storage with B:C ratio of 5.5:1.

2024

- **Management of pulse beetle on cowpea and blackgram seeds during storage:** Treating 10 kg of cowpea and black gram seeds with broflanilide 300 SC @ 1ml/50 ml water protects seeds from infestation up to 6 months of storage with germination of 88% in cowpea and 86% in blackgram seeds after 6 months of storage with B:C ratio of 4.38:1

2023

- **Management of storage pests in pulses:** After threshing the pulses, dry them till the seed moisture is less than 10% and then apply 0.4 ml flupyradifurone 200 SL mixed in 50 ml of water for 10 Kg seeds. Later, dry them in shade for 3-4 hours and store in gunny bag. This seed treatment inhibits legume insect infestation (1.5%) up to 9 months with 4.5:1 B:C ratio and preserves the seed quality.

2022

- **Spinetoram seed treatment of pulses for managing pulse beetle during storage:** After threshing, pulse seeds should be dried to bring down the seeds moisture below 10 per cent. Then treat the pulse seeds with spinetoram 11.7% SC @ 2.5 ml + 50 ml water per 10 kg seed. Shade dry the treated seeds for 3 to 4 hours and stores the seed in gunny bag. Treated pulse seed are free from pulse beetle infestation up to 6 months of storage. It helps in maintaining seed quality parameters up to 12 months of storage

2021

- **Usage of zeolite beads for storing soybean seeds:** Soybean seeds packed in a super grain bag along with zeolite beads in 1Kg seed to 100g Zeolite beads ratio would extend the storability up to 18 months by maintaining all the seed quality parameters

Zeolite

Beads Silica gel

Desiccants

Cloth Bag **Super grain bag**

Storage bags

2020

- **Eco-friendly control of bruchid beetle in stored cowpea:** Cowpea seeds treated with Azadirachtin 10,000 ppm @ 7.5 ml /kg of cowpea seeds can prevent the bruchid attack upto 12 months. The seeds treated with Azadirachtin has no residual effect, enhances seed viability and seed vigour, safer to soil micro and macro fauna.

2019

- **Management of storage insect through botanicals and their influence on seed quality of cowpea during storage:** Cowpea seeds treated with *Acorus calamus* formulation @ 10ml/kg of seeds and stored in gunny bag can prevent the storage insect pests of cowpea up to 12 months of storage and seed quality parameters were above minimum seed certification standards. This botanical seed treatment performs similar to that of insecticidal seed treatment so the present technology is an alternative organic seed treatment.

Infected seeds ***Acorus calamus* formulation**

2017

- **Storage of groundnut pods under modified storage atmosphere:** The groundnut pods packed and stored under modified storage atmosphere of 50% carbon dioxide (CO_2) treatment provide protection against insect pest of groundnut pod borer *Caryodon serratus* (*Olivier*) up to 12 months of storage under ambient conditions without affecting the seed quality parameters.

CO_2 infusion

- **Super grain bags for storing seeds:** Soybean seeds stored in super grain bag under ambient conditions extend the storability up to 18 months without losing viability and vigour as it provides better protection against moisture, pest and diseases.

Super grain bag

- **Storage studies in Jaggery:** Storing jaggery either in aluminium foil or in paper box helps to retain the physical and chemical properties of jaggery effectively for three months under room temperature.

Aluminum Foil

Paper Box

2015

- **Storage of hybrid maize seeds in HDPE bags:** The hybrid maize seeds packed in High Density Poly Ethylene (HDPE) bags treated with spinosad 45SC @ 100 ppm (0.2ml/l) can prevent the storage insect pests of maize upto nine months under ambient conditions without affecting the seed quality parameters.

2013

- **Storage of groundnut pods in HDPE bags:** HDPE bags used for storing groundnut pods for seed purpose are treated with deltamethrin 2.8 EC @ 100 ppm (3.5 ml/l) **OR** Spinosad 45 EC @ 100 ppm (0.2 ml/l) gives effective control for groundnut pod borer upto nine months under ambient conditions in Zone-5.
- **Groundnut pods stored for seed purpose:** Treat groundnut pods with deltamethrin 2.8 EC @ 1 ppm (0.04 ml) **OR** Thiomethoxam 20 wp @ 2ppm (2.7 mg) **OR** Spinosad 45 EC @ 2 ppm (0.04 ml) mixed in 5 ml of water per kg of pods is effective in control of the pod borer, *Carydon serratus*.

