TECHNOLOGY INVENTORY - III

RESEARCH ACCOMPLISHMENTS AND RECOMMENDATIONS

Edited by : Dr. V. K. Kharche Dr. R. N. Katkar Dr. D. T. Deshmukh Dr. A. K. Sadawarte Dr. K. T. Lahariya



DIRECTORATE OF RESEARCH DR.PANJABRAO DESHMUKH KRISHI VIDYAPEETH AKOLA - 444 104 (Maharashtra)

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Dr. V. M. Bhale Vice Chancellor Dr. PDKV, Akola



It is my great pleasure to present "Research Accomplishments 2010-19" covering multidisciplinary technologies developed and recommended by the scientists of Dr. Panjabrao Deshmukh Krishi Vidyapeeth for the benefit of the farming community spread over different agro-ecological situations in eleven districts of Vidarbha region. I hope that the new technologies generated on different aspects viz., Crop Improvement, Crop Production and Protection, Horticulture, Animal Production and Health, Social Sciences, Agricultural Engineering which keep pace with time will serve as source for development departments, NGOs and farmers to update the commodity wise package of practices in the Vidarbha region of Maharashtra.

Foreword

The newly developed crop varieties are climate resilient and suitable for growing under climate change scenario. Efforts have also been made to develop the crop varieties suitable for mechanization. In view of ever increasing problems of labour the farm implements and machineries have also been developed. Various useful technologies have been developed for judicious management of natural resources.

I congratulate Director of Research and team of Scientists for their dedicated efforts for development of these technologies useful to the farming community.

I hope this publication serves as a very good compendium and source of useful technologies to be adopted by farmers. The technologies generated would be very useful for sustaining agricultural crop productivity and improving livelihood security of farmers in Vidarbha region.

Akola Date: 15/12/2021

(V.M.Bhale)

Dr. V. K. Kharche Director of Research Dr. PDKV, Akola



The research on niche areas and important crops of Vidarbha region suitable in Agroclimatic Zones comprising eleven districts viz., Western Vidarbha Zone, Central Vidarbha Zone and Eastern Vidarbha Zone is the main focus on which the agricultural scientists concentrate their research. The location specific problems and need based research in these areas are addressed through systematic and planned research. There are strong linkages with officials of State Department of Agriculture, Horticulture, Animal Husbandry, NGOs and farmers through on-station and on-farm R&D efforts. This has resulted in enhancing the productivity and profitability of niche crops through reducing cost of cultivation, crop diversification, cropping systems and on farm research. The research accomplishments in different spheres are compiled and presented. The research highlights are published by the university time to time and "Research Accomplishments 2010-19" is one of the such publication.

PREFACE

I congratulate conveners of different Sub-Committees of Agricultural Research Review Committees of Dr. PDKV, Akola and Scientists for their untiring efforts in bringing out this publication. The technologies generated would go a long way in helping the farmers to sustain agriculture. The commendable research work carried out by the scientists is most appreciable. I am sure that, this publication will be highly useful for those connected with R&D in agriculture and its allied fields.

I express my sincere gratitude and thanks to Hon'ble Vice Chancellor Dr. V. M. Bhale for his constant guidance and support provided for bringing out this publication.

The agriculture in Vidarbha region is confronted with some new emerging problems faced by climate change, shortage of labour, changing habits, emergence of pests and disease, decline in ground water and scarcity of water, land degradation and increasing cost of inputs. The efforts have been done to overcome such difficulties in newly evolved technologies to reduce the cost of cultivation and conserve the resources for their optimum utilization.

Akola Date: 15/12/2021

T.P.

Dr. PDKV, Akola

(V.K.Kharche)

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INTRODUCTION

Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola was established on 20th October, 1969 with a objective of meeting the requirement of Vidarbha region which is spread over 11 districts of two revenue divisions viz. Nagpur and Amravati. The university is entrusted with the responsibilities of agriculture education, research, extension education and production of breeder and foundation seeds. Since inception, the university has developed infrastructural facilities for research, education and extension education with well trained human resources, degree & PG college and Agriculture Research Stations in Vidarbha region. The research accomplishments during 2010 to 2019 have been presented in this book.

The Vidarbha region is categorised into three different agro-climatic zones on the basis of rainfall, soil type and vegetation, such as Eastern Vidarbha Zone having high rainfall of 1250-1700 mm covering the districts Chandrapur, Gadchiroli, Gondia, Bhandara and part of Nagpur, Central Vidarbha Zone (rainfall 950-1250 mm) comprising Nagpur, Wardha and Yavatmal and Western Vidarbha Zone (rainfall 700-950 mm) which includes Amravati, Akola, Buldana and Washim districts. Paddy is a major crop in eastern region whereas cotton, soybean, sorghum, pigeon pea, black gram, green gram and other oilseeds crops are dominating crops of the western and central Vidarbha. Although, cotton happens to be the major crop in the western and central Vidarbha region, but equally soybean has also made headway in the cropping system.

The research in the university is mainly of applied nature and involves important activities of agriculture research organized through State policies as well as those under national programmes. It has also developed an excellent interaction with the national and international institutes like Department of Biotechnology, New Delhi, Department of Environment and Forests, BARC, Mumbai and ICRISAT, Hyderabad besides ICAR Institutes, etc. The ICAR has been a supportive centre to cater the need of the research programmes in the university. The university has 24 All India Coordinated Research Projects funded by the ICAR, the AICRP on Chickpea and Weed Management being the recent addition during the year 2015-16. The strategic research programmes are also being undertaken through agriculture research stations spread all over Vidarbha region, 17 departments under faculty of Agriculture, Agricultural Engineering and Horticulture at head quarter and the crop research units and state sponsored schemes operating in the university.

The university has developed so far 1441 technologies covering various areas including 174 crop varieties/hybrids and 34 farm implements and machineries that have been developed for the benefit of the farmers in the region. The different important and adopted technologies includes the techniques/methodologies and recommendations pertaining to the area of crop husbandry and production technologies, dryland and cropping / farming system research, integrated nutrient management, plant protection, soil and water conservation, watershed, post harvest and processing technologies besides value addition to enhance the productivity of the crop as well as the income of the farmers.

During the last seven years (2012-13 to 2019-20), 334 technologies have been recommended by the university including crop varieties/hybrids & farm implements for



the benefit of farming community. These technologies are useful to the farmers for sustaining the crop productivity.

The meetings of different Sub Committees of Research Review Committees of Dr. PDKV were held during March-April, every year to discuss the proposals for the recommendations to the farmers and to formulate new research programme. The Joint Agril Research and Development Committee meetings of State Agricultural Universities are regularly held on rotation basis in the month of May, every year where in proposed recommendations are presented by the concerned Co-ordinators and after thorough discussion, the recommendations for farming community are finally released.

The experiments are planned in each discipline as per the need of the farming community in research planning meeting and finalized in University level Research Review Sub Committees. The varieties, implements and machineries, research technologies in each subject are presented, discussed and submitted to Research findings and Recommendation Committee where in the recommendations are finalized and submitted to State Level Joint Research and Development Committee (Joint Agresco) meetings.

SN	Name of JOINT AGRESCO Sub Committee	Number of Recommendation
1	Natural Resource Management	73
2	Horticulture	58
3	Animal Science and Fisheries	03
4	Basic Sciences, Food Science and Bio Technology	16
5	Plant Protection	45
6	Agril. Engineering	57
7	Soil water conservation	11
8	Social Science	25
9	Variety Release Committee for Field Crops	13
10	Variety Release Committee for Horticultural Crops	15
11	Farm Implement Release Committee	18
	Total	334

Table 1 :	Recommendations	approved	by the	Joint	Agresco	committees	of	SAUs
(2012-13 to 2019-20) for the benefit of farmers.								

In Joint Agricultural Research and Development Committee meeting(Joint Agresco) at state level, there are various discipline wise sub committees, where in Coordinators present the recommendation, those are finalized and accepted for release at state level. During 2012-13 to 2019-20, in total 334 recommendations /varieties/ implements and machineries of Dr. PDKV, Akola were accepted and released for farmers. The sub committee wise recommendations accepted in Joint Agresco are given Table 1. These technologies will go a long way in helping the farmers to enhance the productivity and sustainability of agriculture.





RESEARCH ACCOMPLISHMENTS

I. Crop Improvement (2009-10 to 2019-20)

The research has been carried out by the university scientists on the important crops of Vidarbha region, including field crops, Fruit crops, vegetable crops and flower crops.

Varieties Developed :

The systematic research methodology is followed for development of new variety. The need based characters and requirements of particular attribute are considered. The changing needs and demands are also considered in improvement programme. The need for biofortified crop varieties, mechanization and climate resilience are taken into consideration in the research programme.

A. Field crops

Under field crops, Cotton varieties AKH - 9916 and Suvarna Shubhra (AKH-09-5) were released. In case of cereals, kharif sorghum variety PDKV Kalyani (AKSV - 181), Sorghum Wani-103 (PDKV Hurda Kartiki), Wheat variety PDKV Sardar (AKAW - 42106) and paddy variety PDKV Tilak, Sakoli-9 has been realised for cultivation. In pulses Udid variety AKU 80 -1, (PDKV Black Gold), Chick pea varieties, PDKV Kanchan was released while PDKV Kanak was released at national level for Maharashtra, Madhya Pradesh, Gujrat and Rajsthan States which is suitable for mechanical cultivation. The varieties released under oilseeds as Sunflower hybrid PDKVSH-952, Ground nut varieties AK - 335, and Soybean PDKV Yellow Gold has been released at national level which has peculiar characters of resistance to charcoal rot / root rot.

1) Cotton: Variety - AKH-9916

- Released in 2014.
- Suitable for Rainfed.
- Yield : $12-14 \, \text{q} \, \text{ha}^{-1}$.
- Duration : 170-180 days.
- Resistant to sucking pest.

2) Cotton : Variety - Suvarna Shubhra (AKH-09-5)

- Average seed cotton yield (Rainfed) 1300-1600 kg ha⁻¹.
- Maturity duration 150-160 days.
- Boll weight 3.7-4.0 g.
- Staple Length (UHML)- 28-30 mm.
- Ginning Out turn- 35-36%.
- Tolerant to Jassids, Myrothecium leaf spot, grey mildew and Bacterial Leaf Blight diseases.









3) PKV Hy 2 Bt BG-II

- Average Yield: Rainfed: 15-20 q ha⁻¹.
- Resistant to Jassids, moderately resistant to Bacterial blight, Grey mildew and Alternaria Leaf Spot.
- Duration: 170-180 Days.

4) CICR PKV-081 Bt BG-I

- Yield Potential: $20-22 \,\mathrm{q}\,\mathrm{ha}^{-1}$.
- Duration: 140-150 Days.
- Ginning percentage: 35-36%.
- Upper Half Mean Length (mm): 28.5.
- Bundle strength $(g \text{ tex}^{-1})$: 27.9.
- Micronaire value: $3.9 \,\mu g \,\text{inch}^{-1}$.
- Tolerant to sucking pest, suitable for HDPS.

5) CICR PKV Rajat Bt BG-I

- Yield Potential: $20-22 \text{ q ha}^{-1}$.
- Duration: 160-170 Days.
- Ginning percentage: 34-36%.
- Upper Half Mean Length (mm): 26.8.
- Bundle strength (g/tex): 26.
- Micronaire value: $4.5 \,\mu g \,\text{inch}^{-1}$.
- Tolerant to sucking pest.

6) Soybean AMS-1001 (PDKV Yellow Gold)

- Year of Release : 2018.
- Recommended Area : Maharashtra.
- Maturity duration (days): 95 to 100 days.
- Yield advantage of 15-17% over JS-335.
- Average yield : $22-26 \text{ q ha}^{-1}$.
- Moderately resistant to Charcoal rot and Yellow mosaic virus diseases.
- Moderately resistant to Stem fly and Girdle beetle.
- Non shattering up-to 10 days from harvest maturity.











4



AMS-MB-5-18 (Suvarn Soya)

- Year of Release : 2019
- Recommended Area : Central Zone (Maharashtra, MP, Gujarat, Rajasthan, Bundelkhand region of Uttar Pradesh).
- Maturity duration (days): 98-102 days.
- Recorded yield advantage of 18-20% over JS-335
- Average yield : $24-28 \text{ q ha}^{-1}$.
- Resistant to charcoal rot and Alternaria Leaf Spot disease.
- It has shown moderately resistance to girdle beetle, stem fly and leaf defoliators.
- Pod shattering resistance up to 10 days from harvest maturity.

8) AMS-2014-1 (PDKV Purva)

- Year of Release : 2020.
- Recommended Area : Eastern Zone (West Bengal, Bihar, Orissa, Jharkhand, Chhattisgarh).
- Maturity duration(days): 105-107 days.
- Recorded yield advantage of 20-22% over JS-335.
- Average yield : $22-26 \text{ q ha}^{-1}$.
- It has shown moderately resistance to girdle beetle and stem fly.
- Pod shattering resistance up to 10-12 days from harvest maturity.

9) AMS 100-39 (PDKVAmba)

- Year of Release: 2021
- Recommended Area: Central Zone. (Maharashtra, Madhya Pradesh, Rajasthan, Gujarat, Bundelkhand region of Uttar Pradesh).
- Maturity duration (days): 94-96 days.
- Average yield : $28-30 \text{ q ha}^{-1}$.
- Oil : 20.5 per cent and protein content : 44 per cent comparatively more than other varieties.
- It has shown moderately resistance to girdle beetle and stem fly and charcoal rot disease.
- Pod shattering resistance up to 10-12 days from harvest maturity.







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10) Groundnut AK-335 (PDKV-G-335)

- Productivity : $22 24 \text{ q ha}^{-1}$.
- Oil content : 48 %.
- Duration : 110 113 days.
- Moderately resistance to tikka disease.

11) Groundnut : TAG 73

- Yield: $24-28 \, \text{q ha}^{-1}$.
- Shelling outturn : 72-74 %.
- Duration : 110 to 115 days.
- More number of 3 seeded smooth pods.
- Moderate resistance to major pests and diseases.
- Recommended for summer season and seed production in kharif season also.

12) Sunflower (Hybrid PDKVSH-952)

- Higher Seed Yield $(15-18.0 \,\mathrm{q \, ha^{-1}})$.
- Oil Content-36.03%.
- Duration 90 days.
- Moderately resistant to powdery mildew.







13) Safflower: AKS-311

- High yielding, 19.5 % higher seed yield over check Bhima and 23.1% higher over AKS 207.
- High oil content : 33 per cent.
- Tolerant to wilt.
- Distinctness in petal colour: Pale yellow turns to pink and remain pink after fading.





4) Mustard : Variety - TAM-108-1

- Yield 900 kg ha^{-1} .
- Oil content : 40%.
- Duration 101 days.
- 1000 seed weight: 5 g.
- Resistant to aphids.

15) Sorghum (SPH-1635)

- GMS based hybrid.
- grain yield $45 \,\mathrm{q}\,\mathrm{ha}^{-1}$.
- fodder yield $130 \,\mathrm{q} \,\mathrm{ha}^{-1}$.