2010

- **Management of storage pests of maize:** Maize seeds can be treated with spinosad 45 SC @ 0.04 ml mixed in 5 ml of water per kilogram of seed to control storage pests of maize upto nine months.
- **Management of storage pests of cowpea:** Cowpea seeds treated with emamectin benzoate 5 SG @ 40 mg or spinosad 45 SC @ 0.04 ml diluted in 5 ml of water per kg of seed to control the pulse beetle in storage upto 12 months.

2009

- **Mechanical drying of sunflower seeds:** Mechanical drying of sunflower seeds using convective dryer with a temperature of 40˚C is suitable for a seed bed thickness of 5 cm. for 24 hours is recommended for Zone-5. Such mechanically dried seeds can be stored satisfactorily upto 12 months.

- **Mechanical drying of groundnut pods for seed purpose:** Mechanical drying of groundnut pods for seed purpose using a convective dryer at 40˚C for a pod bed of thickness 5 cm for 44 hours has given safe storage moisture level of less than 9 per cent and the seeds can be stored upto 12 months safely.

2008

- **Bio-management of storage pests of maize:** In order to control the storage pests of maize upto nine months, treat the seeds of maize with neem products containing 300 ppm azadiractin @ 5 ml/kg seeds. To prevent damage due to pulse beetle upto 12 months storage, treat the seeds of pulses with neem products containing 10000 ppm azadiractin @ 5 ml/kg of seed.

2007

- **Integrated management of pulse beetle:** Integrated control of pulse beetle is a farmers' friendly, low cost and effective technology to store pulses by applying 3 cm thick layer of locally available sieved sand above the grain surface [stored in metal bin / plastic bin / earthen pot] with tightly closed lids. With this method, grains can be stored for long period. Care should be taken to see that the sand layer inside the container is not disturbed. This is applicable for small scale as well as large scale storing.

VI. ALLIED SCIENCES TECHNOLOGIES

Sericulture has history of more than 2 centuries in Karnataka. Sericulture and silk industries creates an employment for more than 12 lakh households in Karnataka. Sericulture is backbone of small and marginal farmers and weaker sections of the society and traditional source of livelihood in most of the southern districts of Karnataka. Details of the technologies developed both with respect to mulberry production and silk worm health are explained in this chapter. UASB has also developed technology regarding decomposition of waste and residues from sericulture.

Besides pollination, the growing market potential for honey and its products has resulted in bee keeping as an emerging viable enterprise. For the development of beekeeping industry, it is very important to provide scientific proven technology of beekeeping to beekeepers and create mass awareness in potential areas. Technologies regarding colony multiplication and frame bee hives suitable for higher honey production are developed by UASB. Absconding activity during the dearth period is a major challenge. UASB has identified alternate sources and has developed pollen substitutes that can be fed to honey bees. Details of the same are provided further.

Animal production has been a vital part of human civilization for millennia. UASB has brought out animal science related technologies that could add upto sustainable income along with a bunch of technologies that fixes the issues raised due to crop farming like Unproductive saline and alkaline problematic soils can be used for fish pond construction and fish farming. Some of the noteworthy animal science technologies are enlisted and discussed further.

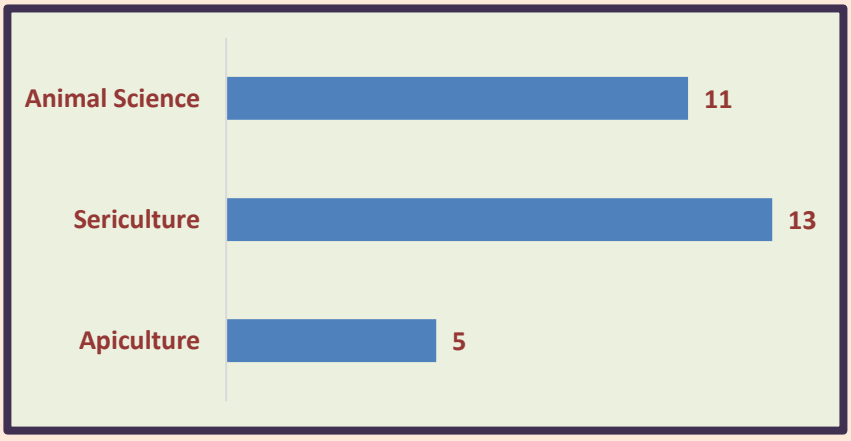


Fig-6: Apiculture, Sericulture & Animal Science related technologies developed by UASB (2000-2025)