16) Kharif Sorghum (AKSV-181 (PDKV KALYANI)

- Higher grain yield (35 q ha^{-1}) .
- Higher fodder yield $(153 \,\mathrm{q \, ha^{-1}})$.
- Duration-117 days.
- Non lodging and shattering.
- Resistant to wilting.

17) Sorghum Wani 103 (PDKV Hurda Kartiki)

- Green Hurda Productivity : $45 \, \text{q} \, \text{ha}^{-1}$.
- Green Fodder Productivity : $200 \,\mathrm{q}\,\mathrm{ha}^{-1}$.
- Duration : 90 Days.
- Non grain shattering and Non lodging.
- Resistance to wilt.
- Tolerant to Jassids.

18) Bajra BBH-3 (PDKV Raj)

- Higher grain (29.03 q ha⁻¹) and fodder yield (52.74 q ha⁻¹) potential.
- Resistant to downy mildew.
- Bold grain size with good grain colour.
- Compared with required check.













19) Udid - Black gram AKU 10-1

- In Vidarbha region it was found to be superior by 18.34%, 22.81%, 18.14% and 31.87% over the existing checks i.e. TAU-1, AKU-15, TPU-4 and BDU-1, respectively.
- In Maharashtra it was found to be superior by 16.25%, 18.08%, 13.29% and 25.54% over the existing checks TAU-1, AKU-15, TPU-4 and BDU-1, respectively.
- Medium bold grain $(4.5 \text{ g } 100 \text{ seed}^{-1})$.
- Early and synchronous maturity (71 days).
- Resistant to Macrophomina blight and moderately resistant to powdery mildew.
- Suitable for Kharif planting in Maharashtra.
- Identified as a multiple disease resistant source for Stem necrosis, Anthracnose and Root rot in AICRP programme.

20) GramAKG-1109 (PDKV-Kanchan)

- Yield : $22 \text{ to } 25 \text{ q ha}^{-1}$.
- Situable for Mechanical Harvesting.
- Release for Central zone of India (Maharashtra, Madhya Pradesh and Gujrat).
- Duration : 109 Days (Early Maturity).
- Medium size grain (24 g/100 grains).
- Resistance to wilt.

21) Chickpea : AKG-9303-12 (PDKV Harita)

- Green seed coat type.
- Medium bold seeded (100 seed weight 21.1 g).
- High yielding over AKGS-1.
- Drought tolerant.
- Resistant to wilt.
- Useful for culinary purpose.
- Alternative green seed coat variety to AKGS-1.





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22) Chickpea PDKV Kanak (AKG - 1303)

- Yield : $22 \text{ to } 25 \text{ q ha}^{-1}$.
- Situable for mechanical harvesting.
- Release for Central Zone of India (Maharashtra, Madhya Pradesh and Gujrat).
- Duration : 109 Days (Early Maturity).
- Medium size grain ($24 \text{ g} 100^{-1} \text{ grains}$).
- Resistance to wilt.

23) Paddy (PKV Kisan) (SKL-22-39-31-25-31-34)

- Dwarf, Non-lodging.
- Duration 130-135 days.
- Medium size grain and good cooking quality.
- Yield : $40-50 \,\mathrm{q}\,\mathrm{ha}^{-1}$.
- Resistant to leaf blast, bacterial leaf blight.

24) Paddy Sakoli-9 (SKL- 2-50-56-45-30-60)

- Productivity : 38 40 q ha⁻¹.
- Duration: 130 135 days.
- Non lodging.
- Grain size medium.
- Resistant to blight disease.

25) Paddy PDKV Tilak (SYE-503-78-34-2)

- Duration : 50% flowering 110-112 days with 140-145 Days to seed maturity (Late Duration).
- Fine grain type (Short Slender) having- Test weight - 12.02-13.0 g.
- Good cooking quality and intermediate Amylose content (22.26%), high milling (70.40%) and head Recovery (58.5%).
- Moderately resistant to Stem borer and Plant Hopper.
- Moderate reaction to neck blast.











26) Rice : PDKV RED RICE -1

- It is red rice variety.
- Yield : 40-45 q ha⁻¹ in Vidarbha region.
- Duration Midlate : 137 days (130-141 days).
- Dwarf (97 cm) and non-lodging.
- Short slender grain with 1000 seed weight : 14.9 g.
- Good cooking quality, high milling recovery (69.96%), Intermediate AC (24.06%), Soft GC (86 mm) with protein content 7.79%.
- Additionally it also content iron 15.97 µg g⁻¹ & Zinc 23.19 µg g⁻¹ grain dry weight of unpolished rice.
- Moderately resistant to leaf blast, leaf scalds and stem borer.

27) Wheat: WSM -1472

- Good yield potential under rainfed (21.34 q ha⁻¹) and restricted irrigation (39.00 q ha⁻¹) condition.
- Heat and drought tolerant variety.
- Superior grain appearance and chapatti making qualities.
- Fetches high market value.
- Multiple disease resistance to rust, kernel blunt and leaf blight.
- Good storability and export potential.

28) Wheat: AKW-4627

- Early Maturing Genotype (96 days) with tolerance to late heat stress.
- Identified by the AICW and BIP Project for IR-LS in Maharashtra and Karnataka state.
- higher grain yield 38-40 q ha⁻¹, more number of earhead (394 earheads /sq m).
- Resistant to Rust and leaf diseases.

29) Wheat: PDKV Sardar (AKAW-4210-6)

- Suitable for cultivation under IR-LS conditions in Maharashtra State.
- Early Maturity and hence wider adaptability to
- sowing time.
 Good yield potential (40-42 gt ha⁻¹) under IR-LS.
- Non-lodging and easy threshing ability.
- Rust resistant.
- High Iron, Zinc & Manganese content (Biofortified).
- Good chapatti and bread making quality.















B) Fruit crops

In case of fruit crops, Acid lime varieties Chakradhar, PDKV Bahar and PDKV Trupti were released. Whereas in case of Mandarin PDKV Mandarin - 5 was released.

Varieties Developed :

1) Acid lime: Variety - Chakradhar

- Released in 2014.
- Seed less, thorn less, acidity : 5.9%.
- fruit size : medium.
- ascorbic acid : 30.3mg.
- yield : 18-20 t ha⁻¹ and peel thickness: 1.02mm.

2) Acid lime : Variety - PDKV Bahar

- Released in 2014. Fruit size : Big.
- yield : $30-35 \text{ t ha}^{-1}$.
- Peel thickness:1.62mm, juice: 53 %, acidity : 6.18% and ascorbic acid 31.47%.

3) Mandarin PDKV, Nagpur Santra (PDKV Mandarin-5)

- Productivity : 27 t ha^{-1} .
- Large to medium size fruits.
- Attractive orange colour fruits.
- Juice : 50% .

4) Acid Lime PDKV Trupti (Akola lime-3)

- Productivity : 27 t ha^{-1} .
- Big size fruits with thick rind.
- Suitable for pickle due to high acidity.











C) Vegetable crops :

Under vegetable crops, Turmeric variety PDKV Waigaon, Brinjal variety, AKLB - 9, Lima bean, variety AKKLB - 2, Okra variety PDKV Pragati and Chilli variety Hirkani were released for cultivation.

Varieties Developed:

- 1) Turmeric: PDKV Waigaon (GDT-06-02)
- Yield: $260 \,\mathrm{q} \,\mathrm{ha}^{-1}$.
- Early maturity(220 days).
- Resistant to leaf spot.
- Curcumin : 6.7%.
- Attractive colour of powder.

2) Brinjal: AKLB-9

- Thorn less.
- Fruit colour : pale green with white streaks.
- Suitable for summer and rainy season.
- Early maturity.
- Yield: 550 g ha^{-1} .

3) Limabean : AKKLB-2

- Long pod.
- Attractive seed colour and Palatable.
- Yield: $35-40 \,\mathrm{q} \,\mathrm{ha}^{-1}$.

4) Okra AKOV-107 (PDKV Pragati)

- Productivity : $99 q ha^{-1}$.
- Duration : 100 105 days.
- Resistant to mosaic disease.
- Green colour fruits.











) Chilli AKC-406 (Hirkani)

- Productivity $48 \,\mathrm{q} \,\mathrm{ha}^{-1}$.
- Dark green coloured fruits.
- Matured fruits dark red coloured.



6) Cowpea: PDKV Rutuja

- Yield of green pods : 80-85 q ha⁻¹.
- Pod length : 15-18 cm.
- Short duration : 50-55 days (First picking).
- Pod colour : Green shining.
- Fleshy pericarp.
- Green pod protein percentage : 4.77 per cent Recommended for kharif and summer season.



D) Flower crops

In case of flower crops, Gladiolus varieties PDKV Roshani and PDKV Gold, Chrysanthemum varieties PDKV Ragini and Bijali Super, While Gaillardia variety PDKV Rohsani were released.

Varieties Developed:

1) Gladiolus : PDKV Roshani (AKGL-04-06-A)

Thick petals and good visual texture Longer shelf life. Good corm and cormel production potential and better storability.

Attractive purplish white petals with white blotch in throat on lower petals More florets per spike Resistant to fussarium wilt.

2) Chrysanthemum : PDKV Ragini (CHR_Mut-05-02)

- New colour pattern i.e. Red tinge on yellow petals.
- More number of flowers plant⁻¹.
- High yield $(179.40 \,\mathrm{q \, ha^{-1}})$.
- Moderately resistant to fussarium wilt.





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3) Gaillardia PDKV Rohini

- Flower productivity 176 q ha⁻¹.
- Attractive brick red coloured flower.
- More flower number plant⁻¹.
- Resistant to insect and disease.

4) Chrysanthemum Bijali super

- Flower productivity 140 q ha⁻¹.
- Attractive white coloured flowers.
- Dwarf plants and spread plant structure.
- Big size flowers with attractive plants.

5) GladiolusAKGL-04-16 (PDKVGOLD)

- Long straight spikes (103.5 cm).
- More number of florets (16.51).
- Attractive pinkish yellow petals with red splash.
- Ability to produce more corms and cormels.
- More Vase life (10.25 days).
- Resistant to fusarium wilt.







II. Farm Implements/Machineries (2009-10 to 2019-20)

In agriculture the use of farm implements and machineries is very essential. There is shortage of agricultural labours and timely completion of operation of land preparation, sowing and fertilizer application, inter cultural and spraying operation and intercultural operation is very urgent need in agriculture.

Post harvest management of farm produce like grains/seeds, fruits, vegetables and their processing for value addition is the need in present day agriculture. Besides this use of energy in agriculture for utilization of unconventional energy source is the urgent need of time in agriculture. The solar energy utilization in agriculture needs to be utilized.

In view of the above, the university has been engaged in the research for development of farm implements, machineries use of unconventional energy use and post harvest management of agricultural produce for grading, processing for value addition. Since 2012 - 13, university has developed many farm implements, machineries, post harvest technologies and released for their use by the farming community in the agriculture.

Farm Implements/Machineries Developed :

1) PKV Bullock Drawn Cotton Planter

• It is recommended to use PKV Bullock Drawn Cotton Planter for sowing of cotton crop.



2) PKV citrus harvester

• It is recommended to use PKV citrus harvester for harvesting of citrus fruits.



3) PKV BBF planter cum inter-row cultivator

• In dry land agriculture simultaneous preparation of broad bed furrow and sowing operation with saving in production cost it is recommended to use tractor drawn PKV BBF planter cum inter-row cultivator.





4) PKV Turmeric Harvester

- It is recommend to use small size tractor drawn PDKV turmeric digger for uprooting the turmeric rhizomes.
- Uprooting efficiency : 98.87 %.
- Saving over conventional method : 33.28 %.

5) PDKV Green Pod Shelling Machine:

It is recommended to use PDKV green pod shelling machine (Capacity 25 kg h⁻¹) for green pigeon pea shelling. PDKV green pod shelling machine is recommended for green pea shelling (Capacity 36 kg h⁻¹) by fixing stainless steel corrugated sheet on rubber roller and by changing the sieves.

- Capacity of the machine is 25 kg ha⁻¹ for green pigeon pea pod shelling and 36 Kg ha⁻¹ for green pigeon pea pod shelling
- It can be operated by 1 hp single phase electric motor.
- Shelling efficiency of the machine is 70 % for green pigeon pea pod shelling and 77 % for green pea pod shelling.

6) **PDKV Turmeric Slicing Machine :**

It is recommended to use PDKV turmeric slicer having capacity 380 kg hr^{-1} for turmeric slicing.

- Capacity of the machine is $350-400 \text{ Kg hr}^{-1}$.
- It can be operated by1hp single phase electric motor.
- Slice thickness as per requirement can be obtained.

7) PDKV De-seeding Machine

For custard apple pulp Modified PDKV deseeding machine is recommended for de-seeding of custard apple pulp for more pulp extraction efficiency and flakes recovery.

- Capacity of the machine is 50 kg h.
- It can be operated by 0.5 hp single phase electric motor
- Easy to operate
- Pulp extraction efficiency is 93 %
- Pulp contain 75 % flakes









) **PDKV Turmeric Washing Machine**

- Raw turmeric washing capacity $-2.25 \,\mathrm{q}\,\mathrm{hr}^{-1}$.
- Washing efficiency-96.19%.
- Portable and safe to handle.
- Easy to operate for unskilled labour.

9) PDKV Hand Operated Custard Apple Deseeding Machine

- Machine Capacity:30 kg hr.
- Pulp separation efficiency 95.9%.
- Pulp recovery : 98%.
- Suitable for small entrepreneurs, farmers.

10) Small Tractor Operated Inter Row Cultivator

- Operated on small tractor (18.5 hp).
- Depth of cultivation is adjustable.
- Work suitable in crops having height up to 45 cm viz. Green gram, black gram and soybean.

11) PDKV Chickpea Pod Stripper

- Green pod stripping capacity of machine : 11 kg ha⁻¹.
- Stripping efficiency : 87.7%.
- Easy operating shifting of machine from one place to another.

12) Manually Operated Seedling Transplanter

- Recommended for transplanting of vegetable seedling in main field.
- Reduces drudgery during transplanting











13) Integrated PKV Mini Dal Mill

- High capacity PKV Mini Dal Mill (5 hp).
- PKV Mini Dal Mill (1 hp) are recommended as per need.

14) PDKV Green Gram Wet Dehuller

Recommended for separating wet green gram dal and overs (Tarfal).

15) PDKV Small Tractor Operated Seed Ferti Drill Cum Inter row Cultivator

PDKV small tractor (18.5 - 25 hp) operated seed ferti drill cum inter row cultivator is recommended for sowing and intercultural operation.

16) PDKV Small Tractor Operated Crop Residue Disintegrator

PDKV small tractor (18.5-25 hp) operated crop residue disintegrator is recommended for in-situ crop residue management

17) PDKV Developed Power Cutter

Dr. PDKV developed power cutter is recommended to use for cutting sugar cane sets and forage.











18) PDKV Rotary Onion Grader

It is recommended to use PDKV Rotary Onion Grader (Capacity-20 TPD) for size grading of onions.

19) PDKV Jamun Pulp Extraction Machine

PDKV Jamun pulp extraction machine is recommended for the extraction of jamun pulp.

20) PDKVAjwain And Fennel Seed Extractor

- Capacity of Ajwain and Fennel seed extraction is 170 kg hr⁻¹.
- Machine is operated on 2 HP motor.
- Two unskilled labours are required for operation of machine.
- Machine is easily movable from one place to another.
- Developed machine have higher capacity than traditional method and seed extraction is economical.

21) PDKV loading/unloading device for onions

- Capacity of machine for loading/unloading of onions from onion storage structure is 20 tons day⁻¹.
- Loading and unloading machine is operated on 2 HP motor.
- Four unskilled labors are required for operation of machine.
- Machine is easily movable from one place to another.
- Developed machine have higher capacity than traditional method and is economical.











- Capacity of dryer : 30 kg batch^{-1} .
- Thermal Efficiency of dryer: 19.35 %.
- Dryer is easy to handle.
- Dryer is easy to transport.
- Drying capacity is better than traditional drying and also less expensive.

23) PDKV Solar Powered Refrigerator

- Refrigerator capacity: 60 lit.
- Solar powered refrigerator uses nano-refrigerant technology and efficiency of refrigeration is 15%.
- Suitable for domestic use and vaccine storage.
- Refrigerator is operated on solar energy.
- Solar powered refrigerator is easy to handle and transport.

24) PDKV Solar Cabinet Dryer

- Capacity of dryer : 20 kg batch^{-1} .
- Thermal efficiency of dryer in winter and summer is 46.58 % and 69 %, respectively.
- This dryer is operated on solar energy.
- Dryer is easy to handle and transport.
- Dryer capacity is more and cost of operation is less as compared to traditional drying

25) PDKV Tractor Operated Garlic Planter

- The average field capacity of PDKV developed tractor operated garlic planter is 0.40 ha hr^{-1} .
- A tractor mounted, 10 row, raised bed precision planter was found suitable for planting graded garlic cloves on a raised bed.
- Seed rate of garlic planter is 676 kg ha^{-1} .
- Germination percentage of garlic of planter is 78.16%.
- The overall saving cost for planting of garlic by using developed garlic planter over conventional method is 78.12%.







26) PDKV Small Tractor Operated Stubble Collector

- Stubble collector is small tractor operated.
- Average field capacity of stubble collector is 0.30 ha hr⁻¹.
- Average stubble collection efficiency of machine is 81.47, 82.12 and 83.73 % in sorghum, mustard and red gram, respectively.
- The cost of operation for the collection of stubble by using developed stubble collector is Rs. 856 ha⁻¹.

27) PDKV Manual Okra Seed Dibbler

- The seed rate of okra seed dibbler is 6 kg ha^{-1} .
- Uniform seed to seed placement is possible.
- The cost of planting of okra seed is Rs.250 ha⁻¹ by using the dibbler.

This dibbler has more effective field capacity and reduced drudgery as compared to manual dibbling.

28) PDKV Ground Nut Decorticator (Power Operated)

- Decorticating efficiency is 89.92 to 93.89 %.
- Seed output capacity is 94 to 98 %.
- The average seed damage percentage is 2.37, 5.10 and 7.59 in AK-303, TAG-73 and TAG 24 variety, respectively.
- Damaged seed, block seed and blown seed is negligible.
- Seed germination percentage is 96 to 97 %.
- Suitable for small farmers and small entrepreneurs.

29) Lathyrus Dal Mill Plant

- Lythyrus dal obtained in one pass.
- The capacity of the machine is 150- 200 kg hr⁻¹ and efficiency is 78 %.
- The machine can separate Dal, Gota, powder, brokens, husk by mechanical means.
- Machine is easy for handling.









30) Biomass Hot Air Rotary Dryer

- The capacity is 2 q. for indoor grain drying.
- It has provision of automatic control on temperature during drying.
- It has a facility to change air flow rates in the range of 1.5 m/s to 3.5 m/s.
- Uniform drying maintain product quality.
- It is also useful for drying of medicinal crops, leafy vegetables, fruits etc.
- The capacity of drying for medicinal and fruit crops is 0.8 to 1 q.
- Highly efficient furnace to achieve more efficiency.
- Minimizes losses of thermal energy from combustor to drying bin.
- Clean combustion based system introduced to tap flue gas and emission.
- It is useful for small scale agro based industry, grain storing warehouses, farmer's groups, self-help group etc.
- The cost of this system is Rs. 370500/- (approx.).
- Overall Dimension are 1500 x 800 x 1000 (L x B x H), mm







III. Recommendations / Technologies (2012-13 to 2019-20) :

The management practices pertaining to crop husbandry, soil health, nutrient management of field and horticultural crops, soil and water conservation, irrigation and drainage are included in the natural resource management. The technologies / recommendations generated under natural resource management have been presented here.

These technologies have been approved in Joint Agricultural Research and Development Committee at state level. They are passed to the state department of agriculture for their dissemination among the farming community for utilization and ultimately enhancing crop productivity and income.

Natural Resource Management

- 1. For minimizing the incidence of leaf reddening in rainfed cotton, application of FYM @ 5 t ha⁻¹ + RDF(30: 30:30) NPK kg ha⁻¹ as a basal dose and 30 kg N at 30 DAS followed by spraying of 2% Urea at flowering stage and 1% Urea + 1% MgSO₄ at boll development stage is recommended.
- Under dry land conditions, for obtaining higher yield, monetary returns and improvement in soil fertility status in cotton integrated application of FYM @5t ha⁻¹ + 50% RDF @ 25:12.5:12.5 kg N:P:K ha⁻¹+ azatobactor + PSB and opening of furrow in each row at 30-40 DAS is recommended.
- 3. For getting the sustainable higher yield and economic returns from Bt cotton grown on Entisols under protective irrigation condition, it is recommended that Bt cotton should be spaced with 120 cm (27778 plants ha⁻¹) along with an application of 150:75:75 NPK kg ha⁻¹.
- 4. In soybean-linseed double cropping system, to maintain soil fertility through integrated nutrient management, as well as to get yield and economic returns comparable to 100 % recommended dose of fertilizer (RDF), application of 75 % RDF to both the crops (i.e. 23:56 kg and 45:23 kg N:P ha⁻¹ to Soybean and Linseed, respectively) along with seed treatment of Rhizobium to Soybean (25 g kg⁻¹









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seed) and Azobactor to Linseed (25 g kg⁻¹ seed) and PSB to both the crops (20 g kg⁻¹ seed) is recommended.

- In medium deep soil having deficiency of sulphur and zinc, application of sulphur @ 30 kg ha⁻¹ + zinc @ 2.5 kg ha⁻¹ along with recommended dose N (30 kg ha⁻¹) and P (75 kg ha⁻¹) is recommended for higher yield of soybean, monetary returns, nutrient use efficiency and quality of grain as well as improving soil fertility status.
- 6. In medium deep black soil having deficiency of zinc, foliar application of zinc through zinc sulphate @ 5 g litre⁻¹ or Zn -EDTA @ 2.5 g litre at 30, 45 and 60 DAE is recommended for obtaining higher yield of soybean, monetary returns and grain quality as well as N and P use efficiency.
- 7. In zinc and boron deficient medium, deep black soils for obtaining higher yield of maize, improvement in grain quality, nutrient use efficiency and monetary returns as well as improvement in soil fertility status, application of zinc @ 10 kg ha⁻¹ + boron @ 1 kg ha⁻¹ along with recommended dose of fertilizer (100: 50: 50 kg N, P_2O_5 and K_2O ha⁻¹) is recommended.
- 8. In order to fulfil the requirement of organics, it is recommended to decompose unused wheat straw with rock phosphate @ 12 % (120 kg t⁻¹) using PDKV decomposer (1 kg t⁻¹) for 90 days with intermittent turnings at regular interval of 15 days followed by its curing for 30 days for preparation of phosphocompost of good quality within 120 days.
- 9 For obtaining higher yield with quality of soybean and also to improve soil fertility in Vertisol, an application of phosphogypsum @100 kg ha⁻¹ once in three years along with recommended dose of fertilizer is recommended.











- For sustaining soil fertility, soybean productivity and obtaining higher monetary returns, application of 50 % recommended N (15 kg ha⁻¹) through glyricidia (2 to 3 t ha⁻¹) + 50% N through inorganics + bio-fertilizers (Rhizobium & PSB 25g kg⁻¹ seed treatment) + 75 kg P_2O_5 + 25 kg K_2O ha⁻¹ is recommended as an Integrated Plant Nutrient Supply System under dryland condition in Vidarbha.
- 11. For sustaining soil fertility, cotton productivity and obtaining higher monetary returns, application of 50 % N (25 kg ha⁻¹) through glyricidia (3 to 4 t/ha) +50 % N through inorganics + biofertilizers (Azotobactor & PSB 25 g kg⁻¹ seed treatment) + 25kg P_2O_5 + 25 kg K_2O ha⁻¹ is recommended as an Integrated Plant Nutrient Supply System under dryland condition.
- 12. For soybean crop, the critical levels of zinc is recommended as 0.65 mg kg⁻¹ in soil and 24 mg kg⁻¹ in plant at grand growth stage, useful for zinc management in medium deep black swell-shrink soils.
- 13. For sorghum crop, the critical levels of potassium is recommended as 330 kg ha⁻¹ in soil and 2.60 % in plant at grand growth stage, is recommended in medium deep black swell-shrink soils.
- 14 To restrict the excessive vegetative growth and for getting higher monetary returns, application of plant growth retardant Chlormequat Chloride @ 1000 ppm (2ml L⁻¹ of water) at 40 DAS is recommended for soybean.











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- 15 Under irrigated condition sowing of Desi chickpea (Vijay and Jaki-9218) up to 15 November is recommended.
- 16 In Cotton-Onion crop sequence for increasing the system productivity, economic returns and nutrient use efficiency, it is recommended to apply 100 per cent N and K in five splits through drip (at given in the following table) and P as basal through soil application



Quantity of	Splits of N and K fertilizers				
fertilizer	Stage of Crop				
to be applied	Bt Cotton (100:50:50 NPK Kg ha ⁻¹)	Onion (150:80:50 NPK Kg ha ⁻¹)			
10% RDNK	Basal	10 DAT			
20% RDNK	20 DAS	20 DAT			
25% RDNK	40 DAS	40 DAT			
25% RDNK	60 DAS	60 DAT			
20% RDNK	80 DAS	80 DAT			



- 17 To check the luxurious vegetative growth of both the crop and to obtain higher yield and monetary returns the application of cycocel growth retardent (2 ml litre⁻¹ water) @ 1000 ppm CCC the stage of flower bud initiation in Soybean + Pigeonpea intercropping is recommended.
- 18. Application of 50 per cent recommended dose of phosphorus (37.5 kg ha⁻¹) through phosphocompost (2 t ha⁻¹) and remaining dose through inorganic fertilizers is recommended for getting higher soybean productivity and improving soil quality.





- 19. In Vertisols, for getting higher cotton productivity, boll weight, fibre quality and monetary returns, application of two foliar sprays of Sulphate of Potash @ 1.5 % (15 g SOP/L) at flowering and boll development stage is recommended alongwith recommended dose of fertilizers.
- 20. For obtaining higher yield and monetary returns of pearl millet in Inceptisols, the application of 30 kg K₂O along with RDF (5 ton FYM, 60:30:00 kg NPK ha⁻¹) is recommended.
- 21. Sulphur deficient soils, for obtaining higher onion bulb yield and monetary returns, nutrient use efficiency and improving soil fertility, soil application of sulphur @ 45 kg ha⁻¹ through gypsum or sulphur @ 30 kg ha⁻¹ through bentonite-S along with recommended dose (10 ton FYM, 100:50:50 kg ha⁻¹ N, P_2O_5 and K_2O) is recommended.
- 22. For obtaining, higher grain yield with maximum economic returns from wheat variety PDKV-Sardar, sowing during 26 Nov. to 2 Dec. is recommended in Vidarbha region.
- 23. In organic farming, application of 100% RDN through vermicompost @ 2.5t/ha for soybean and 7.5 t ha⁻¹ for wheat is recommended for increasing the system productivity, economic returns and improving soil fertility status in soybean - wheat cropping sequence under irrigated condition.












- 24. It is recommended to use soybean straw compost (5 t ha⁻¹) as an alternative source to FYM for maximizing the nutrient availability in soil, yield and economic returns of organic cotton production system.
- 25. Foliar application of 1% urea at 50% flowering stage along with RDF is recommended for more yield and higher economic return in rainfed mustard.
- 26. Application of FYM 10 t ha⁻¹ or Castor cake @500 kg ha⁻¹ or Green manuring of sunhemp 40 days after sowing in Cotton + seed treatment of Azotobactor + PSB @ 25g and trichoderma 4 g kg⁻¹ seed is recommended for sustainable production of organic Arboreum cotton.
- 27. In conservation Agriculture, bio-mulching of sunhempat 45 DAS in Pigeon pea inter cropping (1:2) in first year followed by rotation system of Bt cotton under minimum tillage (1 Harrowing + 1 Hoeing + Herbicide) with 100 % RDF (60:30:30 NPK kg ha⁻¹) is recommended for higher returns from Bt cotton and enhancing soil health.
- 28. In Sorghum-chickpea cropping sequence application of 100 % RDF (80:40:40NPK kg ha⁻¹) out of which 75% RDN through inorganic fertilizer +25% RDN through FYM(2.5 ton) + seed treatment with PSB + Azospirillum to kharif sorghum followed by rabi chickpea without recommended dose of fertilizer is recommended for getting maximum yield, net return and enhancing soil fertility.





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- 29. In sulphur deficit soils application of 30 kg S ha⁻¹ through gypsum (250 kg) or bentonite sulphur(35 kg) along with RDF (60:30:30 kg N:P:K ha⁻¹) is recommended to increase the sustainable productivity and oil content of Bt cotton under rainfed condition.
- 30. In rainfed condition for sorghum crop, low tillage (one hoeing followed by one hand weeding) with 20 kg nitrogen through inorganic fertilizer + 20 kg N through FYM (3.8 t ha⁻¹), 40 kg P_2O_5 and 40 kg K_2O as basal dose and 20kg nitrogen through inorganic fertilizer + 20 kg N through glyricidia (3t ha⁻¹) at 30 DAS is recommended for higher water use efficiency, enhanced soil fertility and higher grain yield.
- 31. In medium deep soils of Vidarbha under rainfed condition, the cotton genotypes AKH 081, Suraj and NH 615 are recommended for high density planting on BBF at 60 x 10 cm spacing (1.66 lakh population ha⁻¹) with 125% RDF(75:37.5: 37.5 NPK + 2.5 Zn kg ha⁻¹) with foliar spray of 1% urea and 1% magnesium sulphate at boll development stage for higher seed cotton yield economic returns and rain water use efficiency.
- 32 It is recommended to apply irrigation at 0.8 Etc through drip with polythene mulch (30 mm) to achieve higher seed cotton yield, monetary return and B:C ratio in Bt cotton.
- 33. It is recommended to adopt conservation tillage (one harrowing and two weeding) and 50 % N through gliricidia green leaf manuring (3.5 t ha⁻¹) and compensation of RDF through chemical fertilizers (30:27:8 kg NPK ha⁻¹)as a alternative to FYM (50 % N) for sustaining productivity of cotton, monetary returns and improvement in soil health of Vertisol under rainfed situations.