6.1 SERICULTURE

Mulberry Production

2022

- **Foliar spray of cultivated sea plant (*Kappaphycus* sp.) extract for enhanced growth and development of mulberry and silkworm:** Foliar spray of cultivated sea plant extract (*Kappaphycus* sp.) LBS 13 @ 1.5 ml/l acts as growth promoter in mulberry (Chlorophyll: 30 days after pruning – 2.37 mg/g, 45 days – 2.55 mg/g, 60 days – 3.85mg/g) and helps in reducing incidence of NPV infection (larval mortality: 3.3% & disease incidence: 11.3%) in silkworm.

Sea Plant

Treated plot Untreated plot

2021

- **Evaluation of suitable intercrops in tree Mulberry for additional income:** Growing determinant type of cowpea as an intercrop in tree mulberry garden, where the space 10x10 ft or 9x9 ft given from plant to plant and row to row gives additional income and increase the profitability of mulberry cultivation. It also improves the soil fertility of tree mulberry garden.

2018

- **Sub surface drip irrigation in mulberry:** Sub surface drip irrigation in mulberry at 4 days interval has been recommended to realize 15-20 per cent higher leaf yield

(41280 kg/ha/year) compared to surface drip irrigation (35263 kg/ha/year). This method of irrigation utilizes 20-25 per cent lesser quantity of water (115 litres) with higher water productivity (356 kg/ha cm) and to earn one rupee profit than surface drip irrigation (307 kg/ha cm and 136 litres respectively).

2005

- **Trenching and Mulching technique (UAS Seri Suvarna Technology) for sustainable rainfed sericulture** is developed.

Mulberry Pests/ Disease

2025

- **Management of thrips and mites in mulberry:** Spraying abamectin 1.9% EC @ 0.75 ml/l significantly reduced thrips (96.3%) and mites (94.6%) population and increased the leaf yield by 16.9%, effective rate of rearing (98%) and egg recovery (55 g/kg) with B:C ratio of 3.41:1 **or** Spraying diafenthiuron 50% WP @ 1g/l reduced thrips (95.3%) and mites (93.5%) infestation and increased the leaf yield by 19.9%, effective rate of rearing (98%) and egg recovery (54.6 g/kg) with B:C ratio of 3.38:1

Application of Propargite

Application of Abamectin

2021

- **Management of mulberry leaf roller:** When the mulberry garden is infested by mulberry leaf roller, spray chlrorfenapyr 10% SC 1.5 ml / 1 l of water. Use mulberry leaves for silkworm rearing only 20 days after the spray of insecticide.

- **Management of Mites in Mulberry:** Spray propargite 57EC @ 1.5 ml per l of water by drenching all the apical leaves of mulberry plant. If the infestation is severe, repeat the same spray at an interval of seven days from first spray. However, the mulberry leaves sprayed with propargite 57 EC @ 1.5 ml l of water are safe to silkworm after 16 days of last spray.

2015

- **Management of mealy bug in mulberry:** Use of dimethoate 30EC @ 2ml/lit at 15 days after pruning is effective for mealy bug management in mulberry garden.
- **Protocol for Induction of male sterility in silkworm uzi fly**, *Exorista bombycis* (Louis) has been developed.

2014

- **Management of uji-fly:** Sticky trap on both sides of the window in silkworm rearing house, has been recommended for effective management of uji-fly.

2013

- **Eco friendly IPM module for mulberry leaf roller:** Spray of 4% NSKE at 15 – 20 days after pruning (DAP) and spray of DPNPV @27.65X10^5PIBs/ml at 25 -30 DAP along with release of egg parasitoid *Trichogramma chilonis* @ 1 lakh/acre at 45-50 DAP. No adverse effect on other traits of silk worm & is cost effective with 7.14:1 BC ratio.

Waste Decomposition

2021

- **Composting of sericulture wastes using compost culture and waste decomposer:** Composting of sericulture waste using compost culture developed by University of Agricultural Sciences, Bengaluru or waste decomposer developed by National Centre of Organic Farming (NCOF), Ghaziabad results in speed up the decomposition process and obtain high nutrient compost (1.5-1.9 % N, 0.5-0.9 % P, 1.5-2.0 % K & 12-15 % C:N ratio) within 80-90 days.

  - ✓ Composting using Compost Culture: One ton of sericulture rearing wastes collected in a constructed pit or compost bag spreading mulberry twigs at the base layer followed by waste from rearing house is then spread over. For each layer of residue spread the part of slurry prepared using 1 kg of compost culture with 3 kgs

of cowdung, 2 l of cow urine and water. All the above steps are repeated in the stated sequence until the pit is filled with1-2 feet above the pit height. Finally, the pit is plastered with mud and cow dung slurry to maintain optimum moisture content inside the heap. To avoid rain, wind, and to maintain the moisture and temperature, the pit should be covered with grass or coconut fronds or polythene sheet. Water is sprayed time to time over the pit to attain 60-70 per cent moisture. 1st turning is done after 30 days of decomposition. Compost will be ready by 80-90 days.

- ✓ Composting using waste decomposer: Mix 2 kgs of jaggery and one bottle of waste decomposer containing 10 g microbial consortium into 200 l of water in a plastic drum. Stir the content of the drum with a wooden stick every day twice, cover it and place under shade. On 6th day, sprinkle 40 l of waste decomposer solution from 200 l to every layer of one ton sericulture rearing wastes filled in a compost pit or compost bag. From rest of 160 l of waste decomposer solution, sprinkle 40 l every day to compost pit within 4 days. Water is sprayed time to time over the pit to attain 60-70 per cent moisture. 1st turning is done after 30 days of decomposition. Compost will be ready by 80-85 days.

Farm Mechanization

2020

- **Multipurpose mobile solar tunnel dryer for drying of silkworm pupae:** A multipurpose forced convection solar tunnel dryer of 60 kg capacity was developed and used for drying of silkworm pupae having size 6.5 x 1.8 x 1.1 m (L x W x H) with MS square tube frame structure and covered with 5 mm thickness toughened glass. The solar tunnel dryer consists of solar collector section and drying section. In drying section four trays with mesh bottom of size 1.2 x 0.9 x 0.08 m was used to facilitate the loading and unloading of the products. A closed thermo-pore was used as insulation material to reduce the heat loss from the dryer. In a solar tunnel dryer, the drying time taken was 6.5 to 9 .0 hours to reduce the moisture content from 103.3 per cent (dry basis) to attain safe moisture content of 8.72 per cent (dry basis) but in case of open sun drying the drying time was 18-22 hours. Results showed that drying rate of silkworm pupae under the solar tunnel dryer was found to be very high during the initial phase of drying due to higher moisture diffusion. Chemical analysis indicated that the quality parameters of solar tunnel dried silkworm pupae were superior compared to open sun dried silkworm pupae. Thermal efficiency of solar tunnel dryer for drying of silkworm pupae was found to be 35-36 per cent. Pupae samples dried in solar tunnel dryer were completely protected from insects, dogs, crows, monkeys, vultures, dust and also the quality was superior.

6.2 APICULTURE

2024

- **Placing Bee hive colonies for pollination in pomegranate:** 4 bee colonies per hectare are required during flowering period to enhance the pomegranate yield by 38.4%.



- **Management of TSBV in *Apis cerana*:** Providing *Phyllanthus niruri* (2g) + Tulsi (0.5g) + Turmeric (0.5g) dissolved in 250 ml of sugar solution; twice a week reduced the infection of Thai Sac Brood disease by 41.7%.