- 34. In Eastern Vidarbha Zone of Maharashtra to get the highest grain yield, Gross monetary returns and net monetary returns from drilled rice, 75 kg seed rate ha⁻¹ for coarse varieties and 50 kg seed rate ha⁻¹ for fine varieties with application of 125: 62.5 : 62.5 kg NPK ha⁻¹ is recommended.
- 35. For obtaining higher system productivity and system profitability, sowing of non Bt. cotton + soybean (4:10)-safflower cropping sequence with tractor drawn seed drill and application of 45:55:30 kg ha⁻¹ NPK to the cotton + soybean (4:10) intercropping and 13.75:13.75:13.75 kg ha⁻¹ NPK to safflower is recommended for dryland condition of Vidarbha region.
- 36. For more yield and higher economic return of irrigated mustard, irrigation at 0.8 IW/CPE ratio (with 50 mm irrigation depth, irrigation at 20, 40 and 55 DAS) is recommended.
- 37. For obtaining higher yield and economic returns of linseed under utera cultivation in Eastern Vidarbha zone, seed treatment with Azatobactor and PSB, two irrigation at an interval of 25 to 30 days after paddy harvest and 100% recommended dose of nitrogen (80 kg ha⁻¹) in two s splits (40 kg ha⁻¹ each at 10 and 40 days after sowing) is recommended.
- 38. It is recommended to adopt. 1.00 ha. Integrated Farming System Model under irrigated condition for small and marginal farmers of Western Vidarbha region of Maharashtra. The IFS model includes the components of various crop and cropping system(0.70 ha) + fruits and vegetables(0.25 ha) + Goatary + Backyard poultry + Rabbit + Organic Kitchen Garden + Compost (0.05 ha) + usefull plantation on field boundaries.







If S model consists of Tonowing enterprises.						
S.N	Components			Area (ha)		
A)	Cropping systems					
	Kharif	Rabi	Summer			
1	Cotton + Pigeon pea (6:2)	-	Sesame	0.20		
2	Soybean + Pigeon pea (5:1)	-		0.15		
3	Sorghum	Wheat		0.15		
4	Soybean	Chickpea		0.15		
5	Cowpea	Fenugreek		0.05		
B)	Horticulture	Total (CS) = 0.70				
6	Custard apple + Agasto + Drumstick 0.25					
C)	Livestock					
7	Goat, poultry and rabbit 0.05			0.05		
D)	Others					
8	Kitchen garden & compost					
9	Boundary plantation of Gliricidiasepium& Carissa carandas —					
Total 1						

- 39. In sorghum Wheat crop sequence, for obtaining higher yields and monetary returns with improving and sustaining soil health, application of 75% RDF (90:45:45 kg N, P₂O₅,K₂O ha⁻¹) or leucana lopping (4.60 t ha⁻¹) or wheat straw (6.25 t ha⁻¹) to kharif sorghum and 75 % RDF (90:45:45 kg N, P₂O₅, K₂O ha⁻¹) through chemical fertilizers to wheat is recommended.
- 40. In salt affected soils of Purna valley in Vidarbha region, growing of *dhaincha* as a green manuring crop between two rows of cotton (1:1) and in situ burring after 40 DAS is recommended as an alternative to gypsum for improving soil health, soil carbon stock, higher productivity and monetary returns of cotton rotated with green gram chickpea.





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41. For improving soil health, productivity and monetary returns in cotton- soybean rotation, it is recommended to apply 25 % recommended N through Dhaincha loppings (2 t ha⁻¹) or Neem cake (3 q ha⁻¹) with remaining recommended dose of NPK of cotton (45: 28: 17 kg NPK ha⁻¹) along with RDF of Soybean through chemical fertilizers or Application of 100 % recommended N of cotton and soybean through FYM (11 t ha⁻¹ to cotton and 5



t ha⁻¹ to soybean) and remaining dose of P & K through phosphocompost to cotton (80 kg ha⁻¹) and soybean (3.8 tha^{-1}).

- 42. In zinc deficient medium deep black soil of vidarbha for obtaining higher yield of chickpea, nutrient uptake, quality of grain and higher monetary returns besides improving soil fertility, soil application of zinc sulphate @ 20 kg ha⁻¹ or two foliar sprays of zinc sulphate @ 0.50 % during flowering and grain filling stage along with recommended dose of fertilizer (25:50:30 kg ha⁻¹ N, $P_2O_5 \& K_2O$) is recommended.
- 43. For chickpea crop, the levels of zinc 0.64 mg kg⁻¹ in soil and 23 mg kg⁻¹ in plant at grand growth stage are recommended as critical levels useful for zinc management in medium deep black swell shrink soils of Vidarbha.
- 44. For getting higher seed yield and economic returns in soybean, foliar application of 2% 19:19:19 (NPK water soluble fertilizer) at pod initiation stage is recommended.









- 45. It is recommended that, Sowing of Kharif sorghum on four row 1.5 m. BBF at 45 cm by tractor is recommended for getting maximum yield, net returns and improved moisture conservation.
- 46. For obtaining higher grain yield and net monetary returns from drill rice in Eastern Vidarbha Zone of Maharashtra, sowing of drill rice at row spacing of 20 cm and plant to plant distance at 10 15 cm is recommended.
- 47. Under rainfed condition, to reduce the subsoil compaction due to use of rotavator, and to improve the moisture retention and other soil physical properties; and also for obtaining higher crop yield, it is recommended to use deep ploughing once in three years and use rotavator every years.
- 48. The integrated application of 2.5 tones of Farm Yard Manure + 1.25 tones of Gypsum 15-20 DAS in Tied Broad Bed Furrow is recommended for improvement in soil properties, yield and monetary returns of soybean in deep black sodic soils of Purna valley of Vidrabha.
- 49. In deep black soil, for obtaining higher grain, protein yield and monetary return of pigeonpea as well improving fertility status of soil, application of recommended dose of 25 kg N and 50 kg P_2O_5 along with 30 kg K_2O and 20 kg S ha⁻¹ is recommended.













Agronomy

- 1. Seed treatment with liquid Azospirillum @ 2 ml kg⁻¹ seed along with RDF is recommended in Kharif Sorghum for obtaining higher grain yield, fodder yield and monetary return.
- 2. Application of 5 t FYM ha⁻¹ along with 75% RDF & ZnSO₄ @ 25 kg ha⁻¹ is recommended for obtaining high green Hurda yield and monetary return from Hurda Sorghum.
- 3. Under dryland condition, for higher productivity and monetary returns, intercropping of vegetables in Hirsutum Cotton + Cowpea or Clusterbean sown at 45 cm in 1:1 row proportion and application of 75:37.5:37.5 NPK kg ha⁻¹ is recommended.
- 4. It is recommended to use 2.5 t ha⁻¹ vermicompost for increase in yield, monetary returns and sustainable soil fertility of organic Chickpea production system.
- 5. It is recommended to use 2.5 t ha⁻¹ vermicompost for higher yield, monetary returns and sustainable soil fertility of organic Soybean production system.
- 6. For increasing the production, monetary return and nutrient use efficiency in pigeonpea, it is recommended to apply 125% N (31.25 kg ha⁻¹), 100 % P (50 kg ha⁻¹ through phosphoric acid) and 100 % K (30 kg ha⁻¹) in five splits (as per table below) through drip irrigation.

Quantity of fertilizer	Days After Sowing
10 % NPK	Basal
20 % NPK	40 DAS
20 % NPK	60 DAS
25 % NPK	80 DAS
25 % NPK	100 DAS

- 7. It is recommended that the pre emergence application of atrazine (0.50 kg a.i. ha⁻¹) @ 1 kg ha⁻¹ followed by post emergence application of tembotrione (0.120 Kg a.i. ha⁻¹) @ 285 g ha⁻¹ at 20DAS are the most remunerative and effective herbicides for controlling weed flora and getting higher yield and economic returns in Maize.
- 8. It is recommended that the post emergence application of Clodinafop Propargyl + Metsulfuron Methyl @ 0.06 + 0.004 kg a.i ha⁻¹ (400 g ha⁻¹) or Sulfosulfuron + Metsulfuron Methyl @ 0.03 + 0.002 Kg a.i. ha⁻¹ (40 g ha⁻¹) at 35 DAS were the most remunerative and effective herbicides for controlling the weed flora and getting higher yield and economic returns in wheat.
- 9. For getting higher grain yield and net monetary returns from greengram, blackgram, chickpea and redgram pulse crops, foliar application of gibbrellic acid at flowering and pod development stages is recommended as follows:

SN	Crop	Dose of gibberellic acid (90% a.i.)
1	Greengram	15 ppm (8.3g GA3 (90% a.i.) ha ⁻¹ in 500 liters of water)
2	Black gram	15 ppm (8.3g GA3 (90% a.i.) ha ⁻¹ in 500 liters of water)
3	Chickpea	15 ppm (8.3g GA3 (90% a.i.) ha ⁻¹ in 500 liters of water)
4	Pigeonpea	25 ppm (13.9g GA3 (90% a.i.) ha ⁻¹ in 500 liters of water)



- 10. Foliar application of 15 ppm GA3 [8.3 g GA3 (90% a.i.) ha⁻¹ in 500 liters of water)] at flowering and pod development stages of soybean crop for getting higher grain yield and net monetary returns is recommended.
- 11. Foliar application of 25 ppm GA3 [13.9 g GA3 (90% a.i.) ha⁻¹ in 500 liters of water)] at square initiation and boll development stages of hybrid Bt cotton crop for getting higher yield and net monetary returns is recommended.
- 12. It is recommended that, spraying of Thidiazuron @ 250 ml ha⁻¹ at 150-155 days after sowing (10 days before picking) on American cotton hybrids is effective for defoliation (96.63%) of cotton leaves for mechanical picking.
- 13. Application of enriched FYM (50 kg FYM ha⁻¹ with 11.25 kg ha⁻¹ each zinc sulfate and ferrous sulfate incubation for 15 days) along with RDF (80:40:40 kg NPK ha⁻¹) is recommended for getting higher grain, fodder yield and quality and economic returns in rainfed sorghum.
- 14. In soybean-maize crop sequence, for obtaining higher system productivity and economic returns, it is recommended to apply 50 per cent RDN (15 kg N ha⁻¹) through vermicompost (1.15 t ha⁻¹) or compost (1.87 t ha⁻¹) and 50 per cent RDN (15 kg ha⁻¹) through urea (and 75:30 kg ha⁻¹ of P:K) to soybean at the time of sowing and supplementation of ZnSO₄ (@ 20 kg ha⁻¹) and FeSO₄ (@ 30 kg ha⁻¹) along with RDF (120:60:30 N:P:K kg ha⁻¹) to maize.
- 15. Under rainfed based mechanized strip intercropping system, for obtaining higher productivity and monetary returns, it is recommended to adopt high density (45 x 15 cm) planting of deshi cotton (AKA-7) + soybean (6:6) supplied with 40:50:25 NPK kg ha⁻¹ or American cotton (AKH-081) + soybean (6:6) supplied with 50:55:30 NPK kg (50% N + 100% P_2O_5 & K_2O for both the crops at the time of sowing and remaining 50% N at 30 DAS to cotton crop)and soybean strip sequenced with mustard at 45 x 15 cm spacing with a fertilizer dose of 20:10:10 NPK kg ha⁻¹ with two protective irrigations through sprinkler.
- 16. In deshi chickpea for achieving optimum germination, higher grain yield and economic returns, seed priming for 4 hours with 0.5% Potassium Nitrate (5g potassium nitrate/ liter water) followed by one hour shed drying and then sowing is recommended.
- 17. In BBF planted drip irrigated Bt cotton for higher seed cotton yield, water use efficiency, water productivity, monetary returns and soil health improvement, in-situ biomulching of sunhemp in between two rows of cotton at 35 days after emergence with RDF (120:60:60NPK kg ha⁻¹) is recommended.
- 18. For effective weed management in sole soybean, post emergence application of Propaquizafop @ 0.050 kg a.i. + Imazethapyr @ 0.075 kg a.i. ha⁻¹ at 21 DAS (2.0 L ha⁻¹ ready mix commercial formulation in 500 L water) or pre emergence application of Diclosulam 84% WDG @ 0.026 kg a.i. ha⁻¹ (30 g ha⁻¹ commercial formulation in 500L water) is recommended for higher seed yield and economic returns.
- 19. In drip irrigated cotton for increasing productivity, effective weed management and economic returns it is recommended to apply 125 % recommended dose of N and K in five splits through drip and P as basal through soil application along with directed spray



(by using protective shield) of herbicide Paraquat 24% SL @ $0.3 \text{ kg a.i ha}^{-1}$ at 30 DAS fb 1 HW 15 days after spraying and repeat spray of Paraquat @ $0.6 \text{ kg a.i ha}^{-1}$ 60 DAS fb 1 HW 15 days after spraying, as per following schedule.

Fertigation Schedule							
Splits of N & K (%)	Stage of crop	Quan	Quantity of N and K $(kg ha^{-1})$		Quant	uantity of fertilizers (kg ha ⁻¹)	
		Ν	K	Р	Urea	MOP	SSP
10 %	Basal	15.00	7.50	75Kg	32.55	12.45	
20%	20DAS	30.00	15.00	P_2O_5	65.10	24.90	470KgSSP
25%	40DAS	37.50	18.75	At the time	81.38	31.12	At the time
25%	60DAS	37.50	18.75	of sowing	81.38	31.12	of sowing
20%	80DAS	30.00	15.00		65.10	24.90	
Total		150	75	75	325.51	124.49	470
Herbicide Schedule							
Herbicio	de St	age of crop	A	ctive ingredi	ent	Quantity	of herbicide
				(kg na)		(K	gna)
Paraquat 24	% SL	30 DAS		0.300			1.25
Paraquat 24	% SL	60 DAS		0.600			2.50
							3.75

20 Spraying of Salicylic acid @ 200 ppm (2 g in 10 liter of water) at flowering and siliqua formation stage is recommended for higher yield of mustard and economic returns.

21 For getting higher yield and monetary returns from soybean, spreaying of Nitrobenzeme 20% @ 500 ppm (2.5 ml Γ^1 of water) at flower initiation state is recommended.