Apis cerana bees infested by Thai Sac Brood disease

2022

- **Pollen substitutes and its feeding methodology in *A. cerana* colonies:** Honey bees showed better acceptance when pollen substitutes were fed through parchment paper followed by petriplates and polyethene cover. Following pollen substitutes (in gms) when supplied reduced the absconding activity during dearth period.
  - ✓ Ragi flour + Milk Powder+ Yeast+ Honey (1.88+1.88+1.25+5) or
  - ✓ Ragi flour + Horlicks powder + Honey (1.88+3.12+5) or
  - ✓ Yeast + Bengal gram + Milk powder + Sugar (4.2+0.4+0.4+5) or

- ✓ Green gram flour + Milk Powder+ Yeast+ Honey (1.9+1.9+1.2+5) or
- ✓ Green gram flour + Horlicks powder + Honey (1.9+3.1+5) or
- ✓ Soyflour + Wheat flour + Yeast + Sugar + Dark rum (1.8+1.8+1.2+5+0.2)

➢ **Six frame hives for *Apis cerana*:** The initiation of honey was earlier in 6 frame hives compared to 8 frame hives (as in PoP). The absconding behavior was more in 8frame hives (28%) compared with 6 frame hives (16%). Similarly the swarming behavior was recorded higher with existing ISI-8frame hives. The growth and development of colony is significantly higher in 6 frame hive compared to 8 frame hive. Hence 6 frame bee hives is more suitable for higher honey production.

2021

➢ **Separate chapter on Double queen system for management of *Apis cerana:*** Adoption of double queen system for management of *Apis cerana* would minimize absconding and enhance foraging activity with higher honey yield and fastens growth and development of colony. This technology is also helpful in colony multiplication.

- ✓ Brood area was higher in DQS (274.6 inch^2) as compared to that of 166.9inch^2 in control.
- ✓ Honey area was higher in DQS (217.7 inch^2) as compared to that of 154.1inch^2 in control.

- ✓ Pollen area was higher in DQS (36.1 inch^2) as compared to that of 21.67inch^2 in control.

6.3 ANIMAL SCIENCE

2014

- **Fish seed rearing and culture technology:** Developed suitable aquaculture technologies to make use of the saline and alkaline waste lands to increase the productivity of these problematic soils. B:C ratio of fish seed rearing activity is 1: 2.37.

  - ✓ Stocking the fish spawn @ 500 nos/m^2 area
  - ✓ Feeding groundnut oil cake and rice bran
  - ✓ Rearing up to 60-80 days
  - ✓ Fingerlings can be obtained with survivability up to 32%

- **Fish culture technology:** Unproductive saline and alkaline problematic soils can be used for fish pond construction and fish farming. The cost: benefit ratio of fish seed farming activity is 1: 2.37.

  - ✓ Stocking the different fish fingerlings @ 1 /2m^2 area
  - ✓ Feeding of groundnut oil cake and rice bran @ 2% of body weight
  - ✓ Fish yield of 2500 kgs/ha./year can be obtained

2002

- Diagnostic methods for cardiac cases and management of dematophtosic in dogs.
- Nutrition management to control mastitis in young calves has been developed.
- Improved feed and fodder formulations including conventional and unconventional sources like sugarcane tops and pressmud have been developed.
- The case of embryonic fatality of chicks has been identified.
- Technology on production and culture of sterile common carp which grows 47 per cent faster and yields more meat per unit weight of fish and which has better conversion efficiency and resistance to the most common bacterial pathogen.
- Protocol for production of triploid fish with higher dressed body weight than diploid fish have been standardized.
- Management practices for better nutrient efficiency in cam seed rearing and bio-enrichment techniques for enhancing the growth of spawn and fry.
- Low cost larval feeding schedules for fish larva has been developed.
- A sensitive rapid and simple immunodot assay for use in the field level detection of viruses has been developed.

Bibliography

- ZREP Research Results Book of Zone-5 for the period from 2005-2006 to 2024-2025
- ZREP Research Results Book of Zone-6 for the period from 2000-2001 to 2024-2025
- Proceedings of ZREP Workshop Zone-5 for the period from 2000-2001 to 2024-2025
- Proceedings of ZREP Workshop Zone-5 for the period from 2000-2001 to 2024-2025
- Research Council Agenda Notes for the period from 2000-2001 to 2024-2025
- Research Council Proceedings for the period from 2000-2001 to 2024-2025
- Research Highlights Bulletin published by Directorate of Research for the period from 2000-2001 to 2024-2025
- Annual Report of UAS, Bangalore for the period from 2000-2001 to 2024-2025