Soil Science and Agricultural Chemistry

- 1. In boron deficient Inceptisols, for obtaining higher onion seed yield and higher monetary returns, recommended dose of fertilizer (100:50:50 N, $P_2O_5 \& K_2O$) along with foliar application of borax @ 0.2% at buttoning stage is recommended.
- 2. For obtaining higher yield and monetary returns of Ajwain crop in Inceptisols, application of 80:40:40 N, P, K kg ha⁻¹ (50 % N and 100% P and K at the time of sowing + 50 % N 40 DAS) is recommended.
- 3. For obtaining higher seed yield, oil content, protein content, monetary returns of Safflower as well as improving fertility status in sulphur deficient deep black soil, application of $20 \text{ kg K}_2 \text{ O ha}^{-1}$ in combination of 20 kg S ha^{-1} along with RDF, 40 kg N and $25 \text{ kg P}_2 \text{ O}_5 \text{ ha}^{-1}$ is recommended.
- 4. For obtaining higher yield, monetary returns of soybean and improvement in soil physical chemical and biological health of the soil in Vertisols, the application of 50% P through NPS and remaining through chemical fertilizer or application of 100 % P through Nitro-phospho-sulpho compost is recommended.





Weed Management

- Pre emergence application of Pendimethalin 38.7 CS PE @ 1.25 kg a.i. ha⁻¹ fb hoeing at 30 DAS and hand weeding at 45DAS is recommended for effective management of weeds under high density planting of cotton for getting higher economic returns.
- Through Post-emergence weeds management spraying of herbicide Quizalofop ethyl 5 EC 100 g a.i/ha or Imazethapyr 10 % SL 100 g a.i ha⁻¹ in 500 litre water at 25-30 days after sowing for effective controlling weeds and obtaining higher pods yields and economic return in Kharif groundnut is recommended.
- 3. It is recommended that the post emergence application of Imazethapyr + Imazamox 70 WG @ 0.070 kg a.i. ha⁻¹ PoE 15 DAS was the most remunerative and effective herbicide for controlling the weed flora and getting higher yield and economic returns in soybean.
- 4. In cotton pre emergence application of Pendimethalin 30 EC @ 1.00 kg a.i. ha⁻¹ followed by directed spray (by using protective shield) of non-selective herbicide Paraquat 24 SL @ 0.60 Kg a.i. ha⁻¹ at 45 days after sowing is recommended for controlling weeds with higher yield and monetary returns.
- 5. It is recommended that the post emergence application of Imazethapyr + Imazomox70WG 0.070 kg a i ha⁻¹ (100 g ha⁻¹) POE 20 DAS was the most remunerative and effective herbicide for controlling the weed flora and getting higher yield and economic returns in groundnut.





Plant Protection

Plant protection includes the research carried out in the disciplines of the Entomology and Plant Pathology. The field, fruit, vegetable and flower, medicinal and aromatic crops as well as forest trees are infested with different insect pests and diseases. Due to insect pests and diseases the crops are damaged, which lead to decrease in economic yield. Hence, the agricultural crops need to be maintained insect and disease free. The research conducted under plant protection and the recommendations emerged are given as under.

- For the eco-friendly management of aphids, jassids, thrips and whiteflies on cotton, spraying of bio-pesticides *Metarhizium anisopliae* @ 50g or *Verticillium lecanii* @ 50 g (2x10⁸ CFU ml⁻¹) in 10 liters of water is recommended.
- 2. For integrated pest management in mungbean seed treatment with Imidacloprid 600 FS 5 ml kg⁻¹ seed and Trichoderma 4 g kg⁻¹ seed followed by spraying of azadirachtin (10000 ppm) 10ml 10^{-1} lit water at 30 days and profenphos (50 EC) 25 ml 10^{-1} lit water at 45 days after crop emergence is recommended.
- 3. For management of pod borer complex of pigeonpea, ETL based spraying of rynaxypyr (20 SC) 2.5 ml or flubendiamide (20 WDG) 5.0 g in 10 liter water is recommended.
- For management of pigeonpea pod fly, application of thicloprid (21.7SC) 4.0 ml or acephate (75SP) 20.0 g 10⁻¹ lit water at grain filling and 15 days after first application is recommended.



- For management of gram pod borer, on chickpea, ETL based spraying of rynaxypyr (20 SC) 2.5 ml or flubendiamide (20 WDG) 5.0 g10⁻¹ lit water is recommended.
- 6. For management of Gonocephalum beetles on chickpea, seed treatment with clothioniadan (50WDG) 2 g kg⁻¹ seed followed by spraying of chlorpyriphos (20 EC) 20 ml 10⁻¹ liter water at 20 days after crop emergence or application of phorate granules (10G) 10 kg ha⁻¹ at sowing and spraying of chlorpyriphos (20 EC) 20 ml 10⁻¹ liter water at 20 days after crop emergence is recommended.
- 7. For the effective management of Gujhia weevil on safflower, application of phorate 10 G @ 10 kg ha⁻¹ (at the time of sowing) followed by spraying of chlorpyriphos 20 EC @ 25 ml 10⁻¹ lit of water at or Lambda Cynalothrin @ 2.5 EC @ 10 ml10⁻¹ lit of water at 10 days after emergence and need based second spraying at 10 days after first application is recommended.
- At the initiation of mite incidence on mandarin, an application of abamectin 1.9 EC @ 3.7 ml or ethion 50 EC @ 10 ml or buprofezin 25 SC @ 10 ml or triazophos 40 EC @ 15 ml in 10 lit water is recommended, for effective management of citrus mite.
- 9. For management of citrus Psylla on new flesh of Nagpur Mandarin first spraying of imadacloprid 17.8 SL @ 2.5 ml or Thiomethoxam 25 WG @ 1 g or Acetamiprid 20 SP @ 2.5 g 10⁻¹ lit of water and after 15 days of interval spraying of neem oil @ 100 ml + 10 g of detergent per 10 lit of water is recommended.











Technology Inventory - III Technology Enventory III



- 10. For obtaining maximum yield of pigeonpea, seed treatment of Rhizobium isolate PKVPR -101 @ 25 g kg⁻¹seed before sowing is recommended.
- 11. The occurrence of pokkahboeng disease in seasonal (suru) sugarcane crop can be predicted 14 days in advance by the following equation. The resulting -ve value will indicate absence of disease and +ve value will

indicate possibility of occurrence of disease. $NY = 0.6234+0.0161X_{1}^{**}+0.0227X_{2}^{**}+$ $(-0.0127X_{3}^{**})+(-0.2288X_{4}^{**})+$ $(-0.0618X_{5}^{**})+0.1354X_{6}^{**}+$ $0.0026X_{7}^{**}-1.2403$

Where,

- NY = Square root of percent disease incidence,
- X_1 = Meteorological Week,
- X_2 = Morning relative humidity,
- X_3 = Evening relative humidity,
- X_4 = Bright sunshine hours,
- $X_5 = wind speed,$
- $X_6 = Evaporation,$
- X_7 = Cumulative rainfall,
- ****** = Significant at 1% level of significance.





12. The occurrence of alternaria leaf spot disease in sunflower crop can be predicted 14 days

in advance by the following equation. The resulting -ve value will indicate absence of disease and +ve value will indicate possibility of occurrence of disease.

Loge Y = $-11.1309 + 0.2680 X_1^{**} + (-0.0793 X_2^{**}) + 0.2262 X_3^{**} + 0.0011 X_4^{**} - 1.0702$

Where,

- loge Y = Natural logarithm of percent disease incidence,
- X_1 = Meteorological Week,
- X_2 = Maximum Temperature,
- $X_3 = Minimum Temperature,$
- $X_4 = Cumulative rainfall,$
- = Significant at 1% level of significance







13. It is recommended that the thrips incidence on rainfed cotton in Vidarbha region can be predicted a week advance by following equation. The resulting negative value will indicate absence of thrips incidence and positive value will indicate possibility of occurrence of incidence.

$$NY + 0.5 = 1.41 + 0.052 X_1^* + (-0.123 X_2^{**}) +$$

$$(-0.024 X_3^{**}) + 0.226 X_4^{**}$$

Where,

- NY+0.5 = Square root of Number(Y+0.5) of thrips per leaf,
- X_1 = Minimum temperature (0C),
- X_2 = Sunshine hours,
- X_3 = Evening relative humidity (%),
- $X_4 = Wind speed (Km hr^{-1})$
- ** = Significant at 1%,
- * = Significant at 5%.
- 14. It is recommended that the leaf hopper incidence on cotton crop grown under rainfed situation in Vidarbha region can be predicted a week advance by following equation. The resulting negative value will indicate absence of leaf hopper incidence and positive value will indicate possibility of occurrence of incidence.







 $Log10 (Y+0.5) = -0.325 + 0.042 X_1^{**} + (-0.042 X_2^{**}) + 0.001 X_3 + 0.00 X_4 + (-0.01X_5) + (-0.023X_6) + (-0.012 X_7)$

Where,

Log10(Y+0.5) = Log10(Y+0.5) of number of leafhoppers leaf¹,

- X_1 = Minimum temperature (0C),
- X_2 = Sunshine hours,
- $X_3 = \text{Relative humidity morning (\%)},$
- X_4 = Relative humidity evening (%),
- $X_5 = Rain Fall (mm),$
- $X_6 = Rainy days,$
- $X_7 = Wind speed (Km hr^{-1}),$
- ** = Significant at 1%

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- 15. For management of whitefly on Bt cotton, ETL based spraying of Difenthiuron 50 WP @ 12 g 10⁻¹ lit. water is recommendation.
- 16. For the effective management of citrus psylla, spraying of novaluron 10 EC @ 5.0 ml 10⁻¹ litre of water on new flush of Nagpur mandarin is recommended.
- 17. For the management of Brown Plant Hopper in Rice ETL based spraying of Imidacloprid 17.8 SL
 @ 2.2 or Fipronil 5 SC @ 20 ml or Thiamethoxam 25 WG @ 2g 10⁻¹ litre water is recommended.
- 18. For the management of soybean leaf defoliator (Tobacco leaf eating caterpillar and semi looper) Chlorpyriphos 20EC @30ml or Indoxacarb 14.5 $SC @ 9.3 ml 10^{-1}$ litre is recommended.
- 19. For the management of leafhopper and whitefly on okra, installation of Yellow sticky trap @ 100 traps ha⁻¹ at 15 cm height above the crop canopy is recommended with following specifications. Foam sheet of 4 mm thickness size of trap 25 cm x 15 cm (60 sq. inches) bright or Brilliant yellow colour Castor oil as a sticky material.

Smearing of castor oil at weekly interval.

Install the trap facing North east and South west direction from onset of sucking pest incidence.











Trap should be installed at 20 cm ap apart from plant so as to avoid contact of plant.

20. The occurrence of twig blight in Nagpur mandarin in advance can be predicted by

following equation. The resulting negative value will indicate absence of disease and positive value will indicate possibility of occurrence of disease. $Y = -76.19 + 3.085 X_1 - 1.741 X_2 + 0.0134 X_3 +$ $0.521X_4 + 0.190X_5 + 0.101X_6 - 0.678X_7$

Where,

- Y=Per cent of incidence of Twig blight
- X_1 = maximum temperature (o C)
- X_2 = Minimum temperature (o C)
- $X_3 =$ Morning Humidity (%)
- $X_4 =$ Evening Humidity (%)
- $X_5 =$ Wind speed (Km hrs.⁻¹)

 $X_6 = Rainfall(mm)$

 $X_7 =$ Bright sunshine hours (hrs.)



21. For the occurrence of canker incidence in Acid lime can be predicted in advance (before 15 Days) by following equation. The resulting negative value will indicate absence of disease and positive value will indicate possibility of occurrence of disease.

$$Y = 43.43 + 3.248X_{1} - 5.543X_{2} - 0.142X_{3} + 2.526X_{4} - 9.266X_{5} - 3.057X_{6} - 7.515X_{7}$$

-2.770X₈

Where,

- Y = Per cent canker incidence
- X_1 = Maximum Temperature (OC)
- X_2 = Minimum Temperature (OC)
- = Morning Humidity (%) Χ,
- X_4 = Evening Humidity (%)
- X_5^{4} X_6^{4} = Wind speed $(\text{km}\,\text{hrs}^{-1})$
- = Rainfall (mm)
- X_7 = Bright Sunshine (hrs.)
- X。 = Evaporation (mm)





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- 22. For the control of powdery mildew of linseed two sprays of Propiconazole (0.1%) or Difenconazole (0.05%) or wettable sulphur (0.25%) or Hexaconazole (0.1%) two spraying of any of these fungicides. One at disease initiation and second 15 days later is recommended.
- 23. For the management of gram pod borer on chickpea and getting higher monetary returns, spraying of Lamda cyhalothrin 5 % EC (@1.25 ml litre⁻¹ of water) or Ethion 50 % EC (@ 2 ml/litre of water) at ETL (2 Larvae mrl⁻¹) followed by second spraying after 15 days is recommended.



- 24. For the ecofriendly management of insect pest of rice viz. stem borer, leaf folder, army worm, green leaf hopper, brown plant hopper & white backed plant hopper and for getting higher B:C ratio, ecofriendly IPM module as given below is proposed
- Seed treatment 3 % salt treatment.
- Paddy seedling roots dip in Chloropyrifos 20 EC solution @10 ml in 10 liters of water upto 12 hrs before transplanting for management of Gallmidge and Stem borer.
- Application of Garadi (*Cleistanthus collinus*) leaves @ 1.5 ton ha⁻¹ at the time of puddling for management of Gall midge, Stem borer and Hopper
- Collect eggs masses of Stem borer & put it in bamboo basket for parasitoids emergence.
- Destruction of wild rice plants adjacent to field.
- Rope drag over the crop if case worm, leaf folder & army worm infestation is seen.
- Collection and destruction of Stem borer infested dead heart, White Ear head and Gallmidge infested silver shoots.
- Withdrawn of water for 3-4 days if case worm and hopper infestation is seen.
- Filling up of water if Army worm infestation is seen.
- Four Release *Trichogramma japonicum* @ 50,000 eggs ha⁻¹ at weekly interval for stem borer management.
- Use of *Metarrhizium anisoplea* @ 2.5 kg ha⁻¹ at the initiation of Brown plant hopper, after withdrawn of water from paddy bundhies.

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25. For effective management of leaf folder, GLH, BPH & WBPH and for higher economic returns on paddy after attaining ETL of any aforesaid pest, spraying of Triazophos 40% EC @ 20 ml 10⁻¹ L of water or Thiomethaxam 25 WG @ 2 g 10⁻¹L of water and second spraying at 15 days interval is recommended.



- 26. Before sowing of pigeonpea, seed treatment of dual inoculation of Rhizobium PKVPR-101 (25 g kg⁻¹ seed) and PSB-3 (20 g kg⁻¹ seed) as biofertilizers is recommended for enhancing the yield.
- 27. Inter cropping of linseed + Chickpea at 4:2 row proportion is recommended for more linseed equivalent yield (LEY) and higher economic returns by minimizing budfly infestation.
- 28. Pre-sowing treatment of Rhizobium isolates, AKCR-1 (25 g kg⁻¹ seed) is recommended for yield of chickpea in Vidarbha region.
- 29. For effective management of root rot of soybean and higher benefit cost ratio seed treatment of Carboxin 37.5% + Thiram 37.5% (combi product)
 @ 2g kg⁻¹seed prior to sowing is recommended.
- 30. For effective management of shoot fly in sorghum, seed treatment with similacloprid 48 FS @ 12 ml kg⁻¹ seed followed by quinalphos 25 % EC spray @ 20 ml 10⁻¹ lit water, 15 days after sowing is recommended.
- 31. For management of shoot and fruit borer in brinjal, spraying of lambda-cyhalothrin 5 % EC @ 6 ml 10⁻¹ lit water or chlorpyriphos 20 EC @ 25 ml 10⁻¹ lit water or quinalphos 25% EC@ 20 ml 10⁻¹ lit water is recommended.











- 32. For reduction in incidence of gall midge on paddy, in gall midge endemic areas, 15 days early planting (from 2 to 20th July) than recommended normal planting is proposed for recommendation.
- 33. Following module is recommended for Integrated Pest Management in non-Bt cotton.
 - 1. Seed treatment with thiamethoxam 30% FS @ 10 ml kg^{-1} seed.
 - 2. Planting one row of maize and cowpea alternate at one meter distance around the field as border crop and at every 9, 10 and 11th row of cotton alternate line of maize, cowpea and sataria, respectively.
 - 3. Application of 5% NSKE at 30 & 45 DAS
 - 4. Use of pheromone traps @ 5 traps ha⁻¹ each for monitoring of *E. vittella* and *H. armigera* at 45 DAS.
 - 5. Release of *Trichogramma chilonis* @ $2 \ln \sin^{-1}(10 \operatorname{cards/ha})$ at 60 DAS.
 - 6. Application of HaNPV @ $500 LE ha^{-1}$ at 75 DAS.
 - 7. Installation of 'T' shaped bird perches @ 25/ha at 80 DAS.
 - 8. Installation of pheromone traps @ 5 traps ha⁻¹ for monitoring of *P. gossypiella* at 85 DAS.
 - 9. Spraying profenophos $50 \text{ EC} @ 20 \text{ m} 110^{-1}$ liters of water at 90 DAS.
 - 10. Use of yellow sticky traps @ 10 traps ha⁻¹ for whitefly monitoring at 100 DAS.
 - 11. Spraying triazophos 40 EC @ 20 ml10⁻¹ liters of water at 105 DAS against whitefly and pink bollworm.
 - 12. Spraying lambda cyhalothrin 5 SC @ 10 ml 10⁻¹ liters of water at 120 DAS against pink bollworm. (Three University combined recommendation).
- 34. It is recommended that to restrict post harvest storage diseases (Penicillium and Geotrichum fruit rot) of Nagpur mandarins, entire surface of the fruits should be exposed to UV-C of 13.4 Watt Ultra Violet output for 10 min. at 10 cm distance from UV-C source under protected conditions and precautions specified for use of UV-C, followed by application of 6% Vegetable wax. [One tube of UV-C can cover 100 average sized fruits in a batch].
- 35. It is recommended that, to restrict post harvest storage diseases (Penicillium and Geotrichum fruit rot) of Nagpur mandarins, fruits should be dipped for 10 min. in 1.0% Sodium Hypochlorite solution prepared in distilled water followed by application of 6% vegetable wax.





- 36. Before sowing of Mungbean, seed treatment of Rhizobium AKMR-12-01 @ 25 g kg⁻¹ seed as a bio-fertilizer should be applied for enhancing yield is recommended.
- 37. Before sowing of Urdbean, seed treatment of Rhizobium WUR-12-1 @ 25 g kg⁻¹ seed as a bio-fertilizer should be applied for enhancing yield is recommended.
 - seed treatment of g kg⁻¹ seed as a bior enhancing yield is
- 38. It is recommended to treat the seed of pigeonpea first with combined product of fungicide Carboxin (37.5 %) + Thiram (37.5 %) @ 3g kg⁻¹ fallowed by Trichoderma viride @10g kg⁻¹ of seed to reduced the wilt incidence and obtaining higher grain yield.
- 39. programme as a donor for on the basis of multi-year screening, Amravati centre soybean genotypes viz. AMS 243, AMS 358, AMS MB 5-18 and AMS MB 5-19 were recommended for utilization in crossing resistance to root rot.
- 40. For effective management of pulse beetle itis recommended to keep 80 tablets (weighing 0.5g each) quintal⁻¹ in stored mung bean.





41. Spraying of Ethion 50% EC @ 20 ml in 10 L of water at 50 % flowering of Chickpea followed by second spraying of Chlorantraniliprole (18.5 SC) 2.5 ml in 10 L of water after 15 days is recommended for effective management of pod borer and higher yield of Chickpea.



- 42 For effective management of Chickpea pod borer and getting more yield with increased net return following plant protection module is recommended Erection of bird purchers on chickpea field @ 15 ha⁻¹ after 30 days of crop sowing
- Spraying of HaNPV @ 500 LE ha⁻¹ (10 ml in 10 L of water) first at bud initiation stage of the crop and second after 10 days
- After 10 days of second application of HaNPV undertake spraying of Azadirachtin300 ppm @ 50 ml in 10 L of water
- 43 For management of Urdbean spraying of Monocrotophos 36 SL @ 12.5 ml in 10 L of water at bud initiation stage followed by spraying of Chlorantraniliprole (18.5 SC) 2.5 ml in 10 L of water after 15 days is recommended.
- 44 Foliar application of combi product of fungicides Metiram 55% + Pyraclostrobin 5% WG (0.3%) is applied at disease initiation and 2nd application at 15 days after 1st application is recommended for management of Cercospora leaf spot of Mungbean.
- 45 Application of Bordeaux paste (1:1:10) on tree trunk as pre and post monsoon with foliar spray (two sprays- pre and post monsoon) of Potassium Phosphonate (3 ml/liter water) is recommended for management of Phytophthora root rot/gummosis of mandarin.
- 46 For effective management of foliage feeder pests on soybean and for getting increased seed yield with maximum net return four sprays of Neem Seed extract @ 5% OR Marigold leaf extract @ 5% starting at 20 days of crop emergence with subsequent sprays at 10 days interval is recommended.
- 47 For getting higher paddy yield and effective management of stem borer application Carbofuran 3 % CG @ 25 kg ha⁻¹ (Carbofuran 3 % CG @ 250 g for 100 m² nursery), 5 days before pulling seedlings from nursery for transplanting and for management of stem borer and leaf folder spraying of Cartap hydrochloride 50 % SP @ 12 g in 10 litres of water if incidence of stem borer (10 % dead heart) or leaf folder (2 damaged leaves per hill with a live larva) is above economic threshold level at 60 to 90 days after transplanting is recommended.
- 48 For effective management of paddy stem borer six innundative releases of *Trichogramma japonicum* @ 1,60,000 eggs ha⁻¹ (8 cards) starting from 30 days after transplanting (DAT) with subsequent releases at an interval of one week is recommended.

Horticulture

Horticulture has utmost importance increasing the income of farmers. Horticulture includes Fruit Science, Vegetable Science, Floriculture and landscape architecture and processing of fruits and vegetables. The research experiments pertaining to these disciplines under horticulture were conducted. The technologies emerged through recommendations for proper management of these horticultural crops are helpful to enhance the productivity and ultimately income.

- In zinc and iron deficient soils of Maharashtra, for obtaining higher yield of sweet orange and improvement in fruit quality, soil application of Zn-EDTA @ 50 g tree⁻¹ and Fe-EDTA @ 100 g tree⁻¹ or one foliar spray of Zn-EDTA @ 0.5 % and Fe-EDTA @ 1.0 % one month after fruit set along with recommended dose (50 kg FYM + 1200 g Nitrogen 400 g phosphorus tree⁻¹) is recommended.
- 2. It is recommended that for better establishment of pomegranate cutting for propagation, hardwood cuttings be treated with IBA 2500 ppm for five minutes and be kept under 70% green shade net house condition.
- 3. For commercial propagation of guava, softwood grafting during first week of February on 9-10 months old rootstock is recommended.
- 4. Soaking of jamberi seed in GA₃ (10 ppm) solution for 24 hours before sowing is recommended for better germination.
- Sowing of ajwain crop variety A.A.-01 during second week of November with wider spacing (45 x 45 cm) is recommended for obtaining the higher seed yield and monetary returns.











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- 6. Sowing of fennel crop variety A.F.-101 during the last week of October with ridges and furrow method is recommended for obtaining the higher seed yield and monetary returns.
- 7. Sowing of cumin variety R.Z-209 during the last week of October with ridges and furrow method is recommended for obtaining the higher seed yield and monetary returns.
- For getting maximum profit better growth, yield and quality from Nagpur Mandarin application of 75% (900g:300g:300g) RDF +VAM 500g + PSB 100g + Azospirillum100g + *T. harzianum* 100 g plant⁻¹ is recommended.
- 9. For commercial propagation of cashew nut under Eastern Vidarbha zone, soft wood grafting in the first week of July is recommended.
- 10. Propagation by air-layering of Karonda, IBA 5000 ppm concentrated lanolin paste application is recommended.







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- 11. The non-conventional crop Dioscorea bulbifera (Air potato) can be cultivated on commercial scale in Vidarbha region.
- 12. The aonla syrup prepared by adding 25 per cent aonla pulp blended with 10 per cent lime juice and stored at cold storage is recommended with the acceptable score to 120 days and 90 days under ambient storage condition.
- 13. For quality flower stalk, more number of the florets, higher flower stalk and corm production with more monetory returns Phule Ganesh variety of gladiolus is recommended in Vidarbha Region.
- 14. The application of 20 t FYM along with NPK @ 100:50:50 kg per hectare (N in three splits) is recommended to Piper longum for obtaining higher fruits yield and monetary returns.
- 15. The plant spacing of 60 x 30 cm with the application of 2.5 t vermicompost ha⁻¹ is recommended to Aloe Vera for obtaining higher leaf yield and monetary returns.











- 16. Drip irrigation at 80% evapotrans? replinishment for all the six stages is recommended for higher fruit yield, quality and water saving in Nagpur mandarin under Central and Western Vidarbha conditions.
- 17. Drip irrigation at 80% evapotrans? replinishment for all the six stages is recommended for higher fruit yield, quality and water saving in acid lime under Central and Western Vidarbha conditions.
- 18. Irrigation at 90% evapotransreplishment and 80% RDF through fertigation is recommended for higher and quality fruit production of hasta baharin acid lime with saving in water and fertilizers, under Central and Western Vidarbha conditions.
- 19. For high density guava orchard planting at 3 x 2 m spacing (1666 plants ha⁻¹) are recommended for obtaining maximum fruit yield and higher monetory returns.
- 20. Pineapple variety "Mauritious" is recommended for obtaining higher yield and quality in eastern Vidarbha zone.











- 21. Kamal Sundaris variety of Sweet potato is recommended for obtaining higher yield and better quality tuber under eastern Vidarbha zone.
- 22. The fenugreek variety CO-2, is recommended for earliness, more fresh green leaf yield and economic returns.
- 23. Pre emergence application of Oxyfluorfen 23.5 EC $@ 0.100 \text{ kg a.i. ha}^{-1} (10 \text{ m} 110 \text{ L}^{-1} \text{ of water}) \text{ followed}$ by the fenoxaprop-p-ethyl 9.3 EC @ 0.100 kg a.i. ha^{-1} (20 ml 10⁻¹ L of water) at 30 DAS is recommended to control weeds and to obtain higher yield in garlic bulbs.
- 24. For commercial propagation of guava through softwood grafting, rootstock NGR-04 and Sardar are recommended for better grafting success.
- 25. The softwood grafting on one year age of rootstock of defoliated scion before 6 days in the month of December is recommended for maximum success in Jackfruit under Vidarbha condition.













- 26. The nutrient dose of 75% RDF + 1.5 Kg Vermicompost + Azotobactor 50g + PSB 50g per plant is recommended for obtaining higher yield and more net returns of banana.
- 27. High density planting at 6m x 3m on raised bed (Indo-Israel Citrus Production Technology) is recommended for obtaining better growth, yield and quality fruits of Nagpur Mandarin.
- 28. Pruning during third week of December at 10ft height is recommended for obtaining higher and better quality yield of Ambia bahar in Nagpur mandarin under high density planting at 6m x 3m.
- 29. Application of potassium @ 600 g plant⁻¹ through Muriate of potashalong with recommended N(1200 g) and P (400 g) is recommended for obtaining maximum fruit yield with best quality Nagpur mandarin fruits as well as getting maximum returns from Nagpur mandarin orchard.
- 30. The organic nutrition management of mandarin through application of 75% Vermicompost (on Nequivalent basis of RDF-i.e. 60 kg plant⁻¹ year⁻¹) + Trichoderma harzianum (40 ml plant⁻¹) + Azadirachtin (1% at 4 ml liter⁻¹ as spray)+ Pseudomonas fluoriscens (30-40 ml plant⁻¹) is recommended for maximum yield with quality







- 31. Drip irrigation at 90 % ER 80 % RDF (960: 320: 320g NPK plant⁻¹) through fertigation is recommended for higher yield and quality of Nagpur mandarin.
- 33. The aonla varieties, Krishna and Chaikaya having less fibre content are recommended for the preparation of best quality candy with maximum nutritional qualities and consumer acceptance.
- 34. The bael syrup prepared by adding 30 per cent bael pulp can be stored in good condition upto 150 days at cold storage and upto 120 days under ambient storage condition is recommended.
- 35. An application of Azotobacter @ 5 kg ha⁻¹ + 75 kg $N + 50 \text{ kg } P_2O_5 + 50 \text{ Kg } K_2O$ is recommended to obtain higher yield with good quality onion bulbs with minimum storage losses.
- 36. The onion variety Bhima Raj is recommended for late kharif season (Rangda) with fertilizer dose of 150:50:50:30 kg ha⁻¹ NPK & sulphur for getting maximum yield under Vidarbha condition.









Technology Inventory - III



- 37. In Sulphur deficient soils, an application of Sulphur
 @ 30 kg ha⁻¹ through bentonitealong with the recommended dose of fertilizer (100:50:50 NPK Kg ha⁻¹) is recommended for getting highest garlic bulb yield and economic return with good storage.
- 38. The coriander variety Pant Haritma, an early duration variety with more fresh leaf yield is recommended for cultivation for higher production and economic returns.
- 39. It is recommended that, the intercropping of Ajwain+Cabbage(1:1) or Ajwain+Radish(1:1) is recommended for getting maximum economic returns and LER.
- 40. The 30 x 25 cm is recommended for gladiolus planting to get quality flowers spike, more no. of corms and net monetary returns.
- 41. Application of RDF (1200: 400:400) in five splits is recommended for higher yield and quality fruits of Ambiabahar in Nagpur mandarin. The RDF splits are as follows

Month	Ν	P_2O_5	K ₂ O
	$(g plant^{-1})$	(g plant ⁻¹)	(g plant ⁻¹)
January	360	160	40
March	360	140	40
May	240	100	120
July	120	0	100
Sept.	120	0	100











- 42. Sowing of Coriander (variety-ACR-1) during second fortnight of October with the moderate spacing of 45 x 45 cm is recommended for obtaining the higher seed yield and economic monetary returns.
- 43. In Baby corn, to obtain the economical and higher yield with quality, it is recommended to sow in the month of September with spacing 45 x 15 cm with dibbling methods.
- 44. It is recommended to apply 187.5:112.5:150 kg NPK ha⁻¹ for obtaining higher and better quality yield of capsicum under 50 per cent green shade net house conditions. Out of 112.5 kg phosphorus, 84.50 kg should be applied through single super phosphate by soil application whereas, 187.5:28:150 kg NPK ha⁻¹ should be applied through urea, phosphoric acid and muriate of potash in twenty equal split doses once in a week through fertigation
- 45. Banana variety Grand Naine (G-9) is recommended under Vidarbha region for successful cultivation, best quality and maximum yield returns.
- 46. It is recommended for successful propagation of pomegranate through air layering the media combination of sphagnum moss and vermicompost 1:1 WV is effective for better success, survival and higher monetary return.











Technology Inventory - III

47. For higher success of grafting in custard apple, ten months old rootstock during January to March is recommended.



- 48. It is recommended that for obtaining maximum flower yield and economic benefit from Jasminum sambac plants, it is recommended to prune the plants during fourth week of December and with medium pruning level(30 cm. Height from soil).
- 49. For commercial propagation of wood apple, softwood grafting on one year old rootstock during first forth night of November is recommended.
- 50. For commercial propagation of guava by air layering, IBA 5000 ppm concentration during the month of July to September is recommended.
- 51. For successful and profitable propagation of pomegranate through air laying, four layers per branch at 15-20 cm distance in month of August is recommended.
- 52. For production of healthy and quality seedling of acid lime, raise bed of 7.5 x 1.0 x 0.45 m dimension containing solarised soil: sand :FYM in 2:1:1 ratio under 50% shednet is recommended.
- 53. Application of fertilizer dose of 150 kg Nitrogen, 50 kg Phosphorus and 50 kg Potassium per hectare is recommended for the higher and better quality seed yield of onion and higher monetary returns.
- 54. For getting early, higher, economical with better quality yield in summer okra, application of chemical fertilizer @ 50 kg N + 25 kg P₂O₅ + 25 kg K₂O ha⁻¹ with vermicompost 2. 0 t ha⁻¹ + 0.5 t Neem cake ha⁻¹ along with seed treatment of 25 g kg⁻¹ seed each of *Azatobactor* and PSB with soil application of 10 kg VAM ha⁻¹ is recommended.
- 55. Application of recommended dose of fertilizer for tuberose (200:300:200 kg ha⁻¹) in four split of Nitrogen (50 kg ha⁻¹ each) at the time of planting, 45, 90 and 135 days after planting and phosphorus and potash (150 kg ha⁻¹ and 100 kg ha⁻¹ each, respectively) applied at the time of planting and 45 days after planting is recommended for obtaining vigorous growth and higher yield of flower spike and bulb yield of tuberose.
- 56. Hardwood cuttings of *Ficus benjamina* L. treated with IBA @1000 ppm is recommended for commercial propagation.
- 57. Sowing of Ashwagandha in the first week of September is recommended for maximum dry root yield and economic returns.
- 58. For obtaining better quality and fruit yield of 'Grand Naine' variety of banana, mulching of black polyethylene sheet (50 Micron) or dry grass 5 kg plant⁻¹ is recommended.



- 59. For utilization of failure khirni rootstock seedlings for regrafting, it is recommended to decap the failure khirni rootstock at 15 cm height from ground level and regrafted in next year in the month of September and keep in polythene tunnel.
- 60. For seed production of Kasurimethi, sowing in second fortnight of October with application of 40:50:25 kg NPK ha⁻¹ is recommended for the higher seed yield and monetary returns.
- 61. Nagpur mandarin fruits coated with GSNpTulsi (0.06 mg GSNp + 15 g guar gum liter⁻¹ of water) is recommended to extend the storability of fruits for 60 days in mrigbahar and 45 days in ambiabahar under cold storage conditions (90-95 % humidity and 4-50C temperature).
- 62. For storage of custard apple pulp and Atemoya pulp for eight and ten months respectively, it is recommended to store in air tight boxes by adding 0.1 per cent Potassium Metabio Sulphide at -20°C in deep freezer.
- 63. In organic production of rabi onion, for obtaining economically higher bulb yield with better quality and storability, it is recommended to apply 4.4 tons FYM + 3.0 tons Vermicompost. +5 Kg. Azatobactor +5 Kg. PSB ha⁻¹.

Medicinal Plants

- 1. The Kalmegh or Safedmusli + Pigeon pea intercropping at 3:1 row proportion is recommended for obtaining higher yield and monetary returns.
- 2. For the vegetative propagation of *B. polymorpha* (Narangi) and D. stockssi (Chivar-mesh) bamboo, two nodes culm cuttings should be treated with 2500 ppm IBA solution.
- 3. TLC method based on arjunetin as marker compound, precoated silica gel G F254 plates and Toluene: Ethyl Acetate: Formic Acid (4:4.5:1.5) as solvent system is recommended for rapid identification of authentic T arjuna bark sample.





Forestry

- 1. For production of maximum new and total bamboo and higher monetary returns, bamboo plantation raised on shallow to medium deep soil with 1.2 to 1.5% slop, it is recommended to apply 30% felling intensity with water conservation treatment of circular trench with 1.75 m diameter, 25 cm depth and 60 cm width around the bamboo clumps.
- 2. For sustainable management of ecotourism in forest areas of Akola district 08 criteria and 60 indicators are recommended, it will help to improve the socio-economic and cultural status of the beneficiaries and helps to improve ecological condition of the ecotourism area.
- 3. For sustainable management of Agroforestry systems in Akola district, 8 criteria and 40 indicators are recommended which will helps to improve the socio-economic and cultural status of beneficiaries and help to improve the ecological conditions of agroforestry systems of the area.
- 4. For maximum biomass production and higher monetary benefit cultivation of eucalyptus clone PDKV/ ITC/413 is recommended on shallow medium soil under rainfed condition.









5. For higher biomass production and higher monetary returns from bamboo plantation cultivation of *Bamboo sabalcooa* (Bhima), *Dendrocalmus stocksii* (Manga) and *Bamboo sabambose* (Katang) species are recommended.

Soil & Water Conservation

- For effective weed control, more yield and economic return in mustard, 2 weeding and 2 hoeing at 20 and 40 DAS or pre-emergence application of herbicide Oxadiargyl (80 WP) @ 90. ga.i. ha⁻¹ or Pendimethalin (30 EC) @ 1.0 kg a.i. ha⁻¹ is recommended.
- 2. The embankment height of 2 to 2.5 m is recommended for dug out type farm ponds to reduce evaporation losses during water storage period till its utilization.



- 3. To enhance the life span of farm ponds in saline tract of Purna river valley, it is recommended to adopt across the slope or contour tillage in the catchment and to provide brush wood inlet spill way to the farm pond.
- 4. Drip irrigation system has been found useful for garlic production as it saves 46% water and gives 20% higher yield over traditional irrigation.
- 5. In assured rainfall zone of Vidarbha region the life of the CCT's in sown silvipasture system is recommended upto 10 years.
- 6. For higher economical returns the double cropping system of Green gram-Chickpea and Soybean-Chickpea along with contour and across slope cultivation with protective irrigation by sprinkler irrigation from farm pond is recommended for the saline tract of purna river valley.







Technology Inventory - III

- 7. The rainfall intensity-duration-frequency (I-D-F) relationship developed for Gadchiroli, Chandrapur, Nagpur and Gondia station is recommended for determination of design rainfall intensity and a returnperiod for flood control, rainwater harvesting and runoff. Formula - In submountain region of Maharashtra for determination of water storage capacity of bunding in agricultural watershed the following computerised based system is recommended. In agricultural watershed to predict the internal water storage in bunds-HEC-HMS model. To determine the supplementary water requirement of the crop and time of irrigation optimization depending on linear programming.
- 8. For Higher in-situ soil and moisture conservation, yield, energy and water use efficiency contour cultivation with ridges and furrow after 30days of sowings recommended for Jawar and Cotton.

Agro-processing and Value addition

- 1. It is recommended to use process technology for powder from pumpkin and various value added products from it as well as cherry/tutty- fruity from pumpkin.
- 2. Ready to cook Ambil powder is recommended for instant Ambil preparation as well as sorgo papad *viz.* Sandoli and Bibadi.













- 3 It is recommended to use process technology for ready to cook is recommended to use Intake of Poha Ladoo @ 100 gm day⁻¹ to the tribal adolescent girls, continuously as a supplement for three months.
- 4 It is recommended to use process technology for value addition of onion and garlic by processing into quality powder, minced (chops) and kibbles (rings).

Agricultural Engineering and Technology

1. PKV marking nut cracker is recommended.

- 2. The PKV Continuous hot air puffing system is recommended for preparation of oil free Ready-to-eat and durable snack foods.
- 3. PKV Animal feed mill is recommended for making animal feed pellets from byproduct of dal mill.












Technology Inventory - III



- 4. PKV Roselle (Ambadi) Calyces Detacher (RCD) is recommended for detaching calyces from roselle fruit.
- 5. PKV onion seed extractor is recommended for onion seed extraction.
- 6. It is recommended to use solar tunnel dryer (3X6X2m) for drying of turmeric slices & red chilli in minimal time and to maintain its quality.
- 7. Soybean husk & sawdust (1:1) and groundnut shell & sawdust (1:1) of 8 to 10 % moisture is recommended to prepare good quality briquettes using piston press machine to conserve energy.
- 8. Dr. PDKV Automated Sprouter is recommended for sprouting of soybeans and for preparation of various products from sprouted soybean.







- 9. After Sunset extended 3 hours are available for drying of Tamato and Gingerslices in solar cabinet dryer with heat storage system is recommended.
- 10. For better milling of pigeon pea grain(Variety-PKV Tara) It is recommended to use enzyme pretreatment of 2:1:1 proportion of xylanase, pectinase and cellulase enzymes at the rate of 45 g/q dm of dry pigeon pea grain.
- 11. It is recommended to use the optimized process parameters such as syrup concentration 48° Brix, syrup temperature 49 °C and duration of osmosis 139 min for osmotic dehydration of sapota samples.
- 12. The osmo-convectively dried PDKV Sapota powder is recommended to dry at 60oC temperature and 1m/s air velocity for better nutritional value.
- 13. It is recommended to cultivate Capsicum in 50% Green shadenet for higher production.



















- 14. In medium to deep black soil for higher in-situ soil, water, nutrients conservation and improving physical properties of the soil (eg. Bulk density, soil resistance etc.), crop growth, water and energy use efficiency and yield in soybean and cotton crop, it is recommended to adopt sub-soilingat 90 cm H.I. up to 55 to 60 cm depth with 2 tyne and 1 blade harrow before sowing.
- 15. It is recommended to use Burr mill (1 HP Motor) for Chironji nut decortication by keeping 12 mm clearance between pair of disc.
- 16. It is recommended that custard apple pulp separated by PDKV de-seeding machine should be stored at -18 to -20° C temperature in deep freeze or cold storage treated with 0.1 per cent potassium metabisulphitefor six months storage period.



- 17. It is recommended to use portable PDKV mini solar dryer (1.6 x 1.0 x 0.9 m) of capacity 10 kg for drying of agricultural produce with quality at domestic level.
- It is recommended to use PDKV natural convection solar dryer having 2.62 sq m solar collector and 35 kg capacity for drying of agricultural produce.



19. Highly thermo efficient (31.34%) and less emission of carbon mono-oxide natural draft cotton stalks based PDKV biomass cook stove is recommended for cooking in rural households.



- 20 The process for preparation of RTE PDKV puffets from composite flour of finger millet foxtail millet, pearl millet, barnyard millet added with sprouted soybean cold extruded using microwave puffing is recommended.
- 21 For maximum retention of volatile oil and piperine content of piper longum the fluidized bed drying and tray drying method at 50 °C temperature is recommended.



- 22 It is recommended to use PDKV green pigeon pea pod shelling machine for green chickpea pod shelling (capacity 25 Kg ha⁰) by using abrasive perforated steelsheet wrapped rubber roller.
- It is recommended that fresh green pigeon pea kernels after blanching in hot water at 95°C for 1 minute with pretreatment of citric acid and KMS @ 0.24%, packed in 300 gauge polypropelene can be stored up to 12 days in ambient condition (15-38°C temp19-49% R H) Fresh green pigeonpea kernels blanched in hot water at 95°C for 7 minutes with pretreatment of citric acid and KMS @ 0.24 %, packed in 200 gauge



polypropylene can be stored in refrigerated (7-8° C temp and 80-85 % RH) condition up to 40 days and in cold storage condition (1-3° C temp. and 90 % RH) up to 90 days.

It is recommended to use roller of emery 30+36 (1:1) with 900 rpm speed and18mm clearance between roller and sieve in PKV Mini dal mill for higher of greengram and black gram dehulled split (83% and 82%, respectively).



- 25. It is recommended to use higher capacity PKV mini dal mill (5 HP), PKV mini mill (1 HP) and Laboratory working model of PKV mini dal mill as per requirement for milling of pulses.
- 26. It is recommended to use the PDKV turmeric slicing machine for slicing of potato and ginger (capacity 2.5 q ha⁻¹).
- 27. After field curing by farmers method, it is recommended to provide natural ventilationusing perforated PVC pipes (pipe dia. 63 mm, hole dia. 25 mm and no. of pipes-9)in onion storage structures [5 m (L) x 1.5 m (W) x 1 m (H)] for minimizing the overall losses during storage of onions.
- 28. It is recommended to use PDKV hallow tumbler tiles with 20% saw dust for roofing material.
- 29. It is recommended to use PDKV single basin solar still coupled with evacuated tube collector to enhance thermal efficiency and maximise the pure water yield.













- 30. It is recommended to use PDKV developed briquetted biomass cook stove for community kitchen to save fuels.
- 31. It is recommended to use drip irrigation at 80% ET with polythelene mulch(Silver-black colour and 50 micron thickness) for highest growth and yield of tomato crop with highest BC ratio.





- 32. It is recommended to use developed drainage coefficient for designing agricultural drainage systems for respective tehsil of different districts of vidharbha region.
- 33. The PDKV process for preparing smooth textured jam from beetroot is recommended
- 34. PDKV Hydroponic structure is recommended for green fodder crops.
- 35. It is recommended to use Dr. PDKV solar insect light trap in IPM practice for attracting insects on the field.
- 36. It is recommended to use Dr. PDKV double basin solar distillation system integrated with vacuum tubes to enhance thermal efficiency and maximize distillate yield.





Technology Inventory - III



- 37. PDKV SPV knapsack cum hand operated sprayers is recommended for spraying in various crops.
- 38. It is recommended to use drip irrigation at 80% evapotranspiration replenishment with polyethylene mulch (silver colour and 50 micron thickness) as per schedule given below, for highest growth and yield of chilli crop.
- 39. It is recommended to use drip irrigation at 80 % evapotranspiration replenishment with polyethylene mulch (silver colour and 50 micron thickness) as per schedule given below, for highest growth and yield of Bitter Gourd crop)
- 40. For obtaining higher yield and superior quality of Nagpur mandarin fruits with more economics returns, water soluble fertilizer should be applied through fertigation with dose of 1020-340-510 NPK(g plant⁻¹) in six splits.
- 41. PDKV Soil bag machine is recommended for the filling of soil in the nursery polybags.
- 42. For transferring harvested rainwater towards low yield wells for increasing their irrigation potential or for increasing groundwater table through recharging by laying











water conveying pipes at 0.4 per cent gradient with inlet end 0.75 m below ground surface with filtering unit consisting of stones (40%), bricks pieces (20%), coal (10%) and sand (30%) is recommended.

- 43. The changes in emery roller 18:24 (1:1), roller speed 850 rpm and feed rate 200 kg/h of PKV Mini Dal Mill is recommended for milling of lathyrus in three pass. Similarly, the changes in emery roller 16:18 (1:1), roller speed 900 rpm and feed rate 200 kg/h of integrated PKV mini dal mill is recommended for milling of lathyrus in two pass.
- 44. The shaft speed 36 rpm, screw length 50.8 mm and screw peach 76 mm of existing mini oil mill is recommended for more oil recovery of safflower seed.
- 45. It is recommended to cultivate tomato in 50 per cent white shednet house with 50 micron plastic mulching for higher fruit yield.
- 46. It is recommended to use reddish purple Light Emitting Diodes (LEDs) during night time for 12 hours with light intensity of 930 lux for enhancing plant growth and nutritive value during green fodder production of wheat and maize in PDKV pipe framed hydroponic structure.
- 47. Low cost PDKV-Koushalya Vermi compost Unit made up of locally available bamboo and 50% shednet is recommended for Vermicomposting in 4 rotations in a year.
- 48. It is recommended to establish 50m3 fixed dome biogas for institutional dairy for 6 kW power generation
- 49. It is recommended to use polyethylene mulch with drip irrigation at 80 per cent replenishment of evapotranspiration and 80 per cent RDF (80:40:40 NPK Kg ha⁻¹) for higher growth and yield of Okra crop with highest B:C ratio.
- 50. For higher onion bulb yield and economic returns it is recommended to apply 120 per cent of RDF (120:60:60 NPK, kg ha⁻¹) with crop spacing of 10 x 7.5 cm, under drip fertigation.

Animal Husbandry and Dairy Science

- 1. It is recommended that blending of 4 % ginger juice and 0.4 % turmeric powder as a natural flavour and colouring agent produce good quality value added herbal softy ice cream
- 2. It is recommended that, blending of 20 % unripe cooked banana pulp in cow milk chakka produced good quality value added banana shrikhand.



3. Feeding of 5% dry azolla in the diet of Giriraja poultry birds is recommended for better body weight and maximum economic gain under intensive rearing

Seed Technology & Plant Physiology

- 1. Pre-sowing hydro priming seed treatment for 8 hrs with 1:2 seed: water ratio followed by drying at room temperature to normal moisture content (10%) is recommended for expected and uniform field emergence, plant stand establishment and maximum seed production of pigeonpea.
- 2. Seed treatment of polymer + flowable thiram @2.4 ml kg⁻¹ of soybean seed before storage is recommended for maintaining the germination percentage above the minimum certification standards during storage of 12 months and higher yield.
- 3. It is recommended that for grading of paddy varieties a sieve of 1.4mm for fine and 1.6 mm for coarse varieties may be used in place of presently recommended 1.8mm sieve.
- 4. The specific gravity separator is recommended for removing the ODV seeds in paddy.









- 5. Two sprays @ 250 ppm of Maleic Hydrazide, first at 50 days followed by 60 days after sowing is recommended for inducing dormancy upto 35 days in green gram.
- 6. Two foliar spray of salicylic acid @1.50 m M at 75 and 105 DAS after sowing under rainfed condition of Maharashtra may be given for maximization of cotton yield.





Biotechnology

1. It is recommended to use Java citronella oil as a botanical bactericide and fungicide at 14000 ppm dissolved in DMSO for the control of Fusarium oxysporum and most common pathogenic fungi and bacterial growth in the commercial banana tissue culture labs for production of contamination free seedlings.



- 2. It is recommended to use primer set ITS-12 and ITS-14 for discrimination of Phytophthora from commonly occurring plant pathogenic fungi present in infected plant and soil samples.
- 3. It is recommended to use primer set BTA-2, BTA-7 and BTA-8 for discrimination of Galgal rootstock from commonly used rootstock Rangpur and Jambhery.
- 4. It is recommended to use essential volatile oil of Java citronella as a gaseous antifungal fumigant in culture rooms and transfer hoods @ 2.5 ml 100⁻¹ cuftarea with replacement of oil at every 10 days interval for effective bio-control of common fungus observed in plant tissue culture laboratories.
- 5. It is recommended to use nanoparticles of copper in place of copper sulphate in the culture media for control of major pathogenic microbes of plant tissue culture at the corresponding dose of media in Banana commercial tissue culture unites.



6 It is recommended to use BTC-CTV-1, BTC-CTV-2, BTC-CTV-3, BTC-CTV-4 set of primer for specific identification of CTV in citrus orchard.

Social Science

Social Sciences include Agricultural Extension Education and Agricultural Economics. The crops varieties, Farm Implements and machineries, crop production, plant protection technologies, recommended by University are beneficial/profitable to the farming community to enhance their income. In Agricultural Extension Education, the information pertaining to extent of adoption of newly released varieties/implements/recommended technology in studied. Stories have been done to demonstrate the recommended technologies on farmers fields ton show their profitability/adoptability by the farming community. The lacunae/drawbacks in the technologies are also revealed for their refinement.

- 1. University recommended soybean technology created significant economic impact on soybean growers in terms of increased yield, income, area, cropping pattern, annual spending pattern. However, socio impact was found very low as far as social participation, is concerned. It is, therefore, recommended to enhance the participation of soybean growers in formal and informal organizations for getting their active participation in rural development.
- 2. The non-remunerative prices, weather related uncertainties, fluctuations in market rates, rise in cost of inputs, lack of irrigation facilities, lack of accurate weather information and crop damages by wild animals were severely affecting factors. Therefore, it is recommended that the Government may give remunerative prices to the farm produce and take due consideration of mentioned factors for reducing the agrarian distress.





3. Ajwain crop is a promising profitable cash crop based on three years average per hectare cost and returns to the ajwain growers. Hence, it is productivity and growing farmers It is recommended that, farmers should incorporate Ajwain crop in Rabi cropping pattern.

4. The findings of the present study concludes that although majority of the gram growers possessed high level of knowledge about recommended package of practices of gram, however there exist a high level of technological adoption gap in improved practices like, seed treatment with biofertilisers, biofungicides and control measures for diseases. The major reason identified for existence of these high technological adoption gap





from the present investigation are unavailability of bio fertilizers/biofungicides in the local market at the time of sowing. It could therefore be concluded that, there is wide scope to overcome these technological adoption gap in gram cultivation.

5. For avoiding the poor efficacy of herbicide technology on farmers' field it is recommended that the State Department of Agriculture should organize regular trainings/workshops, demonstrations and preparation of printed material about use of herbicides before sowing season with the expertise of SAU scientists so that soybean and cotton cultivators in Vidarbha will get technical knowledge for effective use of herbicides.



6. On the basis of this study it is hereby recommended that, there is need to provide

subsidiary occupations by government to the farmers as land fragmentation had highest effect on farmer's distress and to give the remunerative price for their agricultural produce on the basis of cost of cultivation. There is also need of social counselling and to provide agricultural technology and weather related information time to time to the farmers of Eastern Vidarbha Zone to overcome their distress situation.



Technology Inventory - III

7. The research study on Soil Testing Status of the Farmers in Distress Prone Districts of Vidarbha indicated that, nearly two third (62.84%) of the farmers possessed medium level of knowledge about the various soil testing techniques, However, it was observed that majority (85.00%) of the them did not test their farm soil till date. Non availability of soil testing lab nearby village/taluka level is the major constraint perceived by 87.50 per cent of the farmers for non adoption of soil testing techniques.

Hence, it is recommended, that soil sample testing facility should be made available at block level and mobile soil sample testing van along with technical staff should be made available at village level by the State Department of Agriculture, to the farmers, to increase the adoption level of soil sample testing technique and its recommendations at field level.





- 8. Considering the increasing use of herbicide application in wheat crop, it is recommended that for avoiding the poor efficacy of herbicide technology the State Agricultural Universities and Extension Functionaries (Krishi Vigyan Kendras, State Department of Agriculture and NGO's) should organize regular trainings/ workshops, demonstrations, preparation and distribution of printed material about use of herbicides to wheat growers before sowing of wheat crop for effective transfer of this technology.
- 9. To achieve maximum production of Peigon pea crop, it is necessary to adopt the recommended technologies for decrease the cost of production(by Rs,500 to 600 per qt.). So it is recommended that, Pigeon pea producing farmers should use recommended dose of manure and phosphatic fertilizer.
- 10. In order to minimise the price risk and to protect the price security of farming community and also to stabilise the acreage under Red gram and Green gram of Maharashtra state which are the volatile commodities in terms of market prices, it is recommended that long term procurement policy should be adopted to maintain price stability.
- 11. In Amravati revenue division of Vidarbha 96.67 per cent selected cotton and soybeanfarmers and 62.50 per cent selected extension workers were found unaware about the label claims of pesticides. The results regarding the adoption status of the pesticides as per the label claims (Herbicides, insecticides and fungicides) revealed that large number of the selected farmers using pesticides not approved by Central Insecticides Board and





Registration Committee (i.e. without label claims). Hence it is recommended that State Department of Agriculture and KVKs should organize regular trainings / workshops for the extension functionaries and farmers. Distribute printed materials and give wide publicity through Mass Media about crop specific label claims of pesticides for creating awareness about the label claims of pesticides.

12. It is therefore, recommended that, State Department of Agriculture and ATMA regular Training Programme and Field School for the K. Lime growers to increase their knowledge and adoption level about recommended technologies of the University with the technical guidance of Agriculture University Scientists and Subject Matter Specialist of KVK.



- 13. Women Farmers from Gadchiroli and Wardha districts expressed the need for a training on rearing of silkworm. It is recommended to organize residential training at the institute to acquire skill for silkworm rearing.
- 14. In order to minimise the price risk and to protect the price security of farming community and also to stabilise the acreage under Chickpea and Blackgram of Maharashtra state which are the volatile commodities in terms of market prices, it is recommended that long term procurement policy should be adopted to maintain price stability through out the year at least for major markets of the state.
- 15. Considering the factors of market distance, per quintal marketing cost including transportation, producer share in consumers rupees and marketing efficiency of selected market for ajwain, it is recommended that, farmers should sale their produce to Neemuch market (Madhya pradesh), Unjha market (Gujrat) and Bhilwara market (Rajasthan) as compare to local market to gain better market margin to the farmer.



- 16. Maize appeared to be one of the important emerging crop in the Buldhana district and it become additional crop in the cropping pattern of the district. Therefore, it is recommended that to allocate more area invariably under the cultivation of maize crop by providing high yielding varieties and introducing improved technology through university.
- 17. Decline in area and yield of Soybean in Nagpur district was mainly due to low remunerative price in the market, attack of insect and pests and changes in climate were the major reasons. It is recommended that, to overcome these problems government should provide good remunerative prices to the farmers and awareness about the insect and pest management through the concern government agencies.



- 18. From the research study on "Adoption status of the pesticide as per the label claims by the gram growers in Vidarbha" it is recommended that for increasing the adoption status of the insecticides and fungicides as per the label claims by the gram grower organize regular training/workshops for the gram grower about the label claims of pesticides. Distributed printed materials, display flex /banners in villages indicating the list of crop and pest specific pesticides approved by CIBRC for information and use of the farmers and give wide publicity through mass media for creating awareness about the label claims of pesticides. Central Insecticides Board and Registration Committee(CIBRC) should take care to provide the readable label with the pesticides.
- 19. From the research study on "Assessment of self efficacy and stress mindset measures of the farmers in distress prone area of Vidarbha "It is recommended that, for improvement of optimism, self esteem, self efficacy and stress mindset of the farmers in distress prone area, regular counselling and need based training should be provided.
- 20. It is recommended to increase the communication behaviour of Agriculture Assistants that, for timely and effective communication of Agriculture Assistant with farmers, government should provide laptop, smart mobile phone internet facilities to them and reduce their official paper work load and they should be provided training on modern agricultural technology.
- 21. To make attitude of rural youth more favourable towards agriculture as and occupation it is recommended that youth should involve in skill development programme, incubation centre shall be establish at Agriculture University and need to include the agriculture subject in course curriculum of primary level schooling.
- 22. In Eastern Vidarbha district lathyrus crop required low inputs with high B;C ratio in marginal and small size of holding farmers in rainfed cultivation during rabi season as a relay crop. Therefore, it is recommended to develop high yielding varieties of lathyrus and suggest the suitable improved technology by University for increasing the production of lathyrus which helps to improve the economical condition of marginal and small farmers in rainfed area.
- 23. Amravati Division in Vidharbha region 81.80 per cent farmer do not have information about "How to prepare spray solution". So it is to recommend that this information about "How to prepare spray solution" should be given to the farmers of Vidharbha region. (Through, Extension wing of agriculture department, Electronic media etc).
- 24. CROPSAP had average impact of 21.95 per cent in terms of increase in knowledge (19.07%), adoption (13.93%), productivity (29.94%) and income (24.88%) of the Soybean growers. It is therefore, recommended that, Crop Pest Surveillance and Advisory Project should be implemented for longer period of time for the farmers.
- 25. The ha⁻¹ post harvest losses in tomato and brinjal were observed 16.49 q. and 13.29 q., respectively. Therefore, to avoid the post harvest losses, it is recommended that, Government should provide storage and quick transportation facilities and also aware

farmers about post harvest technology through training so as to increase the monetary benefit of the farmers.

- 26. The lac production on Palash tree is economically profitable venture (B: C ratio 1: 2.27) as a subsidiary income of the farmers, therefore, it is recommended that, the Government and Agricultural Universities should promote the lac cultivation by scientific method and cultivation technology of lac cultivation on farmers fields as well as fallow land of the state which will help to enhancing the supplementary income (doubling) of the farmers.
- 27. Fifty per cent of the forest dwellers in Chandrapur, Gondia and Gadchiroli district of Eastern Vidarbha did not receive any specialized trainings regarding livelihood activities and it was noticed that 53.13 per cent forest dwellers had low livelihood knowledge. It is therefore recommended that the extension agencies, in collaboration with forest department should arrange skill based trainings, certificate courses on forestry and explore different livelihood options for forest dwellers.
- 28. The farmers in Maharashtra earned gross economic benefit of Rs. 7271.18 Crores from Dr. PDKV, Akola release of JAKI-9218 variety of chickpea from the release year 2008. Therefore, it is recommended that government should provide substantial funds to the University for further research and extension of improved varieties for the benefit of farming community.

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